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Common Response 10: Surface Water Quality and Groundwater Resources

Overview

This Common Response addresses recurring themes in public comments about the impact analyses for the proposed project and project alternatives regarding surface water quality, described in Chapter 9, *Water Quality*, and groundwater resources, described in Chapter 8, *Groundwater*. The comment themes for Chapter 9 generally relate to the thresholds of significance for making water quality impact determinations, the validity of the hydrologic and hydrodynamic models used to support the water quality analyses, the presentation and use of modeling results to make impact determinations, and the approach taken for the analysis of cyanobacteria harmful algal blooms (CHABs). The comment themes for Chapter 8 generally relate to the California Department of Water Resources' (DWR) selection of groundwater modeling tools and how the tools were used to assess the project's potential impacts on groundwater resources disclosed in the EIR.

Surface Water Quality Impact Analysis

Thresholds of Significance for Chapter 9, *Water Quality*

Comments asserted that the thresholds of significance in Chapter 9 are vague, improper, and not supported by substantial evidence. The sections below address comments received regarding how DWR developed and applied refined thresholds of significance in CEQA Guidelines Appendix G environmental checklist for the purpose of making impact determinations for surface water quality in Chapter 9.

Development of Thresholds of Significance

A lead agency has discretion to formulate standards of significance for use in its environmental impact report (EIR), as discussed in Common Response 1, *CEQA Process, General Approach to Analysis, and Other Environmental Review Issues*. DWR developed thresholds of significance for surface water quality using those presented in the CEQA Guidelines Appendix G under Section X, *Hydrology and Water Quality*. These CEQA Guidelines thresholds of significance benefit from refinements to make them more effective at evaluating the details of impact mechanisms that could lead to potentially significant environmental impacts based on the details of the Delta Conveyance Project alternatives for use in this EIR. Table CR10-1 lists the CEQA Guidelines thresholds of significance related to water quality and DWR's thresholds of significance used for assessing impacts on surface water quality in Chapter 9. A discussion of the refinements made to develop the project-specific thresholds of significance in Chapter 9 is provided after Table CR10-1. CEQA Guidelines Appendix G, Section X, threshold [b] is not listed in Table CR10-1 because it solely addresses groundwater supply and recharge and is addressed in Chapter 8.

Table CR10-1. Crosswalk of Thresholds of Significance in CEQA Guidelines Appendix G and Chapter 9, *Water Quality*

Thresholds of Significance for Water Quality in CEQA Guidelines Appendix G: Environmental Checklist Form, Section X, <i>Hydrology and Water Quality</i>	Thresholds of Significance for Water Quality in Chapter 9, <i>Water Quality</i> , section titled <i>Thresholds of Significance</i>
(a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality?	1. Cause exceedance of applicable state or federal numeric or narrative water quality objectives/criteria or other relevant water quality effects thresholds identified for this assessment from the scientific literature by frequency, magnitude, and geographic extent that would result in adverse effects on one or more beneficial uses of affected waterbodies. (Addressed in Impacts WQ-1 through WQ-14.) 2. Increase levels of a bioaccumulative pollutant by frequency, magnitude, and geographic extent such that the affected waterbody (or portion of a waterbody) would be expected to have measurably higher body burdens of the bioaccumulative pollutant in aquatic organisms that result in substantially increasing the health risks to wildlife (including fish) or humans consuming those organisms (Addressed in Impacts WQ-1 through WQ-14.) 3. Cause long-term degradation of water quality in affected waterbodies that would result in substantially increased risk for adverse effects on one or more beneficial uses. (Addressed in Impacts WQ-1 through WQ-14.) 4. Further degrade water quality by measurable levels, on a long-term basis, for one or more parameters that is already impaired, and thus included on the State's Clean Water Act Section 303(d) list for the waterbody, such that beneficial use impairment would be made discernibly worse. (Addressed in Impacts WQ-1 through WQ-14.) 7. Violate waste discharge requirements issued to the project for construction-related activities. (Addressed in Impact WQ-1.)

Thresholds of Significance for Water Quality in CEQA Guidelines Appendix G: Environmental Checklist Form, Section X, <i>Hydrology and Water Quality</i>	Thresholds of Significance for Water Quality in Chapter 9, <i>Water Quality</i> , section titled <i>Thresholds of Significance</i>
(c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would: (i) result in a substantial erosion or siltation on- or off-site; (ii) substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite; (iii) create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or (iv) impede or redirect flood flows?	6. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would: (a) result in substantial erosion or siltation on- or off-site, or (b) create or contribute runoff water which would provide substantial additional sources of polluted runoff causing siltation or pollution to enter one or more affected waterbodies at levels and frequency that would adversely affect one or more beneficial use. (Addressed in Impact WQ-16.)
(d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?	5. Risk release of pollutants from project facilities upon project facility inundation that would cause degradation of water quality in affected waterbodies at levels and duration that would result in substantially increased risk for adverse effects to one or more beneficial uses. (Addressed in Impact WQ-15.)
(e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?	8. Conflict with or obstruct implementation of a water quality control plan. (Addressed in Impact WQ-17.)

In the EIR, CEQA Guidelines threshold (a) was refined into five separate thresholds of significance (1, 2, 3, 4, and 7) to reflect its three main components: water quality standards; water quality degradation; and waste discharge requirements. These refinements to the thresholds and their application to the surface water quality impact analysis in Chapter 9 are explained later in this section. The portion of CEQA Guidelines threshold (a) related to groundwater quality is addressed in Chapter 8 under Impact GW-7: *Degradation of Groundwater Quality*.

Chapter 9 thresholds 1 and 2 address the “violate water quality standards” portion of CEQA Guidelines threshold (a). A water quality standard has three parts: the designated beneficial uses to be protected in the waterbody, the water quality objectives or criteria to be met to protect the designated beneficial uses, and the Antidegradation Policy. Consequently, exceedance of an objective or criterion alone does not determine whether a water quality standard has been exceeded or violated, nor does it automatically (without consideration of other factors) determine that a significant impact (i.e., an adverse effect on a designated beneficial use) will occur in a waterbody. The frequency, magnitude, and geographic extent of any objective or criterion exceedances must be evaluated to determine whether such exceedances rise to the level of adversely affecting one or more designated beneficial uses of the waterbody.

Chapter 9 threshold 1 applies the basic concept behind CEQA Guidelines threshold (a), with refinements to account for the frequency, magnitude, and geographic extent by which a water quality criterion or objective could be exceeded; these refinements make it possible to relate such exceedances to adverse effects on beneficial uses. The EIR identifies significant impacts under CEQA relative to Chapter 9 threshold 1 when it is anticipated that water quality under a project alternative could change sufficiently to cause exceedances of adopted water quality objectives or criteria, or of other relevant effect thresholds, thereby causing adverse effects on beneficial uses. The EIR avoids making a significant impact determination when the exceedance of a water quality objective, criterion, or other relevant effect thresholds is too infrequent, too low in magnitude, or too isolated geographically to cause any adverse effects on beneficial uses of the waterbody or waterbody segment.

Chapter 9 threshold 2 was developed in recognition that water quality objectives or criteria for some bioaccumulative constituents are expressed in terms of concentrations in aquatic life tissues. Increases in aquatic life body burdens of bioaccumulative constituents caused by project operations could potentially increase the health risks to wildlife (including fish) or humans consuming those organisms even if these levels do not exceed the adopted water quality objectives or criteria applicable to the water column. Threshold 2 enabled meaningful assessment of the potential impacts that project operations could have on beneficial uses related to bioaccumulative constituents, such as mercury and selenium, that accumulate in the tissues of aquatic life and aquatic-dependent birds.

The water quality objectives and criteria applied in the analysis include state-adopted objectives in water quality control plans, such as drinking water primary and secondary maximum contaminant levels; federal water quality criteria promulgated for priority pollutants; and other relevant thresholds obtained from the scientific literature if no adopted objectives or criteria exist (e.g., bromide and organic carbon thresholds for drinking water treatment). The objectives or criteria applied in the impact analyses are defined in each constituent's impact discussion in the section titled *Impacts of the Project Alternatives on Water Quality* in Chapter 9 and in Appendix 9A, *Screening Analysis*. The designated beneficial uses considered in the analysis are defined in water quality control plans, as discussed in Chapter 9, in the section titled *Beneficial Uses*.

Chapter 9 thresholds 3 and 4 address the "otherwise substantially degrade surface ... water quality" portion of CEQA Guidelines threshold (a). This portion of CEQA Guidelines threshold (a) is vague and therefore not sufficiently specific to allow meaningful or precise application as a threshold of significance. Threshold 3 recognizes that impacts due to water quality degradation must be related to the risk of adverse effects to beneficial uses. This refinement enabled DWR to distinguish between minor degradation and greater, long-term (i.e., consistent over time) levels of degradation that would put beneficial uses at risk of adverse effects when making impact determinations.

Chapter 9 threshold 4 was developed in recognition that an impact determination regarding water quality degradation should be more sensitive when a waterbody is already impaired (i.e., when water quality objectives or criteria are consistently not met and thus beneficial uses may be impaired). Threshold 4 provides meaningful sensitivity for already impaired conditions by requiring measurable changes, on a long-term basis, rather than requiring *any* change at any time—that is, a change that could be quantified by modeling but not measured in the actual environment or would not occur frequently enough to discernably alter the existing impairment.

The portion of CEQA Guidelines threshold (a) that relates to violation of a waste discharge requirement is addressed directly by Chapter 9 threshold 7. Threshold 7 is specific to construction activities because construction activities would require obtaining coverage under National Pollutant Discharge Elimination System permits, which will specify waste discharge requirements.

CEQA Guidelines threshold (c) components related to water quality are addressed by Chapter 9 threshold 6. The portions of threshold (c) related to surface runoff, stormwater system capacity, and flooding are addressed in Chapter 7, *Flood Protection*. CEQA Guidelines threshold (d) is addressed by Chapter 9 threshold 5. As described regarding the refinement of CEQA Guidelines threshold (a), thresholds (c) and (d) were refined in Chapter 9 thresholds 5 and 6 to evaluate the frequency, magnitude, and geographic extent of any objective or criterion exceedances to determine whether such exceedances rise to the level of adversely affecting (i.e., causing an impact) one or more designated beneficial uses of the waterbody.

Finally, CEQA Guidelines threshold (e), which relates to conflicting with or obstructing implementation of a water quality control plan, is addressed by Chapter 9 threshold 8.

Application of Thresholds of Significance for Making Impact Determinations

Some comments questioned the refinements to the CEQA Guidelines thresholds discussed in the previous section, suggesting that any exceedances of a water quality objective or criterion obligated a significant impact determination in the Draft EIR.

The Sacramento County Superior Court case of *Contra Costa Water District v. Sacramento Regional County Sanitation District and Board of Directors of the Sacramento Regional County Sanitation District* examined the adequacy of the Sacramento Regional County Sanitation District's water temperature impacts analysis in the Sacramento Regional Wastewater Treatment Plant 2020 Master Plan EIR (Case No. 05CS00908, ruling dated February 13, 2008). Petitioners argued that the Sacramento Regional County Sanitation District's EIR was deficient because it did not properly apply existing standards, specifically the State's Thermal Plan objectives, as thresholds of significance. Petitioners claimed that any exceedance of the Thermal Plan objectives obligated a significant impact determination in the EIR. Superior Court Judge Raymond Cadei wrote the following in his ruling on the petition for writ of mandate on the matter.

The Court concludes that the EIR was not deficient in its analysis of this potential impact. Whether the plant's discharges will cause existing standards to be exceeded is only one possible measure of whether a significant environmental impact will occur. As the case law recognizes, existing standards may operate as a kind of "surrogate" for real-world effects, but must be treated with caution so that reliance on the standards alone does not obscure the real-world effects. ... [t]he fact that a particular environmental effect meets a particular threshold cannot be used as an automatic determinant that the effect is or is not significant, and cannot foreclose consideration of other substantial evidence tending to show that the effect to which the threshold relates might be significant. ... The EIR then went on to provide a thorough and persuasive explanation, based on scientific data, of why the thermal effects of the plant's discharge will be less than significant on aquatic species [despite exceeding Thermal Plan objectives], based on factors such as the size and location of the thermal plume, the existence in the Sacramento River at and near the point of discharge of adequate "zones of passage" around the thermal plume, and manner in which different aquatic species behave when they encounter elevated water temperatures. ... The EIR thus contained an adequate explanation of the reasoning supporting its conclusion that the Thermal Plan did not [alone] provide an

appropriate standard of significance, and of the data underlying that reasoning. ... Moreover, the scientific data summarized in the EIR on this issue constitutes substantial evidence in support of the finding that the thermal impact will be less than significant, and petitioners have not demonstrated otherwise.¹

This court decision clearly indicates that a particular environmental effect meeting a particular threshold of significance, such as exceedance of a water quality objective, cannot be used as an automatic determinant of whether the effect is or is not significant. This becomes particularly evident when one recognizes that infrequent and low-magnitude exceedances can occur with no actual adverse impacts on beneficial uses. Also, for some constituents, no adopted objectives or criteria exist at all (e.g., bromide, which is addressed in Chapter 9 under Impact WQ-3: *Effects on Bromide Resulting from Facility Operations and Maintenance*). In this particular case, lack of exceedances of adopted objectives or criteria alone cannot ensure that an impact on beneficial uses will not occur; thus Chapter 9 threshold 1 contains the clause “or other relevant water quality effects thresholds identified for this assessment from the scientific literature.” By including this clause in its refined threshold, DWR was able to effectively assess constituents such as boron that lack adopted objectives or criteria.

Antidegradation Policy

Chapter 9 thresholds 3 and 4 address water quality degradation. DWR’s water quality impact analyses produced substantial evidence pertaining to how water quality would change in various waterbodies under the proposed project and project alternatives relative to existing conditions. These water quality differences were then compared to Chapter 9 thresholds 3 and 4, as appropriate, to ensure that impact determinations were based on expected real-world environmental effects. For example, Impact WQ-5: *Effects on Electrical Conductivity Resulting from Facility Operations and Maintenance* in Chapter 9 presents analysis of modeling results characterizing changes in electrical conductivity that could occur at 14 locations throughout the Delta, supported by tables and figures of modeling results in Appendix 9G, *Electrical Conductivity*. The modeling results tables presented in Impact WQ-5 and the results presented in Appendix 9G, which are for a 93-year hydrologic period (1923–2015), quantify the potential electrical conductivity degradation; that degradation is discussed in Impact WQ-5 relative to the beneficial uses affected by electrical conductivity changes, which include agricultural water supply uses.

See Common Response 8, *Relationship to Other Plans, Projects, Policies, and Programs*, for further discussion about the relationship of the State Water Resources Control Board’s Antidegradation Policy to the EIR and its authority to implement that policy.

Use of Delta Simulation Model II for Surface Water Quality Impact Analysis

Delta Simulation Model II as Best Available Tool

Several comments suggested different limitations associated with Delta Simulation Model II (DSM2) that would render it not useful for modeling existing conditions (at 2020), the No Project Alternative (at 2040), and the project alternatives (at 2020 and 2040). However, these comments did not offer

¹ Notice of Entry of Judgment, *Contra Costa Water Dist. v. Sacramento Reg’l Cty. Sanitation Dist.*, Case No. 05CS00908 (Feb. 13, 2008).

an alternative model with which to simulate Delta hydrodynamics and water quality. This section addresses comments received regarding the ability of DSM2 to accurately model Delta water quality and the appropriateness of using DSM2 modeling output to make surface water quality impact determinations.

DSM2, a one-dimensional mathematical model for dynamic simulation of one-dimensional hydrodynamics, water quality, and particle tracking in the Delta, is the most current and best available tool for modeling hydrodynamics and water quality in the Delta under baseline existing conditions and project operations. DSM2 is used regularly by many local, state (e.g., DWR), and federal (e.g., Bureau of Reclamation [Reclamation]) agencies for water resource evaluations in California. The latest calibrated and validated version of DSM2 (version 8.2.0) was used in the EIR. Hydrodynamics and electrical conductivity were calibrated and validated using observed data up to 2017. Calibration of temperature was improved in 2010. Simulation of dissolved organic carbon was validated in 2001. Information on DSM2's calibration and validation is provided in Appendix 5A, *Modeling Technical Appendix*, Section C, *One Dimensional Delta Hydrodynamics and Water Quality Modeling Results*, in the sections titled *Delta Simulation Model II (DSM2)* and *Model Calibration*.

To support impact analyses in Chapter 9, DSM2 was used to model electrical conductivity, dissolved organic carbon, source water fractions, channel velocity, and temperature for existing conditions (at 2020); the No Project Alternative (at 2040); and operations of the proposed project and project alternatives at both 2020 and 2040 hydrology and levels of development. DSM2 also was used to simulate residence time (the time required for 90% of water to flush from a defined reach of channels) in support of the CHAB assessment for both 2020 and 2040 hydrology and levels of development. Descriptions of the use of modeling output are provided in Chapter 9, in the section titled *Methods of Analysis*, and in the Chapter 9 appendices for each modeled constituent.

DSM2 modeled electrical conductivity, source water fractions, channel velocity, and temperature for the 1923–2015 period of hydrologic record, and dissolved organic carbon for the 1976–1991 period of hydrologic record, with inputs coming from CalSim 3 modeling results. Details regarding the DSM2 inputs, including inputs from CalSim 3, are provided in Appendix 5A, Section C, in the section titled *DSM2 Modeling Assumptions*.

As a calibrated and verified model, DSM2 produces modeling results that are meaningful and representative of water quality for the given hydrologic inputs. The modeling results presented in Chapter 9 and supporting appendices are not predictive in the sense that the results represent actual water quality conditions in the Delta for each year in the simulation, nor are they intended to be predictive in this manner. The purpose of the DSM2 modeling is not to replicate historical conditions. In addition, the modeling results do not *predict* the future. The purpose of the modeling is to layer a set of baseline conditions (e.g., operating rules) on the historical hydrology and then to apply the proposed project and project alternatives to the baseline condition in order to see, through comparative analysis, how Delta water quality could be affected. The comparative analysis compares alternative conditions to baseline conditions. Because DSM2 is a calibrated model, it can be used to accurately represent water quality under baseline and alternative conditions and, thus, to appropriately identify potential impacts from project operations.

The hydrologic modeling effort, including the water quality assessment, assumed that Delta levees would not be affected by sea level rise. Including a Delta levee overtopping assumption in the assessment would not reflect the DSM2 assumptions described above. A discussion of the reasons a

levee overtopping scenario was not included in the EIR is provided in Common Response 9, *Hydrologic Modeling and Approach*.

Presentation of Model Results as Monthly Averages

Some comments suggested that the impact assessments in Chapter 9 improperly relied on long-term averages of modeling output or that the impact assessments should have presented modeling results on an hourly or daily timestep and assessed impacts of project operations on Delta water quality using that data.

DSM2 runs on a 15-minute timestep so it can effectively track and address the effects of tides on Delta hydrodynamics and water quality. However, given the monthly timestep of the hydrologic inputs from CalSim 3 (e.g., inflows, exports), aggregation and use of DSM2 output on a sub-monthly basis (i.e., 15-minute, daily) was done on a very limited basis in Chapter 9 (see Impact WQ-4: *Effects on Chloride Resulting from Facility Operations and Maintenance*, Impact WQ-5: *Effects on Electrical Conductivity from Facility Operations and Maintenance*, and Impact WQ-14: *Effects on Cyanobacteria Harmful Algal Blooms Resulting from Facility Operations and Maintenance*).

Modeling results for boron, bromide, chloride, electrical conductivity, mercury, dissolved organic carbon, and selenium are presented in Chapter 9 and supporting appendices in several forms. Chapter 9 presents tables with constituent levels or concentrations averaged by month for the entire 93-year simulation period (1923–2015) for bromide, chloride, and electrical conductivity, and 16-year simulation period (1976–1991) for dissolved organic carbon (e.g., the table titled Monthly Average Bromide [in micrograms per liter] at Delta Assessment Locations for the Full Simulation Period under Alternatives 1 and 3, and Difference from Existing Conditions). Presenting modeling results this way provides a broad overview of the direction and magnitude of effects that project operations could have on water quality, relative to baseline existing conditions.

The impact assessments in Chapter 9 did not rely solely on the information presented in the Chapter 9 modeling results tables. The impact assessments also made extensive use of information in the Chapter 9 appendices, which include probability of exceedance plots (e.g., the figure titled Sacramento River at Emmaton, Monthly Average Electrical Conductivity [in micromhos per centimeter], January in Appendix 9G) and plots and tables with constituent levels averaged by water year type (e.g., the table titled Sacramento River at Emmaton, Monthly Average Electrical Conductivity [in micromhos per centimeter], Alternatives 1 and 3, in Appendix 9G). All these results are taken into consideration and inform the impact determinations in Chapter 9.

Each exceedance plot in the Chapter 9 appendices presents 93 individual monthly average data points. These 93 data points address all five water-year types (wet, above normal, below normal, dry, and critical) in a single exceedance plot. A single month of the 93-year simulation period represents 0.09% of the modeled period, which is a very small fraction of the total period. Moreover, assessing 93 modeled water quality conditions for a given month for existing conditions and with project operations (as well as the 93 differences between the two scenarios for the month) provides a large number of data points from which to determine whether project operations would have significant impacts on water quality.

The Chapter 9 appendices present tables and plots with constituent levels averaged by month for each water year type, in addition to the full simulation period, to provide additional information regarding the water year types when the greatest changes would most likely occur. The modeling data were aggregated according to the historical, reconstructed 1922–2015 water year types published on the California Data Exchange Center website (California Data Exchange Center 2022).

The historical, reconstructed water year types on the California Data Exchange Center website were used to aggregate the modeling results because these are publicly available and widely referenced in research and analysis related to the Delta. The presentation of average constituent levels by water year type is informational and the impact conclusions are based on all modeled changes, particularly those represented in the exceedance plots containing modeling output for the entire 93-year simulation period, as well as modeled changes in frequency of exceedance of water quality objectives.

A sub-monthly timestep was needed to assess the effects of project operations on compliance with the Bay-Delta Water Quality Control Plan objectives implemented in State Water Resources Control Board Water Right Decision 1641 for chloride (Impact WQ-4) and electrical conductivity (Impact WQ-5). However, results from this compliance assessment needed to be qualified for both existing conditions and project operations scenarios because modeled noncompliance with Bay-Delta Water Quality Control Plan objectives do not and would not actually occur under real-time operations. Noncompliance as identified by the model are modeling artifacts that occur because of the monthly timestep of the CalSim 3 modeling relative to the 15-minute timestep of the DSM2 model. In real-time operations, reservoir releases are not, and would not, always be held constant for the entire month, as represented in the DSM2 inputs from CalSim 3. Rather, if reservoir releases need to be increased during a certain timeframe during a particular month (e.g., for the last few days of a month) to ensure compliance with existing Bay-Delta Water Quality Control Plan objectives, real-time operations would do so under both existing conditions and project operations scenarios.

Because the proposed project would be implemented long into the future under a variety of hydrologic conditions, understanding water quality effects that occur consistently during a given time of year (i.e., a specific month) for each water year type is of greater importance in determining environmental impacts than understanding a water quality change that may occur infrequently on a single day or in a single hour. This becomes even more relevant as one recognizes that when using the CalSim 3/DSM2 modeling approach, a water quality difference shown between existing condition operations and project operations at a given Delta location has less uncertainty at the monthly average timestep than the same comparison made at an hourly or daily timestep. This is because CalSim 3 was designed to simulate monthly average reservoir releases, Delta inflow, and so on for a monthly timestep. CalSim 3 only changes reservoir releases at the beginning of the month, whereas in a similar scenario, real-time operations may make the release change several days earlier, if needed, to meet Bay-Delta Water Quality Control Plan objectives. In such cases, CalSim 3 may have simulated the monthly average reservoir releases and Delta inflow very well, but it represented these same parameters on the last few days of the month less effectively. Therefore, conducting the water quality analysis primarily on a monthly timestep is a technically sound approach, and caution must be applied when interpreting modeling output at shorter timesteps.

Approach to Cyanobacteria Harmful Algal Bloom Analysis

This section discusses key aspects of the CHABs analysis given common comment themes, including the definition and use of residence time in the Delta, and the use and incorporation of channel velocities in the approach to evaluating CHABs. All information provided in this section clarifies and amplifies the approach, methodology, and impact determinations described in Chapter 9 under Impact WQ-14 and in Appendix 9E, *Cyanobacteria Harmful Algal Blooms*.

As discussed in detail in Appendix 9E, five primary environmental factors provide favorable conditions for *Microcystis* and other cyanobacteria to grow, accumulate, and outcompete other

1 phytoplankton in the water column of Delta waters, thereby forming CHABs. These five factors are
2 listed here.

- 3 1. Water temperatures higher than 19°C (66.2°F).
- 4 2. Low channel velocities resulting in low turbulence and mixing.
- 5 3. Long residence times, which allow cells produced to remain in or near a site rather than being
6 flushed downstream. Long residence times result in accumulation of higher cell densities, which
7 can result, in turn, in higher cyanotoxin concentrations.
- 8 4. Water column irradiance and clarity greater than 50 micromoles per square meter per second
9 ($\mu\text{moles}/\text{m}^2/\text{s}$).
- 10 5. Sufficient nutrient availability (nitrogen and phosphorus levels).

11 Impact WQ-14 assessed how project operations would affect these five factors in the Delta and then
12 integrated the findings to make an impact determination as to whether project operations would
13 affect (worsen) Delta CHABs, relative to those CHABs that occur under existing conditions. The
14 primary Delta locations assessed are those that have been part of routine Delta monitoring
15 programs and/or identified as primary bloom areas within the Delta, as described in Appendix 9E in
16 the section titled *Delta Assessment Locations*.

17 **Residence Time Definition and Use**

18 Some comments asserted that the residence time calculations supporting the CHABs analysis should
19 have been conducted in a manner different from that used in the EIR. Specifically, comments
20 asserted that residence time for the Delta as a whole should have been calculated and that this
21 information should have been used to make the impact determination regarding project operations
22 effects on CHABs. This is different from the approach taken in the EIR, in which residence time
23 within specific Delta channels and open areas was calculated.

24 There are different ways to define and thus calculate residence time for water in the Delta. Hydraulic
25 residence time could be determined for the entire Delta or for specific portions of the Delta. The
26 definition of residence time depends on how the residence time is used in subsequent analyses. It is
27 important for the CHAB assessment to define and calculate residence time in a manner that relates
28 to its effect on CHAB formation and size.

29 Current research, discussed in Appendix 9E in the section titled *Delta*, shows that cyanobacteria
30 cells occur at varying concentrations and frequencies across the Delta. The figure titled *Microcystis*
31 *Frequency of Occurrence Based on Visual Observation Data Collected Since 2007* in Appendix 9E
32 shows that there is low to no occurrence of *Microcystis* cells in the northern and western portions of
33 the Delta. Instead, most *Microcystis* observations occur in the southern and central Delta. Based on
34 visual observation data and previous studies, the densest blooms regularly occur in areas of the
35 Delta where waters have limited exchange with flowing channels (e.g., Discovery Bay and the
36 Stockton Waterfront) (Kudela et al. 2023:10). Importantly, when cyanobacteria cells are observed in
37 flowing channels of the Delta there is substantially less accumulation and aggregation than in areas
38 that have more limited exchange of tidal flows. CHABs' ability to form in particular areas of the Delta
39 is based on site-specific conditions, including residence time, depth, and other localized factors.
40 Residence time (i.e., the length of time a parcel of water remains in a defined area) affects the ability
41 of *Microcystis* and other cyanobacteria cells to accumulate in the area. Given sufficient residence
42 times and other optimal growth conditions in a defined area, *Microcystis* cells will accumulate and

1 form colonies, and colonies can come together to form scum at the surface. Short residence times do
2 not allow such cell accumulation because they are rapidly flushed out of the area. Conversely, long
3 residence times can allow for cell accumulation, ultimately facilitating formation of colonies and
4 scum.

5 Based on how residence time affects CHABs in the Delta, the QUAL module of DSM2 was used to
6 model the length of time it took to flush 90% of the water volume out of 15 defined channel reaches
7 in the Delta, including several locations that have more limited exchange of tidal flows and are
8 known for having annual CHAB events. DSM2 was used because it is the best available model for this
9 purpose, as described in the section titled *Delta Simulation Model II (DSM2) as Best Available Tool* in
10 this Common Response. The modeled channel reach lengths varied by location due to site-specific
11 channel geometry (e.g., branching, alignment, and flow direction). Modeled channel reaches
12 generally ranged from 3 to 9 miles in length. However, due to channel geometry, an approximately
13 1-mile channel reach along the northwest edge of Mildred Island was modeled and a 12-mile
14 channel reach from Venice island to McDonald Island was modeled. Three of the modeled channel
15 reaches are open waterbodies: Franks Tract, Mildred Island, and Discovery Bay. At each location, the
16 same channel length was modeled for baseline conditions and project operations. Because residence
17 modeling results were used in a comparative analysis between baseline and project operations,
18 channel lengths across the assessment locations did not need to be equal. The differences in channel
19 reach lengths across assessment locations was appropriate given the site-specific channel
20 geometries and how CHABs develop within the channels. This approach effectively modeled the
21 extent to which cyanobacteria cells and colonies would be flushed from the modeled channel
22 reaches.

23 Modeling results for existing conditions and project operations were compared to determine the
24 relative magnitude by which project operations would affect area-specific residence times and thus
25 area-specific bloom formation; this analysis is presented in Chapter 9 under Impact WQ-14.
26 Residence time for the same 15 Delta locations was also modeled for the No Project Alternative and
27 project alternatives at 2040; this analysis is presented in Appendix 9L, *Water Quality 2040 Analysis*,
28 under Impact WQ-14.

29 There are inherent limitations related to modeling residence time for open waterbodies because, as
30 a one-dimensional model, DSM2 assumes uniform and instantaneous mixing over the entire open
31 water area and does not account for any variations in localized hydrodynamic conditions. Residence
32 time within portions of an open waterbody can vary based on such site-specific conditions, which
33 DSM2 cannot model. While inherent limitations are present across all modeled scenarios, DSM2
34 residence time modeling for the open water areas can provide a rough estimate of the effect of
35 project operations on residence time. This is the best available method for the comparative,
36 planning-level analysis to identify impacts of the project alternatives on CHABs.

37 Relative to the approach taken in the EIR, calculating a single residence time for the entire Delta
38 would provide less useful information for understanding how project operations would affect CHAB
39 formation and size in the Delta. Comments claiming that the EIR's residence time analysis, which
40 evaluates specific channels or areas, is incorrect because cyanobacteria cells flushed out of one area
41 simply move to another area ignore the basic biology of CHABs. Cyanobacteria cells do not
42 proliferate or aggregate to form colonies and scum at the surface (form large problematic blooms) to
43 the same degree everywhere in the Delta. As described in Appendix 9E, in the section titled
44 *Hydraulic Residence Time*, CHAB formation in an area is dictated by the site-specific conditions,
45 including the local residence time. When cells are flushed out of a favorable CHAB area to less-

favorable areas (areas having greater water column turbulence, cooler temperatures, greater turbidity, or higher salinity), those cells cannot grow and aggregate at the same rate as at the original site. Hence, dispersion of cells to less-favorable areas disrupts their ability to aggregate and form problematic blooms.

In summary, cyanobacteria cannot grow and proliferate at an equal rate in all channels of the Delta. In some portions of the Delta, particularly those that have limited exchange of tidal flows, large CHABs form often, whereas in other portions of the Delta cells exist but no problematic CHABs occur, and in still other areas, cyanobacteria die-off can occur, reducing overall biomass. Taking this variation into consideration, Impact WQ-14 appropriately evaluated residence time in numerous areas of the Delta known to produce CHABs and did not reduce the utility of the residence time analysis by looking at the Delta in its entirety.

Channel Velocities

Comments claimed that the EIR's velocity analysis in Impact WQ-14 is irrelevant to the potential formation of CHABs in the Delta. This assertion is not supported by the current science on CHABs. Rather, the current science has determined that in flowing turbulent waters, *Microcystis* loses the ability to maintain positive buoyancy and control its position in the water column (see the section titled *Channel Velocities and Associated Turbulence and Mixing* in Appendix 9E). Therefore, higher flow rates, with the associated higher channel velocities and turbulence, make it difficult for *Microcystis* to form dense collections of colonies at the water surface (i.e., form large problematic blooms). Moreover, channel velocity and associated turbulence mix all algae throughout the photic zone of the water column and reduce light through turbidity, which allows faster-growing chlorophytes (green algae) and diatoms to outcompete the slower-growing cyanobacteria, including *Microcystis*. In fact, as described in Appendix 9E, a number of studies report critical channel velocity rates that disrupt *Microcystis* blooms for the reasons stated above.

Some comments also claimed that the assessment of changes in DSM2-modeled 15-minute absolute velocity contained in Impact WQ-14 only establishes that channel velocities within the Delta are driven by tides. Because channel velocity, and associated turbulence and mixing, is a known factor affecting CHABs, and because project operations could affect Delta hydrodynamics, the CHABs assessment in the EIR properly evaluated what, if any, effect project operations could have on Delta channel velocities. If project operations would substantially reduce the probability that higher velocities would occur and increase the probability that lower velocities would occur at a specific location, then project operations could make conditions more favorable for CHABs at that location, because lower channel velocity results in less turbulence and less turbidity, both of which are conditions favorable to CHABs. Impact WQ-14 found, by comparing the velocities on the probability exceedance plots, that project operations were shown to have minor, if any, effects on absolute channel velocities when assessed on a 15-minute timestep, relative to velocities for existing conditions. Consequently, project operations would have only minor effects, if any, on channel velocities, and associated turbulence and mixing of the water column, which is one of the five drivers of CHABs in the Delta.

Groundwater Approach and Groundwater Quality

This portion of the Common Response addresses recurring themes in public comments on the impact analyses for the proposed project and project alternatives regarding groundwater resources, described in Chapter 8. The following sections address DWR's selection of the groundwater

modeling tools, including DeltaGW, C2VSim-FG, and IVFM, and how the tools were used to assess the project's potential impacts on groundwater resources disclosed in the EIR.

Use of the DeltaGW Groundwater Model for Analysis of Groundwater Resources

The groundwater model used as part of the evaluation of the Delta Conveyance Project groundwater impact analysis is the DeltaGW Model. It was developed based on the DWR California Central Valley Simulation Fine Grid (C2VSim-FG) Model and was updated and enhanced for the purposes of this project analysis by incorporating local Delta area data. This section addresses the following topics, which were included in multiple comments on the project's potential effects on groundwater.

- Overall suitability of the DeltaGW Model for impact analysis, specifically as it relates to the model platform, resolution, and model sensitivity.
- Simulation of local conditions and site-specific impacts using the DeltaGW Model (i.e., inclusion of local data within the model and representation of physical project features within the model).
- Spatial and temporal scale of analysis.

Suitability of DeltaGW for Delta Conveyance Project Groundwater Impact Analysis

This section addresses comments received regarding the suitability of the DeltaGW Model to accurately assess the impact of the project on groundwater conditions in and around the Delta region.

Maturity of the Integrated Water Flow Model as a Modeling Platform for Assessing the Conditions of Groundwater Basins

Several comments raised questions about the technical maturity of the Integrated Water Flow Model (IWFM) as a modeling platform.

IWFM, a modeling platform for water resources management and planning, has been available to the public since 2002, when it was first released by DWR as IGSM2. The first version of the Integrated Groundwater and Surface-Water Model (IGSM) was developed by Dr. Young Yoon (and his consulting staff) in 1990 as part of a contract funded by the Bureau of Reclamation Mid-Pacific Region, DWR, the State Water Resources Control Board, and the Contra Costa Water District (Dogrul and Kadir 2021). Over the years, IGSM has undergone various upgrades by different groups based on specific applications to numerous groundwater basins in the United States. The model has been applied to groundwater basins in California, Colorado, and Florida. Applications of IGSM in California include the Central Valley, Sacramento County, Pajaro Valley, Friant Service area, Alameda County, City of Sacramento, Pomona Valley, Salinas Valley, and the Chino Basin. In January 2001, DWR initiated a comprehensive review of the theories and code in IGSM version 5.0. Following extensive revisions and enhancements to the theoretical basis of many of the processes simulated in IGSM and to the FORTRAN codes, it was decided to call the newly developed model IGSM2. The basic acronym was retained because end users would find many of the features in IGSM and IGSM2 very similar. IGSM2 version 1.0 was made available to the public in December 2002. Effective September 2005, IWFM became the new name for IGSM2. IWFM version 2.4 was released in May 2006, version

3.0 in February 2007, version 3.02 in April 2010, and version 4.0 in May 2012; then IWFM-2015 was released in September 2014.

In 2013, the California Water and Environmental Modeling Forum published a peer review of three modeling platforms: IWFM, MODFLOW, and HydroGeoSphere (HSG) (Harter and Morel-Seytoux 2013). The review summarizes each modeling platforms' conceptual elements, usability, and application to various groundwater issues common to California. All three platforms solve the same groundwater flow equation and do so in a reasonably accurate way; they differ in the variety of associated modeling tools that help integrate the groundwater flow, transport, and quality systems into the analysis.

Maturity of DeltaGW Model as a Tool for Assessing the Conditions of Groundwater Basins

Some comments also raised concerns about the maturity of the DeltaGW Model and its suitability for analysis in the EIR.

The DeltaGW Model is an integrated surface water–groundwater model developed specifically for the Delta Conveyance Project analysis. It is built on the foundation of the C2VSim-FG model and runs on DWR's IWFM platform. The DeltaGW Model inherits C2VSim-FG's underlying data and assumptions unless otherwise specified in Appendix 8A, *Delta Groundwater Model: Development and Calibration*, in the section titled *DeltaGW Model Enhancements*. It also includes updated and enhanced local data for the Delta area. The model is designed to simulate various processes, such as land surface activities, groundwater flows, surface water flows, and interactions between streams and aquifers in response to changes in water use, land use, and hydrological conditions. The selection of C2VSim-FG as the most appropriate model to build the DeltaGW Model for assessing impacts of the Delta Conveyance Project is documented in the *Model Review and Selection* section of Appendix 8A.

In addition, the DeltaGW Model inherits all the features and capabilities of C2VSim-FG. The C2VSim-FG is an integrated hydrologic model that simulates land surface processes, groundwater flow, streamflow, and the interaction between these systems. C2VSim-FG was calibrated to subregional land and water use data from local information and the California Water Plan; water budgets from local reported information; and reported groundwater elevations at target calibration wells throughout the Central Valley. Data and information from local and statewide sources (e.g., agricultural water management plans, groundwater management plans, local models, urban water management plans) have been compiled into an extensive model input dataset. Using the underlying dataset, C2VSim-FG integrates groundwater and surface water processes and is designed to simulate historical groundwater conditions and produce water budgets for various regions within the Central Valley at various scales. Additionally, the model structure facilitates the addition of detailed features for specific model applications. When employed in an appropriate context (e.g., appropriate baseline conditions, consideration of input data limitations, consideration of model software limitations for simulating complex physical processes), C2VSim-FG can be used to assess the effects of projects and management actions on changes to groundwater and surface water resources within the Central Valley.

As a planning model, C2VSim-FG (and thus DeltaGW) is designed to simulate the surface water and groundwater conditions on a monthly timestep. The use of a monthly timestep is consistent with most other planning-level simulation and operations models in the Central Valley, including

1 statewide operations models, such as CalSim and CALVIN; statewide agricultural economics models,
2 such as SWAP; and planning models used for the California Water Plan, such as WEAP.

3 The C2VSim-FG model is calibrated to target groundwater levels. However, when using C2VSim-FG
4 for local-scale analysis and modeling, users are encouraged to perform further validation of the
5 underlying spatial data prior to using the model for analysis of projects or management actions. An
6 assessment and refinement of data was conducted in development of the DeltaGW Model and is
7 documented in Appendix 8A. The DeltaGW Model represents the best available planning-level
8 analytical tool for the Delta region and is an improved and expanded version of C2VSim-FG, which
9 has been the standard planning model for the Central Valley since 2012.

10 As described in the C2VSim-FG documentation, the accuracy of the model element-level data
11 depends on the level of accuracy of the underlying datasets. The spatial data in the Delta area have
12 been reviewed and verified against available statewide and local data. The DeltaGW Model is
13 calibrated to historical groundwater levels. As part of the development of the DeltaGW Model, the
14 validation occurred through the careful review of all underlying datasets, and those datasets were
15 updated if better information was available. The improvements to the C2VSim-FG datasets used in
16 the DeltaGW Model are documented in the *Data Review and Enhancements* section of Appendix 8A.

17 Calibration of the DeltaGW Model is documented in the sections titled *Calibration Process* and
18 *DeltaGW Model Calibration Results* in Appendix 8A. As part of the calibration process, a sensitivity
19 analysis was performed at various stages of calibration in the PEST-facilitated process to investigate
20 the sensitivity of parameters while fine-tuning the land system and representation of data. The
21 DeltaGW Model is based on an established and mature model, C2VSim-FG, and is further enhanced
22 with additional local data and recalibration, which establishes it as a mature model for assessing
23 groundwater conditions in the Delta study area.

24 **Model Resolution and Representation of Local Surface Water Features**

25 Several comments compared the DeltaGW Model to more spatially refined local models and
26 questioned the suitability of the model grid resolution to accurately assess impacts.

27 The DeltaGW Model inherits the model grid from C2VSim-FG. While the C2VSim-FG grid was
28 developed as part of a regional model, the resolution is suitable for the analysis as part of the EIR.
29 The grid size is finer in areas of higher groundwater gradient and areas that are more critical from a
30 hydrogeologic viewpoint. The average node spacing is 1.5 miles apart and reduces to 0.5 mile along
31 streams. The grid lines are designed to be parallel to the streamflow direction, when possible, to
32 incorporate surface drainage patterns. Similarly, the grid lines follow the groundwater streamlines
33 to capture subsurface drainage patterns. Although the grid resolution of the DeltaGW Model is
34 coarser than that of some local models, calibration statistics show that the model performance
35 accurately simulates local conditions, from both a water budget and a groundwater elevation
36 standpoint. Calibration of the DeltaGW Model is discussed in Appendix 8A. There is a point of
37 decreasing return in reducing the spatial scale, as the data are no longer available with the smaller
38 size of grid cells.

39 C2VSim-FG and DeltaGW are regional models; they do not physically model local streams such as the
40 Old River, Middle River, or Marsh Creek in the same way as they model larger streams such as the
41 Sacramento or San Joaquin Rivers. The high water table and strong tidal forces in the Delta region
42 also result in reverse flows within the river channels of the Old and Middle Rivers. The stream
43 implementation of IWFM assumes that kinematic waves travel along the stream channel without

any diffusion as long as the wave celerity (the speed at which an individual wave advances or propagates) stays constant. Streamflow formulation in IWFM assumes flows only travel in the downstream direction, so backwater effects due to confluences or hydraulic structures cannot be simulated. To account for this limitation in the baseline and alternative model scenarios, flows of the Old and Middle Rivers are taken from the CalSim3 outputs and incorporated into the DeltaGW Model using bypasses to preserve mass balances along reaches of the San Joaquin River. This ensures that the flows simulated within the San Joaquin River are consistent between the two models and that stream aquifer interaction along those portions of the San Joaquin River is accurately simulated. Furthermore, the operation of the Delta Conveyance Project, with diversion from the Sacramento River, would not affect flows along the San Joaquin River, and changes in groundwater elevations within the Delta region near the Old and Middle Rivers and Marsh Creek are minimal. The results of the hydrologic modeling conducted to determine changes in river flows attributable to the project is provided in Chapter 5, *Surface Water*, and its supporting appendices.

Layering and Stratigraphy

Some comments questioned the basis for the model layering and raised concerns about the data underlying the model stratigraphy.

C2VSim-FG includes aquifer stratigraphy for the Central Valley based on review and analysis of detailed lithologic information. The model depicts the Central Valley aquifer system as four stratigraphic layers. The top stratigraphic layer represents the shallow pumping zone in much of the Sacramento Valley and areas outside the Corcoran Clay area in the San Joaquin Valley and Tulare Lake Basin. The second stratigraphic layer represents the deeper pumping zones in the Sacramento Valley and areas outside the Corcoran extent in the San Joaquin and Tulare Lake Basins. In the Corcoran Clay area, the second layer represents the historical pumping zone below the Corcoran Clay. In much of the model area, the third stratigraphic layer represents the remaining freshwater aquifer below the historical depth of pumping wells. The fourth model layer generally represents the saline water aquifer. C2VSim-FG also includes a detailed texture model that is based on the U.S. Geological Survey (USGS) aquifer texture data and refined using other statewide and local datasets throughout the model area. The texture data are used during model calibration to enforce the distribution of aquifer properties based on the lithology.

The following text from the C2VSim-FG model (version 1.0) report describes the data and assumptions behind the C2VSim-FG stratigraphy (California Department of Water Resources 2020). The DeltaGW Model builds on the robust stratigraphy of the C2VSim-FG model.

In order to have C2VSim-FG to represent the salient features of the hydrogeologic system, lithologic logs for wells and borings were analyzed to quantify the textural characteristics of the groundwater system. The USGS texture model was the starting point in compiling C2VSim-FG lithologic data.

USGS first created a texture model from compiling approximately 8,500 drillers' logs throughout the Central Valley to support development of CVHM. For each drillers' log, the geologic materials were recorded every 15 meters. Each lithologic description in the log was classified as representing either a coarse-grained or fine-grained material. The coarse-grained class included sand, gravel, pebbles, boulders, cobbles, or conglomerate, and the fine-grained class consisted principally of clay, lime, loam, mud, or silt.

Building off the USGS texture data, DWR added additional sources to the lithologic database to support development of SVSim. The additional sources included 753 well logs from DWR's Division of Integration Regional Water Management (DIRWM) dataset, 1,476 well logs from DWR's levee

dataset, and 235 well logs from Yuba Water Agency. For the SVSim analysis, the coarse-grained class included gravel, sandy gravel, silty gravel, sand, gravelly sand, silty sand, gravel-sand-silt mixtures, sandy soil, and fractured rock, including lava, which transmit groundwater rapidly. The fine-grained class included clayey gravel, clayey sand, silt, clayey silt, clay, gravelly clay, sandy clay, silty clay, peat, hardpan, clayey soil, tuff, and unfractured rock, which slow the flow of water. Material identified as topsoil in the logs that lacked any modifying attribute was classified using the saturated hydraulic conductivity (Ksat) soils map (Natural Resources Conservation Service Soil Survey Geographic [SSURGO] Database), classifying topsoil with Ksat greater than 1 foot/day as coarse-grained and Ksat less than or equal to 1 foot/day as fine-grained. More information on the SVSim texture model development can be found in the SVSim Technical Memo-1B (California Department of Water Resources 2018).

DWR combined these sources throughout the Central Valley and created a Central Valley-wide texture model following the same methodology as SVSim. The texture model included a total of 10,444 well and boring logs. This extensive dataset provided information about the three-dimensional distribution of coarse-grained and fine-grained materials within the groundwater system.

DWR used the combination of datasets and calculation of coarse-grained proportions for each element to produce a three-dimensional texture model of the groundwater system. Once the texture distributions were developed, they were used to establish initial aquifer parameters and stratigraphy by node and layer in C2VSim-FG. The three-dimensional texture distribution within the groundwater system is correlated to the three-dimensional distribution of hydraulic properties within the groundwater system. For example, higher horizontal hydraulic conductivity tends to occur in regions with a higher percentage of coarse-grained materials. Likewise, lower vertical hydraulic conductivity tends to occur in regions with a lower percentage of coarse-grained materials.

The vertical coverage provided by the well log dataset used to develop the texture model was investigated to understand its spatial and vertical limitations. Approximately 99% (i.e., 10,441/10,444) of the well log locations provide some level of vertical coverage within C2VSim-FG layer 1. Of those 10,441 well log locations, approximately 23% (i.e., 2,428/10,441) provide a maximum vertical coverage of 50% while approximately 77% (i.e., 8,013/10,441) provide a vertical coverage greater than 50%. Approximately 50% (i.e., 5,253/10,444) of the well log locations provide some level of vertical coverage within C2VSim-FG layer 2. Of those 5,253 well log locations, approximately 64% (i.e., 3,346/5,253) provide a maximum vertical coverage of 50% while approximately 36% (i.e., 1,907/5,253) provide a vertical coverage greater than 50%. Approximately 7% (i.e., 707/10,444) of the well log locations provide some level of vertical coverage within C2VSim-FG layer 3. Of those 707 well log locations, approximately 56% (i.e., 396/707) provide a maximum vertical coverage of 50% while approximately 36% (i.e., 311/707) provide a vertical coverage greater than 50%. Approximately 2% (i.e., 207/10,444) of the well log locations provide some level of vertical coverage within C2VSim-FG layer 4. Of those 207 well log locations, approximately 32% (i.e., 67/207) provide a maximum vertical coverage of 68% while approximately 36% (i.e., 140/207) provide a vertical coverage greater than 50% (California Department of Water Resources 2020:64–65).

During the development of the DeltaGW Model, the top two layers of C2VSim-FG were further refined vertically into four layers to better capture the project features and to simulate conditions closer to the ground surface. As described in Appendix 8A, in areas where the combined thickness of

the top two layers exceeded 200 feet, the top layer was assigned a thickness of 65 feet, followed by 50-foot thickness for the second and third layers. The thickness of layer four was set to reach the bottom of the original layer two. For areas where the total thickness of the top two layers was less than 200 feet, the total thickness was divided into four even increments.

Simulation of Local Conditions and Site-Specific Impacts using the DeltaGW Model

Model Representation of Project Features

Some comments questioned how project features were represented in the DeltaGW Model.

As described in Chapter 8, project features (e.g., intakes, slurry walls, tunnels) are simulated in the DeltaGW modeling as low-permeability model elements. Project intakes are represented in the top two layers of the model, to a depth of 115 feet below ground surface. Project alignments (tunnel and tunnel launch/retrieval shafts) are represented in the third layer of the model, at a depth of 115 to 165 feet below ground surface. By assigning low-permeability model elements along the corresponding footprints of the project features, the model simulates the groundwater conditions once the project features are constructed and assesses changes in groundwater with the flow barriers formed by the project features in place.

The upper layers of the groundwater model were refined to better align with the depths and thicknesses of the intakes and alignments. Representing the features using low-permeability elements allows the model to mimic the flow characteristics of the aquifer after the project features are constructed.

Inclusion of Local Wells in the Modeling Analysis

Several comments raised questions about including actual well pumping at specific well locations in the model simulation and about assessing impacts at specific well locations. Other comments raised questions about how the modeling platform distributes pumping across elements rather than depicting pumping at specific point locations and the potential smoothing of localized changes in groundwater elevations.

Specific pumping wells were not included in the model because of data limitations. As described in Chapter 8, the location of production wells is often limited to the Public Land Survey System (PLSS) section number of the wells, and exact coordinates are unknown. Additionally, historical pumping volumes by well were not typically measured, so the data are insufficient to simulate actual wells pumping specified amounts at specified times for the duration of the historical simulation. To compensate for this data gap, pumping in the model is assigned at the element scale. At each timestep, the DeltaGW Model calculates the total agricultural water demand for each element and then subtracts the available surface water for each element; the remaining demand is satisfied with groundwater pumping. The vertical distribution of pumping between layers is determined by pumping specification fractions for each element based on well construction data from DWR's California Statewide Groundwater Elevation Monitoring (CASGEM) database and the Online System for Well Completion Report (OSWCR) database. In urban areas, element pumping is used to represent urban and domestic groundwater pumping. IWFM calculates urban pumping based on population and unit water use and then assigns the pumping volume to various model layers based on the pumping specifications input dataset.

Historical pumping, if available, could be used to calibrate the historical model to better estimate pumping needs based on surface water supplies and agricultural and urban water demands. However, the actual timeseries would not be relevant for the analysis of groundwater impacts under the existing conditions (CEQA baseline) and project alternative scenarios. Groundwater pumping is influenced by numerous factors including climate conditions, land use, and surface water supplies. The historical pumping data only becomes relevant for the analysis when these variables align with the assumptions for the existing conditions baseline. Assumptions for the existing conditions are explained below. An overview of the CEQA baseline is described in Chapter 4, *Framework for the Environmental Analysis*, and supporting information can be found in Appendix 3C, *Defining Existing Conditions, No Project Alternative, and Cumulative Impact Conditions*.

For modeling purposes, existing conditions are characterized by the following: (1) current regulatory environment; (2) current facilities and operational criteria; (3) current water demands and water use; (4) runoff from the mountain and foothill watersheds derived from historical streamflow records; and (5) valley floor surface and subsurface hydrology for current land use. Model assumptions and input data for existing conditions are based on conditions that existed in 2020. To best reflect the pumping rates that would occur under 2020 conditions with varying hydrology, groundwater pumping for the baseline and project alternatives is calculated by the model based on the water needs.

Specific existing wells were not considered during the impact analysis due to the lack of exact coordinates. Instead, groundwater elevations are evaluated at the centroid of PLSS sections for every layer at every timestep. The greatest decline in any layer at each timestep is used to assess the magnitude and frequency of groundwater elevation changes. The changes are tied to the number of wells within each PLSS section for reporting in the EIR. Shallow domestic wells are indirectly evaluated as part of the analysis since groundwater elevation changes in each layer of the model are evaluated independently. Well depth and perforations were not considered in the assessment of groundwater elevation declines. The evaluation of the greatest declines for each PLSS section is a conservative approach to conducting the analysis since all declines are accounted for regardless of the depth of the well.

Spatial and Temporal Scale of Analysis

Spatial Scale of DeltaGW Model

Several comments raised concerns about the potential impacts of the Delta Conveyance Project on basins neighboring the Delta region.

The DeltaGW model is a regional model developed to assess the impacts of the project on groundwater conditions in and around the Delta region. As described in Appendix 8A, the area of analysis for the groundwater model is intended to be the Delta region and the areas immediately surrounding it. Of the Medium and High priority basins in the Central Valley, the DeltaGW model domain extends from the Bear River and Cache Creek in the north to the Tuolumne River in the south. The model domain covers the North American, South American, Cosumnes, Eastern San Joaquin, Modesto, Solano, and East Contra Costa subbasins in their entirety and contain portions of the Yolo and Tracy subbasins. The analysis using the DeltaGW model inherently includes an assessment of project impacts on all the basins previously listed. The spatial scales used for analysis were selected based on the specific needs of impact evaluation. The spatial scale for each of the groundwater related impacts evaluated in the EIR is listed below:

- 1 • **Impact GW-1: *Changes in Stream Gains or Losses in Various Interconnected Stream Reaches***
 - 2 ○ This impact is evaluated at the stream reach scale. A more detailed discussion of the spatial
 - 3 and temporal scale of analysis of interconnected surface water is discussed below in the
 - 4 following two sections.
- 5 • **Impact GW-2: *Changes in Groundwater Elevations***
 - 6 ○ Changes in groundwater elevations are assessed across the entire model domain at the
 - 7 model node scale.
- 8 • **Impact GW-3: *Reduction in Groundwater Levels Affecting Supply Wells***
 - 9 ○ Groundwater elevations are assessed at supply wells within 3 miles of the statutory Delta
 - 10 boundary. The analysis is conducted at the well scale because the analysis is assessing
 - 11 potential impacts on wells within the region.
- 12 • **Impact GW-4: *Changes to Long-Term Change in Groundwater Storage***
 - 13 ○ Changes in storage are presented at the model subregion scale. While the model simulates
 - 14 the storage for each model element and could be aggregated to various scales, including
 - 15 groundwater basin, the analysis focuses on how the project affects regional groundwater
 - 16 storage. DeltaGW model subregion 4 contains the project footprint and is the primary region
 - 17 of analysis. Other model subregions are presented in Appendix 8B, *Impact Analysis:*
 - 18 *Groundwater Model Results.*
- 19 • **Impact GW-5: *Increases in Groundwater Elevations near Project Intake Facilities Affecting***
20 ***Agricultural Drainage***
 - 21 ○ Agricultural drainage volumes are assessed across the entire Delta region. Agricultural
 - 22 drainage is primarily used within the Delta and is not common in neighboring groundwater
 - 23 basins.
- 24 • **Impact GW-6: *Damage to Major Conveyance Facilities Resulting from Land Subsidence***
 - 25 ○ Changes in groundwater elevation, as assessed in Impact GW-2 at the model node scale, are
 - 26 used to evaluate the potential for land subsidence.
- 27 • **Impact GW-7: *Degradation of Groundwater Quality***
 - 28 ○ Groundwater quality is evaluated using changes in groundwater gradients, based on
 - 29 changes in groundwater elevations, as assessed in Impact GW-2.

30 **Presenting Stream-Aquifer Interaction Results at the Stream Reach Scale**

31 Several comments questioned the spatial scale for assessing stream-aquifer interaction. During the
 32 analysis, stream-aquifer interaction was assessed both at the stream reach scale as well as by
 33 individual stream nodes for each timestep. An example of the nodal evaluation of stream-aquifer
 34 interaction can be found in the *Stream-Aquifer Interaction* section of Appendix 8A, in the figure titled
 35 Average Stream-Aquifer Interaction at Each Stream Node in Acre-Feet/Month for Water Year 2015.
 36 The behavior at individual stream nodes was consistent with the stream-aquifer interaction changes
 37 at the stream reach scale. Results are presented at the stream reach scale for clarity. When
 38 evaluating changes in stream-aquifer interaction as a percentage, examining changes at too small a
 39 scale can present challenges due to percentage exaggeration. A very small absolute change in the
 40 quantity of water exchanged between the stream and aquifer can result in a large percentage

change. This occurs when the baseline value of the quantity being measured is relatively small, making even minor absolute changes appear significant when expressed as a percentage. The volume of stream-aquifer interaction can be positive or negative depending on the direction of the flow, so the baseline magnitude could be very small in streams that are both gaining and losing. To address the challenges posed by percentage exaggeration, it is important consider the absolute quantities or volumes of water exchanged, in addition to percentages. Examining the absolute values alongside the relative changes yields a more robust evaluation of the actual scale and practical implications of the observed changes in stream-aquifer interaction. Aggregating the impacts on the stream reach scale and for water years helps provide additional context for the changes. The results are presented in Chapter 8 under Impact GW-1 and further detailed as both volumes and percentages in the *Groundwater Impact Analysis* section of Appendix 8B.

Assessing Results across Model Layers

Some comments queried the methods for assessing groundwater elevation changes and impacts on supply wells, as well as the suitability of the model for determining impacts on groundwater-dependent ecosystems.

Groundwater elevations are simulated and assessed for every node across each layer for each timestep of the model. For changes in groundwater elevation assessed under Impact GW-2, simulated groundwater elevations were compared across different layers and depths (see the *Layering and Stratigraphy* section for additional details regarding groundwater modeled layers). No significant vertical variations in groundwater heads were reported at any layer. Averaging the groundwater elevations across the top three layers of the model allows for a simpler presentation of the results in the EIR. In assessing the declines and effects on supply wells, the greatest decline across any layer was used to evaluate impacts on wells. Because there were no significant modeled vertical variations, there would be no adverse effects on groundwater-dependent ecosystems.

Project impacts on interconnected surface water were analyzed in Chapter 8 under Impact GW-1. Generally, modeling shows minimum differences in annual stream-aquifer interactions between the project alternatives and existing conditions resulting in negative changes to interconnected surface water of less than 1% (except Alternatives 2a and 4a for the San Joaquin River, where it is about 1.2%), maximum values resulting in positive changes to interconnected surface waters of 0.4% to greater than 1%, and annual average of impacts of -0.3% to +0.6%. Given these very small modeled changes, impacts on interconnected surface waters would be less than significant. Because there are very small modeled changes to interconnected surface waters under operations, substantial evidence supports the conclusion that there would be no adverse effects on groundwater-dependent ecosystems.

Analysis of Groundwater Quality, Construction, and Sea Level Rise

The DeltaGW Model was used to assess the impact of project operations on groundwater conditions in and around the Delta. Multiple comments raised questions about impacts not simulated by the model, such as groundwater quality, construction-related impacts and the effects of sea level rise compounded by the project.

Groundwater Quality-Related Impacts

The DeltaGW Model is an integrated groundwater and surface water model that simulates the flow of water among various physical systems; it does not simulate the transport of chemical constituents. Four categories of groundwater quality-related impacts are qualitatively analyzed using the results of the flow model: migration of poor-quality groundwater from one area to another; movement of known contaminant plumes; upwelling of poorer quality water from the lower layers of the aquifer (connate water) due to increased pumping; and migration of salt water from the Delta into the freshwater aquifer due to declining groundwater level at the seawater-freshwater interface. In all four categories, the primary mechanism for constituent movement is advective flow, which is defined as the movement of constituents based on average aquifer properties and the average groundwater hydraulic gradient (as simulated by the DeltaGW Model). While other mechanisms do influence constituent movement, such as dispersion and diffusion, the resultant movement of constituents from these mechanisms is significantly less than that from advective flow.

1. Migration of poor-quality groundwater from one area to another: The primary mechanism for the movement of poor-quality water from one location to another is directly related to hydraulic gradients, which are calculated from groundwater levels, or heads. The DeltaGW Model shows that changes in groundwater elevations as simulated during project operations exceed 5 feet less than 1% of the time over the 94-year simulation period and occur over a very small area of the model under all alternatives. In comparison, historically, seasonal groundwater elevations fluctuate and have deviated from the mean values at wells by more than 5 feet (rise or fall) about 23% of the time and by more than 15 feet (rise or fall) about 5% of the time. Therefore, the groundwater quality impacts from project operations are considered less than significant. The change in groundwater elevation is so small and infrequent compared to the natural fluctuations that would occur without the project, less than 5 feet over 99 percent of the time, that operation of the project would not influence the migration of groundwater. Construction-related impacts on groundwater quality are discussed in the next section.
2. Movement of known contaminant plumes: Near the known groundwater plume sites shown in the figure titled Location of Identified Groundwater Plumes in the Study Area in Chapter 8, changes in groundwater elevations are limited to 1 to 2 feet between the baseline and alternatives; these are unlikely to cause a significant change in groundwater flow paths or hydraulic gradients. The nine figures in Appendix 8B that depict maximum difference contours, found in the section titled *Degradation of Groundwater Quality (Impact GW-7)*, subsection *Alternatives Impacts*, show the locations of the identified groundwater plumes relative to anticipated changes in groundwater elevations resulting from project operations under each project alternative.
3. Upwelling of poorer quality water from the lower layers of the aquifer (connate water) due to increased pumping: The project alternatives did not show increases in groundwater pumping in any area within the model domain due to project operations. Therefore, the possibility of creating significant vertical gradients that would result in the upwelling of poorer quality water due to project operations is less than significant.
4. Migration of salt water from the Delta into the freshwater aquifer due to declining groundwater level at the seawater-freshwater interface: In the Delta area, baseline tidal effects change the saltwater-freshwater interface under a No Project Alternative. The DeltaGW Model shows that in this region, changes in groundwater elevations as simulated during project operations exceed 5

1 feet less than 1% of the time over the 94-year simulation period. Therefore, significant changes
2 in hydraulic gradients in areas near the Delta are not anticipated. These changes are so small
3 that there is no potential for salt water migrating into the freshwater aquifer due to project
4 operations. The impact of seawater rise is described in the section titled *Sea Level Rise* in this
5 Common Response.

6 Construction-Related Impacts

7 The DeltaGW Model serves as a valuable tool for simulating groundwater conditions in and around
8 the Delta region during project operations. The model does not specifically evaluate changes in
9 groundwater conditions caused by construction activities. Instead, its primary purpose is to assess
10 the long-term effects of management actions and operations on groundwater conditions. Given the
11 models limited application to potential construction-type impacts, a qualitative evaluation in Impact
12 GW-1 through Impact GW-7 is performed for disclosing the type, magnitude, and severity of
13 potential groundwater impacts related to construction in the EIR. CEQA does not require a lead
14 agency to develop tools or models in order to evaluate and disclose impacts and lead agencies can
15 use existing, known, and publicly available information. Furthermore, a model is not needed nor
16 required to evaluate construction-related effects because of how the project facilities are being
17 constructed. The impact analysis includes engineering project descriptions and conceptual designs
18 with design criteria and approaches used previously in similar conditions to reduce drawing water
19 from adjacent water bodies and groundwater as presented in the Engineering Project Reports
20 (EPRs; Delta Conveyance Design and Construction Authority 2022a, 2022b) and the knowledge of
21 the groundwater basins and existing groundwater conditions and hydrogeology and anticipated
22 changes in groundwater elevations, storage, and quality.

23 Based on previous experiences along the Sacramento River and similar geological areas, the use of
24 cutoff walls that extend up to 100 to 200 hundred feet below the ground surface have been
25 successful in isolating excavation sites from adjacent surface water or groundwater. The
26 groundwater path to move from outside the cutoff wall into the excavation would either be
27 interrupted by the solid cutoff wall and a very low permeability layer such as clay at the bottom of
28 the excavation or the length of the path would be extended down below the cutoff wall so that
29 seepage rate into the excavation from the bottom would be reduced. The intake construction sites
30 and the tunnel shafts would be totally surrounded by cutoff walls, thereby minimizing the amount of
31 seepage in the excavation and having minimal effect on the groundwater surface surrounding
32 outside the cutoff wall. As described in Chapter 3, *Description of the Proposed Project and*
33 *Alternatives*, field investigations would be conducted prior to and during construction under all
34 alternatives. These investigations will involve assessing subsurface geotechnical conditions,
35 performing site specific pump tests, and designing the cutoff walls as per geotechnical conditions
36 encountered to mitigate exterior (outside of excavation) groundwater impacts to minimize changes
37 in the groundwater levels. Based on observations at similar structures adjacent to surface waters
38 and groundwater, the conditions with those structures in place have been similar to those without
39 the structures. Therefore, even if a groundwater model with a shorter time-step and finer grid than
40 DeltaGW Model was available for this study area, the with-project and without-project conditions
41 would be very similar.

42 Use of a qualitative evaluation is reasonable and appropriate for the purposes of CEQA because the
43 existing model would not meet the purposes of evaluating construction-related impacts and
44 adequate observed data are not available to calibrate a model with a shorter time-step and finer
45 grid. This qualitative evaluation serves as a complementary approach to the DeltaGW Model,

ensuring that both the broader impacts of management actions and the localized effects of construction activities are considered in the overall assessment of groundwater conditions in the Delta region. Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas* is included to address unanticipated future conditions that may result in noticeable changes in groundwater conditions due to construction of the project. Although it is determined that the project would not impact groundwater quality, Mitigation Measure GW-1 has been revised to include monitoring of electroconductivity at select locations during construction to provide data confirming the conclusions in the EIR. Impact GW-1 and Impact GW-2 remain less than significant prior to the implementation of the revised mitigation measure, as described in Chapter 8. The revision to Mitigation Measure GW-1 does not result in a new significant environmental impact, substantial increase in the severity of an environmental impact, or require additional mitigation measures to which DWR was unwilling to commit.

The majority of comments pertaining to construction related impacts on groundwater are focused on impacts resulting from construction dewatering. Dewatering sites will be isolated from the regional groundwater by cutoff walls, depending on the geology at each construction site and the construction methods for each facility. These cutoff walls minimize the changes in groundwater elevation outside the dewatering sites. Dewatering required for construction of the intake facilities and Southern Forebay Emergency Spillway is described in the EPR for the central and eastern alignments and the Dewater Estimates for Intake Facilities and Southern Forebay Emergency Spillway Technical Memorandum (Delta Conveyance Design and Construction Authority 2022a, 2022c).

Dewatering would occur at most construction sites. The most substantial dewatering activities would occur at the intakes and Southern Forebay Emergency Spillway. During preparation of the EPR, groundwater modeling was conducted to estimate dewatering rates and durations for dewatering at the Intake C facilities and Southern Forebay Emergency Spillway. These two locations were selected because they likely represent typical dewatering scenarios for other elements of the project. For Intake C, modeling included the construction and maintenance scenarios for the sedimentation basins. For the emergency spillway, modeling only included dewatering during construction because dewatering would not be required during operations (Delta Conveyance Design and Construction Authority 2022a). Dewatering during operations and maintenance would occur very infrequently only at the intake sedimentation basins, and likely there would be decades between events.

At Intake C, transient modeling showed an overall extraction rate of 2,000 gallons per minute (gpm) (about 9 acre-feet/day) achieved target dewatering levels at the sedimentation basins in 2 to 6 weeks for the scenarios evaluated. For conceptual-level planning, a rate of 1,500 gpm (about 7 acre-feet/day) can be assumed if dewatering is started sufficiently in advance of planned excavation. This 1,500-gpm flow rate would taper into the 200- to 1,000-gpm (1 acre-foot/day to 4 acre-feet/day) continuous rate after 2 to 6 weeks and would remain relatively constant through completion of basin first filling, with slight variations due to changes in river level. For the box conduits, transient simulations suggest that up to 60 gpm would be required to dewater within 2 to 4 weeks in a more conservative case. At the average 1,000 gpm continuous extraction rate, the total volume extracted in a year would be about 1,600 acre-feet, which is less than 1% of the historical model simulated annual changes in groundwater storage. The dewatering flows would be collected, treated, and reused on the construction site. As noted in Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas*, groundwater monitors would be installed around the intake site to determine if dewatering has caused substantial decline in the groundwater elevation. If substantial

groundwater elevation declines occur, the treated dewatering flows would be reinjected into the groundwater aquifer outside of the intake construction site.

For the Southern Forebay Emergency Spillway construction dewatering, the results of transient modeling indicated that 160 gpm with 16 wells met the drawdown target after about 30 days; at which time, steady-state flows would be achieved and could range from less than 10 gpm to 50 gpm (0.04 acre-foot/day to 0.2 acre-foot/day). Due to the location of the spillway, the dewatering activities will be drawing water from the adjacent Italian Slough. At the Southern Forebay Emergency Spillway, the dewatering flows would be collected, treated, and either reused on the construction site or directly returned to Italian Slough.

For the intake facilities, a permanent jurisdictional levee would be moved from the existing site along State Route 160 and built around the exterior of the sedimentation basin and the outlet shaft using a cutoff wall constructed with low permeability core material to an elevation of -85 feet (all elevations are in reference to North American Vertical Datum of 1988 [NAVD88]). Cutoff walls would also be constructed around the entire intake construction site. The cutoff walls and embankments of the jurisdictional levees and sedimentation basins would primarily be constructed with on-site excavated soil to avoid the need to obtain large amounts of soil from quarries and haul soil into and out of the intake sites. Dewatering would occur throughout the site; however, most of the dewatering activities would occur during construction of the sedimentation basins. All dewatering flows, including from the sedimentation basins, would be captured, treated, stored, and reused on-site at the intakes. As noted in Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas*, changes in groundwater elevations due to dewatering at the intakes is not anticipated. However, a series of groundwater monitors will be installed around the intake site along with a series of groundwater recharge and extraction wells. If the groundwater monitoring wells indicate a substantial decline in average groundwater elevations as compared to monitoring results for nearby locations not influenced by intake construction, the treated dewatering flows will be injected into the groundwater on the external side of the cutoff walls. During operations, the groundwater monitoring system would be used to indicate if groundwater seepage from the intake site causes increased groundwater elevations. Under these circumstances, the wells surrounding the intake site can also be used to extract mounded water for return to the sedimentation basins.

At the Southern Forebay, located near Italian Slough and across from the Clifton Court Forebay, a cutoff wall would be installed through the centerline of the embankment around the entire perimeter of the Southern Forebay. This cutoff wall would extend into the embankment foundation using a combination of bentonite, water, and excavated native soil to produce a low-permeability trench backfill to cut off seepage through and beneath the embankments. The actual bottom depth of the cutoff wall would be determined based on site-specific investigations along the cutoff wall alignment; however, the cutoff wall would be intended to penetrate at least 5 feet into a fine-grained confining unit to prevent seepage in pervious units from flowing beneath the cutoff wall. Additionally, a well point system will be installed at the toe of the new embankments for groundwater elevation monitoring and management during construction and operations. Dewatering would occur for a short period of time during construction of the Southern Forebay Emergency Spillway while the existing Byron Tract is excavated for placement of the spillway. Construction of the Southern Forebay spillway would require approvals from Reclamation District 800 for excavation and construction within the Byron Tract levees. As described in Chapter 3, construction at the proposed intakes will require a U.S. Army Corps of Engineers (USACE) Section 408 permit because of changes to the existing jurisdictional levees and the construction of new permanent jurisdictional levees around the sedimentation basins. Section 14 of the Rivers and

Harbors Appropriation Act of 1899, as amended and codified in 33 USC 408 (Section 408), provides that the Secretary of the Army may, upon recommendation of the Chief of Engineers, grant permission to other entities for the permanent or temporary alteration or use of any USACE civil works projects, including levees. The Section 408 permitting process has rigorous requirements for the design and construction of levees to USACE standards and the Title 23 Central Valley Flood Protection Board, including cutoff walls with permeabilities in the 10^{-6} to 10^{-7} centimeters per second (cm/s) range (equivalent to the permeability of clays). In addition, rigorous monitoring and testing will be conducted during construction, with test results reported back to the USACE as part of the permit requirements. Delta Conveyance Construction of embankments at the Southern Forebay, levee improvements on Bouldin Island and Lower Roberts Island, and the ring levee at Twin Cities Complex would be designed with cutoff walls or similar structures based on criteria described in levee design guidance developed by Reclamation.

Because cutoff walls will be constructed using design standards based on USACE and Reclamation standards and design guidance, as described in the EPRs, they should substantially limit reduction of external groundwater levels during construction dewatering activities. At the intakes, the cutoff walls will limit mounding of groundwater external to the cutoff walls during operations when water elevation in the sedimentation basins are higher than the surrounding groundwater levels. The cutoff walls will maintain the stability and integrity of the levees and significantly reduce the movement of groundwater through the embankments.

At locations where dewatering will occur during construction, perimeter wells will be used to monitor for significant changes in groundwater elevations. The mitigation described in Chapter 8 will mitigate for any impacts of construction or operation of the project. Dewatering approaches and associated mitigation measures will be site-specific and developed during the design phase following completion of the detailed geotechnical investigations.

Sea Level Rise

Sea level rise is not evaluated as part of the analysis conducted using the DeltaGW Model. The focus of the DeltaGW Model is primarily assessing changes in groundwater elevations resulting from the project. The changes in groundwater elevations caused by the project would not directly influence the potential effects of sea level rise that would occur, even in the absence of the project. Therefore, the DeltaGW Model does not incorporate sea level rise considerations into its analysis. Furthermore, based on the evaluation of Impact GW-2, which specifically assesses changes in groundwater elevations, it was determined that the observed changes are not significant. Given the lack of significant changes in groundwater elevations, there was no need for further analysis using the DeltaGW Model.

Project operations would not significantly alter X2 locations (the position of the daily average salinity gradient in the San Francisco Estuary) outside of the winter and spring, where X2 position is already much farther west than it is during the summer and fall months (see the section titled *Impacts of the Project Alternatives with Climate Change* in Chapter 30, *Climate Change*). As the most eastward location of X2 does not change substantially under project operations, the project alternatives do not have the potential to substantially increase seawater intrusion.

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