Chapter 8
Groundwater

This chapter describes the environmental setting and study area for groundwater; analyzes impacts that could result from construction, operation, and maintenance of the project; and provides mitigation to reduce the effects of impacts. This chapter also analyzes the impacts on groundwater resources that could result from implementation of compensatory mitigation required for the project and analyzes the impacts that could result from the mitigation measures proposed in other resource chapters in this Draft Environmental Impact Report (Draft EIR).

8.0 Summary Comparison of Alternatives

Table 8-0 provides a summary comparison of anticipated impacts by alternative, as described in Chapter 3, *Description of the Proposed Project and Alternatives,* on groundwater. This table provides information on the magnitude of the most pertinent and quantifiable impacts on groundwater that are expected to result from operation of the project alternatives, and is based on quantitative analyses conducted to assess impacts on groundwater levels, groundwater storage, and interconnected surface water flows. The table presents the CEQA findings after all mitigation is applied. A regional scale integrated groundwater and surface water model, called the Delta Groundwater (DeltaGW) model (see Section 8.3, *Groundwater Impacts*), was used as the analytical tool for quantitative analysis of impacts on groundwater from project operations. The impacts on groundwater from construction and maintenance are discussed qualitatively, as are impacts related to groundwater quality and inelastic land subsidence resulting from groundwater pumping.

The DeltaGW Model simulation results and associated evaluations (including those for qualitative assessments) indicate that no significant groundwater impacts are expected to occur as a result of project operations. All groundwater impacts are under established thresholds for each impact area. There are slight changes in stream losses/gains, groundwater elevations, and groundwater in storage resulting from project operations, but these changes are less than significant and often within the margin of error for the model simulation results. However, during project construction and maintenance, there is a potential for impacts due to temporary localized changes in groundwater elevations from dewatering at construction and maintenance sites. These localized impacts could affect water wells near the project sites, cause changes in groundwater elevation to mobilize existing contaminant plumes, or result in the migration of lower-quality groundwater into areas of higher-quality groundwater. Implementation of Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas* during construction and maintenance would ensure localized impacts on groundwater resources would be avoided.

Impacts resulting in increases in agricultural drainage due to project construction and operations are considered to be less than significant. Implementation of Mitigation Measure GW-5: *Increases in Groundwater Elevations Near Project Intake Facilities Affecting Agricultural Drainage*, would further reduce risks of impacts on agricultural drainage.

Table 8-0. Comparison of Impacts of Project Operations on Groundwater by Alternative

	Alternative								
Groundwater Impact Mechanism	1	2a	2b	2c	3	4a	4b	4c	5
Impact GW-1: Changes in Stream Gains or Losses in Various Interconnected Stream Reaches (%)	-0.82% LTS	-1.19% LTS	-0.64% LTS	-0.67% LTS	-0.85% LTS	-1.21% LTS	-0.64% LTS	-0.77% LTS	-0.81% LTS
Impact GW-2: Changes in Groundwater Elevations	0 LTS	0 LTS	0 LTS	0 LTS	0 LTS	0 LTS	0 LTS	0 LTS	0 LTS
Impact GW-3: Reduction in Groundwater Levels Affecting Supply Wells	0 LTS	0 LTS	0 LTS	0 LTS	0 LTS	0 LTS	0 LTS	0 LTS	0 LTS
Impact GW-4: Changes to Long-Term Change in Groundwater Storage (AF/acre)	0.017 LTS	0.03 LTS	0.01 LTS	0.015 LTS	0.016 LTS	0.029 LTS	0.01 LTS	0.014 LTS	0.024 LTS
Impact GW-5: Increases in Groundwater Elevations near Project Intake Facilities Affecting Agricultural Drainage (%)	+0.06% LTS	+0.10% LTS	+0.09% LTS	+0.04% LTS	+0.08% LTS	+0.12% LTS	+0.11% LTS	+0.06% LTS	+0.07% LTS
Impact GW-6: Damage to Major Conveyance Facilities Resulting from Land Subsidence	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Impact GW-7: Degradation of Groundwater Quality	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS

LTS = less than significant.

8.1 Environmental Setting

This section describes the environmental setting and affected environment for groundwater in the study area that may be influenced by the Delta Conveyance Project or project alternatives.

For the purposes of this analysis, the groundwater study area (the area in which groundwater impacts may occur) primarily consists of the Delta region, shown in Figure 1-1 in Chapter 1, *Introduction*. The project footprint (the conveyance facilities, Southern Forebay, intakes, and Bethany Complex) is within this region. Quantitative analysis of groundwater impacts due to project operations was conducted only for the Delta region. The study area, as defined in Chapter 1, also includes two other regions: (1) Upstream of the Delta region and (2) south-of-Delta State Water Project (SWP) services area region. Impacts on groundwater basins upstream of the Delta region are not included in this chapter because flow changes in those areas resulting from project construction and operation are negligible and are unlikely to cause changes in groundwater. Potential groundwater impacts on groundwater basins south of the Delta are only discussed qualitatively in this chapter. Groundwater impacts on both the Delta and south-of-Delta portions of the study area were evaluated herein because construction effects could occur in the Delta near the construction sites, and operations effects could occur throughout the Delta as well as in the south-of-Delta portions of the Central Valley that use SWP and Central Valley Project (CVP) water as a large portion of their water portfolio (see Chapter 6, *Water Supply,* for further discussion). Many groundwater systems are physically interconnected with surface waters flowing through those groundwater basins; these systems are also discussed in Chapter 5, *Surface Water*, and Chapter 6.

8.1.1 Study Area

The Delta and the Central Valley overlie several extensive groundwater basins that play key roles in local and regional water supply. Rivers draining the Coast Ranges, the Cascade Ranges, and the Sierra Nevada convey water into the Central Valley, interconnect with the underlying groundwater basins, and eventually flow into the Sacramento–San Joaquin Delta and San Francisco Bay. The study area evaluated in this chapter includes the Central Valley groundwater subbasins (both within the Delta and immediately south of the Delta) that could potentially be directly affected by project construction and operations.

Private individual groundwater wells and wells operated by community water agencies provide most of the residential potable water sources for several of the Delta communities, such as Clarksburg, Courtland, Freeport, Hood, Isleton, Rio Vista, Ryde, and Walnut Grove. The largely agricultural San Joaquin Valley uses groundwater to support agricultural and municipal demands (Chapter 6). Some water flowing to and through the Delta is diverted by local Sacramento users (e.g., the cities of Sacramento and Folsom), by users adjacent to or downstream of the Delta (e.g., Contra Costa Water District [CCWD]), and/or exported by the SWP/CVP to areas outside the Delta (Chapter 6). The availability of these surface water supplies influences the groundwater use and conditions of those export service areas.

Throughout the study area, hydrogeology and hydrology strongly influence groundwater flow and aquifer recharge with natural conditions affected by local land and water use. The existing groundwater conditions in the study area are briefly described in Section 8.3, *Groundwater Impacts*, to support discussions of environmental consequences associated with construction of project alternatives, as well as other impacts on groundwater resources stemming from the long-term operations and maintenance of the project facilities.

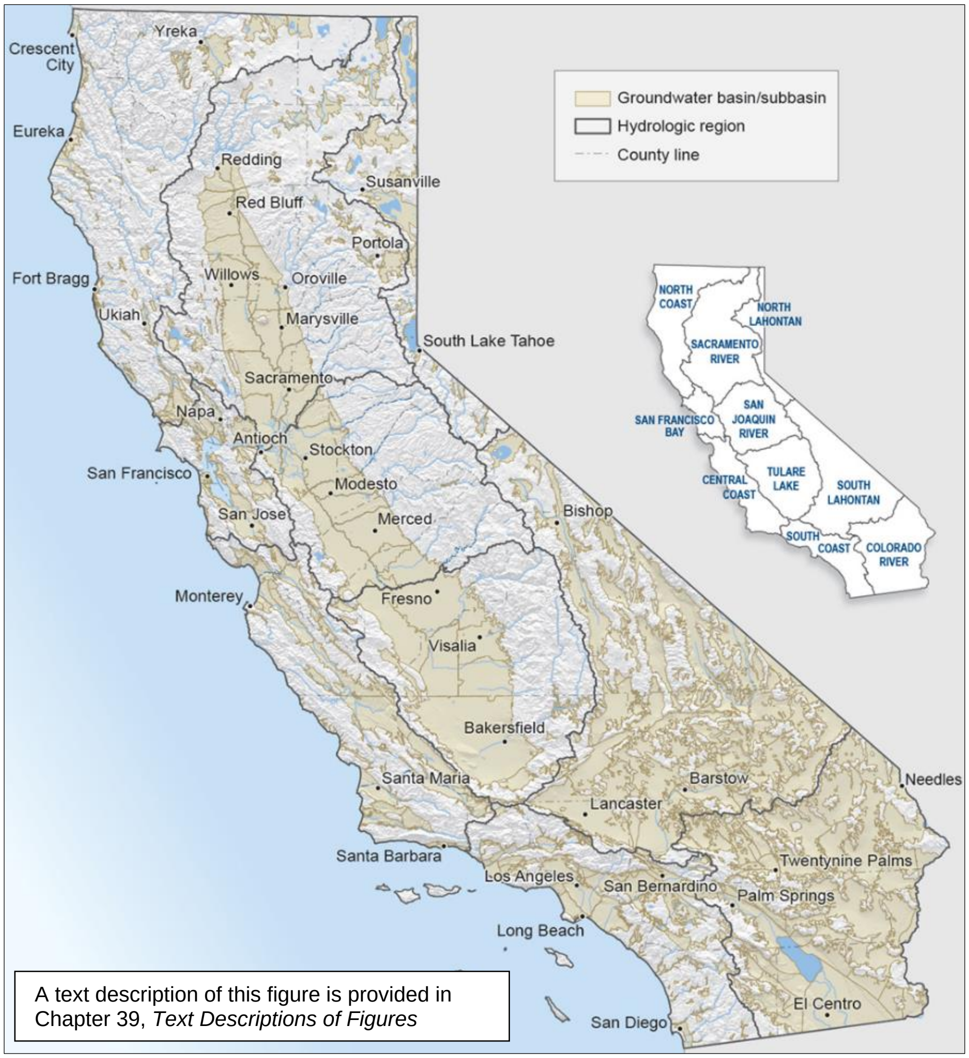
8.1.2 Central Valley Groundwater

Groundwater is a vital resource in California. It accounts for 41% of the state's total average annual water supply and up to 58% of the total annual water supply in drought years. About 83% of Californians depend on groundwater for some portion of their water supply and many communities are 100% reliant on groundwater for all their water needs (California Department of Water Resources 2021:H-1). The importance of groundwater as a resource varies regionally. The Central Valley of California is the biggest user of groundwater in California with 78% of total statewide groundwater use occurring within its borders. In the Central Valley, groundwater represents 53% of the total water supply on an average annual basis, with the Tulare Lake Hydrologic Region meeting about 69% of its local uses with groundwater and the rest of the Central Valley meeting between 15% and 35% of local uses with groundwater. The Central Coast Hydrologic Region has the highest reliance on groundwater to meet its local uses, with more than 90% of its water use supplied by groundwater in an average year. In Southern California, groundwater meets between 15% and 37% of annual use (South Coast Hydrologic Region) and 40% of annual use (South Lahontan Hydrologic Region) (California Department of Water Resources 2021:H-16).

During droughts, California has historically depended more heavily upon groundwater. Groundwater resources will not be immune to climate change; in fact, historical patterns of groundwater recharge have changed considerably. Because droughts are expected to be exacerbated by climate change, efficient groundwater basin management will be necessary to avoid additional overdraft and to take advantage of opportunities to store water underground and eliminate existing overdraft.

8.1.2.1 Groundwater Basins and Subbasins

The California Department of Water Resources (DWR) has delineated 515 distinct alluvial groundwater basins in the state as shown in Figure 8-1 and described in California's Groundwater Update 2020 (California Department of Water Resources 2021:2-4). These basins and subbasins have varying degrees of supply reliability depending on basin yield, storage capacity, and water quality. Outside the Delta, to the north, the Sacramento River watershed overlies the Sacramento Valley groundwater basin; to the south, the San Joaquin River watershed overlies the San Joaquin Valley basin. The Delta region overlies groundwater subbasins from both the Sacramento Valley and San Joaquin Valley groundwater basins.



A text description of this figure is provided in Chapter 39, *Text Descriptions of Figures*

Figure 8-1. California's Groundwater Basin and Hydrologic Regions

The large and diverse Sacramento Valley and San Joaquin Valley groundwater basins have been subdivided into groundwater subbasins based primarily on geologic features (e.g., faults, rock-type contacts), hydrologic features (e.g., rivers), or jurisdictional boundaries (e.g., county lines) (California Department of Water Resources 2021:2-11). The individual groundwater subbasins are not hydraulically distinct from others within a particular basin and may have a high degree of interconnection with neighboring basins. Where connected, the subbasins tend to behave as a single extensive alluvial Central Valley aquifer system.

The Sacramento Valley groundwater basin extends from the Red Bluff Arch south to the Cosumnes River and underlies portions of Tehama, Glenn, Butte, Yuba, Colusa, Placer, Sutter, Solano, Sacramento, and Yolo Counties. The Red Bluff Arch is near the northern end of the Central Valley and separates the Sacramento Valley groundwater basin from the Redding Area groundwater basin. The southern portion of the Sacramento Valley groundwater basin underlies the northern portion of the Delta. The Sacramento Valley groundwater basin is extremely productive and provides much of the water supply for California's agricultural and urban water needs.

The San Joaquin Valley groundwater basin underlies the entire San Joaquin Valley, from the south at the Tehachapi Mountains to the north with its boundary with the Sacramento Valley, where the basin's northern portion underlies the southern half of the Delta. Two hydrologic regions occur in the San Joaquin Valley groundwater basin: the San Joaquin River and the Tulare Lake Hydrologic Regions. Overall, the groundwater basin is continuous, but the surface water regime affects local groundwater conditions. The agricultural area of the San Joaquin Valley is heavily dependent upon groundwater and surface water deliveries south of the Delta to support agricultural and municipal demands. According to DWR estimates, more than half of all groundwater use in the state occurs in the San Joaquin Valley groundwater basin (California Department of Water Resources 2021:H-9), and this use has increased in past years as permanent crops (predominantly fruit and nut trees) replace truck (annual) crops and dry grazing. This recent increase in demands to meet the water needs of permanent crops has resulted in increased overdraft conditions and land subsidence resulting from pumping below the Corcoran Clay layer (a regional aquitard). All but three of the groundwater subbasins in the San Joaquin Valley groundwater basin have been deemed to be in critical overdraft condition under the Sustainable Groundwater Management Act of 2014 (SGMA).

Outside the Delta watershed, other areas that receive surface water from the Delta watershed include the Central Coast Hydrologic Region and portions of Southern California and the San Francisco Bay Area region, which have more hydraulically distinct groundwater basins than the Central Valley. Here too, many of the groundwater basins on the Central Coast and in Southern California have been either adjudicated to address past overdraft conditions or classified as critically overdrafted under SGMA.

8.1.2.2 Groundwater–Surface Water Interaction

Rivers play a large role in the hydrogeology of the Central Valley by bringing water from the uplands during the snowpack's spring melt and providing recharge to the underlying aquifers. In areas of shallow groundwater tables, rivers also can receive groundwater inflow. The quantity and timing of snowpack melt are the predominant factors affecting surface water and groundwater, with peak runoff typically following peak precipitation by 1 to 2 months (U.S. Geological Survey 1991:A2). Rivers drain the Coast Ranges and the Sierra Nevada, bringing the water into the valley and converging with the Sacramento and San Joaquin Rivers aligned along the axes of their respective valleys (see Chapter 5). The drainage in each valley has a key difference: in the San Joaquin Valley, fewer major streams drain the Coast Ranges, whereas the Sacramento Valley has several, including Stony, Cache, Putah Creeks, and numerous other westside tributary creeks that flow to the Sacramento River.

In the Sacramento Valley groundwater basin, the interaction between surface water and groundwater systems is highly variable spatially and temporally. Generally, the major trunk streams of the valley (the Sacramento and Feather Rivers) tend to act as drains and receive groundwater discharge throughout most of the year. The exceptions are areas of depressed groundwater levels attributable to groundwater pumping, where the water table has been artificially lowered, inducing leakage from the rivers that recharge the groundwater system. In contrast, the tributary streams draining into the Sacramento River from upland areas are almost all *losing* streams (water from the streams enters and recharges the groundwater system) in their upper reaches, but some transition to *gaining* streams (water from the groundwater enters the streams) farther downstream, closer to their confluences with the Sacramento River. Groundwater modeling studies of the Sacramento Valley suggest that, on average, the flux of groundwater discharging to the rivers is approximately equal to the quantity of water that leaks from streams to recharge the aquifer system. The studies suggest that, in average years, stream recharge and aquifer recharge are each about 800,000 acre-feet per year (AFY) (Glenn Colusa Irrigation District and the Natural Heritage Institute 2010:8-15–8-17).

In the San Joaquin Valley groundwater basin, the interaction between the surface water and groundwater systems is substantially different. Long-term groundwater production throughout this basin has lowered groundwater levels beyond what natural recharge can replenish. Most streams leak to the underlying aquifers and recharge the aquifer system. For example, along much of the San Joaquin River, the river is a losing river and groundwater is recharged by leakage from the river. This is especially true in the Gravelly Ford area of the San Joaquin River (upstream of Mendota Pool), where the riverbed is highly permeable and river water readily seeps into the underlying aquifer. In the northern portions of the San Joaquin Valley groundwater basin, groundwater levels are shallow adjacent to the river and groundwater discharges into the river (McBain and Trush 2002:4-17–4-23).

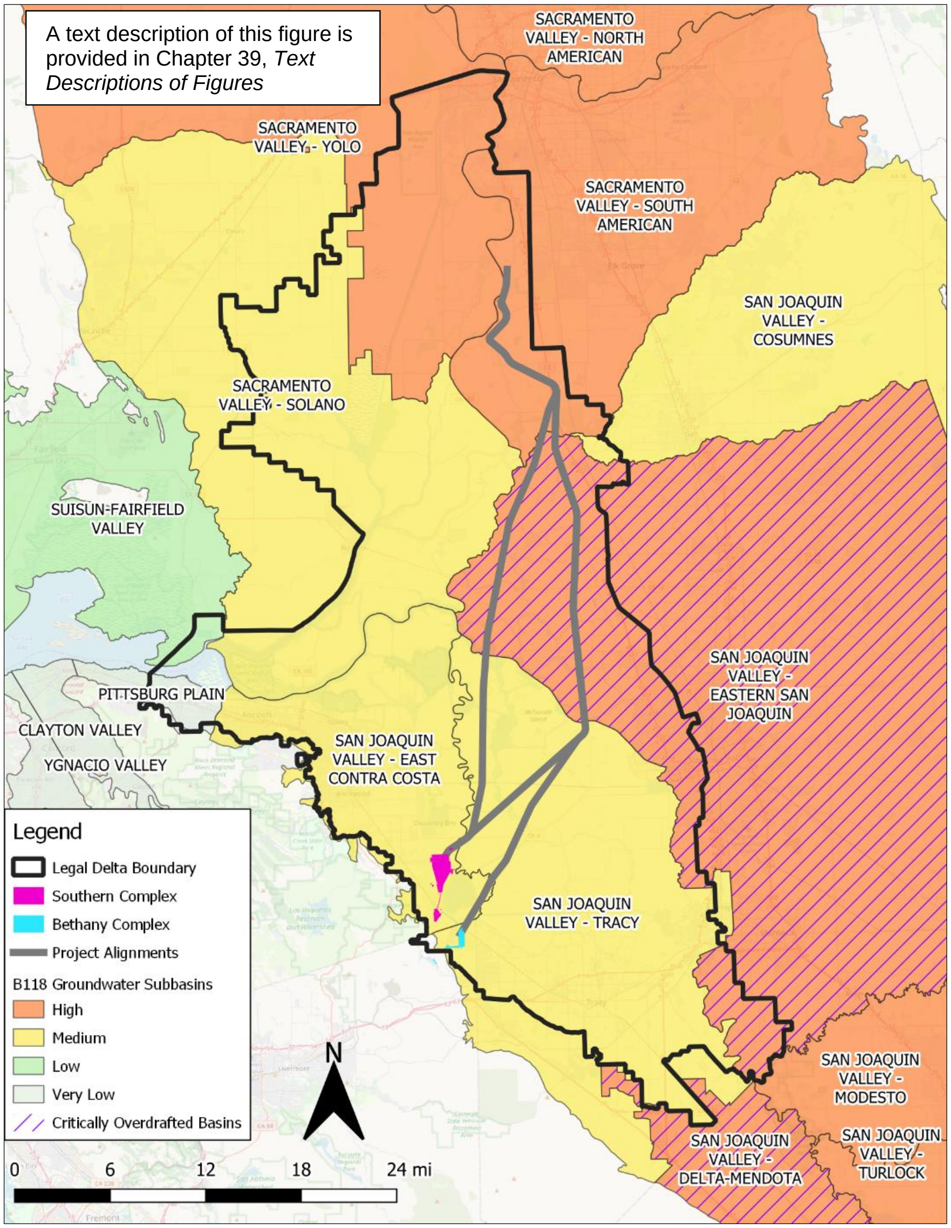
The San Joaquin River has three major tributaries that flow from the east: the Merced, Tuolumne, and Stanislaus Rivers. The Cosumnes, Mokelumne, and Calaveras Rivers also flow into the San Joaquin River where the river joins the tidally influenced Delta. These rivers and many of their tributaries are, for the most part, losing streams in their upper reaches but in some cases transition to gaining streams closer to their confluence with the San Joaquin River (State Water Resources Control Board 2012:9-9). Streams draining from the Coast Ranges on the west side are ephemeral and are predominantly losing streams along their entire length.

Historically, rivers have defined the boundaries for most groundwater subbasins in the Sacramento and San Joaquin Valleys. However, in almost all cases, these rivers do not act as hydraulic barriers or groundwater divides. An example is Putah Creek, which delineates the boundary between the Sacramento Valley groundwater basin’s Yolo and Solano Subbasins (California Department of Water Resources 2004a:1). As Putah Creek flows eastward through Solano and Yolo Counties toward the Sacramento River, numerous diversions along its course reduce streamflow to minimal levels by the time it reaches the Sacramento River. As the creek passes through the Yolo Bypass, which has no well-defined channel, the potential for the creek to act as a hydraulic barrier between the subbasins is further reduced. Although the groundwater system in the Yolo Bypass has not been well studied, it is likely that it functions as a single alluvial aquifer rather than the two discrete aquifers as the official subbasin (Yolo and Solano) designations suggest.

The major regional aquifers that make up the Sacramento Valley and San Joaquin Valley groundwater basins are regionally extensive aquifer systems. These aquifer systems act as large interconnected alluvial aquifers that may be subdivided vertically but are not isolated local-scale aquifer systems as one might infer from the subbasin terminology.

8.1.3 Delta Region Groundwater

The Delta region overlies the western portion of the study area where the Sacramento Valley and San Joaquin Valley groundwater basins converge. Underlying the northern Delta, within the Sacramento Valley groundwater basin, are the Solano Subbasin in the northwest and the South American Subbasin to the northeast, bounded by the Sacramento and Cosumnes Rivers. Within the San Joaquin Valley groundwater basin, the Tracy Subbasin underlies the southern half of the Delta, and the Eastern San Joaquin and Cosumnes Subbasins underlie the central and eastern Delta as shown in Figure 8-2.



A text description of this figure is provided in Chapter 39, *Text Descriptions of Figures*

Figure 8-2. Groundwater Basins underlying the Delta Region

Physical and hydrogeologic characterizations of each major groundwater basin underlying the Delta can be found in DWR's *California's Groundwater*—Bulletin 118 (California Department of Water Resources 2003, 2016), California Water Plan Groundwater Update (California Department of Water Resources 2015), various U.S. Geological Survey reports (U.S. Geological Survey 1960, 2006:8, 2008:6), and other available literature as cited throughout this chapter.

The groundwater basins in the state are assigned a basin priority—high (including critically overdrafted), medium, low, very low—under the provisions of the SGMA. The high- and medium-priority groundwater basins were required to form groundwater sustainability agencies (GSA) and develop and implement groundwater sustainability plans (GSP) to achieve sustainability within 20 years from initial deadline for submission of GSPs. Figure 8-2 shows that the Delta region overlies portions of the critically overdrafted Eastern San Joaquin Subbasin and several high- and medium-priority subbasins.

8.1.3.1 Groundwater Basin Hydrogeology

In general, shallow groundwater conditions and extensive groundwater–surface water interaction characterize the Delta area. Spring runoff generated by melting snow in the Sierra Nevada increases flows in the Sacramento and San Joaquin Rivers and tributaries and causes groundwater levels near the rivers to rise. Because the Delta is a large floodplain and the shallow groundwater is hydraulically connected to the surface water, changes in river stages affect groundwater levels and vice versa. This hydraulic connection is also evident when the tide is high and surface water flows from the ocean into the Delta, thereby increasing groundwater levels nearby.

Groundwater levels in the central Delta are very shallow, and land surface elevations have dropped on several islands resulting in groundwater levels close or above the ground surface in many areas. Maintaining groundwater levels below crop rooting zones is critical for successful agriculture, especially for islands that lie below sea level, and many farmers rely on an intricate network of drainage ditches and pumps to maintain groundwater levels of about 3 to 6 feet below ground surface (bgs). The accumulated agricultural drainage is pumped through or over the levees and discharged into adjoining streams and canals (U.S. Geological Survey 2000).

Delta floodplain deposits contain a significant percentage of organic material (peat), ranging in thickness from 5 to 40 feet in the proposed conveyance alignments. Below the surficial deposits, unconsolidated non-marine sediments occur above the fresh/saline water interface at depths as shallow as a few hundred feet near the Coast Range to nearly 3,000 feet near the eastern margin of the basin. These non-marine sediments form the major water-bearing formations in the Delta. Groundwater in the South American and Eastern San Joaquin Subbasins generally flows from the Sierra Nevada in the east toward the low-lying lands of the Delta to the west.

Groundwater levels in the South American Subbasin have fluctuated over the past 40 years, with the lowest levels occurring during periods of drought. In general, flat to rising water levels mostly occur within the west-central area of the South American Subbasin in the vicinity of the cone of depression near Elk Grove that has been present for many years and along the American River (Sacramento Central Groundwater Authority 2016:2-50). Falling water levels occur in the northeastern portion of the subbasin in the vicinity of three groundwater remediation projects, including the Aerojet Superfund Site, the U.S. Air Force Mather Field Superfund Site, and the McDonnell Douglas 29 Inactive Rancho Cordova Test Site at Mather Field and south of Security Park. Numerous groundwater production wells west of these remediation projects also produce groundwater (Sacramento Central Groundwater Authority 2016:2-50). Areas affected by municipal pumping show a lower groundwater recovery level than other areas (California Department of Water Resources 2004b:2). Groundwater levels in the Eastern San Joaquin Subbasin have continuously declined in the past 40 years due to groundwater pumping. Cones of depression are present near major pumping centers such as Stockton and Lodi (Eastern San Joaquin Groundwater Authority 2019). Groundwater level declines of up to 100 feet have been observed in some wells.

In the Solano Subbasin, the historical general groundwater flow direction is from northwest to southeast (California Department of Water Resources 2004c:1). Increasing agricultural and urban development in the 1940s in the Solano Subbasin caused groundwater level declines. Today, groundwater levels are mostly affected by drought cycles but tend to recover quickly during wet years (California Department of Water Resources 2004c:2).

In the Tracy Subbasin, groundwater generally flows south to north and discharges into the San Joaquin River. According to DWR and the San Joaquin County Flood Control and Water Conservation District, groundwater levels in the Tracy Subbasin have been relatively stable over the past 10 years, apart from seasonal variations resulting from recharge and pumping, and declines in the southeastern portion of the subbasin (California Department of Water Resources 2006:2; GEI Consultants 2021:5-2).

8.1.3.2 Groundwater Quality

A groundwater quality study was performed in the southern Sacramento Valley region in which more than 60 wells were sampled (U.S. Geological Survey 2008:13). As part of the Groundwater Ambient Monitoring Assessment (GAMA) program, two wells were sampled in the Delta area. One is located in the central Delta, west of Sherman Island and the Sacramento River, and has a depth of 800 feet bgs. The other well is located in the eastern Delta, near the Delta Cross Channel, and has a depth of 244 feet bgs. Both wells were sampled for several chemical constituents. Some of the results from this study are reported in this section along with results from other studies and reports.

In the South American Subbasin, total dissolved solids (TDS) levels range from 24 to 581 milligrams per liter (mg/L), with an average of 221 mg/L based on 462 records (California Department of Water Resources 2004b:3). Seven sites present significant groundwater contamination in this basin, including three Superfund sites near the Sacramento metropolitan area. These sites are in various stages of cleanup. Between 2009 and 2018, the most commonly detected chemicals above a primary maximum contaminant level (MCL) or secondary maximum contaminant level (SMCL) in the South American Subbasin were manganese (42%), iron (21%), and arsenic (16%) (California Department of Water Resources 2021). These percentages are for when detections above MCLs or SMCLs occur. Most samples did not report chemicals above their respective maximum levels.

TDS varies more widely in the Eastern San Joaquin Subbasin, ranging between 50 and 3,520 mg/L. The high salinity of groundwater is attributed to poor-quality groundwater intrusion from the Delta caused by the decline of groundwater levels and worsened by sea level rise. This saline groundwater front has been particularly apparent in the Stockton area since the 1970s (San Joaquin County Flood Control and Water Conservation District 2008:vii). Other possible sources of salinity in the subbasin include Delta sediments, deep saline groundwater, and irrigation return water (Eastern San Joaquin Groundwater Authority 2019).

High chloride concentrations have also been observed in well water in the Eastern San Joaquin Subbasin. Chloride concentrations in 2017 are generally less than 150 mg/L, with some higher measurements reaching 2,000 mg/L (Eastern San Joaquin Groundwater Authority 2019:2-55). In addition, large areas of groundwater with elevated nitrate concentrations exist in several portions of the subbasin, such as southeast of Lodi and south of Stockton. The City of Lodi operates the White Slough Water Pollution Control Facility, a 6.3 million gallon per day (average flow) plant on the eastern edge of the Delta, on the western side of Interstate (I-) 5, approximately 1 mile south of Highway 12. Agricultural and stormwater runoff are returned to unlined holding ponds. Water quality concerns have been evaluated regarding elevated nitrates and salinity by the State Water Resources Control Board (City of Lodi 2006:19; Stockton Record Staff 2009; Eastern San Joaquin Groundwater Authority 2019).

Between 2009 and 2018, the most commonly detected chemicals above an MCL or SMCL in the Eastern San Joaquin Subbasin were manganese (16%), arsenic (16%), and iron (15%) (California Department of Water Resources 2021). These percentages are for when detections above MCLs or SMCLs occur. Most samples did not report chemicals above their maximum levels.

Groundwater quality in the Solano Subbasin is generally good and is deemed appropriate for domestic and agricultural use (California Department of Water Resources 2004c:3). However, TDS concentrations at levels higher than 500 mg/L have been observed in the central and southern areas of the basin. Between 2009 and 2018, the most commonly detected chemicals above an MCL or SMCL in the Solano Subbasin were manganese (29%), arsenic (26%), and iron (21%) (California Department of Water Resources 2021). These percentages are for when detections above MCLs or SMCLs occur. Most samples did not report chemicals above their maximum levels.

In the Tracy Subbasin, areas of poor water quality exist throughout. Elevated chloride concentrations are found along the western side of the subbasin near the city of Tracy and along the San Joaquin River. Between 2009 and 2018, the most commonly detected chemicals above an MCL or SMCL in the Tracy Subbasin were arsenic (20%), manganese (18%), and iron (18%) (California Department of Water Resources 2021). These percentages are for when detections above MCLs or SMCLs occur. Most samples did not report chemicals above their maximum levels.

In the East Contra Costa Subbasin, groundwater quality generally meets most water quality objectives and serves domestic and agricultural uses. Naturally occurring salinity levels are elevated basin-wide and nitrate levels are slightly elevated in the shallow zone (less than 150 feet bgs). TDS varies widely across the subbasin, although it is characteristically high, ranging between 500 and 1,500 mg/L in all areas. Chloride concentrations in the subbasin exceed or are near the recommended SMCL for chloride (250 mg/L) in most wells, suggesting that water concentrations are naturally higher for chloride. Nitrate is observed in some areas of the subbasin (i.e., Brentwood), with concentrations exceeding the MCL (10 mg/L) that may be linked to historical agricultural influences in the area. Arsenic concentrations are generally less than the MCL (10 micrograms per liter) basin-wide, and boron concentrations are high in most wells and are attributed to a naturally elevated baseline. Between 2009 and 2018, the most commonly detected chemicals above an MCL or SMCL in the East Contra Costa Subbasin were manganese (36%), TDS (16%), and arsenic (7%) (California Department of Water Resources 2021). These percentages are for when detections above MCLs or SMCLs occur. Most samples did not report chemicals above their maximum levels.

8.1.3.3 Groundwater Production and Use

Groundwater is used throughout the Delta through the mechanisms of pumping and plant uptake in the root zone. However, an accurate accounting of groundwater used in the region is not available because most wells are not metered or otherwise reported in a reliable manner. In the upland peripheral Delta areas, average annual groundwater pumping is estimated to range between 100,000 and 150,000 acre-feet (AF), both for domestic and agricultural uses (CALFED Bay-Delta Program 2000:5.4-8). Although information on groundwater yield is limited in the Delta subbasins, available estimates in the northern San Joaquin Valley groundwater basin indicate that maximum well yield varies from around 1,500 to 3,000 gallons per minute (gpm).

The Stockton metropolitan area uses groundwater in conjunction with surface water for its municipal and industrial water needs. CCWD does not use groundwater to meet any demands, though within CCWD's service area, groundwater is pumped by industries, private individuals, and public municipal utilities including the cities of Martinez and Pittsburg, Golden State Water Company, and Diablo Water District (Contra Costa Water District 2016:6-1). It is estimated that these users can pump approximately 6,500 AFY based on available pumping records and land-use-based estimates. An undetermined number of privately owned groundwater wells exist in the CCWD service area (CALFED Bay-Delta Program 2005:3-6). Groundwater in this area is primarily produced from the Clayton groundwater basin, which has seen gradual declines in groundwater elevation (Contra Costa Water District 2005:18).

Groundwater also provides water supply for the Delta communities of Clarksburg, Courtland, Freeport, Hood, Isleton, Rio Vista, Ryde, and Walnut Grove. In the rural portions of the Delta, private groundwater wells provide domestic water supply (Solano Agencies 2005). In the central Delta, groundwater use is limited because of low well yields and poor water quality. Shallow groundwater occurring at depths of less than 100 feet is too saline and therefore not adequate for most beneficial uses. Approximately 200 square miles of the central Delta are affected by saline shallow groundwater (CALFED Bay-Delta Program 2000:5.4-7). Because shallow groundwater levels are detrimental when they encroach on crop root zones, groundwater pumping is used to drain the waterlogged agricultural fields. Groundwater pumping for agricultural irrigation mostly occurs in the north Delta for orchards and in the south Delta around the city of Tracy.

8.1.3.4 Land Subsidence

Declining land surface elevations in the Delta are well documented and a major source of concern for farming operations. The oxidation of peat soils is the primary mechanism of sinking lands in the Delta (U.S. Geological Survey 2000), and some areas are below sea level (see Chapter 11, *Soils,* and Chapter 10, *Geology and Seismicity*). In portions of the San Joaquin Valley groundwater basin, drops in land surface elevations have occurred as a result of excessive groundwater pumping, below the Corcoran Clay (a regional aquitard) or below other regionally significant clay layers (the predominant mechanism for subsidence in this area). Land subsidence occurs as the result of the compression of the Corcoran Clay and other fine-grained units where groundwater that supports the aquifer framework has been removed by pumping.

8.2 Applicable Laws, Regulations, and Programs

The applicable laws, regulations, and programs considered in the assessment of project impacts on groundwater are indicated in this section, in Section 8.3.1, *Methods for Analysis*, or the impact analysis, as appropriate. Applicable laws, regulations and programs associated with state and federal agencies that have a review or potential approval responsibility have also been considered in the development CEQA impact thresholds or are otherwise considered in the assessment of environmental impacts. A listing of some of the agencies and their respective potential review and approval responsibilities, in addition to those under CEQA, is provided in Chapter 1, *Introduction*, Table 1-1. A listing of some of the federal agencies and their respective potential review, approval, and other responsibilities, in addition to those under NEPA, is provided in Chapter 1, Table 1-2. Federal laws and regulations that address water quality may also apply to groundwater quality, as presented in Chapter 9, *Water Quality*, and Chapter 11, *Soils*, including the Clean Water Act, National Pollutant Discharge Elimination System (NPDES) Program Antidegradation Policy (40 Code of Federal Regulations [CFR] § 131.6); Clean Water Act, Nonpoint Source Management Program (33 United States Code [USC] § 1329); Clean Water Act, Municipal Separate Storm Sewer Systems policy

(40 CFR § 122.34 and § 122.26(d); and Safe Drinking Water Act (42 USC §§ 300f–300j-26). These regulations are federally mandated and implemented in California through the State Water Resources Control Board. State regulations that address water quality may also apply to groundwater quality, including the Order No. 2009-0009-DWQ, NPDES General Permit No. CAS000002, Waste Discharge Requirements for Discharges of Stormwater Runoff Associated with Construction as presented in Chapter 9 and Chapter 11. The State has also mapped Hydrogeologically Vulnerable Areas, defined by the State Water Resources Control Board in 2000 in response to Executive Order D-5-99.

8.3 Groundwater Impacts

This section describes the direct and cumulative impacts associated with groundwater that would result from project construction and operation (including maintenance). Measures to mitigate (i.e., avoid, minimize, rectify, reduce, eliminate, or compensate for) significant impacts, if any, are also discussed in this section. Indirect impacts are discussed in Chapter 31, *Growth Inducement*.

8.3.1 Methods for Analysis

The groundwater analysis addresses two different aspects of the project. First, the analysis addresses changes in groundwater conditions in the vicinity of the project facilities in the Delta resulting from construction activities. Second, the analysis addresses changes in groundwater conditions in the Delta region resulting from project operations.

The Delta Conveyance Project construction- and maintenance-related effects were evaluated qualitatively due to the lack of an available analytical tool at the spatial scale required for the site-specific quantitative analysis. The Delta Groundwater Model used for the quantitative groundwater analysis is a regional-scale model with an average element size of 0.57 square mile. Project facilities have a footprint, which is an order of magnitude smaller than the average element size of the model. Furthermore, the model grid was adapted from an existing model (see Section 8.3.1.1, *Analysis Tool: Delta Groundwater Model*) and was not configured to align with the project facilities. The qualitative evaluations are based on existing groundwater conditions and hydrogeology and anticipated changes in groundwater elevations, storage, and quality from the construction methods and protocols described in *Volume 1: Delta Conveyance Final Draft Engineering Project Report—Central and Eastern Options* and *Volume 1: Delta Conveyance Final Draft Engineering Project Report—Bethany Reservoir Alternative* (Engineering Project Reports) (Delta Conveyance Design and Construction Authority 2022a, 2022b). On the other hand, the effects of project operations on groundwater conditions were evaluated quantitatively using the DeltaGW Model, a numerical integrated groundwater surface water model described in Appendix 8A, *Delta Groundwater Model: Development and Calibration*. The groundwater study area is the area within the DeltaGW Model domain, which covers the valley floor area between the Bear River and Cache Creek in the north and the Tuolumne River in the south. It includes the southern subbasins of the Sacramento Valley groundwater basin (including the Yolo, Solano, and North American Subbasins) and the northern subbasins of the San Joaquin Valley groundwater basin (including the South American, Tracy, East Contra Costa, Cosumnes, and Eastern San Joaquin Subbasins). The quantitative analysis of effects of project operations includes evaluation of resultant changes in groundwater elevations (including associated effects on supply wells and agricultural drainage systems), groundwater storage, and interconnected surface water systems.

The effects of project operations on land subsidence and groundwater quality resulting from changes in groundwater conditions were also evaluated qualitatively due to the lack of an available analytical tool. Finally, impacts on and benefits to the Delta export service areas were addressed qualitatively as the DeltaGW Model area overlies only the area containing project infrastructure and does not include Delta export service areas.

8.3.1.1 Analysis Tool: Delta Groundwater Model

To facilitate quantitative groundwater analyses, a new integrated groundwater–surface water model, called the DeltaGW Model, was developed. The model was used to evaluate the effects of the long-term operation of the water conveyance facilities associated with the project on groundwater resources in the Delta region. As previously noted, construction impacts were evaluated qualitatively and were not included in the DeltaGW Model analysis.

The DeltaGW Model is based on DWR's Integrated Water Flow Model platform (California Department of Water Resources 2021) and simulates land surface processes, groundwater flows, surface water flows, and stream aquifer interactions in response to stresses from water use, land use, and hydrologic variability. The DeltaGW Model utilizes the same model grid structure as the C2VSim-FG model, but covers a smaller model domain that includes the Delta and surrounding areas (Figure 8-3). Model nodes and elements of C2VSim-FG within the DeltaGW Model domain are renumbered to maintain independence from C2VSim-FG. Initially, relevant model input data from C2VSim-FG were mapped to the renumbered grid and element set of the DeltaGW Model. Later, geologic, hydrologic, and land and water use data were enhanced with available recent data from various local and regional sources, including calibrated local models within the DeltaGW Model domain. New boundary conditions were also developed for the northern and southern boundaries of the DeltaGW Model domain. The DeltaGW Model layering is also enhanced to create a six-layer model compared to the four-layer C2VSim-FG model.

The DeltaGW Model is a completely independent and separate model from C2VSim-FG. The DeltaGW Model was calibrated with enhanced data and aquifer layering for a historical period from 1974 to 2015 on a monthly timestep. A detailed description of model development and calibration is provided in Appendix 8A, *Delta Groundwater Model: Development and Calibration*.

The DeltaGW Model domain is subdivided laterally into variably sized elements over a 4,834-square-mile area with an average element size of 0.57 square mile. The model has 8,459 elements and 7,977 nodes, with an equivalent average area of 0.6 square mile per node. The aquifer underlying the model domain is divided vertically into six layers with variable thicknesses to a maximum thickness of 2,900 feet. The top three layers are 65, 50, and 50 feet thick respectively, for a total thickness of 165 feet, which generally corresponds to the bottom of the project tunnel.

The DeltaGW Model domain is divided into five model subregions for the purpose of analysis, as shown in Figure 8-3. Model subregion 4 represents the Delta region, the primary focus of quantitative analysis of project operations. This subregion contains the project footprint of conveyance tunnels, the project intakes, the Southern Forebay, and the Bethany Complex. Within each of these subregions, the DeltaGW Model simulates agricultural demand components, representing crop irrigation requirements, urban demands based on population and per capita water use, and the supply components representing surface water deliveries and estimated groundwater pumping to meet the water demands. The model generates monthly groundwater elevations at each of the model nodes.

Figure 8-3. DeltaGW Model Domain and Model Subregions

8.3.1.2 Approach for Analysis

The analysis methodologies describe the potential impacts on groundwater resources from construction and long-term operations activities associated with the project alternatives. The analyses rely upon geospatial information identifying temporary ground-disturbing activities necessary for project construction in the study area. Longer-term effects resulting from the physical footprints of water conveyance facilities and conservation areas, as well as operational effects on groundwater resources, are described separately. Areas south of the Delta that receive Delta water would not be affected during construction activities in the Delta because the changes in groundwater levels resulting from construction dewatering occur locally around the site of dewatering and do not affect other groundwater basins. During construction activities, the Delta exports are assumed to remain identical to what they would be without construction activities associated with the new conveyance facility.

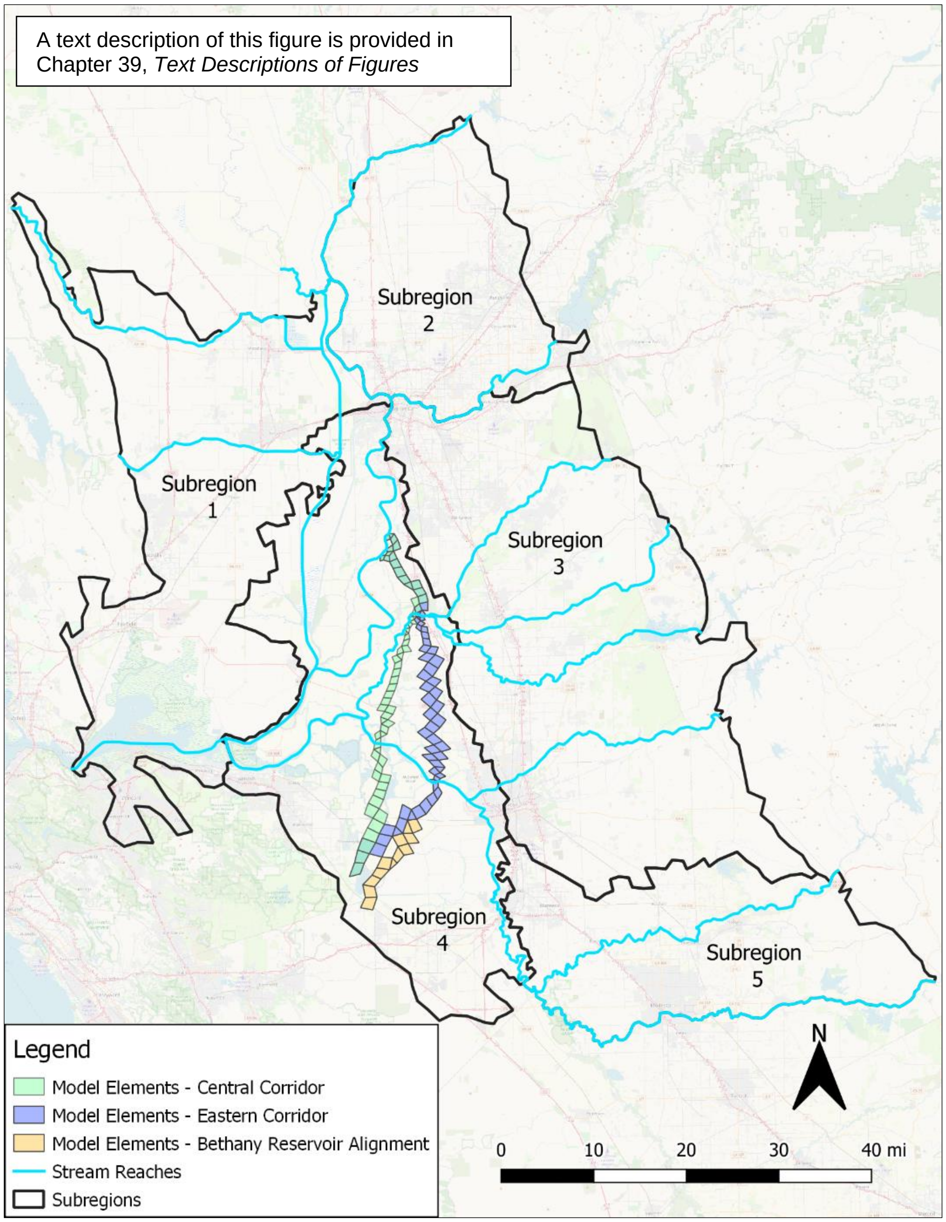
Impacts on groundwater resources from project operations as they relate to stream-aquifer interactions, groundwater levels, hydraulic gradients, and/or the quantity of groundwater in storage were evaluated quantitatively utilizing the DeltaGW Model, which covers the Delta region and adjacent groundwater basins, not the entire Central Valley. As a result, the geographic scope of the quantitative analysis of groundwater impacts of the project does not include the entire Central Valley or areas south of the Delta. At the initiation of this groundwater study, the C2VSim-FG was not available as a fully calibrated model, nor were there uniform models of the Central Coast and Southern California groundwater basins. Therefore, groundwater impacts on areas south of Delta are discussed qualitatively in this chapter. In addition, the results of the DeltaGW Model simulations indicate very limited groundwater-related impacts due to project operations; hence, little to no groundwater-related impacts are anticipated in the Central Valley outside the DeltaGW Model domain, upstream of Delta or south of Delta.

Use of the DeltaGW Model for Evaluation of Impacts of Project Operations

The DeltaGW Model was used to evaluate the operational impacts of project alternatives against the existing (baseline) conditions. Operations are considered over a 94-year simulation period utilizing hydrology from 1922 through 2015. Model stresses for the existing condition and project alternative model runs utilize data from the CalSim 3 model used in the surface water analysis (see Chapter 5, *Surface Water*, and Chapter 6, Section 6.4.1, *Methods for Analysis,* for further descriptions of the assumptions associated with CalSim 3 modeling). Land use, precipitation, evapotranspiration, irrigation periods, and urban demands were all assigned in the DeltaGW Model using the same input data as used in the CalSim 3 model. Surface water flows, diversions, Delta exports, and project operations under existing conditions and the alternatives were obtained from the results of the CalSim 3 analyses and used as input data for the DeltaGW Model. Changes in surface water deliveries unrelated to the Delta Conveyance Project diversions between existing conditions and project alternatives as simulated by the CalSim 3 model for surface water analyses are reflected in the DeltaGW Model. These changes are considered to be a part of the project operational impacts. The physical features of the project are modeled for each alternative as low-permeability model elements whose alignments are shown in Figure 8-4. Each project alternative is simulated in DeltaGW with the combination of intakes and tunnel corresponding to the alternative; as a result, only one conveyance alignment is ever simulated at a time in the DeltaGW Model. Surface water elevation changes occurring in the Southern Forebay are not simulated in the DeltaGW Model because the forebay is not expected to have substantive interactions with the underlying aquifers due to perpetual forebay inundation to a minimum of several feet of water depth. The existing condition in the DeltaGW Model does not include any of the project features. The comparison of the project alternatives against existing conditions reflects differences in groundwater conditions resulting from the physical features of the project (e.g., tunnel and intakes), project operations, and any other changes in flow or surface water diversions expected as a result of the project.

In this analysis, each project alternative is compared to existing conditions (the CEQA baseline) to quantitatively analyze groundwater level changes and associated impacts in the Delta that are caused by operation of the alternative. Detailed modeling assumptions and results are documented in Appendix 8B, *Impact Analysis: Groundwater Model Results*.

In addition to project alternatives, the DeltaGW Model was also used to compare the 2040 No Project Alternative against the 2020 existing condition (CEQA baseline). The 2040 No Project Alternative leverages the same underlying data and assumptions used for the No Project Alternative surface water analysis conducted in CalSim 3, which assumes that the only projects constructed under the No Project Alternative are those built without the Delta Conveyance Project. The DeltaGW modeling analysis did not include other projects explicitly. The DeltaGW model incorporates land use, precipitation, evapotranspiration, irrigation periods, and urban demands data from the CalSim 3 inputs and the surface water flows and diversions from the CalSim 3 outputs. The 2040 No Project Alternative is compared against the existing conditions (CEQA baseline) to evaluate changes in groundwater conditions resulting from climate change, land use, and demand changes under future conditions.



A text description of this figure is provided in Chapter 39, *Text Descriptions of Figures*

Figure 8-4. DeltaGW Model Physical Project Components

Analysis of Groundwater Conditions Upstream of the Delta Region

Groundwater basins underlying the Sacramento Valley are recharged directly through precipitation and irrigation recharge and through the interconnected surface water courses (e.g., Sacramento, Yuba, and Feather Rivers) that run through or adjacent to them. While groundwater is used for both potable and irrigation supply, in most areas of the Sacramento Valley, groundwater levels recover to pre-irrigation season levels each spring. As noted in Chapter 6, *Water Supply*, upstream reservoir storage and river flows do not substantially change between the project alternatives and the existing conditions when operation of the project alternatives are simulated. For Trinity Lake, Shasta Lake, Lake Oroville, and Folsom Lake, storage changes are extremely minimal. In some cases, there are very minor increases in end-of-September storage because of lower releases for exports (because of diversions at the proposed north Delta intakes) and carriage water savings. Additionally, as noted in Chapter 5, *Surface Water*, the long-term average of monthly flows and average monthly flows by water year type on the Sacramento River (a key interconnected surface water course in the Sacramento Valley) as simulated in CalSim 3 under all project alternatives would be similar when compared to existing conditions. As project impacts on upstream interconnected surface water courses are anticipated to be minimal, the resultant impacts on groundwater upgradient from the Delta are also anticipated to be minimal as a result of project operations.

Given the nominal changes in surface water flows and storage in the large upstream reservoirs and the need to utilize a refined flow model (the DeltaGW Model) in the study area to evaluate for impacts immediately adjacent to project infrastructure, the Sacramento Valley groundwater basins and areas upstream of Bear River are not evaluated in this chapter.

Analysis of Groundwater Conditions in South-of-Delta SWP Service Areas

Operations of the Delta Conveyance Project would stabilize surface water deliveries in the south-of-Delta SWP service areas, as described in Chapter 6. Average annual SWP deliveries would increase from existing conditions under all project alternatives for the long-term average, dry years, and critical water years. SWP Table A and Article 56 deliveries are expected to increase under the long-term average, dry years, and critical water years compared to deliveries under existing conditions. Average annual SWP Article 21 deliveries would also increase under the long-term average and, depending on the alternative, would decrease or increase under dry and critical water years. Article 21 deliveries typically include a small amount for north-of-Delta SWP water contractors that could occur every year and occasional but more significant deliveries for south-of-Delta contractors. The project alternatives are not likely to affect the frequency of north-of-Delta Article 21 deliveries but could influence, and likely increase, those for south-of-Delta deliveries.

Longer-term averages show increases in San Luis Reservoir storage across all project alternatives. The project is not expected to affect San Joaquin River flows nor the operations of reservoirs south of the Delta on the tributaries of the San Joaquin River (e.g., CVP Millerton Lake on the San Joaquin River and the New Melones Reservoir on the Stanislaus River); therefore, neither locations and reservoirs on the San Joaquin River (and tributaries) nor San Joaquin Valley groundwater subbasins were evaluated further. Appendix 5A, *Modeling Technical Appendix*, includes flows for additional locations and storage for additional reservoirs within the study area (that are not relevant to the discussion in this chapter).

Thresholds of Significance

The effects of a project alternative on groundwater would be significant under CEQA if implementation of the alternative would result in one of the potential impacts described in this section based on the general questions posed in the CEQA Guidelines Appendix G Environmental Checklist. The thresholds of significance are also discussed below for these potential impacts.

- **Impact GW-1: Changes in Stream Gains or Losses in Various Interconnected Stream Reaches**—Changes in stream gains/losses are considered substantial if the annual increase in stream losses to the groundwater system or the annual decrease in stream gains from the groundwater system for the major streams in the Delta region would be more than 5% with respect to the annual average stream aquifer gains/losses under existing conditions (CEQA baseline) in the corresponding streams. The 5% threshold is deemed reasonable because it is small relative to the historical variations in annual stream gains/losses, which ranges from 62% to 124% of average annual stream gains/losses over the historical period from 1974 to 2015 in stream reaches in the Delta region (Appendix 8A). Annual values are used in assessing impacts on stream gains/losses because groundwater response to streamflow changes is a relatively slow process.

- **Impact GW-2: Changes in Groundwater Elevations**—Groundwater elevation changes resulting from project operations in the study area are considered substantial if these changes are significantly higher than historical groundwater elevation changes. Historical data for the 1974–2015 period from 132 wells in the Delta region (model subregion 4) shows that 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, it is conservative to consider changes in groundwater elevations to be significant when greater than +/-5 feet of change in groundwater elevations occurs more than 5% of the time due to project operations. Short-term (less than 5% of the time) fluctuations in groundwater elevations are not considered significant because the groundwater elevations recover before causing any impact.

- **Impact GW-3: Reduction in Groundwater Levels Affecting Supply Wells**—Reduced groundwater levels could affect the capacity of the supply wells and may result in some shallower wells going dry or requiring well modifications such as the lowering of pump intakes. A review of well completion reports from DWR's Online System of Well Completion Reports (OSWCR) database shows a total of 3,565 production wells were installed within the statutory Delta boundary between 1977 and 2018. These wells have a median depth of 190 feet and an average depth of 211 feet. Reduction in groundwater levels is considered substantial if more than 20 feet of groundwater decline occurs at a supply well in the Delta region. The 20-foot groundwater decline threshold for supply wells is deemed to be a conservative estimate for depletion of groundwater supplies because it is less than 10% of the average depth of supply wells in the statutory Delta.

- **Impact GW-4: Changes to Long-Term Change in Groundwater Storage**—Groundwater storage changes in the Central Valley vary widely—annual reduction has been estimated to be between 900 thousand acre-feet (TAF) and 2,100 TAF from 2006 to 2018 (California Department of Water Resources 2021:6-17). Based on the calibrated DeltaGW historical (1974–2015) model, annual changes in groundwater storage in the Delta region varies widely from -214 TAF (decrease) to 253 TAF (increase) with a long-term change in storage of 1,170 TAF. Historical fluctuations in annual change of storage are approximately 20% of the historical long-term change in storage. Therefore, it is conservative to consider changes in long-term groundwater storage to be substantial if there is more than a 5% difference in the change in long-term storage compared to existing conditions in the Delta region.

- **Impact GW-5: Increases in Groundwater Elevations near Project Intake Facilities Affecting Agricultural Drainage**—Agricultural drainage operations are common in most areas of the Delta to lower groundwater levels to prevent impacts on the root zone of agricultural crops. As such, only increases in groundwater levels are considered to have negative impacts on agricultural drainage operations. It is assumed that existing drainage systems have sufficient capacity for some increased volumes of drainage. Large-scale variations in agricultural drainage (70%–150% of the average) were estimated based on the results of the historical calibrated DeltaGW Model. Therefore, it is conservative to consider more than 10% increase in annual agricultural drainage flows to be substantial.
- **Impact GW-6: Damage to Major Conveyance Facilities Resulting from Land Subsidence**—Substantial and the persistent drop in long-term average groundwater elevations over a wide area in the Delta region (model subregion 4) could result in groundwater-level-induced land subsidence depending on the underlying geologic/hydrogeologic conditions. No quantitative analysis of land subsidence impacts of the project was conducted because of the lack of availability of land subsidence process modeling under project operations. Instead, the drops in groundwater elevations near the major conveyance facilities obtained from the groundwater flow model results were used to qualitatively infer potential for land subsidence due to project operations.
- **Impact GW-7: Degradation of Groundwater Quality**—Substantial degradation of groundwater quality or the substantial migration of groundwater contaminant plumes toward major supply wells would be counter to the state's Antidegradation Policy as stated in State Board Resolution 68-16. No quantitative analysis of water quality impacts of the project was conducted because of the lack of availability of a contaminant transport model to support quantitative analysis. Instead, the changes in groundwater elevations around the known contaminant plume sites obtained from the groundwater flow model results were used to qualitatively infer potential for migration of plumes near the project alignment.

Evaluation of Mitigation Impacts

CEQA also requires an evaluation of potential impacts caused by the implementation of mitigation measures. Following the CEQA conclusion for each impact, the chapter analyzes potential impacts associated with implementing both the Compensatory Mitigation Plan (CMP) and the other mitigation measures required to address with potential impacts caused by the project. Mitigation impacts are considered in combination with project impacts in determining the overall significance of the project. Additional information regarding the analysis of mitigation measure impacts is provided in Chapter 4, *Framework for the Environmental Analysis*.

8.3.2 Groundwater Impacts and Mitigation Approaches

8.3.2.1 No Project Alternative

As described in Chapter 3, *Description of the Proposed Project and Alternatives,* CEQA Guidelines Section 15126.6 directs that an EIR evaluate a specific alternative of "no project" along with its impact. The No Project Alternative in this Draft EIR represents the circumstances under which the project (or project alternative) does not proceed and considers predictable actions, such as projects, plans, and programs, that would be predicted to occur in the foreseeable future if the Delta Conveyance Project is not constructed and operated. This description of the environmental conditions under the No Project Alternative first considers how groundwater could change over time and then discusses how other predictable actions could affect groundwater.

Future Groundwater Conditions

Under the No Project Alternative, SWP/CVP operations are assumed to be similar to existing conditions. It is expected that DWR and Reclamation would continue to operate the SWP and CVP to divert, store, and convey water consistent with applicable laws, contractual obligations, and permit requirements. This alternative also assumes no construction or modifications to SWP or CVP facilities or operations criteria between 2020 and 2040 would occur, and the implementation of GSPs developed in response to the SGMA, including associated projects for the sustainable management of underlying groundwater basins.

Overall, groundwater conditions in the Delta, and SWP and CVP service areas would be expected to vary under the No Project Alternative because of a variety of factors. Sea level rise, climate change, an increase in north-of-Delta urban water demands, and changes in land use could be expected to cause changes in SWP and CVP deliveries as compared to existing conditions, and could result in associated changes in groundwater conditions as groundwater extractions may increase to make up for shortages in surface water deliveries until the high- and medium-priority groundwater basins are operated in compliance with SGMA. Additionally, the implementation of GSPs submitted in 2020 for critically overdrafted subbasins (predominantly in the San Joaquin Valley) and the anticipated implementation of GSPs in noncritically overdrafted medium- and high-priority groundwater basins (predominantly in the Sacramento Valley) could result in the development of new programs and projects to achieve and maintain basin sustainability on a regional level, including the development of new surface water supplies, new groundwater recharge projects, and in some places, groundwater pumping curtailments. Implementation of the GSPs and the resulting achievement of groundwater sustainability by 2040 or 2042 would result in stable groundwater levels and the active management of groundwater extractions within predetermined operating ranges.

For a discussion of the potential responses of SWP and CVP water users to reduced SWP and CVP deliveries, please refer to Chapter 3, *Description of the Proposed Project and Alternatives,* and Appendix 3C, *Defining Existing Conditions, No Project Alternative, and Cumulative Impact Conditions*. As explained therein, responses of urban water users could include water use efficiency measures, increased reliance on groundwater, increased reliance on reservoir storage, contingency planning efforts, increased use of recycled water, increased water transfers, increased reliance on desalination as a water supply, and water use restrictions. Responses of agricultural water users could include increased reliance on reservoir storage, managed aquifer recharge programs to improve supply reliability, increased reliance on groundwater, land fallowing and/or conversion to non-irrigated uses, and water conservation programs.

Historically, precipitation in most of California has been dominated by extreme variability over seasonal, annual, and decadal timescales. In the context of climate change, projections of future precipitation are even more uncertain and potentially variable than projections for temperature. Uncertainty regarding precipitation projections is greatest in the northern part of the state, and a stronger tendency toward drying is indicated in the southern part of the state. The projected reduction in snowpack under climate change can significantly change the availability and pattern of surface water resources because Sierra Nevada snowpack is the primary source of water supply and natural groundwater recharge in California (California Department of Water Resources 2019:1-14). Climate models project more extreme winter precipitation events that would be more in the form of rain rather than snow; therefore, they would generate higher runoffs, creating additional flooding concerns; and a more rapid spring snow melt, leading to shorter, more intense spring periods of river flow and freshwater discharge. These changes in surface water hydrology will have a direct impact on the timing and volume of recharge to the underlying groundwater basins. Sea level rise, another anticipated impact resulting from climate change, could be expected to affect coastal groundwater basins directly by driving seawater further inland in the subsurface, and groundwater basins in and around the Delta indirectly by driving saltwater further inland in Delta surface water, resulting in changes to surface water management and releases from upstream freshwater reservoirs to offset the increased Delta water salinity levels.

The 2040 No Project Alternative was also compared against the existing conditions using the DeltaGW Model to assess potential groundwater impacts that could occur in the absence of the Delta Conveyance Project under future conditions. The 2040 No Project Alternative model run of the DeltaGW Model utilizes the same underlying hydrology and demand data used in the surface water analysis for the 2040 No Project scenario in CalSim 3 (see Chapter 5, *Surface Water,* and Chapter 6, *Water Supply*, for further description of the assumptions associated with CalSim 3 modeling). Water supplies and demands in the 2040 No Project Alternative in CalSim differ from existing conditions in order to represent project changes in land use, urban growth, climate change, and sea level rise.

The 2040 No Project Alternative DeltaGW Model scenario utilizes 2040 land use developed for the California Water Plan Update 2013, 2040 urban demands based on 2015 urban water management plans and population data, and precipitation and evapotranspiration under a climate change assumption. The simulation period considers 94 years of hydrology (from 1922 through 2015). Twenty global climate projections were developed and used to perturb historical observed meteorological data to develop the 2040 climate dataset. The meteorological data were used in developing unimpaired rim water inflows as well as evapotranspiration associated with agricultural and managed wetland water demands. Land use data are based on a future scenario developed for DWR for the California Water Plan, Update 2013, which assumes that recent trends would continue into the future.

The modeled 2040 No Project Alternative assumes construction and operation of the notched Fremont Weir, but does not include any other projects that could occur in the absence of the Delta Conveyance Project. The 2040 No Project Alternative does include the projects that would move forward in the absence of the Delta Conveyance Project. However, the modeled representation of the 2040 No Project Alternative does not include those projects because of their programmatic nature. Furthermore, only projects that are implemented within the DeltaGW Model domain could be included in the analysis. Potential projects under SGMA are not considered as part of this analysis. As a result, modeled groundwater changes occurring under the 2040 No Project Alternative when compared with 2020 existing conditions are predominantly due to climate change conditions and expected changes to land use, agricultural, and urban demands. These changes are presented below in the same categories of changes in groundwater resources listed in *Thresholds of Significance* in Section 8.3.1.2, *Approach for Analysis*, to facilitate understanding of the responses of groundwater system under the 2040 climate change scenario. A detailed description of modeling assumptions is provided in Appendix 8B.

Increase in Stream Losses in Various Interconnected Stream Reaches

Without the project in place, changes to streamflow are dictated by climate change and 2040 level of development. Under 2040 No Project conditions, the Sacramento River, San Joaquin River, and Suisun Bay (the three major interconnected stream courses in the study area) would see a small increase in stream losses to groundwater compared to the existing conditions. The Sacramento River would see a reduction in stream losses, while the San Joaquin River and Suisun Bay would see an increase in losses. This change is caused by the increased gradient between the stream stage and underlying groundwater elevation under 2040 conditions. Long-term average monthly flows during the winter and spring generally increase due to altered inflow patterns as a result of climate change, with more precipitation falling as rain rather than snow, and more extreme winter precipitation events. Between May and October, flows decrease as a result of climate change with diminished snow accumulation and an earlier snowpack melt. The resulting changes in streamflow, coupled with the influence of sea level rise, result in higher average stream stage in the San Joaquin River and Suisun Bay compared to existing conditions. Increased evapotranspiration and greater urban water demands result in greater groundwater use and lower groundwater elevations across the region. Overall, the stream losses would increase by less than 2% with respect to average annual stream aquifer interaction under existing conditions in any water year for all three streams.

Changes in Groundwater Elevation

Under the 2040 No Project Alternative, climate change, land use, and urban demand changes would result in increased pumping to compensate for the increase in water demands resulting from higher future temperatures. Evapotranspiration is assumed to increase by approximately 5% under 2040 climate change conditions. Land use shifts to less water-intensive crops, and overall agricultural water demand would decrease by 54 TAF across the DeltaGW Model domain. Surface water deliveries for agriculture would remain mostly unchanged. Urban water demands would increase by approximately 50% between existing conditions and 2040 conditions, from 841 TAF to 1,268 TAF within the DeltaGW Model domain. While surface water deliveries for urban use would increase, additional groundwater pumping would still occur to meet the increased demand. An increase of 122 TAF of average annual groundwater pumping would occur over the 94-year simulation period, resulting in localized groundwater elevation declines of 50 to 60 feet in some areas of the DeltaGW Model domain. The greatest increase in groundwater pumping and corresponding groundwater elevation decline would occur over a limited area near the city of Fairfield as a result of increased urban water demands. These declines are not the result of project operations as this is an analysis of anticipated impacts on groundwater resources without the project.

Reduction in Groundwater Levels Affecting Supply Wells

Under the 2040 No Project Alternative, groundwater elevations in two Public Land Survey System (PLSS) sections, or 20 (0.3%) of the 5,244 production wells evaluated in the DeltaGW Model, would decline by more than 20 feet relative to the existing conditions. The groundwater declines would be primarily a result of increased pumping to meet increased urban water demands and higher agricultural water demands under climate change conditions and not as a result of project operations. The maximum simulated groundwater decline at a production well would be about 25 feet near the city of Sacramento. However, the 2040 No Project Alternative does not explicitly consider SGMA; it only considers land use/evapotranspiration changes based on current trends/climate change and supply changes independent of SGMA. It is likely that there would be demand reductions or supply augmentation under sustainable groundwater management that may reduce the reported declines.

Long-Term Declines of Groundwater in Storage

In subregion 4 (i.e., the Delta region) of the DeltaGW Model, annual loss in groundwater storage under the 2040 No Project Alternative is about 4,899 AFY relative to the existing conditions. This change equates to an approximately 0.64 AF per acre reduction in groundwater storage across the region at the end of the 94-year simulation period as compared to changes in groundwater storage under existing conditions. This increased loss of groundwater in storage is a result of increased groundwater use associated with higher agricultural and urban water demands in the Delta region under 2040 conditions.

Increases in Agricultural Drainage

Agricultural drainage flows are expected to decrease under the 2040 No Project Alternative relative to existing conditions primarily because of increased pumping to meet higher agricultural water demands under climate change conditions. Overall, agricultural drainage would decrease under the 2040 No Project Alternative by 0.79% or 3,924 AFY relative to existing conditions.

Damage to Major Conveyance Facilities from Land Subsidence

Groundwater declines are expected to occur within the DeltaGW Model domain under the 2040 No Project Alternative relative to existing conditions as a result of climate change, land use, and urban demand changes. As described in the *Changes in Groundwater Elevation* section above, an increase of 122 TAF of average annual groundwater pumping would occur in the DeltaGW Model area over the 94-year simulation period, resulting in localized groundwater elevation declines in some areas of the model domain. The greatest increase in groundwater pumping and corresponding groundwater elevation decline of 50 to 60 feet would occur over a small (less than 3 square miles) area near the city of Fairfield, near the model boundary, as a result of increased urban water demands under 2040 conditions. These declines are not the result of project operations because this is an analysis of anticipated impacts on groundwater resources without the project. These groundwater declines could potentially result in land subsidence, depending on how and where the groundwater is extracted, and may result in damage to existing conveyance facilities in the study area.

Degradation of Water Quality

Degradation of water quality was not evaluated quantitatively; the changes in groundwater elevations from the groundwater flow model were used for a qualitative evaluation of impacts. Changes in groundwater elevations under the 2040 No Project Alternative relative to the existing conditions are expected to occur as a result of climate change increasing water demands. Based on groundwater flow model results, the largest groundwater elevation changes occur in urban areas where demand increases are the most significant. Across the rest of the model domain, changes in groundwater elevations would be less than 10 feet in most of the study area. These changes in groundwater elevations could potentially change the flow of groundwater across the region enough to mobilize contaminant plumes or cause migration of groundwater from areas of poor water quality to areas of higher quality. Notably, the DeltaGW modeling analysis did not include effects of sea level rise, which could contribute to saltwater intrusion in the Delta under 2040 conditions.

Predictable Actions by Others

A list and description of actions included as part of the No Project Alternative are provided in Appendix 3C, *Defining Existing Conditions, No Project Alternative, and Cumulative Impact Conditions*. As described in Chapter 4, *Framework for the Environmental Analysis,* the No Project Alternative analyses focus on identifying the additional water-supply-related actions public water agencies may opt to follow if the Delta Conveyance Project does not occur.

Public water agencies participating in the Delta Conveyance Project have been grouped into four geographic regions. The water agencies within each geographic region would likely pursue a similar suite of water supply projects under the No Project Alternative (see Appendix 3C, *Defining Existing Conditions, No Project Alternative, and Cumulative Impact Conditions*). At this time, it is assumed that the types of projects that are potentially feasible in each region could contribute to meeting demands in the face of further declines in reliable SWP supplies. Based on a review of the 2020 urban and agricultural water management plans of the participating water agencies, Table 8-1 summarizes the types of activities that could affect groundwater by state region in the No Project Alternative. Construction of water supply reliability projects and implementation of demand management measures would be needed to otherwise meet project objectives.

Table 8-1. Examples of Effects on Groundwater from Construction and Operation of No Project Alternative Projects

Project Type	Region(s) in Which Impact Would Likely Occur	Potential Groundwater Impacts
Increased/ accelerated desalination	Northern coastal, southern coastal	<ins>Potential Construction Impacts</ins>: Temporary groundwater quality degradation as a result of the accidental release of hazardous construction chemicals if the construction areas are not properly managed through implementation of construction BMPs. Temporary reductions in groundwater elevations and/or storage if groundwater is used as a supply source during construction and/or if construction required dewatering. <ins>Potential Operations and Maintenance Impacts</ins>: Long-term groundwater quality degradation from intrusion of saline waters as a result of onshore brackish groundwater extractions and/or potential increases in salinity of intruded groundwater.
Groundwater recovery (brackish water desalination)	Northern inland, southern coastal, southern inland	<ins>Potential Construction Impacts</ins>: Temporary groundwater quality degradation as a result of the accidental release of hazardous construction chemicals if the construction areas are not properly managed through implementation of construction BMPs. Temporary reductions in groundwater elevations and/or storage if groundwater is used as a supply source during construction, if construction required dewatering, and/or as a result of groundwater extraction during well development and testing. <ins>Potential Operations and Maintenance Impacts</ins>: Long-term groundwater quality degradation resulting from brine disposal via injection and/or near shore water discharge. Long-term reductions in groundwater elevations and/or storage resulting from the brackish groundwater extraction.

Project Type	Region(s) in Which Impact Would Likely Occur	Potential Groundwater Impacts
Groundwater management	Northern coastal, northern inland, southern coastal, southern inland	Potential Construction Impacts: Temporary groundwater quality degradation as a result of groundwater discharges during well development and testing. Temporary reductions in groundwater elevations and/or storage if groundwater is used as a supply source during construction, if construction required dewatering, and/or as a result of groundwater extraction during well development and testing. Potential Operations and Maintenance Impacts: Temporary groundwater quality degradation as a result of groundwater discharges during well maintenance. Long-term groundwater quality degradation as a result of the operation of groundwater recharge projects.
Water recycling	Northern coastal, northern inland, southern coastal, southern inland	Potential Construction Impacts: Temporary groundwater quality degradation as a result of the accidental release of hazardous construction chemicals if the construction areas are not properly managed through implementation of construction BMPs. Temporary reductions in groundwater elevations and/or storage if groundwater is used as a supply source during construction and/or if construction required dewatering. Potential Operations and Maintenance Impacts: None
Water use efficiency measures	Northern inland, southern coastal, southern inland	Potential Construction Impacts: Temporary groundwater quality degradation as a result of groundwater discharges during well development and testing. Temporary reductions in groundwater elevations and/or storage if groundwater is used as a supply source during construction, if construction required dewatering, and/or as a result of groundwater extraction during well development and testing. Potential Operations and Maintenance Impacts: None

BMP = best management practice.

The project types in Table 8-1 are examples of water reliability projects that could occur if the Delta Conveyance Project were not approved. Desalination projects are potentially feasible in the northern and southern coastal regions. The southern coastal region might pursue larger and more desalination projects than the northern coastal region to replace the water yield that otherwise would have been received through the Delta Conveyance Project. Groundwater recovery (brackish water desalination) is more feasible predominantly across the northern inland, southern coastal, and southern inland regions. Groundwater management projects could occur in all regions, with larger, more extensive management programs occurring in the northern inland areas. Water recycling projects are less tied to any geographic feature and, therefore, could also be pursued in all four regions. The northern inland region would require the fewest wastewater treatment/water reclamation plants, followed by the northern coastal region and southern coastal region. The southern inland region would require the most water recycling projects to replace the anticipated water yield that would otherwise be received through the Delta Conveyance Project. Water efficiency projects could be pursued in all four regions and involve a wide variety of project types, such as flow measurement or automation in a local water delivery system, lining of canals, use of buried perforated pipes to water fields, and the additional detection and repair of commercial and residential leaking pipes. In general, impacts on groundwater from the construction of these projects could include groundwater quality degradation as a result of the accidental release of hazardous construction chemicals if the construction areas are not properly managed through construction best management practices (BMPs) and/or groundwater discharges during well development and testing. Construction impacts could also include the temporary reduction in groundwater elevations and/or storage if groundwater is used as a supply source during construction, if construction requires dewatering, and/or as a result of groundwater extraction during well development and testing. Impacts on groundwater from operation of these other project types include groundwater quality degradation resulting from brine disposal (either via injection or as a result of near-shore ocean discharge) or the recharge of the groundwater basin with surface water or stormwater and/or long-term reductions in groundwater elevations and/or storage resulting from associated project groundwater extractions.

8.3.2.2 Impacts of the Project Alternatives on Groundwater

This section discusses changes to and associated impacts on groundwater resources from construction and operation of the project alternatives relative to existing conditions. As mentioned above, the DeltaGW Model results were used to evaluate the operational impacts of project alternatives against the 2020 existing conditions. Construction practices are discussed in the Engineering Project Reports (Delta Conveyance Design and Construction Authority 2022a, 2022b).

Impact GW-1: Changes in Stream Gains or Losses in Various Interconnected Stream Reaches

Changes in interconnected stream gains or losses are considered to be significant if they result in an annual increase in stream losses to the groundwater system or an annual decrease in stream gains from the groundwater system of more than 5% with respect to the average annual stream-aquifer gains/losses under existing conditions (CEQA baseline). The three interconnected stream courses in the study area considered herein to evaluate this impact are the Sacramento River reach from the mouth of American River to the confluence of San Joaquin River; San Joaquin River reach from the mouth of Stanislaus River to the confluence of Sacramento River; and Suisun Bay (Sacramento River reach from the confluence with San Joaquin River to the outlet of the DeltaGW Model). Figure 8-5 shows these three stream reaches as simulated in the DeltaGW Model.

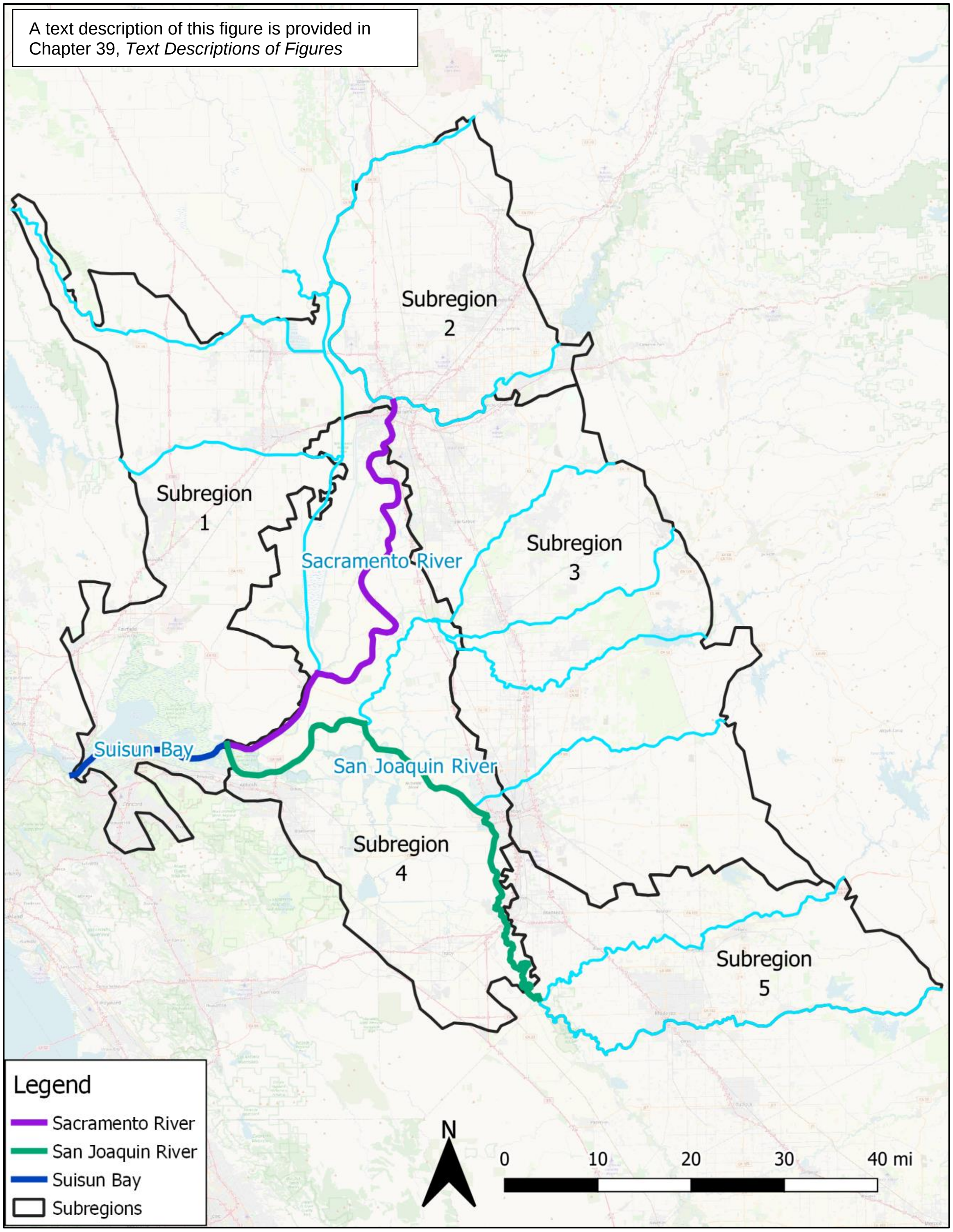


Figure 8-5. Interconnected Surface Water Reaches Analyzed in the DeltaGW Model

All Project Alternatives

Changes in stream gains or losses as a result of project operations were evaluated by comparing simulated stream gains or losses for each stream reach under existing conditions with those simulated for each project alternative. Net changes to gains or losses across each river reach were compared against the average annual stream-aquifer interaction in each river reach as a measure of the likelihood of the project impacts on downstream and on ecological users of those watercourses. Detailed simulation results can be found in Appendix 8B.

Project Construction

Project construction under all project alternatives would not result in significant changes in interconnected stream gains or losses as a result of construction activities. Project construction would include the installation of slurry cutoff or sheet pile walls to reduce the potential for dewatering impacts at the intakes and at the Southern Complex. The tunnel shafts would be "wet" constructed such that the shaft walls would be slurry walls that prevent movement of groundwater. The shaft would be constructed downward under wet conditions and the base would be formed using concrete base "tremie plugs" that seal the bottom. Because the water would be removed from a closed system within the tunnel shaft after the concrete liner and plug have been constructed, the adjacent groundwater formations would not be affected during the dewatering of the shaft. No dewatering would occur along the tunnel during tunnel boring.

The most substantial dewatering activities would occur at the intakes and Southern Forebay Emergency Spillway (Delta Conveyance Design and Construction Authority 2022a, 2022b). At the project intakes, deep cutoff walls would be constructed in the foundations of the sedimentation basin, outlet channel perimeter embankment, and the temporary levee, as well as at the back of the intake structure to isolate the internal subsurface from surrounding local groundwater for both construction and operations phases. Additionally, piezometers would be installed outside the slurry wall to allow monitoring of potential groundwater level impacts during construction for management of dewatering activities. If required to mitigate potential impacts, Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas* could be implemented in which a series of groundwater recharge and extraction wells could be installed around the external perimeter of the intake cutoff wall system to allow discharge of captured dewatered water back into the subsurface on the external side of the deep cutoff walls in the event that some local external effects due to dewatering are observed. Conversely, these wells could be used to extract mounded water for return to the sedimentation basins if needed to maintain local groundwater levels during construction and operations.

Dewatering at the Southern Complex would occur during construction at the Southern Forebay Emergency Spillway, Southern Forebay Outlet Structure, and the Outlet and Control Structures west of Byron Highway (for Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, and 4c) and at the Delta-Mendota Control Structure (for Alternatives 2a and 4a). Dewatering at the Southern Forebay Emergency Spillway, adjacent to Italian Slough, would occur for several months. Sheet pile walls would be used to limit impacts on groundwater levels from dewatering at the Southern Forebay Spillway and Southern Forebay Outlet. Dewatering at the Outlet and Control Structures west of Byron Highway and the Delta-Mendota Control Structure would be managed using well points for controlled dewatering, while dewatering at the Bethany and Southern Complex pumping plants would be actively managed until structure walls would be connected into underlying clay layers. At all dewatering locations in the Southern Complex, a network of piezometers would be installed to monitor for impacts during construction and allow adaptive management of dewatering practices to maintain local groundwater conditions. As with the intakes, if needed, Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas* could be implemented, in which a series of groundwater recharge and extraction wells could also be installed to allow discharge of captured dewatered water back into the subsurface in the event that some local external effects due to dewatering are observed, or for additional groundwater extraction to mitigate for mounded water outside the construction.

Groundwater dewatering events that could temporarily reduce stream gains or increase stream losses depend on the proximity of the interconnected streams to the construction sites and the rate and period over which dewatering occurs, as described in the Engineering Project Reports (Delta Conveyance Design and Construction Authority 2022a, 2022b). For alternatives involving more intakes (i.e., Alternatives 2a and 4a), the magnitude of dewatering would be higher, but slurry cutoff walls would be installed around project intake facilities to reduce the amount of groundwater entering the construction site and the associated need for groundwater dewatering pumping required for construction. This, in turn, would reduce the potential for impacts on the shallow aquifer system and on stream gains and/or losses from adjacent streams. As such, the impacts of these dewatering events on interconnected surface waters would occur during the construction period and would be short term in nature, and would be minimized through construction practices, including Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas*, if needed to reduce impacts through the recharge of groundwater dewater outside the slurry and/or sheet pile walls.

Operations

The cutoff walls described in the *Project Construction* section above should also substantially limit reduction of external groundwater levels during internal dewatering activities and limit mounding of water external to the walls during operations when basin levels are higher than the surrounding groundwater levels.

As described in Chapter 3, each alternative would utilize a different number of intakes diverting surface water at rates up to 1,500 or 3,000 cubic feet per second at each intake. Table 8-2 summarizes the number of intakes and the total amount of water diverted via those intake points in TAF per year under each project alternative based on the results of the surface water analysis described in Chapter 6. These diversions may result in changes to the gains or losses from various reaches of interconnected surface waters in the model domain.

Table 8-2. Number of Intakes and Volume of Surface Water Diverted during Operations by Project Alternative

Alternative	Number of Intakes	Diversion Capacity (cfs)	Volume of Water Diverted (annual average in TAF)
1	2	6,000	742
2a	3	7,500	775
2b	1	3,000	559
2c	2	4,500	677
3	2	6,000	742
4a	3	7,500	775
4b	1	3,000	559

Alternative	Number of Intakes	Diversion Capacity (cfs)	Volume of Water Diverted (annual average in TAF)
4c	2	4,500	677
5	2	6,000	749

Note: Diversion volumes at the intakes by alternative are from CalSim 3.
TAF = thousand acre-feet.

As simulated in the DeltaGW Model, project operations would result in the diversion of surface water from identified intakes, resulting in a net reduction in surface water flows in the Sacramento River between the intake structures and the Delta. The reduction in streamflow, along with changes in groundwater elevations due to the physical project features, results in differences in stream-aquifer interaction for each project alternative. Stream-aquifer interaction occurs when there is a hydraulic connection between a stream and the underlying aquifer system. Streams can be losing (water going out of stream into the aquifer) or gaining (groundwater coming into stream) at different locations depending on the corresponding hydraulic gradient between the stream and the surrounding groundwater level at those locations. Table 8-3 summarizes the minimum, maximum, and average annual differences between the project alternatives and existing conditions in total stream gains and losses in the entire Sacramento River reach in model subregion 4, with the operating conditions as set forth for each alternative. A negative value in Table 8-3 means that under the alternative, the stream loses more water or gains less water compared to existing conditions. A positive value means that under the alternative, the stream gains more water or loses less water compared to existing conditions. On average, the values are positive, indicating that streams would lose less water or gain more water under the alternative compared to existing conditions. Table 8-4 summarizes the same information for the San Joaquin River reach, and Table 8-5 summarizes the model results for the Suisun Bay reach.

Table 8-3. Annual Minimum, Maximum, and Average Change in Stream Aquifer Interaction relative to Existing Conditions (CEQA Baseline) in the Sacramento River Reach in Model Subregion 4

Alternative	Minimum Difference between Alternative and Existing Conditions	Maximum Difference between Alternative and Existing Conditions	Average Difference between Alternative and Existing Conditions	Exceeds Threshold of Significance (5%)
1	-0.16%	+1.54%	+0.52%	No
2a	+0.04%	+1.69%	+0.62%	No
2b	-0.24%	+0.94%	+0.30%	No
2c	-0.18%	+1.51%	+0.50%	No
3	-0.17%	+1.53%	+0.52%	No
4a	+0.04%	+1.69%	+0.61%	No
4b	-0.24%	+0.94%	+0.29%	No
4c	-0.19%	+1.50%	+0.50%	No
5	-0.17%	+1.53%	+0.52%	No

Note: This table presents the change in stream-aquifer interactions. Negative values mean that under the alternative, the stream loses more water or gains less water when compared to existing conditions. Positive values mean that under the alternative, the stream gains more water or loses less water when compared to existing conditions.

Table 8-4. Annual Minimum, Maximum, and Average Change in Stream Aquifer Interaction relative to Existing Conditions (CEQA Baseline) in the San Joaquin River Reach in Model Subregion 4

Alternative	Minimum Difference between Alternative and Existing Conditions	Maximum Difference between Alternative and Existing Conditions	Average Difference between Alternative and Existing Conditions	Exceeds Threshold of Significance (5%)
1	-0.82%	+0.44%	-0.11%	No
2a	-1.19%	+0.67%	-0.29%	No
2b	-0.54%	+0.58%	-0.03%	No
2c	-0.58%	+0.45%	-0.09%	No
3	-0.85%	+0.40%	-0.11%	No
4a	-1.21%	+0.87%	-0.28%	No
4b	-0.63%	+0.61%	-0.02%	No
4c	-0.77%	+0.42%	-0.08%	No
5	-0.84%	+0.47%	-0.11%	No

Note: This table presents the change in stream-aquifer interactions. Negative values mean that under the alternative, the stream loses more water or gains less water when compared to existing conditions. Positive values mean that under the alternative, the stream gains more water or loses less water when compared to existing conditions.

Table 8-5. Annual Minimum, Maximum, and Average Change in Stream-Aquifer Interaction relative to Existing Conditions (CEQA Baseline) in Suisun Bay reach in Model Subregion 1

Alternative	Minimum Difference between Alternative and Existing Conditions	Maximum Difference between Alternative and Existing Conditions	Average Difference between Alternative and Existing Conditions	Exceeds Threshold of Significance (5%)
1	-0.64%	+1.05%	+0.21%	No
2a	-0.64%	+1.27%	+0.24%	No
2b	-0.64%	+1.14%	+0.15%	No
2c	-0.67%	+1.11%	+0.17%	No
3	-0.64%	+1.05%	+0.21%	No
4a	-0.64%	+1.27%	+0.24%	No
4b	-0.64%	+1.14%	+0.15%	No
4c	-0.67%	+1.11%	+0.17%	No
5	-0.57%	+1.05%	+0.22%	No

Note: This table presents the change in stream-aquifer interactions. Negative values mean that under the alternative, the stream loses more water or gains less water when compared to existing conditions. Positive values mean that under the alternative, the stream gains more water or loses less water when compared to existing conditions.

Under all project alternatives, annual changes in simulated stream gains or losses in the Delta region as a percentage of total annual stream-aquifer interaction from the corresponding stream reach are less than 5%.

CEQA Conclusion—All Project Alternatives

Impacts on groundwater elevations from dewatering as part of project construction would be reduced through the use slurry cutoff walls and/or sheet piles, minimizing changes in groundwater elevations in the shallow aquifer system and interconnected surface water system gains and/or losses resulting from dewatering activities during construction. Maintaining the water conveyance facilities may also require dewatering. During annual removal of sediment, the sedimentation basin at the intake structure would not need to be drained. Water removed during the infrequent dewatering for structural repairs to the sedimentation basins would probably occur for a brief time and would not affect surrounding groundwater levels enough to cause substantial changes in stream aquifer interactions because, similar to the construction phase, dewatered water would be discharged back into the groundwater aquifer in the event of a significant drop in levels outside the cutoff walls. Also, dewatering during operations and maintenance would occur very infrequently (likely decades between events). However, impacts on groundwater conditions and interconnected surface waters could vary by location and at a small-scale during construction. Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas* would reduce impacts during construction and O&M to less than significant, even for those alternatives that have the highest number of intakes with larger construction footprints.

Minimum changes in interconnected Sacramento River flows resulting from project operations range from -0.24% to +0.04% of annual stream-aquifer interaction, while maximum changes in interconnected flow range from +0.94% to +1.69% of annual stream-aquifer interaction. On an average annual basis, differences in Sacramento River flows range from +0.29% to +0.62% of annual stream-aquifer interaction. Therefore, there would be less-than-significant impacts on the overall Sacramento River flows resulting from project operations because the percent differences in Sacramento River flows as simulated between existing conditions and those simulated for each project alternative are less than 5% of the annual stream-aquifer interaction.

Minimum changes in interconnected San Joaquin River flows due to project operations range from -0.54% to -1.21% of annual stream-aquifer interaction, while maximum changes in interconnected flow range from +0.40% to +0.87% of annual stream-aquifer interaction. On an average annual basis, differences in San Joaquin River flows range from -0.02% to -0.29% of annual stream-aquifer interaction. Therefore, there would be less-than-significant impacts on the overall San Joaquin River flows resulting from project operations because the percent differences in San Joaquin River flows as simulated between existing conditions and those simulated for each project alternative are less than 5% of the annual stream-aquifer interaction.

Minimum changes in interconnected Suisun Bay flows due to project operations range from -0.57% to -0.67% of overall bay flows, while maximum changes in interconnected flow range between +1.05% to +1.27% of overall annual stream-aquifer interaction. On an average annual basis, differences in Suisun Bay flows range from +0.15% to +0.24% of annual stream-aquifer interaction. Therefore, there would be less-than-significant impacts on the overall Suisun Bay flows resulting from project operations because the percent differences in Suisun Bay flows as simulated between existing conditions and those simulated for each project alternative are less than 5% of the annual stream-aquifer interaction.

In summary, as changes in the overall flows in interconnected surface water reaches for the Sacramento and San Joaquin Rivers and Suisun Bay resulting from project operations would be minimal, impacts relative to the threshold would be less than significant.

Mitigation Measure GW-1: Maintain Groundwater Supplies in Affected Areas

Prior to construction, the location of existing wells would be determined within the anticipated area of influence of project sites at which dewatering would occur during construction or maintenance. These sites include the north Delta intakes (construction and maintenance), the Southern Forebay Spillway and Outlet Structure (only used during construction dewatering), and the Bethany Complex Surge Basin (only used during construction dewatering). Initially, the area of influence would be considered to be within 0.5 mile of the dewatering areas for each site and will be validated or refined during the design phase.

Based on available information, site investigations and desk studies, the location of existing wells, depths of the wells and the depth to groundwater within these wells would be determined. During geotechnical explorations and construction, new monitoring wells would be installed sufficiently close to the groundwater dewatering sites and along the Sacramento River (for the intakes) and Italian Slough (for the Southern Forebay). Existing monitoring wells or new monitoring wells (to be installed as part of field investigations during the design phase) inside and outside the area of influence would also be used. Monitoring would be conducted to assess changes in water levels attributable to dewatering activities and maintenance by comparing changes in groundwater elevations within and outside the dewatering area of influence. Monitoring wells at the intakes would continue to be used as part of a conveyance operations monitoring program.

No monitoring would occur near tunnel shaft locations because dewatering would be limited to volume within the constructed tunnel shaft after the shaft has been isolated from the aquifer.

Monthly groundwater monitoring would be initiated as soon as access to existing wells was obtained (wherever applicable) and as soon as new monitoring wells were installed. Monitoring would continue through the construction phase for up to 6 months following termination of construction dewatering activities and for at least 5 years after commencement of conveyance operations at the intakes.

Monitoring preparation would include:

- During the design phase, the locations of existing wells that would require monitoring would be determined. The information would be used to determine the need and location for construction of new monitoring wells. Groundwater levels would be monitored in accessible existing wells. Monitoring of groundwater levels in accessible existing wells would be conducted on a weekly or monthly basis for the durations stated above, as needed.
    - The area of influence of construction dewatering operations and conveyance operations would be refined from the assumed 0.5-mile radius based upon the location of potentially affected existing wells and existing available groundwater and hydrogeologic information.
- Additional monitoring wells would be installed at the intakes, Southern Forebay structures, and Bethany Reservoir Surge Basin, as needed, during future geotechnical explorations and the construction phase. Groundwater levels would be monitored in the newly-constructed monitoring wells and existing wells (as noted above). Monitoring of groundwater water levels in new monitoring wells would be conducted on a weekly or monthly basis for the durations stated above, as needed.

  - New monitoring wells would be constructed outside the slurry cutoff walls and/or sheet piles, but within the project right-of-way.

- All monitoring data would be reported to the public on a monthly basis and in an annual summary report. The monthly reports would contain tabular water level data as well as changes in water levels from the previous months. The annual report would summarize monthly data and show the most recent water level contour map as well as the preconstruction contour map and hydrographs. The final report would include water level contour maps for the area of the groundwater aquifer that is affected by dewatering showing initial, preconstruction water levels, construction phase water levels, post-construction water levels, and annual conveyance operations water levels, as applicable.

- The results of preconstruction and construction-related monitoring and geotechnical and hydrogeologic testing during field investigations would be used to determine if supplemental re-injection and/or extraction wells would be needed.

During construction or maintenance dewatering, if the results of groundwater monitoring described above indicate that the difference between average groundwater elevation declines in monitoring wells inside the area of influence of dewatering and control (background) monitoring well outside the area of influence is more than 10% of the depth of the shallowest known well inside the area, mitigation of impacts to groundwater supplies would be needed. For wells that may be impacted by groundwater level declines described herein, the following would be implemented:

- Reinject groundwater using injection wells; potable supplies would be brought in temporarily while injection wells are constructed and the groundwater basin recharges, if needed.

The following additional measures would also be implemented if injection wells are not feasible in an area or not sufficient to offset potential impacts on groundwater levels in the area of influence:

1. Deepen or modify (e.g., lower pump intakes) wells used for domestic or agricultural purposes; potable supplies would be brought in temporarily while wells are modified, if needed.
2. Secure a temporary water supply or compensate farmers for production losses due to a reduction in available groundwater supplies.

Mitigation Impacts

Compensatory Mitigation

Although the CMP described in Appendix 3F, *Compensatory Mitigation Plan for Special-Status Species and Aquatic Resources*, does not act as mitigation for impacts on this resource from project construction or operations, its implementation could result in changes in stream gains or loss impacts.

Creation of the wetlands and other habitats on Bouldin Island, at the in I-5 ponds (Ponds 6, 7, and 8), and in the North Delta Arc would result in increased groundwater levels at areas in the vicinity of the new habitats. This, in turn, would affect the local hydraulic gradients resulting in the movement of groundwater from mounds (elevated groundwater levels) under the new ponds and habitats into adjacent stream courses when surface water levels are low. As such, the CMP would benefit interconnected surface waterbodies in the Delta. Therefore, implementation of compensatory mitigation would not change the overall impact conclusion of less than significant.

Other Mitigation Measures

Other mitigation measures proposed would not have impacts on interconnected stream gains or losses because no mitigation measures would result in the gain or loss of groundwater through activities such as dewatering. Therefore, mitigation measures are unlikely to result in changes in stream gains or losses, and there would be no impact.

Overall, changes in stream gains or losses related to compensatory mitigation and implementation of other mitigation measures, combined with project alternatives, would not change the less-than-significant with mitigation impact conclusion.

Impact GW-2: Changes in Groundwater Elevations

Changes in groundwater elevations at and around project facilities are considered to be significant if there is greater than +/-5 feet of change in simulated groundwater elevations more than 5% of the time when compared to simulated groundwater elevations under existing conditions over the duration of the 94-year analysis period from 1922 to 2015.

All Project Alternatives

Changes in groundwater elevations resulting from project construction, including those related to construction-related dewatering, were evaluated qualitatively. Changes in groundwater elevations as a result of project operations were evaluated quantitatively by comparing simulated groundwater levels under existing conditions with those simulated for each project alternative. Groundwater levels were compared at each of the model's 7,977 nodes. The frequency at which the groundwater elevation difference threshold is exceeded is reported for each model node. Detailed simulation results can be found in Appendix 8B.

Project Construction

Project construction under all project alternatives may result in localized changes to groundwater levels in the immediate area of the constructed facilities. Construction would require some short-term dewatering, as described under Impact GW-1, at facilities such as the Southern Forebay Emergency Spillway, Southern Forebay Outlet Structure, the California Aqueduct Control Structure, and the South Delta Outlet and Control Structure (for Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, and 4c), and the Delta-Mendota Control Structure (for Alternatives 2a and 4a); and longer-duration dewatering as the intakes are constructed. No dewatering would occur along the tunnel during tunnel boring, and limited removal of groundwater would occur as a result of tunnel shaft construction.

During construction dewatering of the intakes, groundwater levels would be lowered to about -20 feet mean sea level (MSL) via pumping and maintained at those levels during construction of facilities in the deeper excavations, such as the sedimentation basin. Slurry cutoff walls would be installed around project intake to reduce the amount of dewatering pumping required for construction.

Slurry cutoff walls would also be installed as part of the tunnel launch shaft construction. Once the slurry cutoff walls were in place, the tunnel launch shaft would be excavated and an approximately

30-foot-thick concrete base slab would be placed at the bottom of the shaft. The concrete plugs constructed in the bottom of the shafts would isolate the shafts from the adjacent groundwater basins prior to removing the isolated water from the shaft.

The highest amount of dewatering pumping would occur at the intakes with continuous groundwater pumping at rates ranging from 100 gpm to 2,000 gpm, as described in the the Engineering Project Reports (Delta Conveyance Design and Construction Authority 2022a, 2022b). That dewatering activity could result in short-term lowered groundwater levels locally and a short-term loss of groundwater in storage. However, as previously described under Impact GW-1, monitoring of potential groundwater level impacts during construction would occur for these dewatering activities. If required to mitigate potential impacts, Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas*, would be implemented in which a series of groundwater recharge and extraction wells would be installed around the external perimeter of each intake cutoff wall system to allow discharge of captured dewatered water back into the subsurface on the external side of the deep cutoff walls in the event that local external effects due to dewatering exceed average seasonal variations. Conversely, these wells could be used to extract mounded water for return to the sedimentation basins if needed to maintain local groundwater levels.

Sheet piles would be used during construction at the Southern Forebay Emergency Spillway and Southern Forebay Outlet. Similar to the slurry cutoff walls at the intakes, the sheet pile walls would limit impacts on groundwater levels from dewatering, and as with the intake facilities, piezometers would be installed and used to monitor for impacts during construction and for adaptive management during dewatering activities. If local groundwater level variations exceed average season averages, Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas*, would be implemented in which a series of groundwater recharge and extraction wells would also be installed to allow discharge of captured dewatered water back into the subsurface in the event that local external effects due to dewatering exceed average seasonal variations, or for additional groundwater extraction to mitigate for mounded water outside the construction.

Dewatering at the Outlet and Control Structures west of Byron Highway, and the Delta-Mendota Control Structure would be managed using well points for controlled dewatering, while dewatering at the Bethany and Southern Complex pumping plants would be actively managed until structure walls are keyed into underlying clay layers. At all dewatering locations in the Southern Complex, a network of piezometers would be installed for monitoring for impacts during construction to allow management of dewatering practices to maintain average local seasonal groundwater conditions, as needed under Mitigation Measure GW-1.

Operations

Surface water diverted from the project's north Delta intakes would result in a reduction in surface water flows, which, in turn, may reduce recharge to the underlying groundwater basins resulting in changes to groundwater elevations. Additionally, the physical presence of the project facilities may act as no-flow barriers to subsurface groundwater flow and could result in changes to groundwater flow direction and/or the reflection of pumping depressions, resulting in increases or decreases in groundwater elevations.

Shallow (i.e., upper 200 feet) groundwater zones are those that could be affected by the presence of project infrastructure and by diversion of surface water at the intakes. The tunnel outside diameter would range from 28 to 44 feet depending upon the project design capacity. The top of the tunnel would generally be located between 100 and 120 feet bgs; and the bottom of the tunnel would generally be located between 140 and 160 feet bgs. This depth correlates to the upper three layers of the DeltaGW Model. In the model, layer 1 extends from the ground surface to a depth of 65 feet bgs. Layer 2 extends from 65 feet bgs to 115 bgs, and layer 3 extends from 115 bgs to 165 feet bgs. Simulated groundwater changes in these model layers were used to evaluate potential impacts from operations under the nine project alternatives.

Table 8-6 presents the time frequency of number of model nodes exceeding +/-5 feet change in groundwater elevations for each project alternative relative to existing conditions. The impacts of project operations on groundwater elevations in the model area under all project alternatives are considered to be less than significant because zero model nodes exceed the +/- 5-foot difference threshold more than 5% of the time (56 months) of the 94-year (1,128 months) model simulation period in a monthly time step.

Table 8-6. Number of Model Nodes Exceeding Various Difference Thresholds in Groundwater Elevations relative to Existing Conditions in more than 5% of the Total Simulation Months

Alternative	+/- 1 ft to +/- 2 ft	+/- 2 ft to +/- 3 ft	+/- 3 ft to +/- 4 ft	+/- 4 ft to +/- 5 ft	> +/- 5 ft	Exceeds Threshold of Significance (> +/- 5 ft more than 5% of simulation months)
1	22	2	0	0	0	No
2a	65	2	1	1	0	No
2b	10	0	0	0	0	No
2c	21	1	0	0	0	No
3	24	2	0	0	0	No
4a	69	2	1	1	0	No
4b	12	0	0	0	0	No
4c	23	1	0	0	0	No
5	26	4	1	0	0	No

Note: Analysis is conducted over a 94-year simulation period or 1,128 months. Five percent of months equals 56 months. Total number of nodes in the model = 7,977. Each node has an average effective area of 0.6 square mile; differences evaluated using an average of the simulated groundwater elevations across the top three layers of the model.

Dewatering associated with project maintenance would occur periodically at the intakes and only in rare cases when repairs were needed. During annual removal of sediment, the sedimentation basin at the intake structure would not need to be drained. Water removed during the infrequent dewatering for structural repairs to the sedimentation basins is expected to occur for a brief time and the flows would be tested prior to discharge. Dewatering associated with project maintenance would be managed similarly to dewatering operations during construction.

CEQA Conclusion—All Project Alternatives

Impacts on groundwater elevations from dewatering as part of project construction and/or maintenance would be lessened through the use of slurry cutoff walls as part of project construction. In addition, localized impacts on existing groundwater wells during project construction would be avoided by monitoring groundwater elevations adjacent to construction dewatering locations during project construction., This monitoring process is described in the Engineering Project Reports (Delta Conveyance Design and Construction Authority 2022a, 2022b) and, if needed, Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas*, would be implemented to allow discharge of captured dewatered water back into the subsurface on the external side of the construction in the event that some local external effects beyond average seasonal variation due to dewatering are observed, or for additional groundwater extraction to address mounded water outside the construction. Potential groundwater level impacts are expected to be short-term and localized in nature, but local conditions can vary so impacts may have the potential to occur. In addition to the steps described in the Engineering Project Reports, Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas* is available to further address construction-related effects on groundwater.

Additionally, as simulated in the DeltaGW Model, no model nodes exceeded the +/- 5-foot change in groundwater elevations in more than 5% of the simulated months resulting from simulated project operations for each alternative. As such, the impact is less than significant and Mitigation Measure GW-1 is available to further ensure impacts on local groundwater supplies is avoided during the construction and operation phases of DCP.

Mitigation Measure GW-1: Maintain Groundwater Supplies in Affected Areas

See description of Mitigation Measure GW-1 under Impact GW-1.

Mitigation Impacts

Compensatory Mitigation

Although the CMP described in Appendix 3F does not act as mitigation for impacts on this resource from project construction or operations, its implementation could result in changes in groundwater elevation impacts.

Creation of the wetlands and other habitats on Bouldin Island, at the I-5 ponds (Ponds 6, 7, and 8), in the North Delta Arc would result in increased groundwater levels at areas in the vicinity of the new habitats, thereby lessening potential drops in groundwater elevations during project construction and operations. The CMP would have a positive impact on groundwater elevations. Therefore, implementation of compensatory mitigation would not change the overall impact conclusion of less than significant.

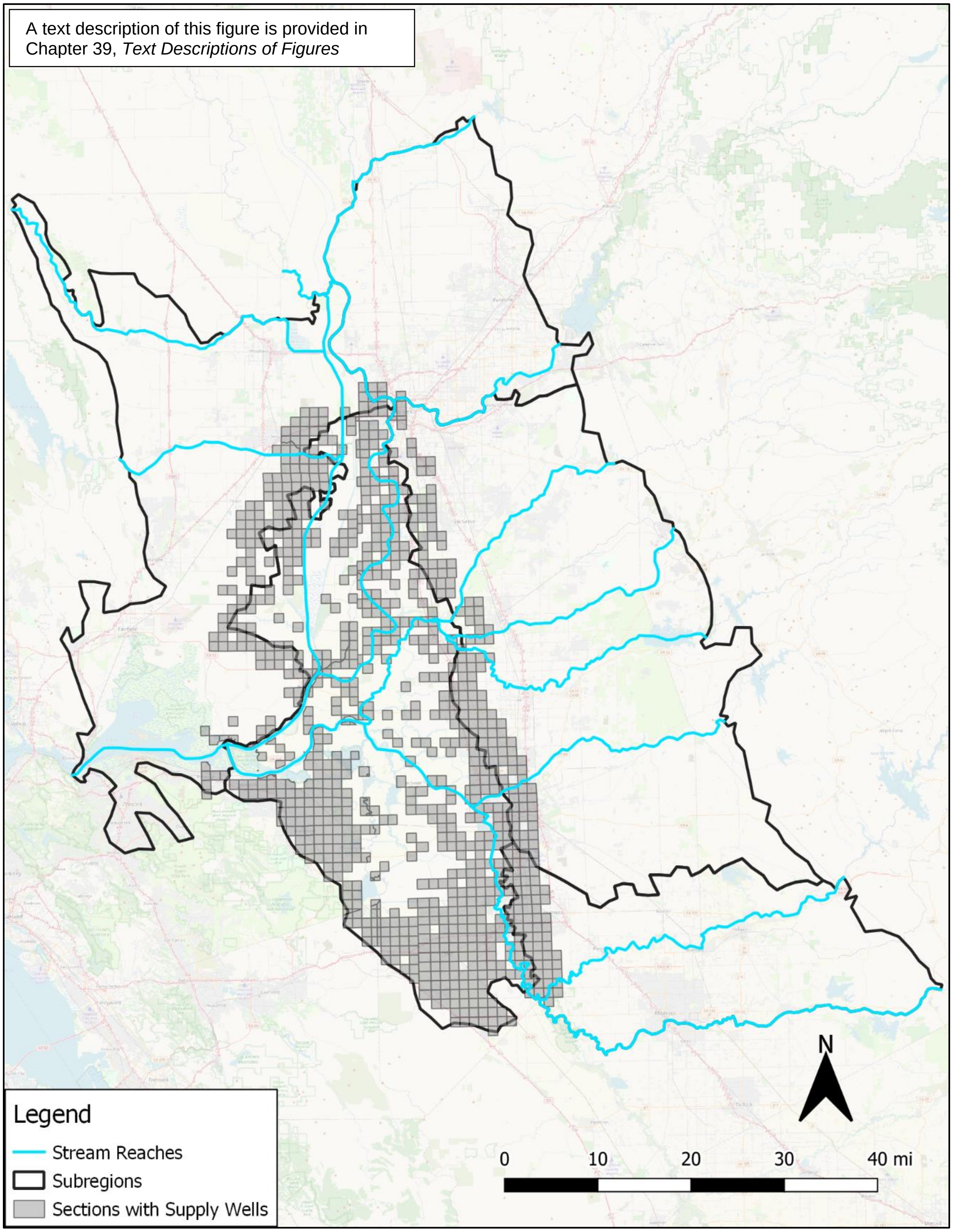
Other Mitigation Measures

Other mitigation measures proposed would not have impacts on groundwater elevations because no mitigation measures would involve activities such as dewatering. Impacts on groundwater elevations from dewatering as part of project construction and/or maintenance would be lessened through the use of slurry cutoff walls and/or sheet piles as part of project construction. Therefore, mitigation measures are unlikely to result in changes in groundwater elevations, and there would be no impact.

Overall, changes in groundwater elevations related to compensatory mitigation and other mitigation measures, combined with project alternatives, would not change the less-than-significant with mitigation impact conclusion.

Impact GW-3: Reduction in Groundwater Levels Affecting Supply Wells

Reductions in groundwater levels are considered significant when they result in declines that exceed 20 feet at any supply well in the Delta region. Project operations were simulated in the DeltaGW Model to identify when declines in groundwater elevations of 20 feet or more relative to the existing conditions (CEQA baseline) elevations may occur at any supply well within 3 miles of the statutory Delta boundary. A total of 5,244 production wells across 918 PLSS sections were identified from DWR's OSWCR database for evaluation. The exact locations of the wells are not known, only the PLSS section number of wells are known. As a result, DeltaGW Model results were evaluated at the centroid of each PLSS section to determine the total number of supply wells that could be affected by project operations due a decline in groundwater elevations when comparing the simulated groundwater levels of alternatives with the existing conditions (CEQA baseline). Figure 8-6 shows the location of the 918 PLSS sections containing supply wells within 3 miles of the statutory Delta boundary as simulated in the DeltaGW Model.



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2 **Figure 8-6. PLSS Sections with Supply Wells Within 3 Miles of the Delta Region**

All Project Alternatives

Changes in groundwater elevations resulting from project construction, including those related to construction-related dewatering, and the potential to affect location supply wells were evaluated qualitatively. Changes in groundwater elevations as a result of project operations were evaluated by comparing simulated groundwater levels under existing conditions at identified supply well locations with those simulated for each project alternative. Detailed simulation results can be found in Appendix 8B.

Project Construction

Project construction under all project alternatives may result in changes to groundwater levels in the immediate area of the constructed facilities with long-duration groundwater dewatering, such as at the intake locations. Construction would require some short-term dewatering at the tunnel shafts (few weeks at each shaft) and for a few months at the Southern Forebay Emergency Spillway, the Southern Forebay Outlet Structure, the California Aqueduct Control Structure, and the South Delta Outlet and Control Structure (for Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, and 4c); the Delta-Mendota Control Structure (for Alternatives 2a and 4a) during construction; and longer-duration dewatering as the intakes are constructed.

As previously noted, during construction dewatering of the intakes, groundwater levels would be lowered to about -20 feet MSL via pumping and maintained at those levels during construction of facilities in the deeper excavations, such as the sedimentation basin. Slurry cutoff walls and/or sheet pile walls would be installed around project intake and tunnel shaft facilities to reduce the amount of dewatering pumping required for construction. Concrete plugs would be constructed in the bottom of the shafts to isolate the shafts from the adjacent groundwater basins prior to removing the isolated water from the shaft. The highest amount of dewatering pumping would occur at the intakes with continuous groundwater pumping at rates ranging from 100 gpm to 2,000 gpm, as described in the Engineering Project Reports. This dewatering could result in short-term lowered groundwater levels locally at neighboring supply wells and a short-term loss of groundwater in storage (Delta Conveyance Design and Construction Authority 2022a, 2022b). However, as previously described under Impact GW-1, piezometers would be installed outside the slurry wall and/or sheet pile walls to allow monitoring of potential groundwater level impacts affecting neighboring supply wells during construction for adaptive management of dewatering activities. If required to mitigate potential impacts, Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas*, would be implemented in which a series of groundwater recharge and extraction wells would be installed around the external perimeter of each intake cutoff wall system to allow discharge of captured dewatered water back into the subsurface in the event that local external effects on neighboring supply wells due to dewatering beyond average seasonal variation are observed. Conversely, these wells could be used to extract mounded water for return to the sedimentation basins if needed to maintain local groundwater levels.

Sheet piles would be used during construction at the Southern Forebay Emergency Spillway and Southern Forebay Outlet. Similar to the cutoff walls at the intakes, the sheet pile walls would limit impacts on groundwater levels from dewatering, and as with the intake facilities, piezometers would be installed and used to monitor for impacts during construction and for adaptive management during dewatering activities. If needed, Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas*, would be implemented in which a series of groundwater recharge and extraction wells would also be installed to allow discharge of captured dewatered water back into the subsurface in the event that local external effects due to dewatering beyond average seasonal variation are observed, or for additional groundwater extraction to mitigate for mounded water outside the construction.

Dewatering at the Outlet and Control Structures west of Byron Highway, and the Delta-Mendota Control Structure would be managed using well points for controlled dewatering, while dewatering at the Bethany and Southern Complex pumping plants would be actively managed until structure walls are keyed into underlying clay layers. At all dewatering locations in the Southern Complex, a network of piezometers would be installed for monitoring for impacts during construction to allow management of dewatering practices to maintain local groundwater conditions within average seasonal variation limits.

Operations

Project operations have the potential to influence groundwater elevations. Surface water diverted at the project's intakes may result in a reduction in surface water flows which, in turn, may reduce recharge to the underlying groundwater basins resulting in changes to groundwater elevations. Additionally, the physical presence of the project facilities may act as no-flow barriers to subsurface groundwater flow and could result in changes to groundwater flow direction and/or the reflection of pumping depressions, resulting in increases or decreases in groundwater elevations.

Table 8-7 presents the number of supply wells with groundwater elevations declines relative to existing conditions from operations of each project alternative. Some of the wells evaluated may fall within the project construction boundaries. The OSWCR database used for the analysis does not include exact coordinates for each well so specific wells could not be excluded from the analysis, such as wells that would be within the project construction boundaries. The impacts of project operations on groundwater elevations in the underlying subbasin under all project alternatives are considered to be less than significant because there are no supply wells exceeding the 20 feet or more of groundwater elevation change threshold, and the maximum number of supply wells experiencing a 2-foot change in groundwater elevation as a result of project operations (well within typical background water level fluctuations) is only 12, representing less than 1% of all supply wells within 3 miles of the statutory Delta boundary.

Table 8-7. Number of Supply Wells with Decline in Groundwater Elevations Relative to Existing Conditions

Alternative	1 ft to 2 ft Decline	2 ft to 3 ft Decline	3 ft to 4 ft Decline	4 ft to 5 ft Decline	5 ft to 10 ft Decline	10 ft to 15 ft Decline	15 ft to 20 ft Decline	> 20 ft Decline	Exceeds Threshold of Significance (>20 ft Decline)
1	55	12	0	0	0	0	0	0	No
2a	75	11	0	0	0	0	0	0	No
2b	40	2	0	0	0	0	0	0	No
2c	54	12	0	0	0	0	0	0	No
3	55	12	0	0	0	0	0	0	No
4a	75	11	0	0	0	0	0	0	No
4b	40	2	0	0	0	0	0	0	No
4c	54	12	0	0	0	0	0	0	No
5	52	12	0	0	0	0	0	0	No

Note: This table evaluates the changes in groundwater elevations at supply wells in the region based on the PLSS section they reside. Some wells may fall within project construction boundaries. Number of wells shown in the table are based on the number wells within the PLSS sections that fall within each range of groundwater elevation declines.

CEQA Conclusion—All Project Alternatives

Under all project alternatives, groundwater dewatering would occur during construction of the intakes (sedimentation basins) and the Southern Complex. Impacts on groundwater elevations from dewatering as part of project construction have the potential to significantly affect local groundwater elevations and, in turn, the use of nearby supply wells. These impacts would be reduced through the use of slurry and/or sheet pile cutoff walls (at the intake and tunnel shafts) and sheet piles (at the Southern Forebay Spillway and Outlet) to separate the dewatered area from the surrounding groundwater basin. Areas adjacent to construction dewatering locations would be monitored for potential impacts on groundwater levels and associated operational impacts on wells in the area of effect (Delta Conveyance Design and Construction Authority 2022a) as described in Chapter 3, *Description of the Proposed Project and Alternatives.* Should impacts on surrounding groundwater levels, and therefore potentially on nearby supply wells, be observed beyond average seasonal variation, dewatering operations would be managed, including the use of Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas*, if required. With this mitigation measure, impacts would be lessened through the combined use of slurry cutoff walls/sheet piles and recharge wells outside the dewatering area to generally “circulate” shallow groundwater, thereby reducing significant changes in groundwater elevations, and associated impacts on supply wells, resulting from dewatering activities.

Drops in simulated groundwater elevations as a result of project operations would not exceed 20 feet at any identified supply well within the DeltaGW Model domain. Additionally, only roughly 2% of identified supply wells within the model domain would experience groundwater elevation declines between 5 and 10 feet resulting from simulated project operations for each alternative (within the range typically seen as a result of hydrologic fluctuations). As such, the impact is less than significant for operations for all project alternatives relative to reductions in groundwater elevations affecting supply wells.

Mitigation Measure GW-1: Maintain Groundwater Supplies in Affected Areas

See description of Mitigation Measure GW-1 under Impact GW-1.

Mitigation Impacts

Compensatory Mitigation

Although the CMP described in Appendix 3F does not act as mitigation for impacts on this resource from project construction or operations, its implementation could result in reduction in groundwater level impacts.

Use of surface water for creation of the wetlands and other habitats on Bouldin Island, at the I-5 ponds (Ponds 6, 7, and 8), and in the North Delta Arc would result in increased groundwater levels at areas in the vicinity of the new habitats. This, in turn, would minimize impacts on nearby supply wells stemming from decreases in groundwater elevations resulting from project construction and operations. Thus, the CMP would have a positive impact on groundwater elevations. Therefore, implementation of compensatory mitigation would not change the overall impact conclusion of less than significant.

Other Mitigation Measures

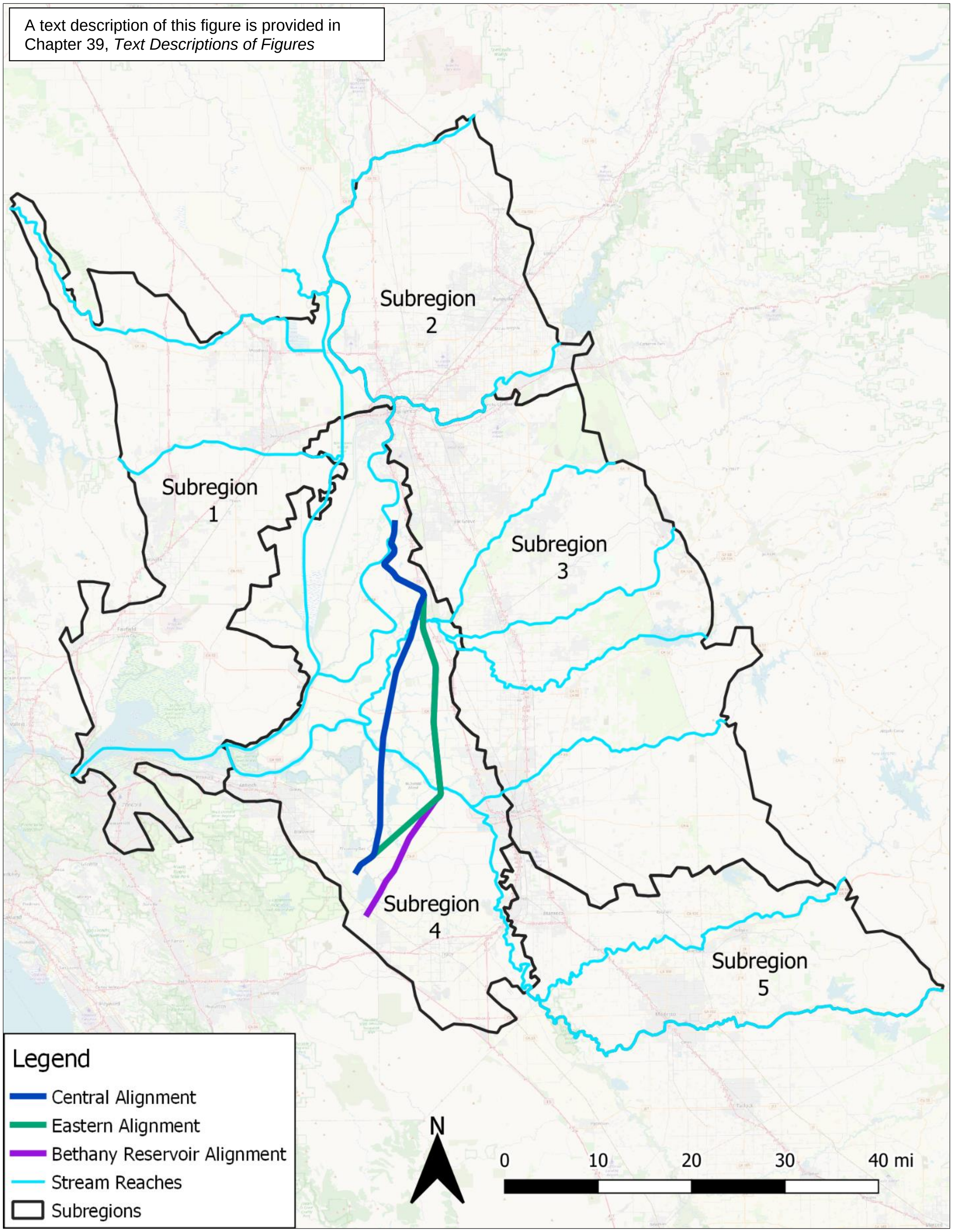
Some mitigation measures would involve providing new water wells or relocating and/or replacing wells, pipes, power lines, drainage systems, and other infrastructure that would have the potential to result in a reduction in groundwater levels. The mitigation measure with potential to result in a reduction in groundwater levels affecting supply wells is Mitigation Measure AG-2: *Replacement or Relocation of Affected Infrastructure Supporting Agricultural Properties*. Temporary reductions in groundwater levels resulting from mitigation measures would be similar to construction effects of the project alternatives in certain construction areas and would contribute to groundwater level impacts of the project alternatives. Mitigation measures involving short-term groundwater dewatering may result in temporary changes to groundwater levels. The impacts of operating relocated and/or replaced wells on groundwater elevations in the underlying subbasin are not substantial because there are no supply wells exceeding the 20 feet or more of groundwater elevation change threshold. In addition, groundwater elevations would be tracked through groundwater monitoring programs to prevent changes in groundwater levels. Therefore, other mitigation measures are unlikely to reduce groundwater levels affecting supply wells and the impact of groundwater levels would not be substantial.

Overall, the impact of reduced groundwater levels from construction of compensatory mitigation and implementation of other mitigation measures, combined with project alternatives, would not change the less-than-significant with mitigation impact conclusion.

Impact GW-4: Changes to Long-Term Change in Groundwater Storage

Changes in groundwater storage are considered to be significant when there is more than a 5% decrease in the change in long-term change in aquifer storage in the DeltaGW Model subregion 4 (the model subregion containing the project footprint) relative to existing conditions. DeltaGW Model subregion 4 overlies the Tracy, East Contra Costa, Solano, Yolo, Eastern San Joaquin, South American, and Cosumnes groundwater subbasins, of which the Eastern San Joaquin Basin has been designated by DWR as being in critically overdrafted condition. Figure 8-7 shows the location of project infrastructure in the DeltaGW Model subregion 4.

A text description of this figure is provided in Chapter 39, *Text Descriptions of Figures*



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2 **Figure 8-7. Location of Project Infrastructure in the DeltaGW Model**

All Project Alternatives

Project construction–related impacts on the long-term change in groundwater in storage were evaluated qualitatively. Project operations–related changes in long-term change in groundwater storage in the groundwater basins underlying project facilities were evaluated quantitatively using the DeltaGW Model by comparing the long-term change in groundwater in storage over the model period as determined under existing conditions with that simulated for each project alternative. Detailed model results can be found in Appendix 8B.

Project Construction

Project construction under all project alternatives may result in changes to the volume of groundwater in the immediate area of the constructed facilities. Construction would require some short-term dewatering that may result in the reduction of groundwater in storage in the area of those facilities. Slurry cutoff walls or sheet piles would be constructed around facilities requiring dewatering (such as the intakes, tunnel shafts, and Southern Forebay Spillway and Outlet Structure) to reduce impacts of the dewatering pumping. However, reductions in the volume of groundwater in storage as a result of project construction where dewatering would occur for several years, though anticipated to be localized and short-term in nature, may be considered significant without mitigation. Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas*, would further address these impacts through the recharge of groundwater outside the slurry walls/sheet piles as needed. Groundwater dewatering at the tunnel shaft locations would occur for only a few weeks and be limited to the volume of water inside the shaft after the shaft is constructed and sealed from the adjacent groundwater. Groundwater dewatering at the Southern Forebay Emergency Spillway would occur for a few months and be adjacent to Italian Slough; but dewatering at this location would be managed using sheet piles. Additionally, dewatering would occur at the Southern Forebay Outlet Structure, the California Aqueduct Control Structure, and the South Delta Outlet and Control Structure (for Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, and 4c), and the Delta-Mendota Control Structure (for Alternatives 2a and 4a); however, at these locations, construction dewatering would be local, or in the case of the pumping plants, the structural foundation would be keyed into underlying clay layers. Construction activities with implementation of Mitigation Measure GW-1 are not anticipated to result in significant impacts on groundwater in storage.

Operations

Surface water diverted at the project intakes would result in a reduction in surface water flows which, in turn, may reduce recharge to the underlying groundwater basins, resulting in changes to the volume of groundwater in storage at any one time. For each project alternative, Table 8-8 presents the long-term change in groundwater storage in AF, the difference in long-term groundwater storage relative to existing conditions (also in AF), and the percent difference in long-term groundwater storage relative to existing conditions as a result of project operations. Under existing conditions, the long-term change in groundwater storage declines 900,666 AF over the 94-year simulation period. The total area of DeltaGW subregion 4 is 718,470 acres. The relative change in storage in terms of AF per acre is also provided in Table 8-8 for additional context. Under all project alternatives, the region would see an increase in groundwater storage due to increased surface water supplies, as simulated in the surface water analysis. The increase in surface water supply reduces groundwater use and thus reduces the decline in groundwater storage.

Table 8-8. Long-Term Change in Groundwater Storage in Acre-Feet and Change Relative to Existing (CEQA Baseline) Conditions

Alternative	Long-Term Change in Groundwater Storage (AF)	Increase (+) / Decrease (-) relative to Existing Conditions (AF)	Increase (+) / Decrease (-) relative to Existing Conditions (AF/Acre)	Percent difference relative to Existing Conditions	Exceeds Threshold of Significance (More than 5% Decrease)
Existing Conditions (CEQA Baseline)	-900,666	N/A	N/A	N/A	N/A
1	-888,318	+12,348	+0.017	+1.37%	No
2a	-879,382	+21,285	+0.030	+2.36%	No
2b	-893,318	+7,349	+0.010	+0.82%	No
2c	-889,901	+10,765	+0.015	+1.20%	No
3	-888,860	+11,807	+0.016	+1.31%	No
4a	-879,757	+20,909	+0.029	+2.32%	No
4b	-893,771	+6,895	+0.010	+0.77%	No
4c	-890,442	+10,224	+0.014	+1.14%	No
5	-883,656	+17,010	+0.024	+1.89%	No

Note: Negative values indicate a reduction in change in storage.

CEQA Conclusion—All Project Alternatives

Reductions of groundwater in storage resulting from dewatering activities as part of project construction and/or maintenance would be lessened through the use of slurry cutoff walls and sheet piles during construction. Areas adjacent to construction dewatering locations would be monitored for potential impacts on groundwater levels, which would be mitigated as needed under Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas*. Changes in groundwater levels and the area over which those changes occur can be used to calculate potential changes in groundwater in storage. The spacing, depth, and location of recharge wells and monitoring piezometers, as well as thresholds for target external groundwater levels, would be determined after further site-specific investigation, testing, and analysis during future design phases.

Additionally, the percent change of volume of groundwater in storage during operations, as calculated by DeltaGW Model simulations as compared to existing conditions, was less than 5% under all project alternatives. As such, the impact is less than significant for all project alternatives relative to changes in the volume of groundwater in storage for construction and operations. In addition, Mitigation Measure GW-1 is available to further ensure impacts on local groundwater supplies are avoided during operation of the DCP.

Mitigation Measure GW-1: Maintain Groundwater Supplies in Affected Areas

See description of Mitigation Measure GW-1 under Impact GW-1.

Mitigation Impacts

<u>*Compensatory Mitigation*</u>

Although the CMP described in Appendix 3F does not act as mitigation for impacts on this resource from project construction or operations, its implementation could result in groundwater storage impacts.

Creation of the wetlands and other habitats on Bouldin Island, at the I-5 ponds (Ponds 6, 7, and 8), and in the North Delta Arc would result in increased recharge to the underlying groundwater basins. This, in turn, would increase the volume of groundwater in storage during project construction and operations. As such, the CMP would have a positive impact on groundwater storage. Therefore, implementation of compensatory mitigation would not change the overall impact conclusion of less than significant.

<u>*Other Mitigation Measures*</u>

Some mitigation measures would involve providing new water wells or relocating and/or replacing wells, pipes, power lines, drainage systems, and other infrastructure that would have the potential to result in changes to long-term groundwater storage. The mitigation measure with potential to result in changes to long-term groundwater storage is Mitigation Measure AG-2: *Replacement or Relocation of Affected Infrastructure Supporting Agricultural Properties*. Temporary changes to long-term groundwater storage resulting from mitigation measures would be similar to construction effects of the project alternatives in certain construction areas and would contribute to groundwater levels impacts of the project alternatives. Mitigation measures involving groundwater dewatering may result in changes to groundwater storage. However, groundwater dewatering associated with mitigation measures would be localized and temporary and would not affect long-term groundwater storage. Therefore, other mitigation measures are unlikely to change long-term groundwater storage and the impact of groundwater storage would not be substantial.

Overall, the impact of long-term groundwater storage from construction of compensatory mitigation and implementation of other mitigation measures, combined with project alternatives, would not change the less-than-significant with mitigation impact conclusion.

Impact GW-5: Increases in Groundwater Elevations near Project Intake Facilities Affecting Agricultural Drainage

Changes in groundwater elevations at and around project facilities have the potential to affect agricultural drainage operations. Reductions in groundwater elevations through the use of existing agricultural drains help alleviate problems with high groundwater levels affecting the root zones of agricultural operations; therefore, only increases in groundwater elevations are considered to have a negative impact on agricultural operations. Increases in groundwater elevations are considered to be significant relative to impacts on agricultural operations when groundwater level rises cause more than a 10% increase in annual agricultural drainage flows when compared to existing conditions.

All Project Alternatives

Changes in groundwater elevations, and their resultant changes in agricultural drainage, during project operations were evaluated by comparing simulated groundwater levels and associated volumes of agricultural drainage under existing conditions with those simulated for each project alternative. Detailed simulation results and contour maps showing the changes in groundwater elevations and associated volumes of agricultural drainage can be found in Appendix 8B. Qualitative analyses were performed for project construction.

Project Construction

Project construction requires the installation of slurry and/or sheet pile cutoff walls around project intake facilities and sheet piles around Southern Forebay facilities to lower groundwater elevations during construction. These cutoff walls also have the potential to act as no-flow boundaries, increasing groundwater levels and potentially increasing root zone inundation. Impacts on groundwater elevations, and on resultant agricultural drainage volumes, as a result of project construction practices are expected to be localized and short-term in nature and are not anticipated to result in significant impacts on groundwater levels. Additionally, as previously discussed, piezometers would be installed outside the slurry walls and sheet piles to allow monitoring of potential groundwater level impacts during construction for adaptive management of construction activities. Further, if needed, Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas*, would be implemented in which a series of groundwater recharge and extraction wells would also be installed within the construction site to allow additional groundwater extraction to mitigate for mounded water outside the slurry walls or sheet piles during project construction, thereby minimizing impacts on agricultural drainage (Delta Conveyance Design and Construction Authority 2022a, 2022b).

Operations

Slurry walls and subsurface project facilities constructed as part of the project have the potential to act as no-flow barriers to groundwater flows and may result in increases in groundwater elevations in the areas immediately near their location. The potential for the increased groundwater elevations to result in increased agricultural drainage was evaluated by comparing the simulated volumes of agricultural drainage occurring in the Delta region under each alternative with that estimated by the model for existing conditions. Increases in agricultural drainage occur as a response to higher groundwater levels. For all alternatives, the maximum groundwater level increase across the Delta region is within 0.5 to 1 foot relative to existing conditions. Increases in agricultural drainage are distributed across the entire Delta region and are not expected to be concentrated in any single area.

The results of the CalSim 3 surface water analysis, detailed in Chapter 5, *Surface Water*, and Chapter 6, *Water Supply*, show an increase in surface water supplies across the Delta region, which results in decreased groundwater use and a higher water table. Table 8-9 summarizes the volume of agricultural drainage occurring under each alternative simulation in AF, along with the change in drainage relative to existing conditions both as a volume in AF and as a percent change.

Table 8-9. Volume of Agricultural Drainage in Acre-Feet and Percent Change in Agricultural Drainage Relative to Existing Conditions

Alternative	Volume of Agricultural Drainage (AF)	Increase (+)/ Decrease (-) with Respect to Existing Conditions (AF)	Percent Change Relative to Existing Conditions	Exceeds Threshold of Significance (10%)
1	540,746	+320	+0.06%	No
2a	540,954	+528	+0.10%	No
2b	540,915	+489	+0.09%	No
2c	540,652	+226	+0.04%	No
3	540,857	+431	+0.08%	No
4a	541,061	+635	+0.12%	No
4b	541,020	+594	+0.11%	No
4c	540,763	+337	+0.06%	No
5	540,780	+354	+0.07%	No

CEQA Conclusion—All Project Alternatives

Impacts resulting in increases in agricultural drainage due to project construction and operations are considered to be less than significant. At most construction sites, the buried portion of the facilities or the slurry walls would extend over a very small portion of the site (less than 1% of the property). At the intakes, the slurry walls would extend over a larger portion of the property; however, because monitoring would occur during project construction to provide real-time feedback on groundwater conditions, allowing for modifications to groundwater extractions and recharge to limit impacts on agricultural operations in the immediate area and aquifer groundwater elevations (Delta Conveyance Design and Construction Authority 2022a, 2022b). Additionally, groundwater wells installed through Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas* would allow additional extraction of groundwater, reducing mounding and associated impacts relating to project construction.

Modeling conducted to simulate project operations shows that changes in agricultural drainage relative to existing conditions range from a 0.06% increase to a 0.12% increase in agricultural drainage over the simulated period, all less than the 10% change in agricultural drainage threshold. The impact on construction and operational-related impacts on agricultural drainage are considered less than significant. Implementation of Mitigation Measure GW-5: *Increases in Groundwater Elevations Near Project Intake Facilities Affecting Agricultural Drainage*, would further reduce risks of impacts on agricultural drainage.

Mitigation Measure GW-5: Increases in Groundwater Elevations near Project Intake Facilities Affecting Agricultural Drainage

The groundwater monitoring well system (including existing wells) described under MM GW-1 would be used during construction and maintenance to determine if increases in groundwater elevations within the area of influence would exceed observed increases outside the area of influence. If groundwater elevations increase more than 10% inside the area of influence over conditions outside the area of influence, existing or new dewatering wells (including re-injection wells described for Mitigation Measure GW-1) would be used to extract groundwater and reduce the groundwater elevations to average seasonal elevations.

Mitigation Impacts

Compensatory Mitigation

Although the CMP described in Appendix 3F does not act as mitigation for impacts on this resource from project construction or operations, its implementation could result in groundwater elevation impacts.

Implementation of the CMP resulting in the creation of the wetlands and other habitats on Bouldin Island, the I-5 ponds (Ponds 6, 7, and 8), and in the North Delta Arc would likely result in increased groundwater levels at areas in the vicinity of the new habitats. These increased groundwater levels, along with increases in groundwater elevations in the study area as a result of project operations, may affect agricultural drainage in the vicinity of wetlands and other habitats sites. Active management of the new wetlands and habitats (i.e., adjusting amounts of applied water) may be able to address localized changes to groundwater levels, further minimizing impacts on agricultural drainage. Given that most of the proposed habitats to be constructed and managed under the CMP are either habitats or seasonal or emergent wetlands, the addition of approximately 10 acres of new depressions (lakes or ponds) in a total area of over 6,000 acres represents an increase of approximately 0.17%; therefore, impacts would not be substantial. Implementation of compensatory mitigation would not change the overall impact conclusion of less than significant.

Other Mitigation Measures

Other mitigation measures proposed would not have impacts on increased groundwater elevations affecting agricultural drainage because no mitigation measures would result in no-flow boundaries or increased groundwater levels and potentially increasing root zone inundation in the area where the alternatives would be constructed or would be operated. Therefore, mitigation measures are unlikely to result in the increase in groundwater elevations affecting agricultural drainage, and there would be no impact.

Overall, increases in groundwater elevations affecting agricultural drainage related to compensatory mitigation and implementation of other mitigation measures, combined with project alternatives, would not change the less-than-significant impact conclusion.

Impact GW-6: Damage to Major Conveyance Facilities Resulting from Land Subsidence

Reductions in groundwater elevations at and around project facilities have the potential to cause land subsidence as a result of the removal of groundwater from subsurface formations, resulting in damage to major conveyance facilities. Project construction–related impacts on potential land subsidence were evaluated qualitatively. Also, the evaluation of project operations–related impacts on potential land subsidence was conducted qualitatively because of the lack of availability of land subsidence process model. Instead, declines in groundwater elevations near the major conveyance facilities obtained from the DeltaGW Model results were used to qualitatively infer potential for land subsidence due to project operations.

All Project Alternatives

As described in Chapter 11, *Soils*, land subsidence in the Delta typically occurs as the result of the oxidation of organic soils. While some of the project facilities would be constructed on soils that are subject to excessive subsidence, geotechnical investigations would be conducted at all facilities to identify the subsidence potential and types of soil avoidance or soil stabilization measures that should be implemented to ensure that the facility settlement is within the design limits or facilities are constructed to withstand subsidence and differential settlement and to conform to applicable state and federal standards. Conformance with these standards would protect the integrity of the project facilities against any subsidence that takes place and would reduce the potential hazard of subsidence or settlement to acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that is prone to subsidence.

Land subsidence south of the Delta (San Joaquin Valley and Tulare Lake region) typically occurs as a result of the removal of groundwater from clay formations, and more significantly, could occur as a result of the removal of groundwater below the Corcoran Clay layer (U.S. Geological Survey 2018:47). Decreases in groundwater elevations are indicators of the potential for this impact to occur. As noted in Impact GW-2: *Changes in Groundwater Elevations*, changes in groundwater elevations as simulated during project operations resulted in changes of less than 5 feet across most of the model domain, with dewatering occurring in the upper 165 feet of the groundwater basin. Groundwater elevation changes exceeding 5 feet were infrequent and occurred over a limited area under all alternatives and occurring above significant clay layers and are, therefore, unlikely to result in land subsidence. Detailed simulation results can be found in Appendix 8B.

Project Construction

Project construction under all project alternatives may result in changes to groundwater levels in the immediate area of the constructed facilities. Construction would require some short-term dewatering at the tunnel shafts and Southern Forebay Emergency Spillway, Southern Forebay Outlet Structure, the California Aqueduct Control Structure, and the South Delta Outlet and Control Structure (for Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, and 4c); the Delta-Mendota Control Structure (for Alternatives 2a and 4a); and for longer duration during construction at the intakes. Decreases in groundwater elevations as a result of project would be localized and short-term in nature, and construction activities would not result in significant impacts on groundwater levels, as described under Impacts GW-2, GW-3, and GW-4. Furthermore, project construction activities would occur at depths above 165 bgs, which is above the Corcoran Clay layer that does not exist in the Delta but may be present in the southeastern edge of the model domain, abutting and into the Eastern San Joaquin and Tracy Subbasins. The depth of Corcoran Clay is approximately 200 feet near the City of Tracy.

Operations

As demonstrated through the simulation of project operations, under all alternatives, groundwater level impacts would occur in the upper three model layers extending from the ground surface to around 165 feet bgs. Furthermore, model results show that groundwater elevation declines of greater than 5 feet occur less than 1% of the time or 1 year of the 94-year simulation period from 1922 to 2015. As such, land subsidence from sub-Corcoran Clay pumping would be unlikely to occur as groundwater level impacts would occur in the aquifer above the Corcoran Clay. Land subsidence within the Delta occurs, as previously noted, predominantly as the result of the oxidation of organic soils and would therefore not be influenced by groundwater elevation changes from project operations.

CEQA Conclusion—All Project Alternatives

Potential subsidence-related impacts resulting from project construction in areas of the Delta with organic soils is addressed in Chapter 11. Construction of some project facilities would require dewatering, which would be reduced through the use of slurry cutoff walls and sheet piles. However, in all cases, dewatering would occur in the upper 165 feet of the aquifer and would, therefore, not result in significant pumping below the Corcoran Clay—a mechanism known to result in inelastic land subsidence south of the Delta (U.S. Geological Survey 2018:47). Therefore, subsidence-related impacts resulting from construction would be less than significant.

The likelihood of major project facility operations resulting in groundwater extraction-induced land subsidence would be less than significant because DeltaGW modeling simulations have shown that groundwater elevation changes resulting from project operations would be around 5 feet or less in the upper model layers (extending to 165 feet bgs). Model results show that groundwater elevation declines of greater than 5 feet occur less than 1% of the time or 1 year of the 94-year simulation period from 1922 to 2015. Groundwater extractions from this depth are not sub-Corcoran and therefore would not induce land subsidence and related impacts on facilities resulting from aquifer compaction below the Corcoran Clay.

Mitigation Impacts

Compensatory Impacts

Although the CMP described in Appendix 3F does not act as mitigation for impacts on this resource from project construction or operations, its implementation could result in damage to major conveyance facility impacts.

Under the CMP, wetlands and other habitats would be created on Bouldin Island, at the I-5 ponds (Ponds 6, 7, and 8), and in the North Delta Arc in the area of the Delta. As described in Chapter 11, *Soils*, dropping land elevations in the Delta is predominantly the result of the oxidation of organic soils, increased groundwater levels resulting from the development of managed wetlands and lakes/ponds may result in increased saturation of soils in the study area, creating anoxic conditions and thereby reducing the potential for additional soil oxidation. Therefore, with implementation of the CMP, there would be little to no impact on land subsidence resulting from groundwater extractions. Implementation of compensatory mitigation would not change the overall impact conclusion of less than significant.

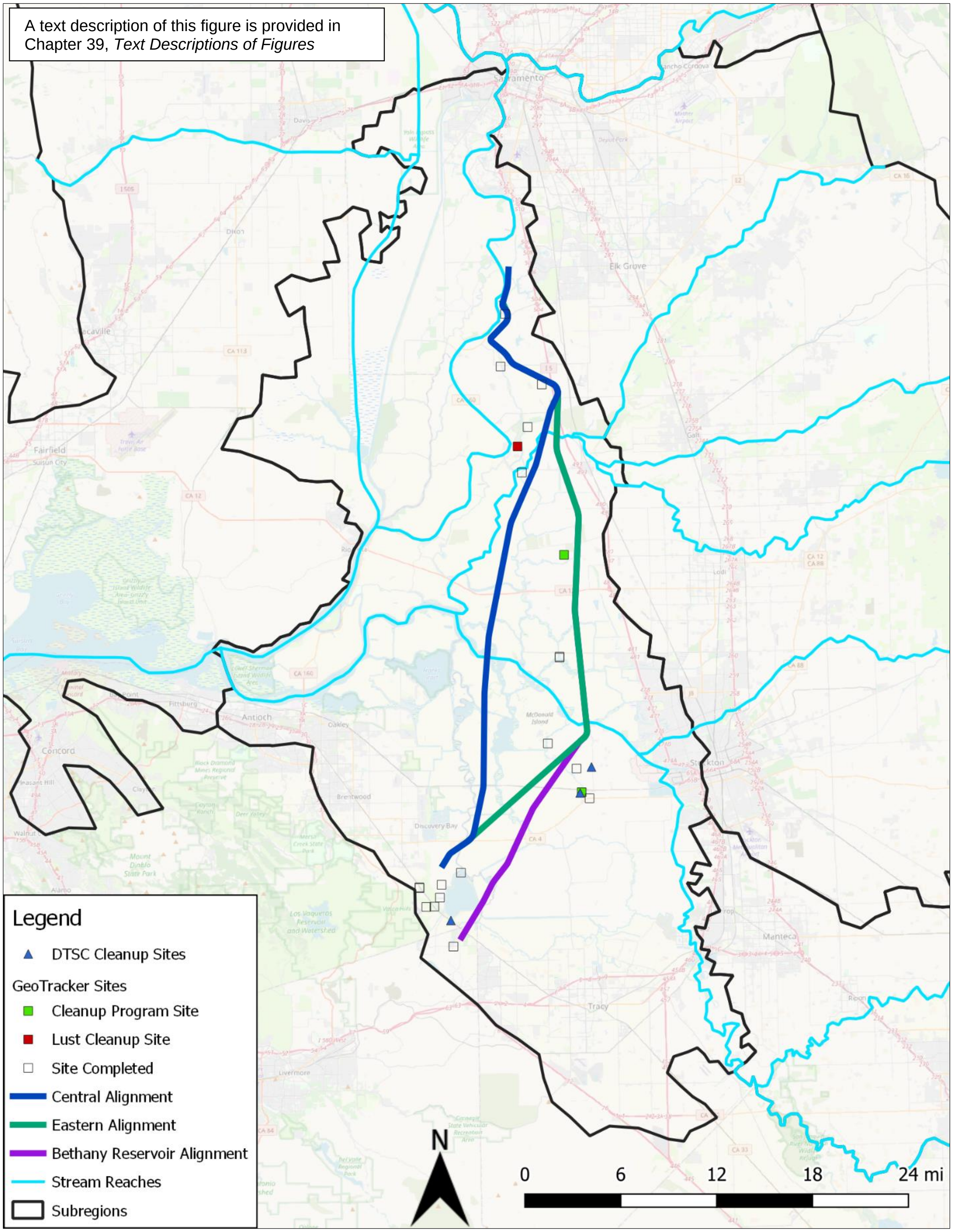
Other Mitigation Measures

Some mitigation measures would involve providing new water wells or relocating and/or replacing wells, pipes, power lines, drainage systems, and other infrastructure that would have the potential to damage major conveyance facilities resulting from land subsidence. The mitigation measure with potential to result in damage to major conveyance facilities resulting from land subsidence is Mitigation Measure AG-2: *Replacement or Relocation of Affected Infrastructure Supporting Agricultural Properties*. Temporary land subsidence resulting from mitigation measures would be similar to construction effects of the project alternatives in certain construction areas and would contribute to land subsidence impacts of the project alternatives. Mitigation measures involving localized and short-term groundwater dewatering would not induce land subsidence. Groundwater level management during construction dewatering would minimize the potential for land subsidence and associated damage to major conveyance facilities due to mitigation measures. Therefore, other mitigation measures are unlikely to damage major conveyance facilities resulting from land subsidence and the impact of land subsidence would not be substantial.

Overall, the impact of damage to major conveyance facilities resulting from land subsidence from construction of compensatory mitigation and implementation of other mitigation measures, combined with project alternatives, would not change the less-than-significant impact conclusion.

Impact GW-7: Degradation of Groundwater Quality

Groundwater quality impacts could result from (1) project construction practices, (2) the migration of existing groundwater contaminant plumes toward supply wells due to changes in groundwater flow paths occurring during project construction and/or operations, and/or (3) the inducement of the migration of poorer-quality (higher-saline) water into the areas of higher-quality groundwater. GAMA-Geotracker is a database maintained by the State of California that identifies contamination sites. Figure 8-8 shows the location of identified groundwater plumes in the study area; more information regarding these sites can be found in Chapter 25, *Hazards, Hazardous Materials, and Wildfire*. Additionally, Figures 8B-3 through 8B-11 in Appendix 8B, *Impact Analysis: Groundwater Model Results*, show the locations of these identified groundwater plumes relative to anticipated changes in groundwater elevations resulting from project operation under each project alternative.



A text description of this figure is provided in Chapter 39, *Text Descriptions of Figures*

Figure 8-8. Location of Identified Groundwater Plumes in the Study Area

As described in Chapter 25, *Hazards, Hazardous Materials, and Wildfire,* a preliminary search of government databases was conducted to identify Cortese (i.e., state-identified hazardous waste) sites within 0.25 mile of project facilities. The following lists summarizes the relevant content in Tables 25-1 through 25-5.

- Eight listed sites are within 0.25 mile of the intakes and North Tunnels between the intakes and Twin Cities Complex, all of which have been treated and are closed.
- Seven listed sites are within 0.25 mile of the eastern alignment; of these, three sites have been treated and are closed and two are undergoing remediation for soil and water contamination with total petroleum hydrocarbons. Additionally, the Stockton Naval Communication Station is within both the eastern alignment (Alternatives 3, 4a, 4b, and 4c) and the Bethany Reservoir alignment (Alternative 5) and is discussed under Bethany Reservoir Alignment in Chapter 25.
- Eight listed sites are within 0.25 mile of the Southern Complex; of these three sites have been treated and are closed and five have been designated as cleanup program sites/voluntary cleanup sites. Of these five, at least one has ongoing remediation work for soil and groundwater contamination.
- Seven listed sites are within the Bethany Reservoir alignment. Of these, four sites are closed and three are within the project footprint for Alternative 5 and involve petroleum/gasoline leaks that contaminated both soil and groundwater. The three sites are near project facilities: proposed utility line, supervisory control and data acquisition (SCADA) fiber line route, and levee access road and, as such, are not expected to be affected by changes in groundwater elevations. Similarly, one additional site, the Stockton Naval Communications Station, has ongoing remediation for soil and groundwater contamination; however, this site is within the project footprint for SCADA fiber routes on Rough and Ready Island and would not involve groundwater exposure or management.

All Project Alternatives

As noted in Impact GW-2, 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. However, near the groundwater plume sites shown in Figure 8-8, changes in groundwater elevations are limited to 1 to 2 feet between the baseline and alternatives, which is unlikely to cause a change in groundwater flow paths. Figures 8B-3 through 8B-11 in Appendix 8B show the locations of these identified groundwater plumes relative to anticipated changes in groundwater elevations resulting from project operation under each project alternative.

Project Construction

The potential for project construction activities to result in groundwater contamination is addressed in Chapter 25 under Impact HAZ-1: *Create a Substantial Hazard to the Public or the Environment through the Routine Transport, Use, or Disposal of Hazardous Materials*. Additionally, groundwater removed with the dewatering system would be treated as necessary, stored, and reused for water supply on-site (see Chapter 3, *Description of the Proposed Project and Alternatives*). If the total volume of on-site water flows, including treated dewatering flows, exceed the on-site storage and water demands, water would be discharged in accordance with the Stormwater Pollution Prevention Plan described in Appendix 3B, *Environmental Commitments and Best Management Practices*. Use of slurry walls to minimize dewatering flows would minimize the volume of water to be removed from the groundwater, as described above and in the Engineering Project Reports (Delta Conveyance Design and Construction Authority 2022a, 2022b). As such, there would be no adverse effect.

As previously described under Impact GW-2, project construction under all project alternatives may result in changes to groundwater levels in the immediate area of the constructed facilities. Dewatering of the tunnel shafts would occur for a few weeks following isolation of the shaft from adjacent groundwater within the slurry wall and completed tunnel shaft. Dewatering of the Southern Forebay Emergency Spillway adjacent to Italian Slough would occur over a few months. Dewatering would also occur for a few months at the Southern Forebay Outlet Structure, the California Aqueduct Control Structure, and the South Delta Outlet and Control Structure (for Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, and 4c), and the Delta-Mendota Control Structure (for Alternatives 2a and 4a). Dewatering at the intakes would occur within a slurry wall throughout most of the construction period. However, monitoring for impacts from, and adaptive management of, dewatering, including the potential implementation of Mitigation Measure GW-1: *Maintain Groundwater Supplies in Affected Areas*, would avoid excessive reductions in groundwater elevations on the surrounding aquifer. Impacts on groundwater elevations, and therefore groundwater hydraulic gradients, as a result of project construction are anticipated to be localized and short-term in nature and are not anticipated to result in significant impacts on groundwater levels. As such, the change in groundwater hydraulic gradients resulting from changes in groundwater levels are not likely to mobilize existing contaminant plumes in groundwater. Furthermore, Mitigation Measure HAZ-2: *Perform a Phase I Environmental Site Assessment Prior to Construction Activities and Remediate If Necessary*, would identify if there is existing groundwater contamination at a site on or within 0.25 mile of the project alignment. Based on this information, additional actions, such as changes to pumping and/or recharge locations and rates under Mitigation Measure GW-1 can be assessed and modified, if needed, to mitigate the potential for plume migration, further limiting the likely impacts of plume mobilization. Since pumped groundwater would be recharged immediately outside the slurry walls through Mitigation Measure GW-1 as needed, no significant regional changes in groundwater flow directions are anticipated and the inducement of poor-quality groundwater into areas of better quality is unlikely. It is therefore anticipated that there would be no significant change in groundwater quality as a result of project construction.

Finally, practices for minimizing construction-related impacts to groundwater quality can be found in Appendix 3B, *Environmental Commitments and Best Management Practices*. These practices employed during construction would minimize or eliminate potential impacts such that there would be no significant change in groundwater quality as a result of project construction.

Operations

Similar to project construction, the potential for project operations and maintenance activities to result in groundwater contamination is addressed in Chapter 25 under Impact HAZ-1. Dewatering of the sedimentation basins at the intakes during project maintenance would occur rarely and only if non-periodic structural repairs were needed. During annual removal of sediment, the sedimentation basin would not need to completely be drained. Water removed during the infrequent dewatering would probably occur for a brief time and the flows would be tested and discharged into the tunnel. Groundwater management practices associated with infrequent dewatering during project maintenance for structural repairs to the sedimentation basins are similar to those that would be conducted during project construction and would also minimize dewatering impacts to the extent practicable, as described in the Engineering Project Reports, resulting in no adverse effects from project operations and/or maintenance (Delta Conveyance Design and Construction Authority 2022a, 2022b).

Project operation and maintenance under all alternatives would occur within the same footprint as construction. As noted in Chapter 25, project operations and maintenance activities would occur after identified Cortese sites were evaluated and, if needed, remediated. Therefore, the risk to expose the environment to hazardous materials from a known Cortese site is low. Similarly, as demonstrated through the simulation of project operations under all alternatives, groundwater level impacts would occur in the upper three model layers, extending from the ground surface to a depth of around 165 feet bgs. Model results show that groundwater elevation declines of greater than 5 feet occur less than 1% of the time or 1 year of the 94-year simulation period from 1922 to 2015. Groundwater elevation changes near active contamination sites identified in Figure 8-8 never exceed 1 to 2 feet. Therefore, the likelihood of plume mobilization as a result of changes in groundwater elevations is considered to be less than significant. Contour maps of maximum groundwater elevation changes are presented in Appendix 8B.

Finally, similar to construction dewatering, maintenance dewatering near the intake facilities would temporarily lower groundwater levels and cause small changes in groundwater flow patterns near the study area. Groundwater elevations outside the slurry walls would be monitored and dewatering operations would be managed. If required, Mitigation Measure GW-1 would be implemented, recharging dewatering flows immediately outside the slurry walls, to manage impacts. As such, no significant regional changes in groundwater flow directions are anticipated and the inducement of poor-quality groundwater into areas of better quality is unlikely. Therefore, it is anticipated that there would be no change in groundwater quality as a result of project operations and/or maintenance.

CEQA Conclusion—All Project Alternatives

Significant impacts on groundwater quality as a result of project construction are not anticipated as construction-related practices and BMPs would minimize the potential for water quality impacts. Because of the temporary and localized nature of construction dewatering, the potential for the inducement of the migration of poor-quality groundwater into areas of higher quality groundwater would be low, and similarly, the likelihood of the inducement of the migration of existing contaminant plumes in groundwater would be low. Further, the planned treatment of extracted groundwater prior to reuse, storage, and possible discharge into adjacent surface waters and/or to land would prevent significant impacts on groundwater quality.

No significant groundwater quality impacts are anticipated in and adjacent to the project alignment due to project operations because significant changes to regional patterns of groundwater flow are not anticipated. Additionally, project operations and maintenance activities would follow BMPs, minimizing any impacts relating to spills or other occurrences that could affect groundwater quality. This impact would be less than significant.

Mitigation Impacts

Compensatory Mitigation

Although the CMP described in Appendix 3F does not act as mitigation for impacts on this resource from project construction or operations, its implementation could result in groundwater quality impacts.

Under the CMP, wetlands and other habitats would be created on Bouldin Island, at the I-5 ponds (Ponds 6, 7, and 8), and in the North Delta Arc and would not be expected to directly affect groundwater quality. Additionally, the increased groundwater levels from the habitat creation may result in a westward groundwater hydraulic gradient, a project benefit that would reduce the potential for saltwater movement from Delta waters into the underlying groundwater basins around the intake areas. As such, with implementation of the CMP, there would be little to no impact on groundwater quality. Implementation of compensatory mitigation would not change the overall impact conclusion of less than significant.

Other Mitigation Measures

Some mitigation measures would involve providing new water wells or relocating and/or replacing wells, pipes, power lines, drainage systems, and other infrastructure that would have the potential to degrade groundwater quality. The mitigation measure with potential to result in degradation of groundwater quality is Mitigation Measure AG-2: *Replacement or Relocation of Affected Infrastructure Supporting Agricultural Properties*. Temporary groundwater quality degradation resulting from mitigation measures would be similar to construction effects of the project alternatives in certain construction areas and would contribute to groundwater quality impacts of the project alternatives. Groundwater removed with the dewatering system would be treated as necessary prior to reuse, storage, and possible discharge. Water would be discharged in accordance with the Stormwater Pollution Prevention Plan Because of the temporary and localized nature of construction dewatering, the potential for migration of poor-quality groundwater into areas of higher-quality groundwater would be low, and similarly, the likelihood of migration of existing contaminant plumes in groundwater would be low. Therefore, other mitigation measures are unlikely to result in the degradation of groundwater quality and the impact of groundwater quality would not be substantial.

Overall, the impact of degradation of groundwater quality from construction of compensatory mitigation and implementation of other mitigation measures, combined with project alternatives, would not change the less-than-significant impact conclusion.

8.3.3 Cumulative Analysis

Cumulative effects result from incremental impacts of a proposed project when added with other past, present, and reasonably foreseeable future projects. This section identifies the potential for past, present and reasonably foreseeable future programs, projects, and policies to cause adverse cumulative impacts on groundwater resources.

When the effects of any of the project alternatives are considered in combination with the effects of initiatives listed in Table 8-10, the cumulative effects on groundwater resources could be adverse. The specific programs, projects, and policies are identified below based on the potential to contribute to an impact on groundwater identified under a project alternative that could be deemed cumulatively considerable. The potential for cumulative impacts on groundwater resources is described for effects related to the construction of water conveyance facilities and effects stemming from the long-term implementation of the proposed project alternatives.

The list presented in Table 8-10 includes projects considered for this cumulative effects section; for a complete list of such projects, consult Appendix 3C, *Defining Existing Conditions, No Project Alternative, and Cumulative Impact Conditions*. Several projects that are included in Table 3C-3 for the cumulative impact assessment might have had construction impacts on groundwater resources, but they have been completed and therefore were not included in this analysis.

Table 8-10. Cumulative Impacts on Groundwater from Plans, Policies, and Programs

Program/Project	Agency	Status	Description of Program/Project	Effects on Groundwater Resources
North Delta Flood Control and Ecosystem Restoration Project	DWR	Final EIR completed in 2010.	Project implements flood control and ecosystem restoration benefits in the north Delta (California Department of Water Resources 2007).	Potential increase in groundwater levels and groundwater recharge; potential groundwater seepage to adjacent islands/tracts; potential groundwater contamination
Dutch Slough Tidal Marsh Restoration Project	DWR	Final EIR completed in 2010. Supplemental EIR completed in 2014.	Project includes breaching levees and restoring a tidal channel system on parcels between Dutch Slough and Contra Costa Canal (California Department of Water Resources and California State Coastal Conservancy 2014).	Potential groundwater intrusion onto adjacent parcels.
Los Vaqueros Reservoir Expansion Project	CCWD, Reclamation, and DWR	Final EIS/EIR completed in 2010 with Final Supplement completed in 2020. Final feasibility report completed in 2020.	Project will increase the storage capacity of Los Vaqueros Reservoir and divert additional water from the Delta.	Construction of the first phase was completed in 2012 (raising the dam height by 34 feet). The second phase has been evaluated in an environmental impact report/environmental impact statement that indicates no adverse effects or less-than-significant effects on groundwater resources.
Eastern San Joaquin Integrated Conjunctive Use Program	Northeastern San Joaquin County Groundwater Banking Authority	Final Programmatic EIR completed in 2011.	Program will improve the use and storage of groundwater by implementing conjunctive use projects such as water transfers and groundwater banking.	Affect groundwater level fluctuations due to groundwater banking operations; potential groundwater quality impacts; mostly beneficial effects; the effects would be located outside of the action alternatives conveyance footprint area
Grassland Bypass Project	Reclamation, San Luis & Delta-Mendota Water Authority	Final EIS/EIR completed in 2009.	Reduce effects from agricultural drainage on wildlife refuges and wetlands. Will convey subsurface agricultural drainage to Mud Slough (tributary of San Joaquin River) (Bureau of Reclamation and San Luis and	Beneficial, neutral, or less-than-significant effects on subsurface agricultural drainage and shallow groundwater levels; beneficial effects on groundwater salinity

Program/Project	Agency	Status	Description of Program/Project	Effects on Groundwater Resources
			Delta-Mendota Water Authority 2009:ES-2).	
San Joaquin River Restoration Program	Reclamation, USFWS, NMFS, DWR, and CDFW	Final EIS/EIR completed in 2012.	The San Joaquin River Restoration Program is a direct result of a September 2006 legal settlement by the U.S. Departments of the Interior and Commerce, the Natural Resources Defense Council, and the Friant Water Users Authority to restore spring and fall run Chinook salmon to the San Joaquin River below Friant Dam while supporting water management actions within the Friant Division. Public Law 111-11 authorized and directed federal agencies to implement the settlement. Interim flows began October 1, 2009, and full restoration flows are scheduled to begin no later than January 2014. Site-specific improvements are ongoing.	Temporary construction-related effects on groundwater quality; changes in groundwater levels and groundwater quality along San Joaquin River; changes in groundwater levels and groundwater quality in CVP/SWP service areas
California EcoRestore	DWR, Delta Conservancy, various other state and local agencies, NGOs, and private sector partners	Initiated in 2015.	This program will accelerate and implement a suite of Delta restoration actions for up to 30,000 acres of fish and wildlife habitat by 2020. Construction of improvements is ongoing.	Potential for direct and indirect effects on groundwater conditions adjacent to tidal habitat restoration sites.
SGMA Implementation	DWR (in collaboration with State Water Resources Control Board)	Signed into law September 2014.	Defines rules and regulations that DWR needs to implement to help local agencies manage groundwater resources sustainably. GSPs for critically overdrafted groundwater basis were submitted to DWR by January 31, 2020.	The SGMA requires the formation of locally controlled GSAs, which must develop GSPs in groundwater basins or subbasins that DWR designates as medium or high priority. This will have a beneficial effect on groundwater resources, as most areas will manage groundwater extractions to not exacerbate further groundwater level declines.
San Francisco Bay Area Integrated Regional Water Management Plan	Bay Area Water Quality and Supply Reliability Program	Final Released September 2013.	The Bay Area Integrated Regional Management Plan is an evolving plan that will be used to prioritize projects and provide information for projects to be	Program identifies local water supply projects to increase water supply reliability in the Bay Area, including for SWP

Program/Project	Agency	Status	Description of Program/Project	Effects on Groundwater Resources
			funded by state and federal agencies, such as the Proposition 50 and Proposition 1 projects.	and CVP water users. One of the identified goals is for better conjunctive use and groundwater management. This would have a beneficial effect on groundwater resources.
Sacramento River Water Reliability Study	Placer County Water Agency	Notice of Preparation in 2003. Project is on hold during recent recession. Reclamation was preparing a joint NEPA document; however, the NEPA process was halted in 2009. The study has been suspended.	Placer County Water Agency, Sacramento Suburban Water District, and the cities of Roseville and Sacramento, are investigating the viability of a joint water supply diversion from the Sacramento River, consistent with the Water Forum Agreement to meet planned future growth within the Placer-Sacramento region, maintain reliable water supply while reducing diversions of surface water from the American River in future dry years to preserve the river ecosystem, and enhance groundwater conjunctive management to help sustain the quality and availability of groundwater.	Outcomes of this study could help with improved groundwater and management in the region and reduced impacts on groundwater levels and quality.
Harvest Water	Sacramento Regional County Sanitation District	Project is currently in design. All CEQA documentation is complete.	Harvest Water is being developed by Regional San and has the potential to deliver up to 50,000 AFY of drought-resistant recycled water to irrigate more than 16,000 acres of permanent agriculture and habitat conservation lands near the Cosumnes River and Stone Lakes Wildlife Refuge. This recycled water would be used in-lieu of pumping groundwater. Additionally, Harvest Water proposes wintertime irrigation and wildlife-friendly recharge basins in the study area where the soils are suitable, to provide further groundwater recharge.	Project will offset groundwater use in the area near the intake facilities, helping the groundwater basin move toward and manage for groundwater sustainability and increasing groundwater levels.
In-Delta Storage Project (Delta Wetlands Project)	DWR and Reclamation	Draft Supplemental Report to 2004 Draft State Feasibility Study In-Delta	The In-Delta Storage Project, described in the 2004 Draft State Feasibility Study, would store about 217,000 AF of water in the south Delta for a wide array of water supply, water	Project is inconsistent with Contra Costa County General Plan Policy for Agricultural Lands and Delta Protection Commission’s

Program/Project	Agency	Status	Description of Program/Project	Effects on Groundwater Resources
		Storage Project completed in 2006.	quality, and ecosystem benefits. The project would consist of two reservoir islands (Webb Tract and Bacon Island), two habitat islands (Holland Tract and Bouldin Island) and four integrated facilities (two facilities on each of the storage islands). Water storage would be created on the islands by strengthening existing levees and building new embankments inside the existing levees. The integrated facilities would control water diversions and releases into and out of the reservoir islands. The facilities control structures would be consolidated to combine all operational components needed to make diversions and releases. The components of each facility would include a fish screen, a transition pool, three inlet/outlet structures, a midbay, a pumping plant and associated conduit, a bypass channel and engineered embankments. This project has been re-defined under the Delta Wetlands Project	Land Use Plan Principles for Agriculture and Recreation. Project will also result in conversion of existing agricultural land. Reservoir islands might affect shallow groundwater levels and agricultural drainage patterns.
Shasta Lake Water Resources Investigation	Reclamation	Final EIS completed in 2015. Final Feasibility report completed in 2020.	The project is a multipurpose plan to modify Shasta Dam and Reservoir to increase survival of anadromous fish populations in the upper Sacramento River; increase water supplies and water supply reliability; and, to the extent possible through meeting these objectives, include features to benefit other identified ecosystem, flood damage reduction, and related water resources needs which could result in additional storage capacity of 256,000 to 634,000 AF.	Program identifies water supply plans to maintain and possibly increase water supply reliability for CVP water users, which would indirectly benefit groundwater resources by helping reduce the amount of groundwater that needs to be pumped for agricultural irrigation.
North-of-the-Delta Offstream Storage Investigation	DWR and Reclamation	Draft EIR/EIS completed in 2017. Summary of project description information	The plan will provide offstream storage in the northern Sacramento Valley for improved water supply and water supply reliability, improved water quality, and enhanced survival of anadromous fish and other	Program identifies water supply plans to maintain and possibly increase water supply reliability for CVP and non-CVP water users. This would help with decreasing the

Program/Project	Agency	Status	Description of Program/Project	Effects on Groundwater Resources
		released in 2021.	aquatic species. All alternatives include a new reservoir at the Sites location, with various facilities for water conveyance.	reliance on groundwater supply in dry years.
Upper San Joaquin River Basin Storage Investigation	Reclamation	Draft EIS published in August 2014.	The Upper San Joaquin Storage would contribute to restoration of the San Joaquin River, improve water quality of the San Joaquin River, and facilitate additional conjunctive management and water exchanges that improve the quality of water deliveries to urban communities.	Program identifies water supply plans to maintain and possibly increase water supply reliability for CVP and non-CVP water users. This would help with decreasing the reliance on groundwater supply in dry years in the export service areas within the San Joaquin and Tulare groundwater basins.
Riverside-Corona Feeder Conjunctive Use Project	Western Municipal Water District and Reclamation	Final Supplemental EIS and EIR published in 2011. Final Supplemental EIR/EIS completed in 2012.	The project would allow WMWD to purchase water from SWP and store up to 40,000 AF of water in the San Bernardino basin area and Chino basin and to extract the water from the groundwater basins. The facilities would convey local water supplies and deliver treated imported water.	Program would maintain and possibly increase water supply reliability for SWP water users, especially in drier years. This program would allow for better conjunctive use and management.
Seawater Desalination Project at Huntington Beach	Metropolitan Water District of Orange County	Final Subsequent EIR completed in 2010. Awaiting permits.	Water treatment plant would provide up to 50 million gallons per day of desalinated water.	Program would maintain and possibly increase water supply reliability for SWP water users. This would help with decreasing the reliance on groundwater supply.
Carlsbad Seawater Desalination Plant	San Diego County Water Authority and other water suppliers	Desalination plant is currently operating.	Water treatment plant provides up to 50 million gallons per day of desalinated water.	Program would maintain and possibly increase water supply reliability for SWP water users. This would help with decreasing the reliance on groundwater supply.
Emergency Storage Project	San Diego County Water Authority	Project is operational.	The project will increase the amount of water stored locally. New water storage and pipeline connections distributes water throughout the region if imported water supplies are reduced. The Emergency Storage Project is expected to meet the county's emergency water needs through 2030.	Program would maintain and possibly increase water supply reliability for SWP water users. This would help with decreasing the reliance on groundwater supply.
Del Puerto Canyon Reservoir	San Joaquin River Exchange	Final EIR was certified in 2020 but a	DPWD and the Exchange Contractors are partnering to construct and operate the Del	Project will provide additional surface water to offset current

Program/Project	Agency	Status	Description of Program/Project	Effects on Groundwater Resources
	Contractors Water Authority, Del Puerto Water District	CEQA lawsuit filed. The Bureau of Reclamation is currently working on an EIS. Design is pending.	Puerto Canyon Reservoir, an 800-acre reservoir that would store up to 82,000 AF of water. The project will deliver water from the Delta-Mendota Canal into the new reservoir, where it will be stored and released on a carefully managed basis. The reservoir would allow water to be delivered into storage during wetter periods until it is needed in drier periods for irrigation, groundwater recharge, or wildlife beneficial uses (up to 60,000 AFY).	groundwater use in the Delta-Mendota groundwater subbasin. Project may increase water supply reliability for CVP water users, which would indirectly benefit groundwater resources by helping reduce the amount of groundwater that needs to be pumped for agricultural irrigation
San Luis Reservoir Expansion	Reclamation	Draft Appraisal Report published in December 2013. Final Supplemental Environmental Impact Statement completed in 2020.	The plan is to increase the storage capacity of San Luis Reservoir (behind B.F. Sisk Dam) to improve the reliability of CVP and SWP water supplies dependent upon San Luis Reservoir. Seismic risks under the dam and in the Delta, regulatory constraints to operating Delta export facilities, algae blooms at low water levels, and future climate change have and will reduce the reliability of CVP/SWP deliveries dependent upon the San Luis Reservoir.	Program identifies water supply plans to maintain and possibly increase water supply reliability for CVP and SWP water users. This would help with decreasing the reliance on groundwater supply.
South Delta Temporary Barriers Project	DWR	Ongoing Program. Comprehensive Operations Plan and Monitoring Special Study released in 2019.	The program was initiated in 1991 and includes four rock barriers across South Delta channels. The objectives of the project are to increase water levels, improve water circulation patterns and water quality in the southern Delta for local agricultural diversions, and improve operational flexibility of the SWP to help reduce fishery impacts and improve fishery conditions.	Program identifies water supply plans to maintain water supply reliability for CVP and SWP water users. This would help with decreasing the reliance on groundwater supply.
Implementation of Senate Bill X7 7	DWR	Legislation was adopted in 2009.	This legislation requires the state to achieve a 20% reduction in urban per capita water use by December 31, 2020; require each urban retail water supplier to develop urban water use targets; agricultural water suppliers to implement efficient water management practices; and DWR in consultation with other state agencies, to develop	The legislation would reduce water demands for existing water users; and reduce projected demands for future growth.

Program/Project	Agency	Status	Description of Program/Project	Effects on Groundwater Resources
			a single standardized water use reporting form.	
Irrigated Lands Regulatory Program	Central Valley Regional Water Quality Control Board	Program began in 2003 to prevent agricultural runoff from impairing surface waters, and in 2012, groundwater regulations were added to the program.	This program regulates discharges from irrigated agricultural lands. Its purpose is to prevent agricultural discharges from impairing the waters that receive the discharges. The California Water Code authorizes State and Regional water boards to conditionally waive waste discharge requirements if this is in the public interest. On this basis, the Los Angeles, Central Coast, Central Valley, and San Diego regional water quality control boards have issued conditional waivers of waste discharge requirements to growers that contain conditions requiring water quality monitoring of receiving waters. Participation in the waiver program is voluntary; dischargers must file a permit application as an individual discharger, stop discharging, or apply for coverage by joining an established coalition group. The waivers must include corrective actions when impairments are found.	Reduces the potential for groundwater contamination from agricultural practices.
Bay-Delta Water Quality Control Plan Update	State Water Resources Control Board	Ongoing development.	The State Water Resources Control Board is updating the 2006 Bay-Delta WQCP in four phases: Phase I: Modifying water quality objectives (i.e., establishing minimum flows) on the Lower San Joaquin River and Stanislaus, Tuolumne, and Merced Rivers to protect the beneficial use of fish and wildlife and (2) modifying the water quality objectives in the southern Delta to protect the beneficial use of agriculture; Phase II: Evaluating and potentially amending existing water quality objectives that protect beneficial uses and the program of implementation to achieve those objectives. Water	Water supplies of water rights users and SWP and CVP water users could be affected if increased instream flow and/or Delta outflow objectives are established in the regulatory process to protect beneficial uses. This could result in increased groundwater pumping and decreased groundwater levels in some areas.

Program/Project	Agency	Status	Description of Program/Project	Effects on Groundwater Resources
			quality objectives that could be amended include Delta outflow criteria; Phase III: Requires changes to water rights and other measures to implement changes to the WQCP from Phases I and II; Phase IV: Evaluating and potentially establishing water quality criteria and flow objectives that protect beneficial uses on tributaries to the Sacramento River.	
Southport Sacramento River Early Implementation Project	USACE	Final EIS issued May 2015.	This project would implement flood risk–reduction measures along the Sacramento River South Levee in the city of West Sacramento, Yolo County, California. The area of flood risk-reduction measure implementation extends along the right (west) bank of the Sacramento River south of the Barge Canal downstream 5.6 miles to the South Cross Levee, adjacent to the Southport community of West Sacramento.	Significant impacts on groundwater could result from construction dewatering activities; these impacts would be reduced to a less-than-significant level with the implementation of groundwater well protection measures during construction.

AFY= acre-feet per year; CCWD = Contra Costa Water District; CDFW = California Department of Fish and Wildlife; CEQA = California Environmental Quality Act; CVP = Centra Valley Project; DPWD = Del Puerto Water District; DWR = California Department of Water Resources; EIR = environmental impact report; EIS = environmental impact statement; GSA= groundwater sustainability agency; GSP = Groundwater Sustainability Plans; NEPA = National Environmental Policy Act; NMFS = National Marine Fisheries Service; Reclamation = U.S. Bureau of Reclamation; SGMA = Sustainable Groundwater Management Act; SWP = State Water Project; USACE = U.S. Army Corps of Engineers; USFWS = U.S. Fish and Wildlife Service; WMWD = Western Municipal Water District; WQCP = Water Quality Control Plan.

8.3.3.1 Cumulative Impacts of the No Project Alternative

The cumulative No Project Alternative scenario would include projects listed in Table 8-10 and could have effects on groundwater resources. Generally, these projects in the study area would have positive effects on the underlying groundwater basins on a long-term basis, but could have potential negative effects during construction. However, construction effects would likely be short-term in duration. The No Project Alternative scenario may also put additional strains on water resources that may include an increase in demand for groundwater to meet future water needs. However, medium and high priority basins are subject to SGMA and projects listed in Table 8-10 would also have to undergo independent environmental analysis. Therefore, it is anticipated that there would be no cumulative impact on groundwater resources under the No Project Alternative.

8.3.3.2 Cumulative Impacts of the Project Alternatives

The projects listed in Table 8-10 could occur along with construction of the Delta Conveyance Project. As presented before, groundwater impacts associated with the project alternatives are similar to one another. The projects listed in Table 8-10 also would have to undergo independent environmental analysis and comply with SGMA. Simultaneous construction of the Delta Conveyance Project and other projects in the vicinity of the project could potentially result in significant impacts on groundwater if construction BMPs and compensatory mitigation are not implemented.

Potential project impacts would be predominantly realized through the routine transport, use, or disposal of hazardous materials, the release of hazardous materials into the environment, or significant changes in groundwater gradients that result in the movement of existing groundwater contamination plumes. However, impacts from minor spills or drips would be avoided by thoroughly cleaning up minor spills as soon as they occur, by monitoring groundwater levels for adverse effects during construction, and by the recharge of groundwater extracted as part of dewatering operations during construction, which would minimize the potential for resultant plume movement. While foreseeable projects have the potential to cause similar impacts, it is assumed these projects would also implement similar construction BMPs and follow all regulations regarding the transport, disposal, and handling of hazardous wastes during construction. Furthermore, as the project results in the remediation and cleanup of certain hazardous sites and locations in the study area, groundwater quality conditions would improve. Therefore, all project alternatives would not result in an incremental cumulatively considerable impact.

The simultaneous operation of the Delta Conveyance Project along with projects listed in Table 8-10 are anticipated to have more beneficial impacts on groundwater than adverse for all alternatives. Most of the projects in Table 8-10 focus on the development of surface water supplies that would offset groundwater use and improve the reliability of local water supplies and SWP/CVP deliveries, thereby reducing stresses and demands on the local groundwater systems. Additionally, the availability and use of more reliable surface water supplies would result in increased groundwater percolation and recharge, raising groundwater levels. The increased reliability of CVP and SWP supplies would allow GSAs charged with managing the long-term sustainability of groundwater basins, along with water agencies, to improve the conjunctive use of their surface water and groundwater supplies and reduce stress on the underlying groundwater basins. Cumulative effects on groundwater supplies described in previous sections are expected to be mostly positive, with some effects negligible or less than significant under all project alternatives and are therefore anticipated to have less-than-significant cumulative impacts in the region.