Appendix 23C
Health Risk Assessment and Ambient Air Quality Analysis Methodology

This appendix discusses the approach and methodology used to conduct the localized ambient air quality analysis (AAQA) and health risk assessment (HRA) for the proposed Delta Conveyance Project (project) and alternatives for this Draft Environmental Impact Report (Draft EIR). As discussed in Chapter 23, *Air Quality and Greenhouse Gases*, potential changes in localized pollutant concentrations and health risks during operations and maintenance are assessed qualitatively, except for stationary standby engine generators, as discussed further below. The AAQA evaluates the potential for construction generated pollutant concentrations to exceed the short-term (< 24-hour) federal and state air quality standards and long-term (annual) federal and state standards. Criteria pollutants analyzed include nitrogen oxides (NO_X), carbon monoxide (CO), particulate matter (PM10 and PM2.5), and sulfur dioxide (SO_2). The HRA assesses the potential impacts from receptor exposure to diesel particulate matter (DPM) and, where applicable, localized PM2.5.

Results of the AAQA and HRA are evaluated in Chapter 23, *Air Quality and Greenhouse Gases*, Impact AQ-5: *Result in Exposure of Sensitive Receptors to Substantial Localized Criteria Pollutant Emissions* and Impact AQ-6: *Result in Exposure of Sensitive Receptors to Substantial Toxic Air Contaminant Emissions*. Readers are directed to the following additional appendices for further information on the mass emissions calculations and criteria pollutant community health impact analysis.

- Appendix 23A, *Mass Emissions Estimation Methodology*: Presents the methodology used to estimate construction and operational mass emissions from the project.
- Appendix 23B, *Air Quality and GHG Analysis Activity Data*: Provides all analysis inputs for the estimation of criteria pollutants and greenhouse gas emissions.
- Appendix 23D, *Criteria Pollutant Health Impact Assessment Methodology*: Presents the methodology used to correlate construction-generated regional criteria pollutant emissions to potential human health consequences.

23C.1 Methods for Analysis

The analysis focuses on the following two types of air pollutants that would be generated by the project and are of concern to human health:

- **Criteria pollutants.** These are air pollutants that are widespread and ubiquitous and for which the U.S. Environmental Protection Agency (EPA) and California Air Resources Board (CARB) have set ambient air quality standards. The criteria pollutants considered here include particulate matter (PM), CO, NO_2, and SO_2. PM10 is PM with a mean mass diameter smaller than or equal to 10 microns and PM2.5 is PM with a mean mass diameter smaller than or equal than 2.5 microns.
- **Toxic air contaminants (TAC).** The TAC of concern for construction of the project is DPM. DPM is a known human carcinogen and may cause other serious health effects.

Air quality analysis methods are discussed in detail here, including modeling assumptions, release characterization, and other modeling inputs needed to characterize dispersion.

23C.1.1 Localized Criteria Pollutant Dispersion Modeling Analysis

23C.1.1.1 Ambient Air Quality Analysis

A quantitative ambient air quality analysis (AAQA) was performed to assess the potential impact from construction-generated criteria pollutants to cause new or contribute to existing violations of the national ambient air quality standards (NAAQS) and California ambient air quality standards (CAAQS). The AAQA considers both long-term (annual) emissions and short-term (less than 24 hours) impacts of criteria pollutants, as applicable, based on the established air quality standard. The pollutants of concern with established long-term standards are NO_2,[1] PM10, and PM2.5. The pollutants of concern with established short-term standards include the following:

- CO (1 hour and 8 hours)
- PM10 and PM2.5 (24 hours)
- NO_2 (1 hour)
- SO_2 (1 hour and 24 hours)

Mass emissions quantified for project construction were used as inputs to EPA's AERMOD dispersion model to estimate offsite pollutant concentrations resulting from construction activities. AERMOD is a steady-state,[2] multiple-source, Gaussian dispersion model designed for use with emission sources and is suitable for assessing both elevated point sources and low-level emissions sources. AERMOD is EPA's regulatory dispersion model specified in the *EPA Guideline for Air Quality Methods* (Code of Federal Regulations, Title 40, Part 51, Appendix W). The latest version of AERMOD (version 19191) is used to quantify pollutant concentrations.

The following two types of emission rates are analyzed to estimate offsite pollutant concentrations.

1. Short-term concentrations and air quality impacts are assessed based on a representative maximum hourly and daily scenario that accounts for all emissions from construction activities that could take place concurrently. This scenario reflects maximum activity levels from project construction.
2. Annual concentrations and air quality impacts are assessed based on annual emissions rates quantified for the project, as described in Appendix 23A, *Mass Emissions Estimation Methodology*.

[1] NO_X is both a regional and localized pollutant. Regional effects (i.e., ozone formation) take place over long distances and time scales and are not analyzed through a localized ambient air quality analysis. Likewise, since reactive organic gas (ROG) is a regional pollutant, it is not addressed in the localized analysis. Rather, ozone impacts (through NO_X and ROG emissions) are addressed through a comparison of project emissions to the air district thresholds. Localized effects can occur from the conversion of NO_X to NO_2, and these effects are assessed through the localized NO_2 analysis to confirm emissions would not exceed the CAAQS or NAAQS.

[2] Steady-state means that the model assumes no variability in meteorological parameters over a 1-hour time period.

Construction emissions from all major physical features of the project (e.g., intakes, forebay) are included in the analysis. The combined effect of emissions from geographically proximate construction activities are also addressed, such as the transport of construction material to staging areas. Emission source types included within the AERMOD model include off-road and on-road vehicle exhaust emissions, as well as nonvehicular emission sources such as concrete batch plants and fugitive dust generated during earthmoving activities.

As the construction sources are all low-elevation, non-point source emissions, maximum off-site concentrations are always found at the construction fence line.[3] Modeled receptor locations are placed along the fence line of the project construction areas to conservatively identify the location with maximum concentrations, even though it is highly unlikely sensitive receptors would remain at the construction fence line for extended periods of time. Receptor grid spacing of 25 meters (82 feet) as recommended by the Bay Area Air Quality Management District (BAAQMD), San Joaquin Valley Air Pollution Control District (SJVAPCD) and Yolo-Solano Air Quality Management District (YSAQMD) is used along the fence line within these air districts. Within the Sacramento Metropolitan Air Quality Management District (SMAQMD), a spacing of every 10 meters (32.8 feet) is used pursuant to SMAQMD guidance. Per air district guidance, receptors in the BAAQMD are modeled with a flagpole receptor height of 1.5 meters (4.9 feet; breathing height); receptors in the Yolo-Solano Air Quality Management District (YSAQMD) and SMAQMD are modeled with a flagpole receptor height of 1.8 meters (5.9 feet); and in SJVAPCD receptors are modeled at ground level, 0 meters.

As discussed in Appendix 23A, *Mass Emissions Estimation Methodology,* emission rates are developed for each alternative's construction components (e.g., intakes, forebay, rail tracks, shafts, roads, batch plants, and reusable tunnel material areas).

23C.1.1.1.1 Emission Source Release Characterization

The emission rates are incorporated into the AERMOD model by spatially allocating their emissions to their individual emission source areas. The location and size of the emission source areas are based on the construction areas as found in the Delta Conveyance ESRI GIS database. The emission sources are modeled in three dimensions with each emission source having area along with elevation and release height.

All proposed construction sources, except for on-road vehicles, are modeled as polygon area sources[4] as most construction sources would operate within a multi-sided polygon with varying side lengths. Exhaust emissions from construction equipment are modeled using a release height of 5.0 meters (16.4 feet) with an initial vertical dimension of 4.65 meters (15.3 feet), while fugitive dust emissions from construction areas are modeled with a 0.9-meter (2.95-foot) release height and an initial vertical dimension of 0.79 meter (2.6 feet). The use of a 5.0-meter (16.4-foot) release height from the construction equipment corresponds to a mid-range of expected plume rise from construction equipment during daytime atmospheric conditions. Dust emissions from concrete batch plant operations are modeled using a release height of 15 meters (49.2 feet) with no initial vertical dimension.

[3] The only exception to this was for the concrete batch plants, which are modeled at 15 meters (49.2 feet) elevated release height. For concrete batch plants, additional receptors were added as needed in the off chance that the fence line receptors were not the highest.

[4] A polygon area source can define an irregularly shaped polygon with up to 20 sides. The dispersion model treats the emissions as an area source.

On-road emissions from vehicles and trucks are modeled as line area sources near project features to account for the combined air pollution from both project features and the on-road vehicles. The exhaust emissions from the haul trucks are modeled using a release height of 3.4 meters (11.2 feet) and an initial vertical dimension of 1.21 meters (3.97 feet). Commute vehicles were modeled using a release height of 1.3 meters (4.3 feet) and an initial vertical dimension of 3.36 meters (11.0 feet). Re-entrained road dust emissions are modeled with a release height of 0.85 meter (2.798 feet) and an initial vertical dimension of 0.79 meter (2.6 feet).

23C.1.1.1.2 Meteorological Data

To run AERMOD, the following hourly surface meteorological data are required: wind speed, wind direction, ambient temperature, and opaque cloud cover. In addition, daily morning upper air sounding data are required.

These meteorological variables are used to estimate air dispersion of pollutants in the atmosphere. Wind speed determines how rapidly pollutants are transported away from the source, while wind direction determines where pollutants are transported. The difference in ambient temperature and exhaust temperature determines the initial buoyancy of emissions from point sources. The opaque cloud cover and upper air sounding data are used in determining other dispersion parameters. These parameters include: atmospheric stability (a measure of atmospheric turbulence that determines the rate at which pollutants disperse laterally and vertically); the aloft vertical temperature gradient; surface roughness length (the greater the roughness, the more turbulent mixing); convective and mechanical boundary layer height (the vertical depth through which pollutants may be dispersed); Bowen ratio (ratio of sensible to latent heat flux); and albedo (reflectiveness of the earth's surface back to space without absorption). All of these dispersion parameters are used to construct similarity theory profiles of the boundary layer parameters used to determine the rate of turbulent mixing.

Four different sets of meteorological data were used for the AERMOD modeling. These included meteorological data for the Sacramento Executive Airport in Sacramento, Nut Tree Airport in Vacaville, Stockton Metropolitan Airport in Stockton, and Byron Airport in Byron. The Sacramento Executive Airport data set included hourly data from 2010 through 2014 and was supplied by SMAQMD (2019). The Stockton Metropolitan Airport meteorological data was provided by SJVAPCD (2018) and included hourly data from 2013 through 2017. The Nut Tree Airport meteorological data was provided by the California Air Resources Board (2020) for the years 2009 through 2013. The Byron Airport raw meteorological data was provided by the National Weather Service (as available on the University of Utah's website [2021]) and included hourly data from 2018 through 2020. This site was processed using the most recent version of AERMET (Version 21112) for use in the AERMOD modeling.

The Sacramento meteorological data were used for modeling of receptors within the jurisdictions of SMAQMD. The Stockton meteorological data were used for modeling of receptors within the jurisdiction of the SJVAPCD. The Vacaville meteorological data were used for modeling receptors within the jurisdiction of YSAQMD. The Bryon Airport meteorological data were used for modeling receptors within the jurisdiction of the BAAQMD (see Table 23C-1).

Table 23C-1. Meteorological Data Summary

Meteorological Data (Years)	Meteorological Data Collection Location	Use for Modeling Areas Located
Sacramento (2010–2014)	Sacramento Executive Airport, Sacramento, CA	SMAQMD
Vacaville (2009–2013)	Nut Tree Airport, Vacaville, CA	YSAQMD
Stockton (2013–2017)	Stockton Metropolitan Airport, Stockton, CA	SJVAPCD
Byron (2018–2020)	Byron Airport, Byron, CA	BAAQMD

BAAQMD = Bay Area Air Quality Management District; CA = California; SJVAPCD = San Joaquin Valley Air Pollution Control District; SMAQMD = Sacramento Metropolitan Air Quality Management District; YSAQMD = Yolo-Solano Air Quality Management District.

Figures 23C-1, 23C-2, 23C-3, and 23C-4 show wind roses for the Sacramento Executive Airport, Nut Tree Airport, Stockton Metropolitan Airport, and Byron Airport, respectively. Wind speeds are presented in terms of meters per second (1 meter per second is equal to 2.24 miles per hour). The Sacramento wind rose shows predominant winds from the southwest and south. The Nut Tree Airport wind rose shows predominate wind direction from the southwest. Wind roses for Stockton show that winds from the west and northwest predominate. The Byron Airport wind rose shows winds predominate from the southwest.

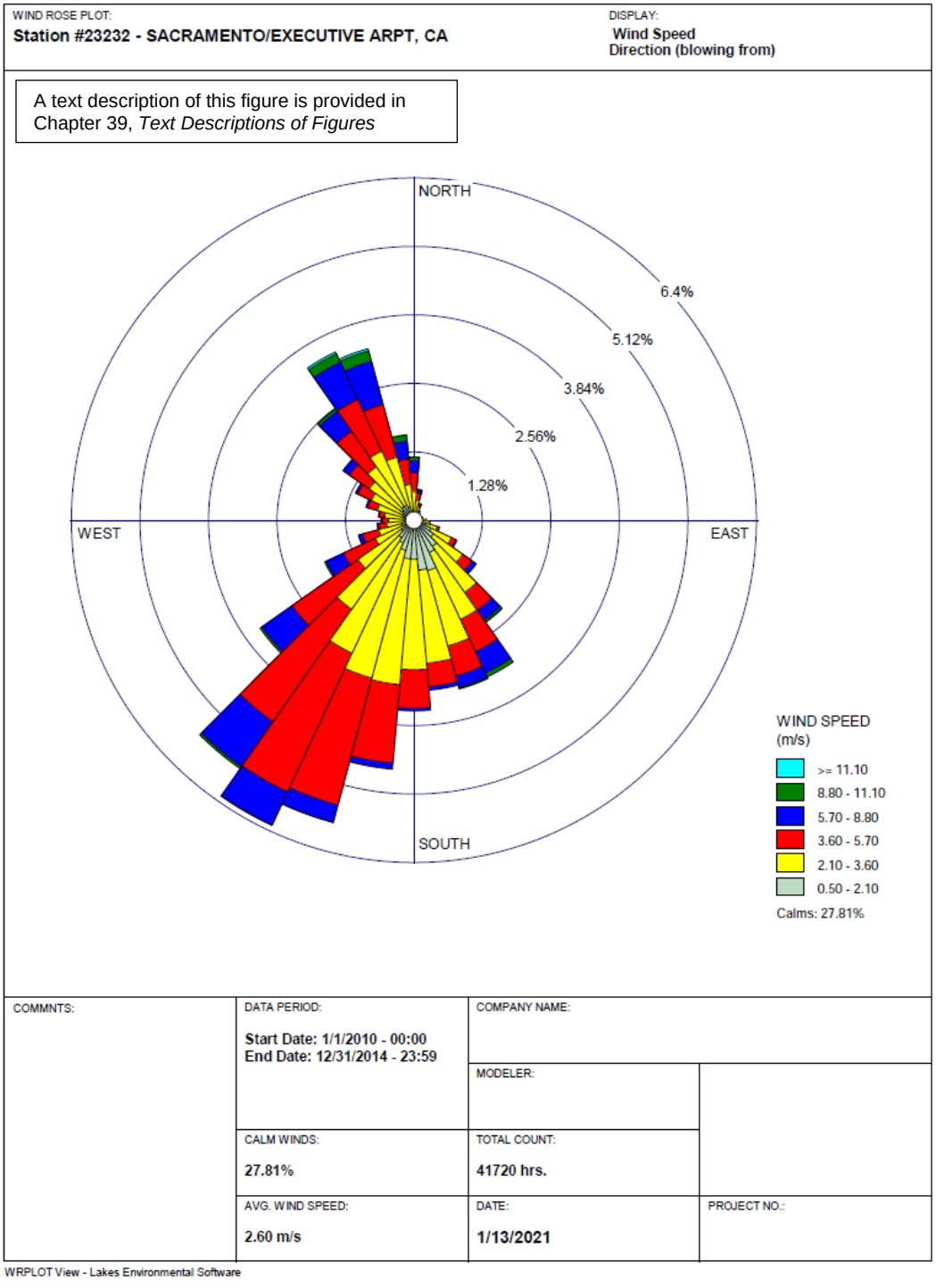


Figure 23C-1. Five-Year Wind Rose Sacramento Executive Airport

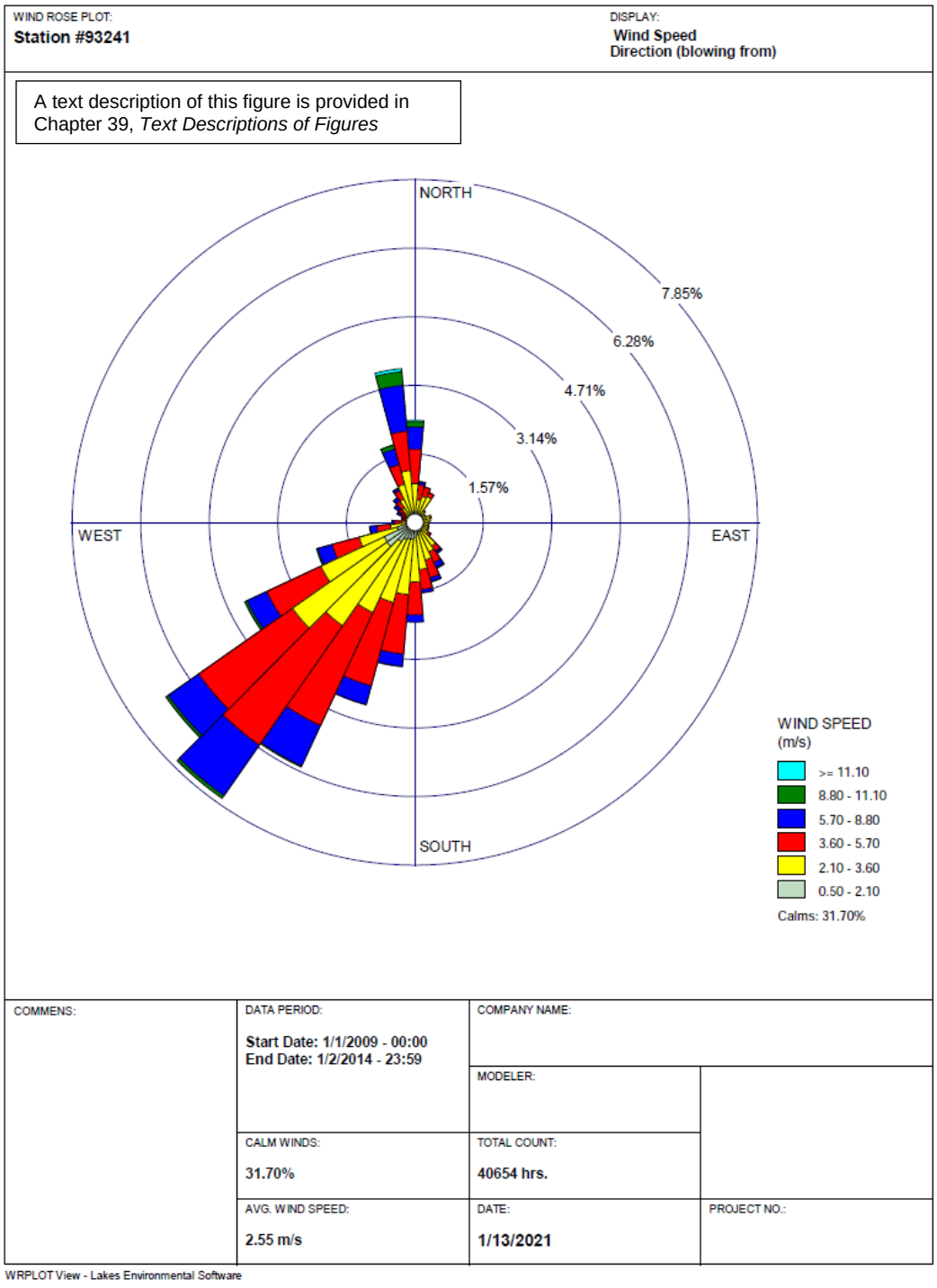


Figure 23C-2. Five-Year Wind Rose Nut Tree Airport

Figure 23C-3 shows the wind roses for Stockton Airport.

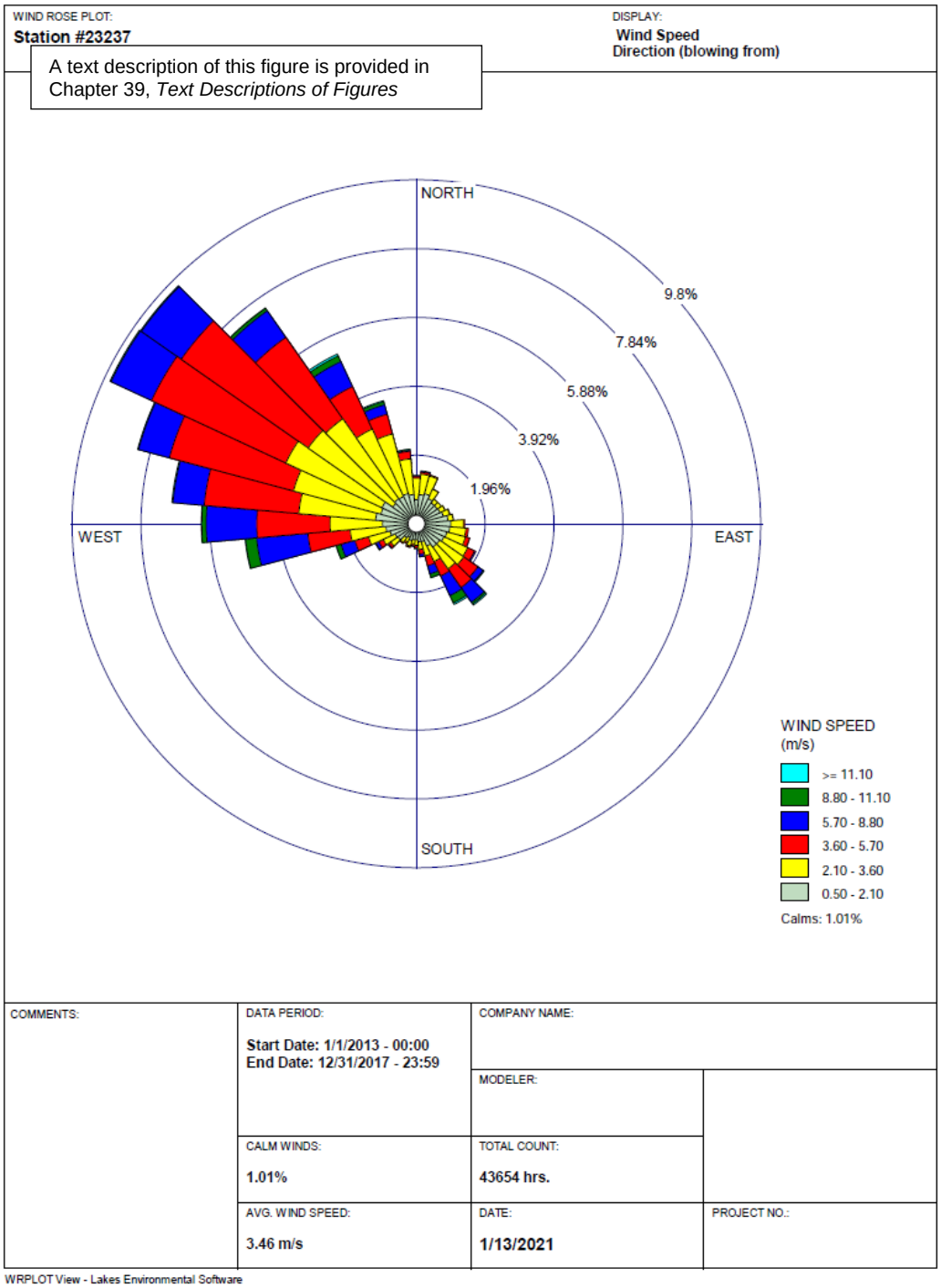


Figure 23C-3. Five-Year Wind Rose Stockton Airport

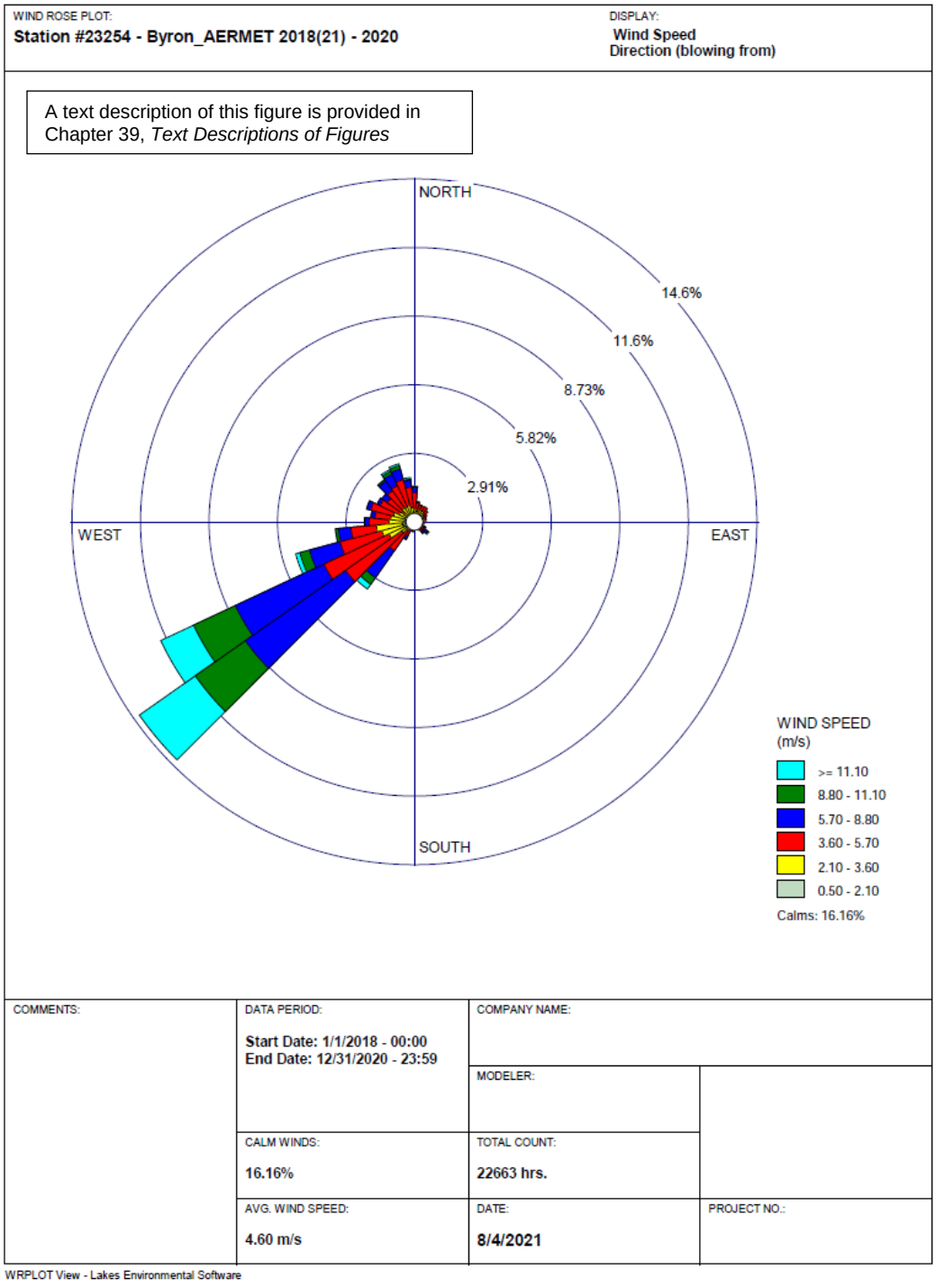


Figure 23C-4. Three-Year Wind Rose Byron Airport, Byron

23C.1.1.1.3 Terrain and Dispersion Coefficients

Elevation data (1-arc second or 30-meter horizontal resolution) was imported from the National Elevation Dataset maintained by the U.S. Geological Survey and is used to determine ground level height throughout the study area. AERMOD has two sets of dispersion coefficients that depend upon the surrounding land use within a 3-kilometer (1.9-mile) radius of the study area. A review of the local air quality study area, as defined in Chapter 23 indicates that no locations have majority (i.e., greater than 50% by land use area) urban land use characteristics. Hence, all modeling is done using the rural dispersion coefficients.

23C.1.1.1.4 Background Concentrations and Significant Impact Levels

To assess whether the modeled air quality impacts are significant, the impacts are compared against significant impact levels (SIL) or ambient air quality standards, depending upon the local attainment status. The SILs and air quality standards are presented in Chapter 23, Table 23-9. For comparison against air quality standards, background concentrations or design values must be added to the project's contribution. Chapter 23, Table 23-4 reports some statistics on measured concentrations for the three most recent years (2018–2020) of the most representative air quality monitoring station in each of the three air districts (SMAQMD—Sacramento T Street, SJVAPCD—Hazelton Street, BAAQMD—Bethel Island Road). These stations were selected from the available CARB monitoring network based on their proximity to the project footprint. The stations are about 7, 8, and 5 miles, respectively, to the nearest point along the conveyance alignment. The Sacramento T Street and Stockton-Hazelton Street stations are in downtown Sacramento and Stockton, respectively, and as such, monitored pollutant concentrations are influenced by urban emission sources (e.g., congested roadways, construction activity, industrial facilities). Data from these stations are therefore more representative of existing conditions in portions of the study area nearest to cities and roadways. Emissions sources along more rural parts of the study area in Sacramento and San Joaquin counties (e.g., through the Delta) are much less concentrated, and as such, monitored pollutant concentrations from the Sacramento T Street and Stockton-Hazelton Street provide a conservative representation of ambient conditions.

Table 23C-2 identifies the federal and state methods for establishing design values for each of the pollutants. Tables 23C-3 and 23C-4 summarize the project analysis design value for each air district, air pollutant, and averaging period. These are the background values used in combination with project feature impacts to compare against ambient air quality standards.

Table 23C-2. Determination of Design Value Concentrations

Pollutant/ Averaging Time	NAAQS Form	NAAQS Background Form	CAAQS Form	CAAQS Background Form
Carbon Monoxide (CO)				
1-hour	Not to be exceeded more than once per year	Highest concentration during most recent 3 years	Never to be exceeded	Highest concentration during most recent 3 years
8-hour	Not to be exceeded more than once per year	Highest concentration during most recent 3 years	Never to be exceeded	Highest concentration during most recent 3 years
Nitrogen Dioxide (NO_2)				
1-hour	98th percentile of the annual distribution of the 1-hour daily averaged over 3 years	98th percentile of the annual distribution of daily maximum	Never to be exceeded	Highest 1-hour concentration during most recent 3 years
Annual	Annual mean	Highest annual concentration for most recent 3 years	Never to be exceeded	Highest annual concentration for most recent 3 years
PM2.5				
24-hour	98th percentile, averaged over 3 years	Average of the 98th percentile 24-hour values over most recent 3 years	Never to be exceeded	Highest 24-hour average during the most recent 3 years
Annual	Annual mean, averaged over 3 years	Average of the annual values over most recent 3 years	Never to be exceeded	Highest annual average over the most recent 3 years
PM10				
24-hour	Not to be exceeded more than once per year on average over 3 years	Average of the 2nd highest yearly values for most recent 3 years	Never to be exceeded	Highest 24-hour average during the most recent 3 years
Annual	Not applicable	Not applicable	Never to be exceeded	Highest annual average over the most recent 3 years
Sulfur Dioxide (SO_2)				
1-hour	Annual distribution of the 1-hour daily maximum concentrations, averaged over 3 years	99th percentile of the annual distribution of daily maximum 1-hour values averaged across the most recent 3 years	Never to be exceeded	Highest 1-hour concentration during most recent 3 years
24-hour	Not applicable	Not applicable	Never to be exceeded	Highest 24-hour average during the most recent 3 years

NAAQS = national ambient air quality standards; CAAQS = California ambient air quality standards.

Table 23C-3. Design Values by Air District for NAAQS (2018–2020)

Pollutant/Averaging Time	SMAQMD	SJVAPCD	BAAQMD
Carbon Monoxide (CO)			
1-Hour	4.3 (ppm) [a]	3.1 (ppm)	2.4 (ppm)
8-Hour	3.0 (ppm) [a]	2.7 (ppm)	2.1 (ppm)
Nitrogen Dioxide (NO_2)			
1-Hour	53.8 (ppb)	56.5 (ppb)	25.3 (ppb)
Annual	9.0 (ppb)	12.0 (ppb)	5.0 (ppb)
PM2.5			
24-Hour	43.4 ($\mu g/m^3$)	68.6 ($\mu g/m^3$)	49.6 ($\mu g/m^3$) [b]
Annual	10.4 ($\mu g/m^3$)	13.7 ($\mu g/m^3$)	9.3 ($\mu g/m^3$) [b]
PM10			
24-Hour	191.9 ($\mu g/m^3$)	118.6 ($\mu g/m^3$)	42.6 ($\mu g/m^3$)
Annual	Not Applicable	Not Applicable	Not Applicable
Sulfur Dioxide (SO_2)			
1-Hour	2.7 (ppb) [c]	2.7 ppb [d]	3.3 (ppb)
24-Hour	Not Applicable	Not Applicable	Not Applicable

BAAQMD = Bay Area Air Quality Management District; ppb = parts per billion; ppm = parts per million; SMAQMD = Sacramento Metropolitan Air Quality Management District; SJVAPCD = San Joaquin Valley Air Pollution Control District; $\mu g/m^3$ = micrograms per meter cubed.

[a] No CO monitoring available at T Street, Sacramento; used monitoring data from Bercut Drive, Sacramento.

[b] No PM2.5 monitoring available at Bethel Island; used monitoring data from Rincon Avenue, Livermore.

[c] No SO_2 monitoring available at T Street, Sacramento; used monitoring data from Avalon Drive, Sacramento.

[d] No SO_2 monitoring in San Joaquin County; used nearest location from Avalon Drive, Sacramento.

Table 23C-4. Design Values by Air District for CAAQS (2018–2020)

Pollutant/Averaging Time	SMAQMD	SJVAPCD	BAAQMD
Carbon Monoxide (CO)			
1-Hour	4.3 (ppm) [a]	3.1 (ppm)	2.4 (ppm)
8-Hour	3.0 (ppm) [a]	2.7 (ppm)	2.1 (ppm)
Nitrogen Dioxide (NO_2)			
1-Hour	66.0 (ppb)	72.0 (ppb)	43.0 (ppb)
Annual	9.0 (ppb)	12.0 (ppb)	5.0 (ppb)
PM2.5			
24-Hour	Not Applicable	Not Applicable	Not Applicable
Annual	12.8 ($\mu g/m^3$)	17.4 ($\mu g/m^3$)	11.3 ($\mu g/m^3$) [b]
PM10			
24-Hour	309.5 ($\mu g/m^3$)	198.6 ($\mu g/m^3$)	151.0 ($\mu g/m^3$)
Annual	31.2 ($\mu g/m^3$)	29.5 ($\mu g/m^3$)	15.7 ($\mu g/m^3$)
Sulfur Dioxide (SO_2)			
1-Hour	8.6 (ppb) [c]	8.6 (ppb) [d]	9.8 (ppb)
24-Hour	1.7 (ppb) [c]	1.7 (ppb) [d]	2.6 (ppb)

BAAQMD = Bay Area Air Quality Management District; ppb = parts per billion; ppm = parts per million; SJVAPCD = San Joaquin Valley Air Pollution Control District; SMAQMD = Sacramento Metropolitan Air Quality Management District; $\mu g/m^3$ = micrograms per meter cubed.

[a] No CO monitoring available at T Street, Sacramento; used monitoring data from Bercut Drive, Sacramento.

[b] No PM2.5 monitoring available at Bethel Island; used monitoring data from Rincon Avenue, Livermore.

[c] No SO_2 monitoring available at T Street, Sacramento; used monitoring data from Avalon Drive, Sacramento.

[d] No SO_2 monitoring in San Joaquin County; used nearest location from Avalon Drive, Sacramento.

23C.1.1.2 Carbon Monoxide Hot-Spot Analysis

Increased offsite traffic congestion during construction may contribute to localized increases in CO, known as CO "hot spots." SJVAPCD, BAAQMD, and YSAQMD have adopted screening criteria that provide a conservative indication of whether a project will cause a CO hot-spot and would require additional site-specific dispersion modeling to determine whether CO CAAQS would be exceeded. Traffic data indicate that no intersections in the transportation study area would exceed BAAQMD's volume-based screening criteria (24,000 vehicles per hour), but some intersections in San Joaquin County would degrade intersection level-of-service (LOS), thereby failing SJVAPCD's CO screening criteria (refer to Appendix 20A, *Delta Conveyance 2020 Traffic Analysis*). Deterioration of intersection LOS could also indicate conflicts with local congestion management plans (CMP), which would violate BAAQMD screening criteria.

A microscale CO hot-spot analysis at three intersections was performed to verify that construction traffic would not cause or contribute to a violation of the CO CAAQS. The potential for CO hot spots was evaluated using the Caltrans Institute of Transportation Studies *Transportation Project-Level Carbon Monoxide Protocol* (CO Protocol) (Garza et al. 1997:B-1–B-24). The CO Protocol details a step-by-step procedure to determine whether project-related CO concentrations have a potential to generate new air quality violations, worsen existing violations, or delay attainment of CAAQS or NAAQS for CO. Additional details of the modeling are described in the following subsections.

23C.1.1.2.1 Intersection Selection

The intersections included in the transportation analysis were ranked by their total weekday PM peak-hour (4:30 to 5:30 p.m.) traffic volumes and delay. The intersection within each of the three study area air districts in which project traffic would occur on local roadways (SMAQMD, SJVAPCD, and BAAQMD)[5] with the highest total traffic volume and worst congestion were selected for CO modeling. Analyzing these intersections provides a conservative assessment of potential CO effects because CO concentrations at all other intersections within each air district would be lower than those estimated for the selected intersections. The following intersections were selected for the analysis:

- Hood-Franklin Road/Southbound I-5 on- and off-ramps
- SR 12/Terminous Drive
- Byron Highway/Clifton Court Road

23C.1.1.2.2 Receptor Locations

Receptors for the intersection analyses were identified in accordance with CO Protocol (Garza et al. 1997:B-16). All receptors were located at a height of 1.8 meters (5.9 feet) and placed 3 meters (9.8 feet) from the roadway, so they were not within the mixing zone of the travel lanes. It was assumed that the public could access these locations regardless of whether sidewalks exist at the receptor location.

23C.1.1.2.3 Emission Model

Vehicular emissions were estimated using EMFAC2017, which is a mobile source emission estimate program that provides current and future estimates of emissions from highway motor vehicles. Consistent with the traffic analysis, CO emission factors are based on 2020 vehicle mixes for projected conditions in SVAB, SJVAB, and SFBAAB. CARB designed EMFAC2017 to address a wide variety of air pollution modeling needs, and the program incorporates fleet-specific emission rates, realistic driving patterns, separation of start and running emissions, correction factors for engine deterioration, and annual fleet compositions.

23C.1.1.2.4 Dispersion Model

Mobile source dispersion models are the basic analytical tools used to estimate CO concentrations expected under given traffic, roadway geometry, and meteorological conditions. The mathematical expressions and formulations that constitute the various models attempt to describe as closely as possible a complex physical phenomenon. Caltrans' CALINE4 dispersion model was used to estimate pollutant concentrations near roadway intersections.

CALINE4 is a Gaussian model recommended in the Caltrans CO Protocol. Gaussian models assume that the dispersion of pollutants downwind of a pollution source follow a normal distribution around the center of the pollution source. The model is described in *CALINE4 – A Dispersion Model for Predicting Air Pollutant Concentration near Roadways* (Benson et al. 1989:8-49). The analysis of roadway CO effects followed the CO Protocol (Garza et al. 1997:B-9).

[5] Project traffic would be prohibited from using Delta roads. There would therefore be no impact on local intersections within YSAQMD.

23C.1.1.2.5 Meteorological Conditions

The transport and concentration of pollutants emitted from motor vehicles are influenced by three principal meteorological factors: wind direction, wind speed, and the temperature profile of the atmosphere. The values for these parameters were chosen to maximize pollutant concentrations at each prediction site (i.e., to establish a conservative situation).

- **Wind direction**—Maximum CO concentrations are normally found when the wind is assumed to blow approximately parallel to a single roadway adjacent to the receptor location. However, at complex intersections, it is difficult to predict which wind angle would result in maximum concentrations. Therefore, at each receptor location, the approximate wind angle that would result in maximum pollutant concentrations was used in the analysis. All wind angles from 0° to 360° were considered.
- **Wind speed**—CO concentrations are greatest at low wind speeds. A conservative wind speed of one mph was used to predict CO concentrations during peak traffic periods.
- **Temperature and profile of the atmosphere**—An ambient temperature based on the CO Protocol (Garza et al. 1997:B-6) was chosen. Winter low temperatures of 35°F, 36°F, and 37°F were assumed for the intersections in SMAQMD, SJVAPCD, and BAAQMD, respectively, based on the average minimum temperature in January or December over an approximately 30-year period (based on Western Regional Climate Center data accessed in May 2021). Neutral atmospheric stability (stability class G) conditions and a mixing height (the height in the atmosphere to which pollutants rise) of 1,000 feet were used.

The selection of these meteorological parameters was based on recommendations from the CO Protocol (Garza et al. 1997:B-14). These data were found to be the most representative of the conditions in the study area.

23C.1.1.2.6 Persistence Factor

Peak 8-hour concentrations of CO were obtained by multiplying the highest peak-hour CO estimates by a persistence factor. The persistence factor accounts for the following characteristics:

- Over an 8-hour period (as distinct from a single hour), vehicle volumes fluctuate downward from the peak hour.
- Vehicle speeds may vary over an 8-hour period compared to a single hour.
- Meteorological conditions, including wind speed and wind direction, vary compared with the conservative assumptions used for the single hour.

The persistence factor used in the analysis is 0.6, which is recommended in the CO Protocol for rural locations (Garza et al. 1997:Table B-15).

23C.1.1.2.7 Background Concentrations

Background CO concentrations based on local air quality monitoring data (2018 to 2020) were added to project-level results to account for sources of CO not included in the modeling. Actual 1- and 8-hour background concentrations in future years would likely be lower than concentrations used in the CO modeling analysis because the CO emissions and concentrations are decreasing due to continuing improvements in engine technology and the retirement of older, higher-emitting vehicles.

23C.1.1.2.8 Traffic Information

Traffic data for the air quality analysis was derived from traffic counts and other information developed as part of an overall traffic analysis for the project. The microscale CO analysis was performed based on data from this analysis for the weekday PM Peak Hour (4:30 to 5:30 p.m.) traffic period. This is the period when maximum traffic volumes occur on local streets and the greatest traffic and air quality effects of the project are expected.

23C.1.2 Health Risk Analysis

23C.1.2.1 Project Construction

A construction HRA was conducted to assess the potential impacts associated with public exposure to DPM[6] and, for locations within the BAAQMD, localized PM2.5. The HRA was conducted using the guidelines provided by the Office of Environmental Health Hazard Assessment (2015:1-1–9-17), California Air Pollution Control Officers Association (2009:8–75), and local air districts (San Joaquin Valley Air Pollution Control District 2019:3–7; Sacramento Metropolitan Air Quality Management District 2020:5-1–5-10; Yolo-Solano Air Quality Management District 2007:11–13; Bay Area Air Quality Management District 2020:1–27).

Air dispersion modeling for the HRA was conducted using the same general methodology as in the AAQA with the principal difference being the location of the receptors. Annual average PM concentrations are determined at actual sensitive receptor locations for each project feature. Construction emissions were evaluated using the year with the highest emission rates from the mass emission inventory (refer to Appendix 23A) and the resulting maximum excess cancer risk, chronic hazard index, and PM2.5 concentration for receptors within the BAAQMD. Total emissions are temporally allocated to occur over an exposure duration of 8 hours per day during daytime hours, Monday through Friday, reflective of with when the majority of construction activities would occur.

In addition to onsite construction activities, haul truck DPM emissions were included in the analysis to account for their potential contribution to health risk impacts. Haul trucks are associated with the transport of construction material and supplies to each feature or the removal of material from each feature. Haul truck emissions that occurred within 1,000 meters (3,280.8 feet) of a project feature were included in the modeling of each feature.

A screening analysis was performed to confirm DPM emissions resulting from haul trucks traveling beyond 1,000 meters (3,280.8 feet) from the project footprint would not result in a significant health risk impact. Because the haul roads occur over a wide array of orientations, the screening analysis evaluated roadway orientations over all possible angles ranging from 0 to 360 degrees, every 10 degrees. Each roadway was modeled as a 2-kilometer (6,561.7 feet) by 7.6-meter (25-feet) line area source using unitized emissions. Receptors were placed at 3 (9.8 feet), 10 (32.8 feet), 20 (65.6 feet), 30 (98.4 feet) and 50 (164.0 feet) meters to span the range of possible residences that are near the roadways. Each roadway screening analysis was scaled by the maximum annual DPM emission rate

[6] While DPM is a complex mixture of gases and fine particles that includes more than 40 substances listed by EPA and CARB as hazardous air pollutants, OEHHA guidance (2015) indicates that the cancer potency factor developed to evaluate excess cancer risks was developed based on total (gas and PM) diesel exhaust.

on that roadway resulting from project construction vehicles to determine the maximum incremental DPM concentration. Emissions were assumed to occur during daytime hours.

23C.1.2.1.1 Sensitive Receptors

Application of the AERMOD dispersion model determines pollutant concentrations at sensitive receptors. Sensitive receptors in this assessment include all residences, medical facilities, nursing homes, schools and school yards, daycare centers, community parks, and playgrounds that are shown in Figures 23-3 through 23-5 in Chapter 23. The modeling domain also includes area beyond the 1,000-foot local air quality study area to capture additional receptors within 1,000 meters (3,280.8 feet) of project features. The analysis therefore captures all potentially impacted receptors in vicinity of project construction, including receptors within 1,000 meters of physical construction features in the City of Stockton. For each sensitive receptor, exposure calculations are applied to determine the health risk. Per air district guidance, BAAQMD receptors are modeled with a flagpole receptor height of 1.5 meters (4.9 feet; breathing height), receptors in the YSAQMD and SMAQMD are modeled with a flagpole receptor height of 1.8 meters (5.9 feet), and SJVAPCD receptors are modeled at ground level, 0 meters.

23C.1.2.1.2 Exposure Assessment

The exposure assessment methodology according to the OEHHA 2015 *Air Toxics Hot Spots Program, Risk Assessment Guidelines, Guidance Manual for Preparation of Health Risk Assessments* is outlined as follows:

- **Potentially Exposed Populations**: This HRA evaluates project-related construction health impacts on off-site sensitive receptors.
- **Exposure Assumptions**: The exposure parameters used to estimate excess lifetime cancer risks for potentially exposed populations were based on the risk assessment values contained in OEHHA's guidance (Office of Environmental Health Hazard Assessment 2015:5-1–5-59).
- **Calculation of Intake**: The dose estimated for each exposure pathway is a function of the concentration of the DPM and the intake of DPM.

23C.1.2.1.3 Toxicity Assessment

The toxicity assessment characterizes the relationship between the magnitude of exposure and the magnitude of adverse health effects that may result from such exposure. For risk assessments, adverse long-term health effects are classified into two categories—cancer and noncancer endpoints. Toxicity values are used to estimate the likelihood of adverse effects occurring in humans at different exposure levels. CARB has identified that the best estimate of the cancer potency factor for DPM is 1.1 milligrams per kilogram-day $(mg/kg\text{-}day)^{-1}$ and for chronic noncancer, a reference exposure level of 5 micrograms per meter cubed ($\mu g/m^3$) (Office of Environmental Health Hazard Assessment 2016:7).

23C.1.2.1.4 Age Sensitivity Factors

The estimated excess lifetime excess cancer risks for children are adjusted using age sensitivity factors (ASF) that account for an "anticipated special sensitivity to carcinogens" of infants and children as described in OEHHA's guidance (Office of Environmental Health Hazard Assessment 2015:8-5). Excess cancer risk estimates were weighted by a factor of 10 for exposures that occur

from the third trimester of pregnancy to 2 years of age and by a factor of three for exposures that occur from 2 years through 15 years of age. A weighting factor of one is applied to ages 16 and older.

23C.1.2.1.5 Estimation of Maximum Excess Cancer Risks

Excess lifetime cancer risks are conservatively estimated as the upper-bound incremental probability that an individual will develop cancer over a lifetime as a result of exposure to potential human carcinogens. The estimated excess cancer risk is expressed as a unitless probability. The excess cancer risk attributed to DPM is calculated by multiplying the chemical dose at the inhalation boundary (e.g., lungs) by the cancer potency factor.

The equation used to calculate the potential excess lifetime cancer risk for the inhalation pathway is:

$$Risk = C_i \times INR \times CPF \times ASF \times ED/AT \times FAH$$

Where:

Risk = Excess cancer risk

C_i = Annual average air concentration for DPM

INR = Intake rate per mass per day

CPF = Cancer potency factor for DPM

ASF = Age sensitivity factor

ED = Exposure duration (in years)

AT = Averaging time for lifetime cancer risk (70 years)

FAH = Fraction of time spent at home (conservatively set equals 1)

For each receptor, risks were evaluated over the total construction duration for each project feature to determine total risk from the project.

23C.1.2.1.6 Estimation of Maximum Chronic and Acute Noncancer Hazard Index

The potential for exposure to result in adverse chronic noncancer effects is evaluated by comparing the estimated annual average air concentration to the noncancer chronic reference exposure level. As DPM is the only pollutant evaluated for chronic noncancer, the hazard index equation is:

$$HI = C_i/C_{rel}$$

Where:

HI = Hazard index

C_i = Annual average concentration of DPM

C_{rel} = Chronic noncancer reference exposure level for DPM (5 $\mu g/m^3$)

The acute hazard effect is evaluated by comparing the short-term air concentration to the acute exposure reference level. Two air pollutants, SO_2 and NO_2, are emitted during construction of the project and have acute reference exposure levels. Although the two pollutants have different health

end points, the two hazard indexes will be summed to conservatively report the total acute hazard index. This can be expressed mathematically as shown in the following equation:

$$AHI = C_{SO2}/C_{rel}(SO_2) + C_{NO2}/C_{rel}(NO_2)$$

Where:

AHI = Acute Hazard index

C_{SO2} = Hourly average concentration of SO_2

$C_{rel}(SO_2)$ = Acute reference exposure level for SO_2 (660 µg/m^3)

C_{NO2} = Hourly average concentration of NO_2

$C_{rel}(NO_2)$ = Acute reference exposure level for NO_2 (470 µg/m^3)

23C.1.3 Standby Engine Generator Testing during Operations and Maintenance

Each of the project intakes, the South Delta Pumping Plant, South Delta Outlet and Control Structure, Delta-Mendota Canal Control Structure, the Bethany Reservoir Pumping Plant, and the Bethany Reservoir Discharge Structure would have standby engine generators that would be used in the event of a power outage. The generators would be used to power the gates and lights during a power outage. Because the standby engine generators are stationary sources that would remain at the same location and result in regular (monthly) emissions, an HRA was conducted to assess the potential impacts associated with public exposure to DPM and, for locations within the BAAQMD, localized PM2.5.

The HRA was conducted following the same methods as described in Section 23C.1.2.1, *Project Construction,* but modeling the generators as point sources. Each intake has two 50 horsepower (hp) generators with the other features having only a single generator. These small generators were conservatively assumed to have a relatively low stack height of 3 meters (9.8 feet). Other stack parameters are based on the smallest engine horsepower used in Appendix E to the CARB Staff Report: *Initial Statement of Reasons for Proposed Rulemaking* (California Air Resources Board 2003:Table E-1). The generators would be permitted to operate up to 6 hours per year. An HRA was conducted at each feature location using the maximum annual DPM emissions. To conservatively estimate the impact from the two generators operating at the intakes, emissions from those locations were combined as though occurring at the exact same location.

23C.2 References Cited

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Attachment 23C.1
Cumulative Health Risk Assessment

Delta Conveyance Cumulative HRA Analysis Scenario 1 (Central and Eastern Conveyance Alignment Options)
Analysis 1 evaluates the MEI exposed to ***project*** *pollution and adds background risks at that location.*

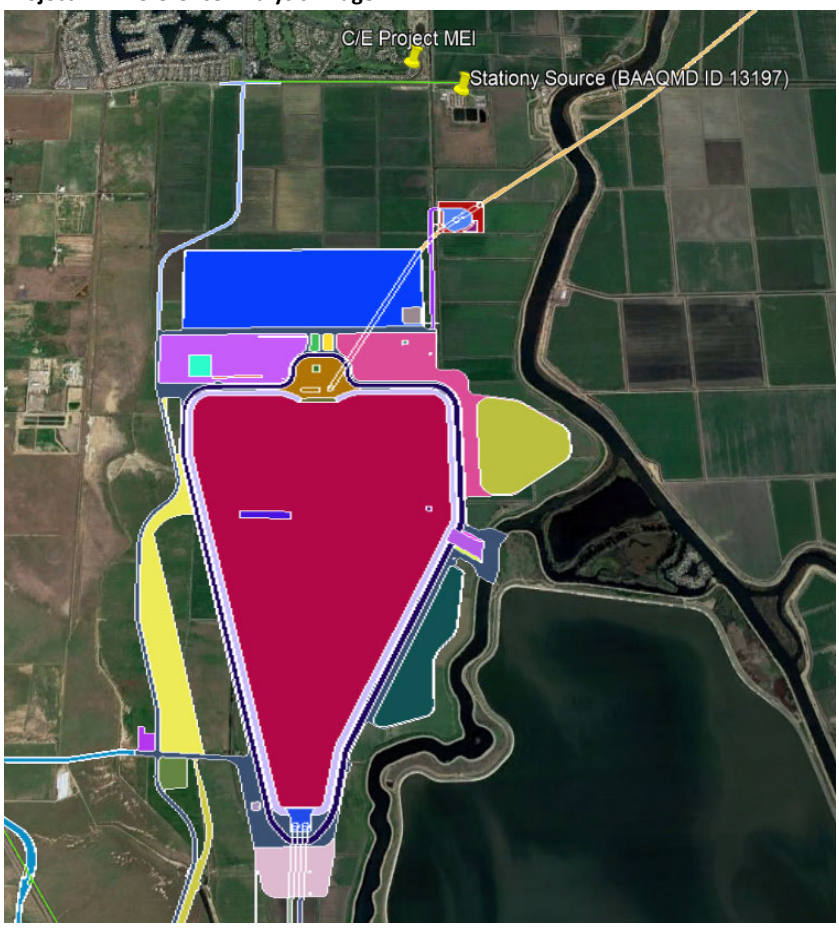
Project sources	Project MEI (results from project-level analysis)
Existing sources	Rail Roadways Stationary Source
Receptor location (project MEI)	(624121.12, 4194609.26)
Project Alternative	2a/4a

Results

Source	Cancer (per million)	HI	PM2.5 (ug/m3)
Contributions from Existing Sources at the Project MEI			
Rail	0.13	0.00	0.00
Roadways	3.96	0.01	0.05
Stationary Source*			
Town of Discovery Bay	0.64	0.00	0.00
Contributions from Project Construction			
Alternative 4a	1.66	0.15	0.10
Total Combined Risk	6.38	0.17	0.15
BAAQMD Threshold	100	10.0	0.8

* Background risk adjusted using BAAQMD distance multipliers.

Project MEI Reference Analysis Image



Delta Conveyance Cumulative HRA Analysis Scenario 2 (Bethany Conveyance Option)

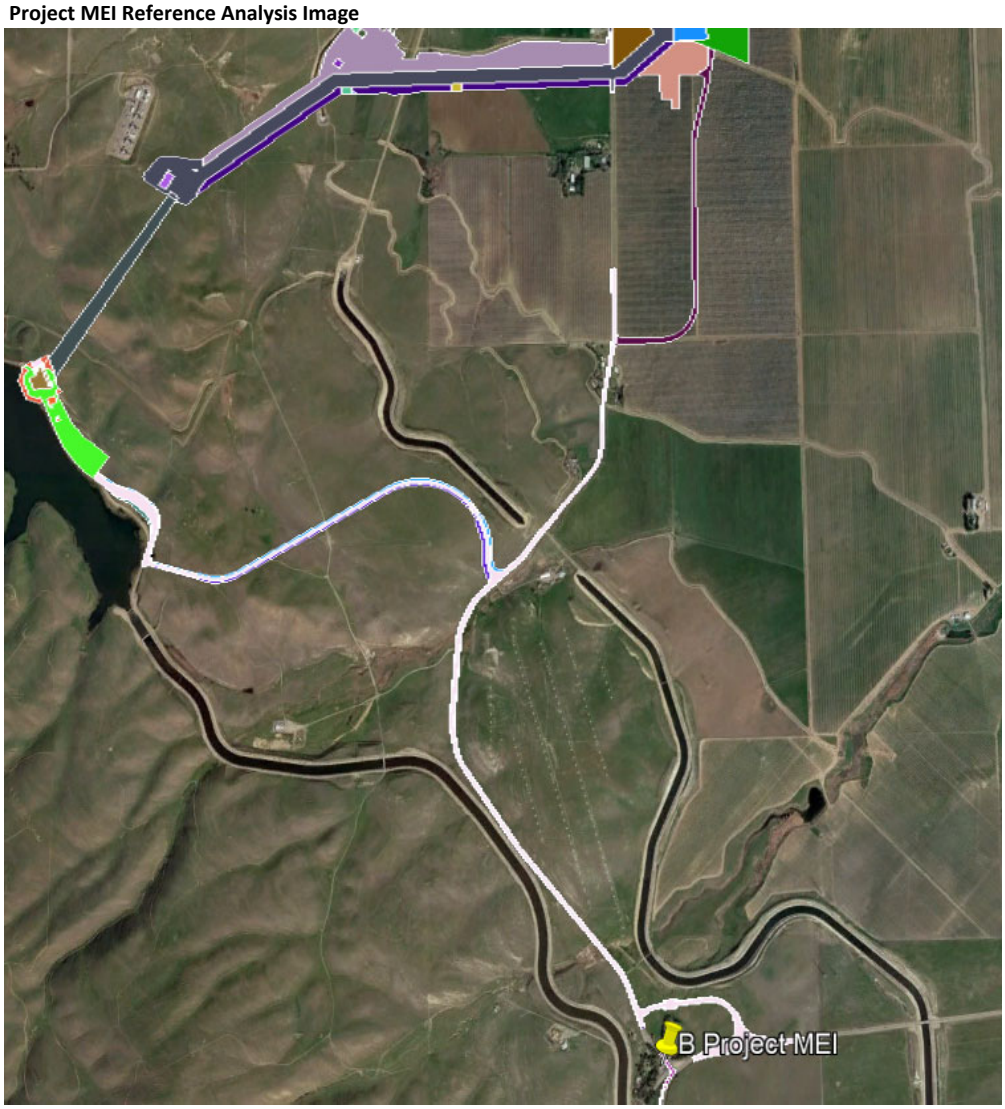
Analysis 2 evaluates the MEI exposed to ***project*** *pollution and adds background risks at that location.*

Project sources	Project MEI (results from project-level analysis)
Existing sources	Rail Roadways
Receptor location (project MEI)	(625481.67, 4179524.14)
Project Alternative	5

Results

Source	Cancer (per million)	HI	PM2.5 (ug/m3)
Contributions from Existing Sources at the Project MEI			
Rail	0.68	0.00	0.00
Roadways	6.94	0.02	0.10
Contributions from Project Construction			
Alternative 5	0.72	0.14	0.07
Total Combined Risk	8.33	0.16	0.17
BAAQMD Threshold	100	10.0	0.8

Project MEI Reference Analysis Image



Delta Conveyance Cumulative HRA Analysis 3 (Central and Eastern Conveyance Alignment Options)

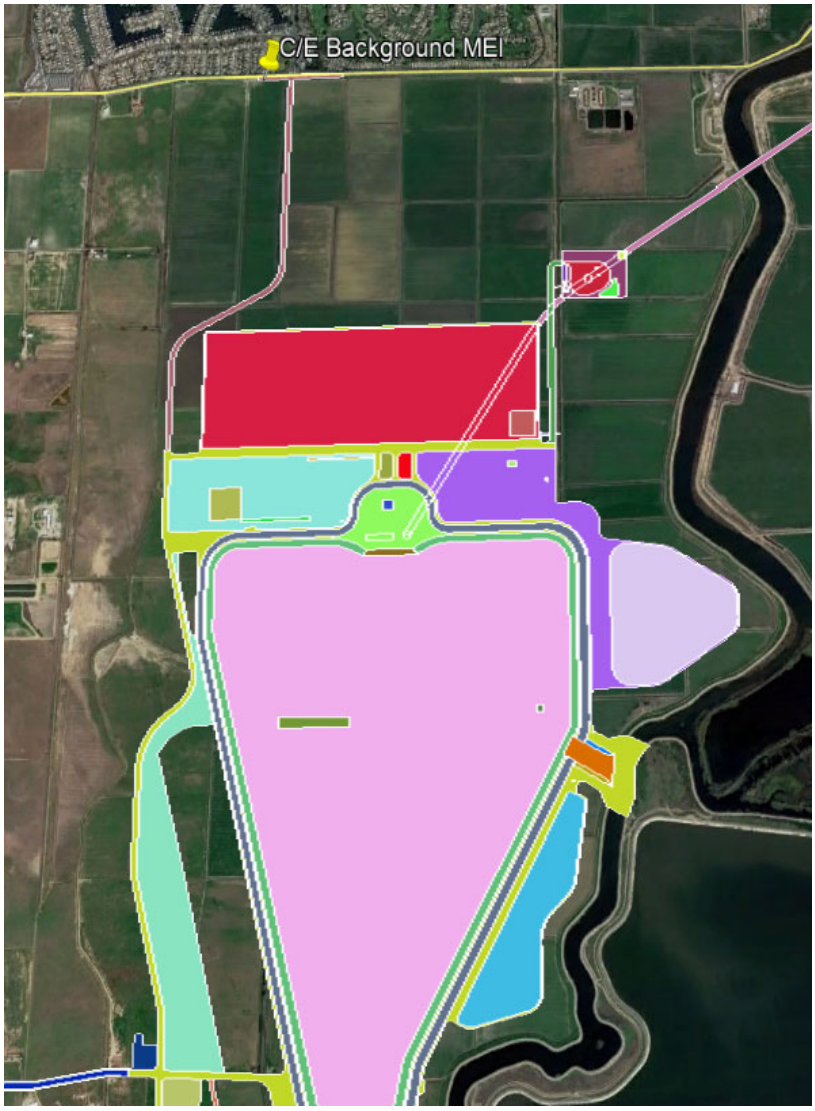
Analysis 3 evaluates the MEI exposed to ***background*** *pollution (C/E alignment option) and adds the max project risk contribution.*

Project sources	Project contribution at Background MEI location
Existing sources	Rail Roadways
Receptor location (background MEI)	(622756.9094, 4194513.8057)
Project Alternative	2a/4a

Results

Source	Cancer (per million)	HI	PM2.5 (ug/m3)
Contributions from Existing Sources at the Background MEI			
Rail	1.10	0.00	0.00
Roadways	51.69	0.12	0.62
Contributions from project construction			
Alternative 2a/4a	1.67	0.15	0.10
Total Combined Risk	54.45	0.28	0.72
BAAQMD Threshold	100	10.0	0.8

Background MEI Reference Analysis Image



Delta Conveyance Cumulative HRA Analysis 4 (Bethany)

Analysis 4 evaluates the MEI exposed to ***background*** *pollution (Bethany alignment option) and adds the max project risk contribution.*

Project sources	Project contribution at Background MEI location
Existing sources	Rail Roadways
Receptor location (background MEI)	(625415.8574, 4178994.1662)
Project Alternative	5

Results

Source	Cancer (per million)	HI	PM2.5 (ug/m3)
Contributions from Existing Sources at the Background MEI			
Rail	0.67	0.00	0.00
Roadways	11.00	0.03	0.16
Contributions from project construction			
Alternative 5	1.16	0.14	0.07
Total Combined Risk	12.83	0.17	0.22
BAAQMD Threshold	100	10.0	0.8

Background MEI Reference Analysis Image

