7.12 Hydrology and Water Quality

7.12.2 Groundwater

Groundwater and surface waterbodies are connected physically in the hydrologic cycle; changes in either surface water or groundwater quantity affect the other. Groundwater levels in many basins across California have declined steadily over time from agricultural and municipal uses. In some places, groundwater pumping supplements surface water diversions. Other areas of the state do not have surface water rights or access and are wholly dependent on groundwater (DWR 2021). When groundwater extraction exceeds replenishment, the basin is in *overdraft*. When that condition is chronic, users are said to be *mining* the groundwater basin (Choy and McGhee 2014). The legislature passed the Sustainable Groundwater Management Act (SGMA) in 2014 to address groundwater overpumping and consequences of that over-extraction, including overdraft, which are described as "undesirable results" under the statute (see SGMA discussion in Section 7.12.2.2, *Environmental Setting*).

Local public agencies in basins subject to SGMA were required to develop management plans that bring basins back into balance and achieve a *sustainable yield*, which is defined under SGMA as the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin, that can be withdrawn annually from a groundwater supply without causing an undesirable result (Wat. Code, § 10721(w)). In some areas, surface water, including imported surface water, has been used to alleviate declining groundwater levels through substitution, managed groundwater recharge (percolation or injection into the groundwater basin), or both. The management of surface water supplies and groundwater supplies together is called *conjunctive use* and can be an effective approach in long-term water supply planning, so long as it does not impair the quality and sustainability of either water source. Where the proposed Plan amendments require increased instream flows in order to reasonably protect fish and wildlife beneficial uses, less surface water may be available to supplement groundwater. Local public agencies have been on notice since 2012 regarding State Water Board's intention to update the Bay-Delta Plan to provide increased instream flows for the protection of fish and wildlife beneficial uses in the Sacramento River watershed and Delta (^SWRCB 2009, ^SWRCB 2012). Such notification should have informed groundwater sustainability agency (GSA) groundwater planning efforts and management assumptions regarding the amount of surface water supplies in excess of environmental needs that may be available to augment groundwater supplies.

The proposed Plan amendments would increase streamflows in some areas, which could affect groundwater in multiple ways. Increased groundwater pumping could occur in response to reduced Sacramento/Delta surface water supplies. It is difficult to determine how much groundwater would be available or what the groundwater pumping capacity would be to replace reduced surface water supplies. In addition, greater instream flows would increase natural groundwater recharge from stream-aquifer interactions (i.e., infiltration from streambeds). However, reduced surface water diversions may in turn reduce the overall irrigated acreage in the study area, which could result in a reduction in the incidental recharge that occurs when irrigation exceeds evapotranspiration and cropland consumptive use. Reduced surface water availability also may reduce opportunities for managed recharge. An increase in groundwater pumping or a reduction in incidental or managed groundwater recharge could lead to reductions in groundwater volume, which has the potential to exacerbate existing poor groundwater water quality conditions, including sources of drinking water.

This section describes the environmental setting, potential impacts, and mitigation measures for groundwater effects that may result from changes in hydrology and changes in water supply. The analysis focuses on changes in groundwater levels and quality that could occur as a result of increased substitute groundwater pumping and reduced incidental recharge. The analysis is informed by both qualitative discussion and quantitative modeling results of the impacts that may result under various contingencies.

For a discussion of potential subsidence impacts related to reduced groundwater levels, see Section 7.9, *Geology and Soils.* For a discussion of potential impacts on surface water, see Section 7.12.1, *Surface Water*.

Section 7.1, *Introduction, Project Description, and Approach to Environmental Analysis*, describes reasonably foreseeable methods of compliance and response actions, including actions that would require construction. These actions are analyzed for potential environmental effects in Section 7.21, *Habitat Restoration and Other Ecosystem Projects*, and Section 7.22, *New or Modified Facilities*.

7.12.2.1 Environmental Checklist

The checklist below contains only the questions relevant to the analysis of potential groundwater impacts. See the Environmental Checklist in Section 7.12.1, *Surface Water*, for the complete *Hydrology and Water Quality* checklist.

IX. Hydrology and Water Quality—Groundwater	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
Would the project:				
a. Violate any water quality standards or waste discharge requirements?	☒	☐	☐	☐
b. Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted)?	☒	☐	☐	☐
f. Otherwise substantially degrade water quality?	☒	☐	☐	☐

7.12.2.2 Environmental Setting

This section describes the groundwater setting to inform the impact discussion in this section and in Section 7.21, *Habitat Restoration and Other Ecosystem Projects*; Section 7.22, *New or Modified Facilities*; and Chapter 9, *Proposed Voluntary Agreements.*

Overview of Groundwater Hydrology

Groundwater is the water occurring beneath the earth's surface that completely fills (saturates) the void space of rocks or sediment. An *aquifer* is defined as a body of rock or unconsolidated sediment that has sufficient permeability to allow groundwater to flow through it. Most of California's groundwater occurs in material deposited by streams, called *alluvium*. Alluvium consists of coarse deposits, such as sand and gravel, and finer-grained deposits such as clay and silt. Coarse materials, such as sand and gravel deposits, usually provide the best aquifers. The California Department of Water Resources (DWR) defines a *groundwater basin* as an alluvial aquifer or a stacked series of alluvial aquifers with reasonably well defined boundaries in a lateral direction and a definable bottom. A *subbasin* is created by dividing a groundwater basin into smaller units using geologic and hydrologic barriers or institutional boundaries. Groundwater also is found outside of alluvial groundwater basins in fractured-rock aquifers that are composed of volcanic, igneous intrusive, metamorphic, and sedimentary rocks. (DWR 2015a).

Aquifer systems are recharged primarily through rainfall percolation; seepage from rivers, streams, and water conveyance facilities; subsurface inflow along basin boundaries; intentional groundwater storage or recharge projects; and recharge that occurs as a byproduct of excess irrigation (referred to in this analysis as *incidental groundwater recharge*).

The interaction between groundwater and surface water rivers and streams depends on a variety of factors, including the magnitude and direction of the river/stream (through the streambed and banks), the hydraulic properties of streambed and bank material, and the hydraulic gradient (the gradient between the river stage and the nearby groundwater levels). *Gaining streams* are portions of a river/stream system where adjacent groundwater levels are higher than the river stage, and groundwater seeps or discharges to the river/stream. Conversely, a *losing stream* occurs where river stage is higher than adjacent groundwater levels, and water flows from the river or stream into the aquifer. Where subsurface materials are saturated between the streambed and water table, conditions are connected, whereas when an unsaturated zone exists between the streambed and aquifer, the two are disconnected. Where groundwater levels are lower than the elevation of the river bed, there is no direct hydraulic connection between the two, and the area separating the river bed from the groundwater becomes partially unsaturated, causing water from the river to percolate through this area to the water table (USGS 2016). Areas of gaining/losing streams have been identified in the Sacramento River watershed and San Joaquin Valley regions; long-term modeling of surface water and groundwater interactions suggests a significant increase in groundwater pumping throughout the Central Valley since the 1920s, leading to most river systems in the Central Valley having transitioned from gaining stream systems to losing stream systems (TNC 2014).

Declining groundwater levels indicate a condition of overdraft in an aquifer, which occurs when more water is pumped from an aquifer than is replaced by recharge via precipitation, irrigation water, streambed seepage, and intentional recharge. Overdraft of groundwater subbasins occurs over a period of years and can result in a loss of connection between groundwater and surface water systems, degradation of groundwater quality, land subsidence, and other effects. Drought conditions typically result in an increase in groundwater pumping to compensate for surface water supply shortages (DWR 2014a). As a result of increased pumping in the 2012–2016 drought, groundwater levels decreased in many basins throughout the state compared with levels monitored in spring 2010 (Lund et al. 2018).

DWR's Bulletin 118 series, *California's Groundwater*, defines the boundaries and describes the hydrologic characteristics of California's groundwater basins and provides information on groundwater management and recommendations for the future (^DWR 2003). Each of the alluvial groundwater basins are identified, numbered, and further subdivided into subbasins in some locations. Subbasin boundaries can be flexible and could change in the future. Like watersheds, basins and subbasins can be grouped into a larger groundwater basin as appropriate for a given discussion or inquiry. Bulletin 118 identifies 515 alluvial groundwater basins and subbasins in California.[1]

In 2009, the Legislature adopted a set of statutes requiring groundwater basin elevations to be monitored locally or else monitored by DWR, with the consequence that locals would be ineligible for certain state funds (Wat. Code, § 10920 et seq.). In addition, DWR was required to prioritize the alluvial groundwater basins identified in Bulletin 118 based on multiple factors including, but not limited to, overlying population, rate of growth, number of wells, irrigated acreage, and degree to which the basin is relied upon as a primary source of water, and to identify basins subject to critical conditions of overdraft (Wat. Code, §§ 10933, 12924). This statutory directive became DWR's California Statewide Groundwater Elevation Monitoring (CASGEM) Program, which tracks seasonal and long-term groundwater elevation trends in groundwater basins statewide.

Subsequently, SGMA (discussed below) required DWR, by January 31, 2015, to prioritize basins under the CASGEM Program as high-, medium-, low-, or very low-priority based on the criteria identified in Water Code section 10933 (Wat. Code, § 10722.4). The CASGEM Program findings indicated that 94 of California's groundwater basins, which account for 96 percent of California's annual groundwater pumping, qualify as high- or medium-priority (DWR 2020). In 2016, DWR released its final list of critically overdrafted groundwater basins, which includes 21 basins and subbasins in the study area (DWR 2016b). As a result of the 94-day comment period following the release of the 2016 Bulletin 118 update, DWR conducted another round of basin boundary adjustments and prioritization, referred to as the *SGMA 2019 Basin Prioritization* (DWR 2020). The SGMA 2019 Basin Prioritization results indicate that 94 basins qualify as high- or medium-priority (DWR 2020). The majority of these high- and medium-priority basins are located within the study area (see Figures 7.12.2-1a and 7.12.2-1b).

Adjudications

When water users within a groundwater basin are in dispute over their respective rights to the resource, they can seek an *adjudication*, which is a legal determination of those rights in court. Through an adjudication, the court can identify who the groundwater extractors are, what type of rights they hold, and how much groundwater each is entitled to in relation to the others. Typically, the court retains continuing jurisdiction over the adjudicated area and appoints a watermaster to ensure that groundwater within the adjudicated area is managed in accordance with the court's decree, since the amount of available groundwater may fluctuate from year to year. Of the 29 existing groundwater adjudications in the state, 28 are in the San Joaquin Valley, Central Coast, and Southern California regions (Table 7.12.2-1 and Figure 7.12.2-2).

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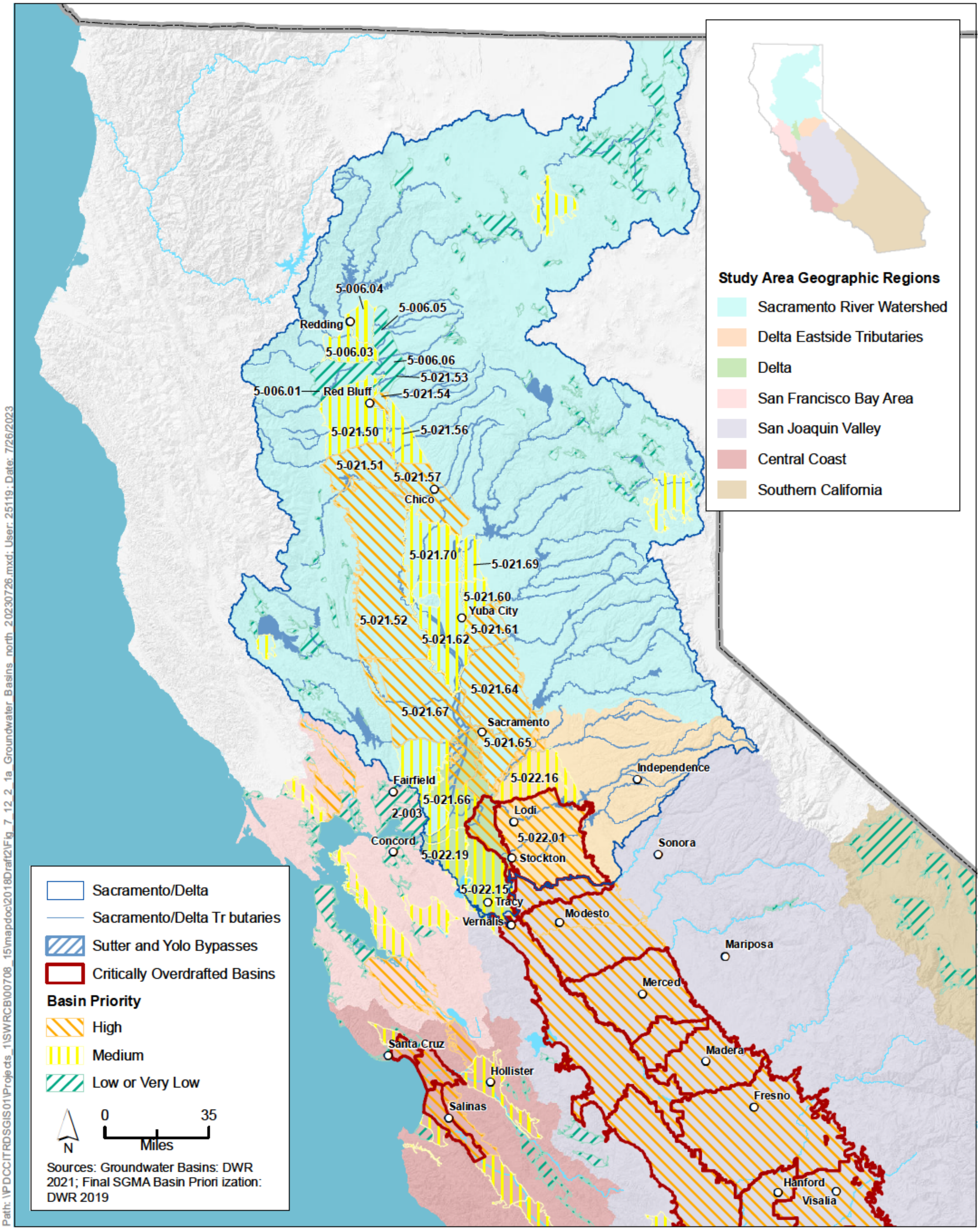
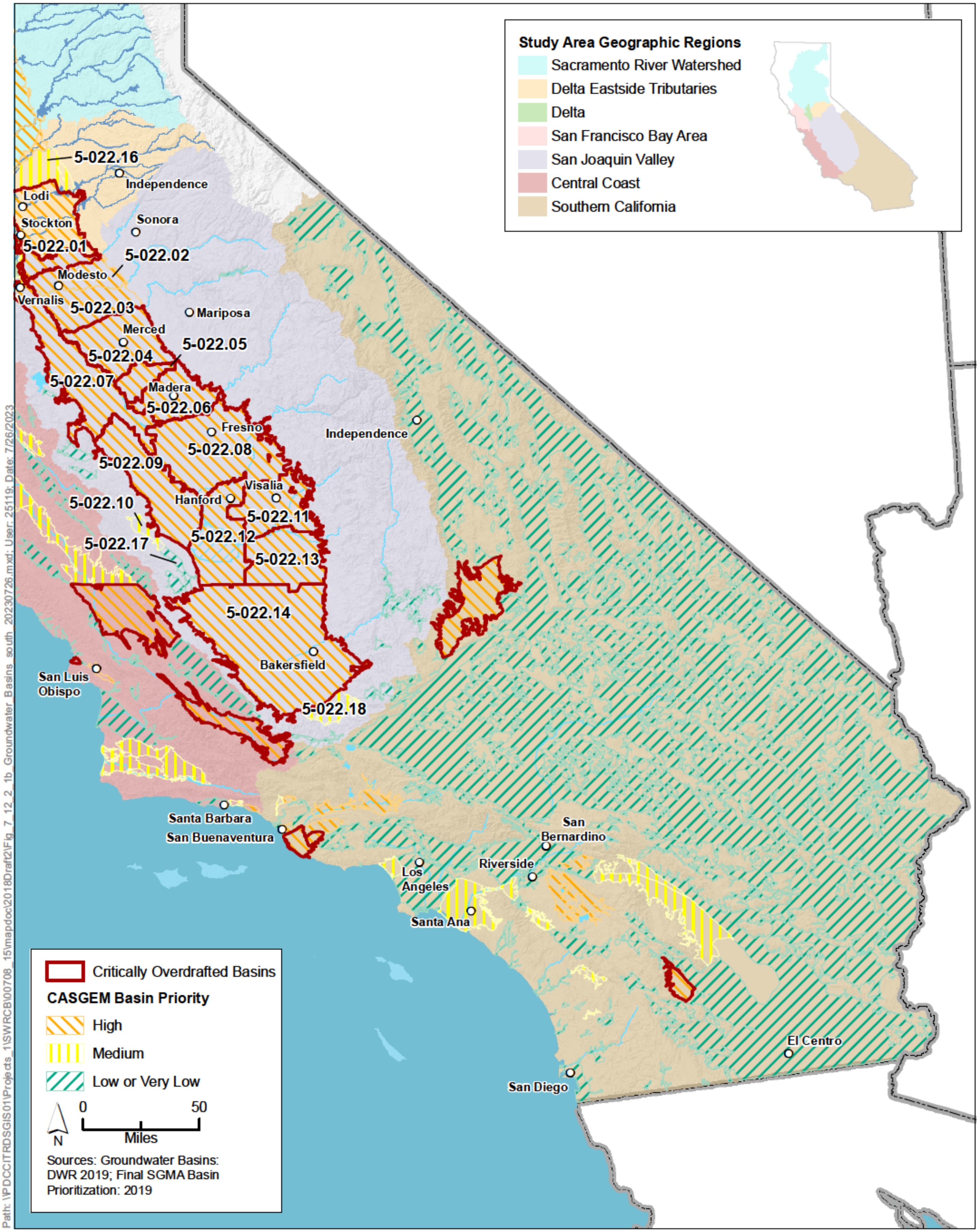
[1] Borrego Valley was subdivided pursuant to DWR's basin boundary modification process in 2016 and the San Luis Rey Valley was subdivided pursuant to Assembly Bill 1944 (Eduardo Garcia), ch. 255, Stats. of 2018, thus bringing the total number of alluvial groundwater basins and subbasins in California to 517.



7.12.2-1a
Groundwater Basins and Subbasins in the Study Area (northern)



Path: \PDCCITRDSGIS01\Projects_1\SWRCB\00708_15\mapdoc\2018Draft2\Fig_7_12_2_1b_Groundwater_Basins_south_20230726.mxd; User: 25119; Date: 7/26/2023

Figure 7.12.2-1b
Groundwater Basins and Subbasins in the Study Area (southern)

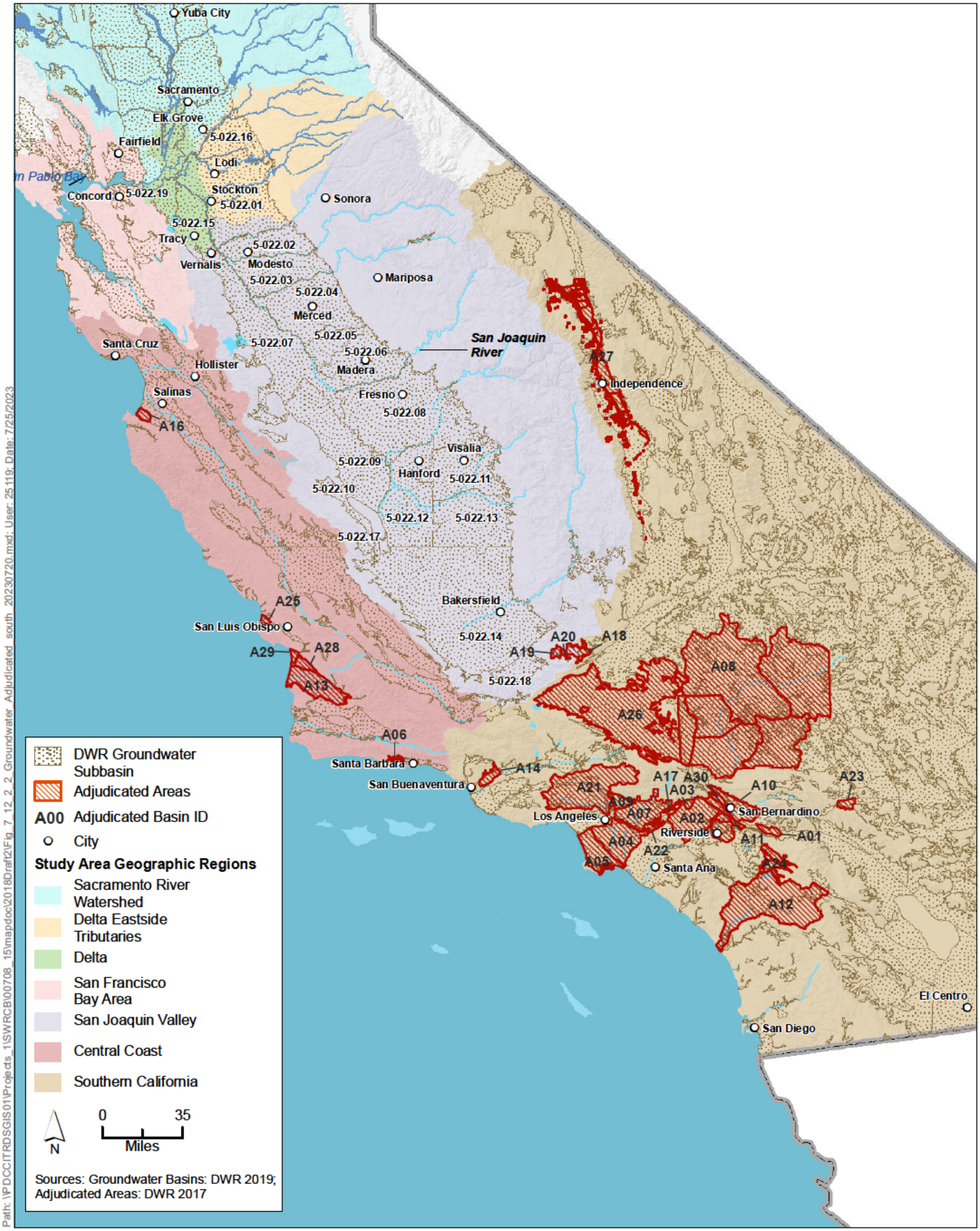


Figure 7.12.2-2
Adjudicated Groundwater Basins in the Study Area

Table 7.12.2-1. Adjudicated Groundwater Basins and Subbasins in the Study Area

Judgement	Basin Name	Subbasin Name	Basin Number	Adjudicated Basin ID	Region(s)
Brite Basin	Brite Valley	Brite Valley	5-080	A20	San Joaquin Valley
Cummings Basin	Brite Valley, Cummings Valley	Brite Valley, Cummings Valley	5-080, 5-027	A19	San Joaquin Valley
Tehachapi Basin	Brite Valley, Tehachapi Valley West, Tehachapi Valley East	Brite Valley, Tehachapi Valley West Tehachapi Valley East	5-080, 5-028 6-045	A18	San Joaquin Valley Southern California
Los Osos Basin	Chorro Valley, Los Osos Valley	Chorro Valley, Los Osos Valley – Los Osos Area, Los Osos Valley – Warden Creek	3-042, 3-008.01, 3-008.02	A25	Central Coast
Nipomo Mesa Management Area	Santa Maria River Valley	Santa Maria River Valley – Santa Maria	3-012.01	A28	Central Coast
Northern Cities Management Area	Santa Maria River Valley	Santa Maria River Valley – Arroyo Grande, Santa Maria River Valley – Santa Maria	3-012.02, 3-012.01	A29	Central Coast
Santa Maria Valley Management Area	San Antonio Creek Valley, Santa Maria River Valley	San Antonio Creek Valley, Santa Maria River Valley – Santa Maria	3-014, 3-012.01	A13	Central Coast
Seaside Basin	Salinas Valley	Salinas Valley – Monterey, Salinas Valley – Seaside	3-004.10, 3-004.08	A16	Central Coast
Wright Judgement	Goleta	Goleta Basin – Central, Goleta Basin – West, Goleta Basin – North	3-016	A06	Central Coast
Antelope Valley	Antelope Valley	Antelope Valley	6-044	A26	Southern California
Beaumont Basin	Coachella Valley, Upper Santa Ana Valley	Coachella Valley – San Gorgonio Pass, Upper Santa Ana Valley – San Timoteo, Upper Santa Ana Valley – Yucaipa	7-021.04, 8-002.08, 8-002.07	A01	Southern California
Central Basin	Coastal Plain of Los Angeles, Coastal Plain of Orange County, San Gabriel Valley	Coastal Plain of Los Angeles – Central, Coastal Plain of Los Angeles – West Coast, Coastal Plain of Orange County, San Gabriel Valley	4-011.04, 4-011.03, 8-001, 4-013	A04	Southern California

Judgement	Basin Name	Subbasin Name	Basin Number	Adjudicated Basin ID	Region(s)
Chino Basin	San Gabriel Valley, Upper Santa Ana Valley	San Gabriel Valley, Upper Santa Ana Valley – Chino, Upper Santa Ana Valley – Cucamonga, Upper Santa Ana Valley – Rialto-Colton, Upper Santa Ana Valley – Riverside-Arlington	4-013, 8-002.01, 8-002.02, 8-002.04, 8-002.03	A02	Southern California
Cucamonga Basin	Upper Santa Ana Valley	Upper Santa Ana Valley – Chino, Upper Santa Ana Valley – Cucamonga	8-002.01, 8-002.02	A03	Southern California
Hemet-San Jacinto Basin	San Jacinto	San Jacinto	8-005	A24	Southern California
Inyo County Basins	Indian Wells Valley, Owens valley, Rose Valley	Indian Wells Valley, Owens Valley – Fish Slough, Owens Valley – Owens Valley, Rose Valley	6-054, 6-012.02, 6-012.01, 6-056	A27	Southern California
Lytle Creek Basin	Upper Santa Ana Valley	Upper Santa Ana Valley – Rialto-Colton, Upper Santa Ana Valley – San Bernardino	8-002.04, 8-002.06	A30	Southern California
Main San Gabriel Basin	Coastal Plain of Los Angeles, Raymon, San Gabriel Valley	Coastal Plain of Los Angeles – Central, Raymond, San Gabriel Valley	4-011.04, 4-023, 4-013	A07	Southern California
Mojave Basin	Antelope Valley, Bessemer Valley, Caves Canyon Valley, Coyote Lake Valley, Cronise Valley, Cuddeback Valley, El Mirage Valley, Harper Valley, Iron Ridge Area, Johnson Valley, Kane Wash Area, Langford Valley, Lower Mojave River Valley, Lucerne Valley, Middle Mojave River Valley, Superior Valley, Upper Mojave River Valley, Upper Santa Ana Valley	Antelope Valley, Bessemer Valley, Caves Canyon Valley, Coyote Lake Valley, Cronise Valley, Cuddeback Valley, El Mirage Valley, Harper Valley, Iron Ridge Area, Johnson Valley – Soggy Lake, Johnson Valley – Upper Johnson Valley, Kane Wash Area, Langford Valley – Langford Well Lake, Lower Mojave River Valley, Lucerne Valley, Middle Mojave River Valley, Superior Valley, Upper Mojave River Valley, Upper Santa Ana Valley – Cajon	6-044, 7-015, 6-038, 6-037, 6-035, 6-050, 6-043, 6-047, 7-050, 7-018.01, 7-018.02, 6-089, 6-036.01, 6-040, 7-019, 6-041, 6-049, 6-042, 8-002.05	A08	Southern California

Judgement	Basin Name	Subbasin Name	Basin Number	Adjudicated Basin ID	Region(s)
Puente Basin	San Gabriel Valley	San Gabriel Valley	4-013	A22	Southern California
Raymond Basin	Raymond, San Gabriel Valley	Raymond, San Gabriel Valley	4-023, 4-013	A09	Southern California
San Bernardino Basin Area	San Jacinto, Upper Santa Ana Valley	San Jacinto, Upper Santa Ana Valley – Cajon, Upper Santa Ana Valley – Chino, Upper Santa Ana Valley – Rialto-Colton, Upper Santa Ana Valley – Riverside-Arlington, Upper Santa Ana Valley – San Bernardino, Upper Santa Ana Valley – San Timoteo, Upper Santa Ana Valley – Yucaipa	8-005, 8-002.05, 8-002.01, 8-002.04, 8-002.03, 8-002.06, 8-002.08, 8-002.07	A10, A11	Southern California
Santa Margarita River Watershed	Cahuilla Valley, Elsinore, San Jacinto, San Luis Rey Valley, Santa Margarita Valley, Temecula Valley, Terwilliger Valley, Vandeventer Flat	Cahuilla Valley, Elsinore – Elsinore Valley, San Jacinto, San Luis Rey Valley – Lower San Luis Rey Valley, Santa Margarita Valley, Temecula Valley, Terwilliger Valley, Vandeventer Flat	9-006, 8-004.01, 8-005, 9-007.02, 9-004, 9-005, 7-026, 7-063	A12	Southern California
Santa Paula Basin	Santa Clara River Valley	Santa Clara River Valley – Fillmore, Santa Clara River Valley – Mound, Santa Clara River Valley – Santa Paula	4-004.05, 4-004.03, 4-004.04	A14	Southern California
Six Basins	San Gabriel Valley	Six Basins – Pomona Basin, Six Basins – Canyon Basin, Six Basins – Upper Claremont Heights Basin, Six Basins – Ganesha Basin, Six Basins – Live Oak Basin, Six Basins – Lower Claremont Heights	4-013	A17	Southern California
Upper Los Angeles River Area	Coastal Plain of Los Angeles, Raymond, San Fernando Valley	Coastal Plain of Los Angeles – Central, Raymond, San Fernando Valley	4-011.04, 4-023, 4-012	A21	Southern California
Warren Valley Basin	Joshua Tree, Warren Valley	Joshua Tree, Warren Valley	7-062, 7-012	A23	Southern California

Judgement	Basin Name	Subbasin Name	Basin Number	Adjudicated Basin ID	Region(s)
West Coast Basin	Coastal Plain of Los Angeles, Coastal Plain of Orange County	Coastal Plain of Los Angeles – Santa Monica, Coastal Plain of Los Angeles – West Coast, Coastal Plain of Orange County	4-011.01, 4-011.03, 8-001	A05	Southern California

Source: DWR n.d.

Sustainable Groundwater Management Act and Other State and Local Authorities

In 2014, former Governor Edmund "Jerry" Brown signed into law a three-bill legislative package establishing SGMA and related provisions in order to address ongoing unsustainable groundwater use in California's alluvial groundwater basins and the physical, societal, and environmental consequences of that over-extraction, including overdraft. SGMA redefined groundwater sustainability as the "management and use of groundwater in a manner that can be maintained during the [50-year SGMA] planning and implementation horizon without causing undesirable results" (Wat. Code, § 10721 (v)). Under SGMA, undesirable results occur when one of the following effects become "significant and unreasonable": chronic lowering of groundwater levels indicating a depletion of supply, reduction of groundwater storage, seawater intrusion, degraded water quality, land subsidence, and depletions of interconnected surface waters that affect beneficial uses of surface waters (Wat. Code, § 10721 (x)).

SGMA tasks local agencies in basins designated as high- and medium-priority under the SGMA 2019 Basin Prioritization process and subject to the Act to halt overdraft and balance levels of pumping and recharge in order to avoid undesirable results. SGMA requires those local agencies to form GSAs to develop, adopt, and implement groundwater sustainability plans (GSPs). Multiple GSAs may form within a basin, and they may coordinate on a single plan or develop multiple plans for the basin that also must be coordinated. Development of a GSP requires an understanding of local geology and hydrogeology, historical and current groundwater elevations and quality, subsidence, groundwater-surface water interactions, historical and projected water demands, groundwater extractions and recharge, surface water supplies, and other elements. A basin's GSP describes how the GSA will ensure that their basin is operated within its sustainable yield, as defined by SGMA, including projects, programs, and enforcement actions that will be taken to achieve sustainability. SGMA authorizes GSAs to regulate, limit, and suspend groundwater extractions in order to achieve basin-wide sustainability.

Once GSPs are adopted, SGMA requires DWR to review and evaluate each GSP to determine whether the plan is likely to achieve the sustainability goal for the basin and whether it adversely affects the ability of an adjacent basin to implement a GSP or achieve its sustainability goal (Wat. Code, § 10733). DWR has up to 2 years from the time of submittal to assess plans (Wat. Code, § 10733.4, subd. (d)). In 2016, DWR adopted regulations to help guide GSAs in development of their GSPs (Cal. Code of Regs., tit. 23, § 350 et seq.). Under DWR's regulations, a GSP establishes a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of implementation (Cal. Code Regs., tit. 23, § 354.24). The GSP must include an evaluation of the basin for the existence of the six undesirable results and establish minimum thresholds for each. Minimum thresholds are numeric values that, if exceeded, may cause undesirable results for each applicable sustainability indicator (Cal. Code Regs., tit. 23, § 354.24, subd. (b)).

When evaluating whether a plan is likely to achieve the sustainability goal for the basin, DWR considers whether the proposed management options are feasible and likely to prevent undesirable results and ensure that the basin is operated within its sustainable yield, and whether the GSP includes a reasonable assessment of overdraft conditions and reasonable means to mitigate overdraft, if present (Cal. Code Regs., tit. 23, § 355.4, subd. (b) (5–6)). Additionally, DWR considers minimum thresholds, schedule, implementation, compliance with statute, and the beneficial uses and users affected by groundwater use in the basin, among other criteria (Cal. Code Regs., tit. 23, § 355.4). The assessment may include recommended corrective actions to address deficiencies identified by DWR in its review (Wat. Code, § 10733.4). DWR must review plans and issue an assessment of the plan every 5 years following submittal to DWR (Wat. Code, § 10733.8).

If local agencies in high- or medium-priority groundwater basins subject to SGMA are unwilling or unable to manage their groundwater resources, SGMA authorizes the State Water Board to intervene: (1) if no agency or group of agencies has opted by June 30, 2017, to serve as the GSA or GSAs for the entire basin; (2) if the GSA or GSAs do not complete their GSPs by the relevant deadline (i.e., 2020 or 2022); (3) if there are overlapping GSAs; (4) when there are multiple GSPs in a basin and no coordination agreement; (5) when DWR, in consultation with the State Water Board, determines that the GSP is inadequate or the GSP is not being implemented in a manner that is likely to achieve the plan's sustainability goal(s), and the basin is in a condition of long-term overdraft; or (6) after January 31, 2025, the State Water Board determines that the basin is in a condition where groundwater extractions result in significant depletions of interconnected surface waters (Wat. Code, § 10735.2).

The State Water Board commences the intervention process by noticing a public hearing to determine whether to designate the basin as probationary. If the basin is designated as probationary, the State Water Board provides the local agencies or GSAs in the basin at least 180 days to remedy any deficiencies (Wat. Code, § 10735.4). If the deficiencies are remedied, the basin is removed from probation. If the deficiencies are not remedied, the State Water Board may need to directly manage the basin through adoption of an Interim Plan. The Interim Plan must outline the State Water Board's management solutions, a timeline, and a monitoring plan for ensuring that the sustainability goal is met (Wat. Code, § 10735.8). All extractors in an unmanaged area, probationary basin, or basin managed by the State Water Board through an Interim Plan must submit annual extraction reports to the State Water Board, although the State Water Board may exclude certain extractors from reporting. All extraction reports must be accompanied by a fee to cover the State Water Board's intervention costs (Wat. Code, § 5202).

Consistent with SGMA's requirements, 21 critically overdrafted basins submitted 46 GSPs to DWR by January 31, 2020. In January 2022, DWR issued assessments for 20 basins, approving 8 with corrective actions, indicating that another 12 were incomplete, and providing the incomplete basins an additional 180 days to correct their deficiencies. In July 2022, the 12 critically overdrafted basins deemed "incomplete" resubmitted their GSPs for DWR re-review. In March 2023, DWR deemed six of those GSPs adequate and six inadequate, triggering State Water Board evaluation for intervention (DWR 2023a). In addition, in January 2022, the remaining 63 high- and medium-priority basins subject to SGMA that were not deemed critically overdrafted were required to submit their adopted GSPs and submitted 65 plans. DWR has until January 2024 to complete its review of these basins and, as of April 27, 2023, DWR approved 12 of those plans (DWR 2023b).

The State Water Board and nine regional water boards also have authorities related to groundwater diversion, use, and quality that are independent of, and in addition to, SGMA. The State Water Board has a duty to protect, where feasible, the state's public trust resources. The State Water Board also is empowered under article X, section 2 of the California Constitution and Water Code section 100 to prevent the waste or unreasonable use, unreasonable method of use, or unreasonable method of diversion of all waters of the state. Water Code section 275 directs the State Water Board to "take all appropriate proceedings or actions before executive, legislative, or judicial agencies . . ." to enforce the constitutional and statutory prohibition against waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion, commonly referred to as the *reasonable use doctrine*. The reasonable use doctrine applies to the diversion and use of both surface water and groundwater, and it applies irrespective of the type of water right held by the diverter or user (*Peabody v. Vallejo* (1935) 2 Cal.2d 351, 366–367).

The State Water Board also is tasked with issuing permits and licenses for managed groundwater recharge projects that divert surface waters to underground storage. Capturing surface water to recharge groundwater aquifers artificially is usually not a beneficial use of water in and of itself but is a method of diversion to storage and generally requires an appropriative water right that identifies how the stored water will be beneficially used. Managed groundwater recharge projects take advantage of the natural storage capacity in groundwater aquifers and allow that water to later be extracted for irrigation, municipal and domestic supplies, industrial purposes, or other uses. More rarely, water stored underground may be put to beneficial use without pumping the water to the surface (referred to as *in-situ* or *non-extractive* beneficial use). Examples of non-extractive beneficial uses include use as a seawater intrusion barrier, for prevention of subsidence, or to support groundwater-dependent ecosystems. Any water right permit application or petition on an existing water right that involves diversion of surface water to underground storage and non-extractive beneficial use should describe the reason or need to keep the water in the basin. Temporary permits may be issued pursuant to Water Code section 1425 et seq.

In accordance with Governor Brown's Executive Order B-39-17, the State Water Board developed a streamlined permitting process for diversions of water from high-flow events to underground storage. The streamlined application process is available to GSAs and local agencies as defined by SGMA. The streamlined process directly assists GSAs and other local agencies working to address SGMA and adverse impacts caused by extractions. Water right applications are eligible for the streamlined permitting process if they meet certain criteria, including proposed diversions during high-flow events between December 1 and March 31. These criteria and analyses will ensure that applications are unlikely to injure other legal users or adversely affect fishery resources or other public trust resources. Alternatively, on March 10, 2023, in response to existing and expected high-flow events from record snowpack in some areas, Governor Gavin Newsom issued Executive Order N-4-23 allowing for the diversion of flood flows for groundwater recharge without a permit until June 1, 2023, under specified conditions, including that such diversions must be to avoid catastrophic flooding. Among other requirements, N-4-23 specified that diverters must coordinate with the GSA or GSAs in their basin and limited such diversions to those using existing infrastructure or temporary pumps. Unlike the B-39-17 streamlined permitting program, N-4-23 did not allow diverters to claim a water right to the volume of flood flows diverted for recharge. Groundwater storage and recovery projects also may require water quality approvals from the State Water Board or regional water boards.

Like state agencies, local agencies have tools in addition to SGMA that can help manage groundwater basins sustainably. This may be necessary and advisable in some of the groundwater basins in the study area where SGMA is not mandatory, including several basins in the northern Sacramento Valley with important native fisheries. In these areas, local governments can use their authorities to manage groundwater extraction in their jurisdictions. For example, a county could implement a well installation moratorium; require environmental review, including assessment of cumulative impacts of new well installations; require setbacks between wells and surface waters to minimize impacts on fish and wildlife; and other actions that could effectively minimize the rate or magnitude of decreasing groundwater elevations and migration of contaminant plumes. Local measures also could be imposed to complement an existing GSP. For example, Water Code section 10608.48 requires agricultural water suppliers to implement several efficient water management practices if the measures are locally cost effective and technically feasible, including conjunctive use of groundwater. SGMA suggests that counties coordinate with GSAs by forwarding all permit requests for new, enlarged, or reactivated groundwater wells (Wat. Code, § 10726.4 (b)).

Overview of Groundwater Quality

Groundwater quality is related to numerous natural and anthropogenic (human-induced) factors that affect the presence, concentration, and movement of groundwater pollutants. Natural factors that affect groundwater quality include hydrogeologic and soil conditions, geography, presence and type of naturally occurring contaminants, geochemical characteristics, and climate. Anthropogenic factors that affect groundwater quality include agricultural and irrigation practices, waste disposal practices and facilities, water use including groundwater pumping, and regulations and standards. Water quality degradation of groundwater due to these various factors, including saline intrusion, is among the components of the SGMA 2019 Basin Prioritization described above. Groundwater quality is tracked statewide through the State Water Board's Groundwater Ambient Monitoring and Assessment (GAMA) Program, which monitors and assesses groundwater quality in basins that account for 95 percent of California's groundwater use. In basins subject to SGMA, the State Water Board's Groundwater Management Program utilized GAMA Program information to provide DWR a public list of potential constituents of concern to assist GSAs in comprehensively describing and setting appropriate sustainable management criteria for groundwater quality in their GSPs (SWRCB 2022).

Sources of chemicals introduced to groundwater include fertilizers, manure, and pesticides applied to agricultural lands; landfills; industrial-discharge lagoons; leaking gasoline storage tanks; cesspools and septic tanks; urban contaminants; and domestically used chemicals (Morris et al. 2003; Harter et al. 2012). Many naturally occurring chemicals in groundwater come from dissolving rocks, soil, and decaying plant material. Human activities at, or near, the surface of the earth can increase the concentration of naturally occurring substances such as salts, minerals, and nutrients.

Agricultural operations are a major source of groundwater contamination in California, from sources such as irrigation runoff, flows from tile drains, dairy waste, and storm water runoff. Agricultural operations can affect groundwater quality by transporting pollutants, including pesticides, sediment, nutrients, salts (including selenium and boron), pathogens, and heavy metals, from cultivated fields. Factors influencing the level of groundwater contamination include the type and amount of crops grown; irrigation methods; water use; presence of pathogens and volatile organic compounds (VOC); and types of nutrients and pesticides used, including nitrates from synthetic and animal waste fertilizers (NCWA 2014). Areas that are poorly drained and have naturally saline soils can be more susceptible to accumulation of salts in groundwater.

Groundwater currently is pumped beyond sustainable yields in many areas in California. Overpumping of groundwater can exacerbate groundwater quality issues. Groundwater pumping can result in lowered groundwater levels (in unconfined aquifers) or pressure heads (in confined aquifers), which can alter the groundwater flow gradient in the vicinity of groundwater pumping locations. A change in the direction and rate of the groundwater flow can create a hydraulic gradient between a well and surrounding saturated zone. These changes can affect groundwater quality by exacerbating the migration of surface contaminants and mobilizing naturally occurring trace elements such as uranium, arsenic, and radium. Groundwater pumping also can lower water levels and allow salt water to migrate inland and upward toward the freshwater zone, resulting in saltwater contamination of the aquifer. Serious saline intrusion is primarily a consideration for coastal aquifers and is confined to relatively few regional settings, but paleo-saline waters may occur in inland aquifers at depth (Morris et al. 2003; Smedley and Kinniburgh 2002; Barringer and Reilly 2013). The influence of groundwater pumping on groundwater quality depends on numerous factors, such as location and depth of the well, groundwater pumping volumes and rates, number and proximity of nearby wells, hydrogeological characteristics of the aquifer (e.g., consolidated clays with low permeability or unconsolidated sands with high permeability), distance between the well(s) and the contaminant(s), contaminant characteristics (e.g., highly mobile in water or adhering primarily to soil), and land use in overlying areas.

Several state programs are aimed at regulating groundwater quality and waste discharges. The State Water Board's Site Cleanup Program regulates and oversees the investigation and cleanup of sites where recent or historical unauthorized releases of pollutants have occurred. The types of pollutants encountered at these sites can be plentiful and diverse; they include solvents, pesticides, heavy metals, fuel constituents, and other pollutants. The regional water boards oversee activities pertaining to the cleanup of pollution at sites to ensure that the dischargers clean up and abate the effects of discharges in a manner that promotes attainment of either background water quality or the best water quality that is reasonable if background levels of water quality cannot be restored, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible. The Underground Storage Tanks Program addresses releases of petroleum and other hazardous substances from tanks.

Multiple regulatory programs focus on agricultural sources of groundwater pollution. The Irrigated Lands Regulatory Program (ILRP) regulates discharges from irrigated agricultural lands through waste discharge requirements (WDRs) or conditional waivers of WDRs (Orders) to growers. These Orders contain conditions requiring water quality monitoring of receiving waters and corrective actions when impairments are found. The Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) initiative has the goal of developing sustainable solutions to the increasing salt and nitrate concentrations that threaten the achievement of water quality objectives in Central Valley surface waters and groundwater. CV-SALTS requires actions that reduce nitrate discharges and should result in practices that reduce salt loading. Also, the General Order for Existing Milk Cow Dairies (R5-2007-0035) and National Pollutant Discharge Elimination System Dairy General Permit CAG015001 regulate discharges of waste to surface waters and groundwater from existing milk cow dairies in the Central Valley.

The Central Valley Regional Water Quality Control Board's (Central Valley Water Board) Oil and Gas Production Program regulates various types of constituent discharges from oil and gas well stimulation activities, including salts, metals, pesticides, radionuclides, volatile and semi-volatile compounds, and other oil field chemicals. In 2013, Governor Brown signed Senate Bill (SB) 4 (Pavley, Statutes of 2013), which set in place requirements for oil and gas operators, the Department of Conservation's Geologic Energy Management Division (formerly Division of Oil, Gas and Geothermal Resources), the State and regional water boards, and other agencies related to performing or permitting well stimulation treatments (Wat. Code, § 10783). During 2014, the Central Valley Water Board specifically added oil field discharges to land to its regulation. The Central Valley Water Board, working with the Governor's office and State Water Board, is addressing the significant issues associated with the land discharge of produced water (i.e., in surface impoundments or ponds) and will bring all pond operators under a consistent regulatory scheme. Enforcement orders and general WDRs will include requirements to conduct extensive characterization of wastewater (both flow and quality) and characterization of groundwater beneath each pond, with a determination of whether groundwater has been degraded (or polluted).

Domestic Water Supplies

Groundwater also is a source of drinking water for many communities and rural areas in California. Approximately 31 million Californians get a portion of their drinking water from a public water system that relies on groundwater for at least part of their drinking water supply (SWRCB 2020). Groundwater drinking water sources can be subject to a range of water quality issues that can affect public health. Unless otherwise designated by the regional water boards, all groundwater is considered suitable, or potentially suitable, for municipal or domestic water supply. The State Water Board's Division of Drinking Water regulates public water systems, which are defined under the Health and Safety Code (§ 116275). Public water systems are required to provide drinking water that meets all drinking water standards, as well as to conduct routine sampling and analysis of their drinking water supplies to certify compliance. Drinking water standards (maximum contaminant loads [MCLs]), are found in title 22 of the California Code of Regulations. In accordance with the California and federal Safe Drinking Water Acts, drinking water standards are set at levels necessary to protect the public from acute and chronic health risks associated with consuming contaminants in drinking water supplies, including groundwater. Primary MCLs address health concerns, and secondary MCLs address aesthetics such as taste and odor. MCLs address a range of water quality constituents, such as nitrate, which is the most commonly occurring anthropogenic contaminant in drinking water wells (^SWRCB 2013). The MCL for nitrate is 10 milligrams per liter for nitrate plus nitrite as nitrogen (or 45 milligrams per liter of nitrate as nitrate) established by the California Department of Public Health (Cal. Code Regs., tit. 22, § 64431).

A permit for operation from the Division of Drinking Water is required for public water systems. Private domestic wells are not regulated by the state and therefore are under no state requirements to be monitored, tested, or treated to meet the requirements of the California and federal Safe Drinking Water Act. As a result, water quality data for private domestic wells generally are limited. However, the State Water Board's GAMA Program, through its Domestic Well Project, samples private wells on a county level for well owners who volunteer when the project is active in their county. The GAMA Program uses the results to evaluate water quality of domestic wells. The GAMA Program's Priority Basins Project also has focused on collection of data from shallow aquifers in order to better characterize water quality at aquifers depths that are likely to contribute to the majority of private domestic wells in the basin[2] (SWRCB 2018a).

Private domestic wells may have more significant water quality issues compared with municipal drinking water wells. This likelihood rises in communities of color in California, which have some of the highest estimated arsenic, nitrate, and hexavalent chromium levels (Pace et al. 2022). Municipal drinking water wells typically do not exceed federal and state MCLs for water quality at the same frequency as private domestic wells in the same groundwater basin. This is because municipal wells generally are deep; and water quality tends to be better in deeper aquifers because infiltration of surface contaminants has not yet reached older, deeper portions of the aquifer. Furthermore, water quality is managed to the MCLs such that, if an exceedance of drinking water standards is found at a public well, the municipal water agency must take corrective action, including taking the well offline, to ensure that the water supply meets the MCL requirement before it is delivered to consumers. Conversely, private domestic wells used for drinking water may have more significant water quality issues than municipal wells because they are unregulated and often are shallower than municipal wells; therefore, they are more susceptible to surface contaminants. Contaminated shallow

[2] See: https://www.waterboards.ca.gov/water_issues/programs/gama/priority_basin_projects.html.

groundwater also may migrate in the aquifer and eventually can reach the zone of drinking water wells.

Private domestic well owners may be less able to absorb costs associated with declining groundwater elevations or degraded water quality compared with municipal drinking water suppliers. The State Water Board provided funding for replacement or deepening of private domestic wells affected by the 2012–2016 drought through its Cleanup and Abatement Account.[3] SB 108 (Senate Budget and Fiscal Review Committee) Statutes of 2017 also provided limited funding for replacement of private domestic wells that could no longer be used due to declining groundwater elevations. The State Water Board will promote and support future funding sources as appropriate.

Economically Disadvantaged Communities

In California, economically disadvantaged communities (DACs) often disproportionately experience impacts on their drinking water supplies. *DACs* are defined as those communities with an annual median household income that is less than 80 percent of the statewide annual median household income. (Pub. Resources Code, § 75005, subd. (g)).

DACs often are served by small public water systems and rely on groundwater either in whole or in part for their water supply. Their groundwater wells often are shallow and thus are more susceptible to water quality issues or the risk of going dry if the groundwater level is lowered. While the public water systems serving DACs still are required to maintain essential resources and meet public health requirements, these systems are less likely to have the resources (e.g., infrastructure and financing) of more affluent communities to respond adequately to water supply or water quality emergencies. Systems serving DACs may be unable to treat their water source, find alternative supplies for a contaminated drinking water source, deepen their wells, or build new wells. As a result, DACs may be more vulnerable than other municipalities and cities to impacts on groundwater supplies.

A subset of DACs comprises individuals who are low income and located outside of incorporated city boundaries (i.e., outside of city limits). These disadvantaged unincorporated communities (DUCs) often are people of color. DUCs risk significant violations of their human right to water because they lack political clout and economic resources (London et al. 2021). Some DUCs are *fringe communities*, meaning they exist within a city's spheres of influence but in areas that are not annexed. Other DUCs are *island communities*, areas surrounded by one or more cities but unincorporated; still others are *legacy communities*, located in more remote areas that lie beyond the growth boundaries of incorporated cities that have existed that way for at least 50 years. DUCs can be among the most underinvested communities and may lack safe and affordable drinking water, sewer systems, safe housing, public transportation, parks, sidewalks, and streetlights (^PolicyLink 2013).

The State Water Board is at the forefront of assisting DACs with obtaining clean, safe, and reliable water supplies. In doing so, the State Water Board is making its commitment to the human right to water through financial assistance, technical assistance, consolidations, and other means. For example, during the 2012–2016 drought emergency, the State Water Board made $19 million in Cleanup and Abatement Account funding available for DACs to address interim emergency drinking

[3] See: https://www.waterboards.ca.gov/water_issues/programs/grants_loans/caa/drinking_water_well.html.

water needs due to drought-related emergencies or threatened emergencies and contaminated water supplies (SWRCB 2016).

Many financial assistance programs include additional assistance for eligible DACs. During the 2012–2016 drought, many county and nonprofit programs provided financial assistance to communities with affected drinking water supplies. In addition, the State Water Board provides technical assistance to DACs and at-risk drinking water systems to identify potential solutions. State technical assistance programs provide help with preparing financial assistance applications; performing compliance audits; reviewing proposed projects and alternatives; planning and preparing budgets; and performing community outreach, awareness, and education. The Drinking Water State Revolving Fund and Proposition 1-eligible projects can assist publicly owned water systems (e.g., counties, cities, districts), privately owned community water systems (e.g., for-profit water utilities, nonprofit mutual water companies), and nonprofit or publicly owned noncommunity water systems (e.g., public school districts) with planning, design, and construction of drinking water infrastructure projects that improve the community's water efficiency and ensure a drought-resilient water supply. Potential solutions include stringent conservation measures, interconnections with other water systems (i.e., consolidation), development of new water sources, expansion of existing sources (e.g., deepen wells, extend reservoir intakes), and treatment of sources that produce water that does not meet drinking water quality standards. Locally implemented, cost-effective, and technically feasible strategies such as agricultural and municipal water conservation and efficiency, water reuse and recycling, and storm water capture are potential solutions as well. Triggers and responses are developed and implemented at the local level.

Sometimes the best solution for ensuring a safe drinking water supply is for a small, struggling water system to join a larger public water system. SB 88 (Committee on Budget and Fiscal Review), Statutes of 2015, amended the California Health and Safety Code sections 116680–116684 to authorize the State Water Board to require public water systems that consistently fail to meet standards to consolidate with, or obtain service from, a public water system. Consolidating public water systems and extending service from existing public water systems to communities and areas that currently rely on under-performing or failing water systems, as well as private wells, reduces costs and improves reliability (^SWRCB 2015), although consolidation may not always be feasible due to geographic constraints (Harter et al. 2012).

The State Water Board's Low-Income Water Rate Assistance (LIRA) program provides rate relief for low-income ratepayers of water utilities. The aim of the program is to counteract the increasing unaffordability of drinking water as a result of drought, water leaks, and aging pipes and infrastructure. The program offers cost-effective methods of assistance to low-income water customers besides rate assistance, including billing alternatives, installation of water conservation devices, and leak repair. *Low-income* refers to a household with income that is equal to or no greater than 200 percent of the federal poverty guidelines (SWRCB 2018b).

In July 2019, Governor Newsom signed SB 200 (Monning), which establishes the Safe and Affordable Drinking Water Fund to help local water systems provide safe drinking water over the near and long term. Among other statutory changes, the Safe and Affordable Drinking Water Fund will provide $130 million annually to enable the State Water Board to provide critical ongoing operations and maintenance support for small community water systems that are unable to meet safe drinking water standards (SWRCB 2019). As of November 2020, the State Water Board is developing an Expenditure Policy for the program and Expenditure Plan for 2020 to 2021 funds. The Board has started the comprehensive statewide needs assessment and developing the metrics to measure

SB 200 progress and objectives (LAO 2020). Closing this funding gap will allow the State Water Board to address the full array of issues that in the past have been barriers to solving water supply, infrastructure, and operational issues. This fund will provide crucial support for operations and maintenance so once-struggling systems can provide a sustainable source of safe drinking water. The money may be used to help fund operations and maintenance, consolidation with larger systems, provision of replacement water, and administrators to run the small systems.

Sacramento River Watershed

Groundwater Hydrology

Water in the groundwater basins in the Sacramento River watershed occurs primarily in alluvial basins and to some extent in the mountain and hard rock upland areas. The aquifer system is unconfined to semiconfined and lacks extensive confining subsurface clay layers (SWRCB 1999). Groundwater in the upper tributary watersheds is found in limited alluvial aquifers and within fractured bedrock. The hydrology of fractured bedrock aquifers is poorly understood, and well yields are highly variable.

Two large groundwater basins underlie the valley floor of the Sacramento River watershed: the Sacramento Valley basin and the Redding Area basin. The Sacramento Valley and Redding Area basins each consist of multiple subbasins. An additional 66 groundwater basins and subbasins are in the Sacramento River watershed, located in foothill and mountain areas above the valley floor; however, these alluvial basins are relatively small compared with the Sacramento Valley and Redding Area basins. (^DWR 2003)

The Sacramento Valley basin covers approximately 3.8 million acres, extending from the Red Bluff Arch at its northern boundary to the Cosumnes River at the southeastern boundary (DWR 2015a). The Sacramento Valley basin is one of the largest groundwater basins in California; it underlies all of Sutter County and parts of Yuba, Tehama, Glenn, Butte, Colusa, Yolo, Solano, Placer, and Sacramento Counties (DWR 2015a). The groundwater basin and subbasin boundaries do not completely align with the boundaries of the Sacramento River watershed. For example, portions of the South American subbasin underlie the Delta eastside tributaries region; and portions of the Solano, Yolo, and South American subbasins underlie the Delta region. This section identifies the basins and subbasins with the majority of their area located within the Sacramento River watershed.

The Redding Area basin, immediately north of the Sacramento Valley basin, is the second largest groundwater basin within the Sacramento River watershed. It covers approximately 389,370 acres (609 square miles) and extends from the Red Bluff Arch north to the city of Redding, underlying portions of Shasta and Tehama Counties.

Table 7.12.2-2 lists the medium- and high-priority basins and subbasins for which the majority of the basin underlies the Sacramento River watershed. Other basins and subbasins within the Sacramento River watershed are low- or very low-priority groundwater basins or are outside of the Sacramento Valley (Figure 7.12.2-1a). There are no critically overdrafted groundwater basins underlying the region. (CNRA 2022.)

Table 7.12.2-2. Medium-Priority and High-Priority Groundwater Subbasins—Sacramento River Watershed

Basin Number	Basin - Subbasin Name	Basin Priority
5-006.03	Redding Area - Anderson	Medium
5-006.04	Redding Area - Enterprise	Medium
5-012.01	Sierra Valley - Sierra Valley	Medium
5-021.50	Sacramento Valley - Red Bluff	Medium
5-021.51	Sacramento Valley - Corning	High
5-021.52	Sacramento Valley - Colusa	High
5-021.54	Sacramento Valley - Antelope	High
5-021.56	Sacramento Valley - Los Molinos	Medium
5-021.57	Sacramento Valley - Vina	High
5-021.60	Sacramento Valley - North Yuba	Medium
5-021.61	Sacramento Valley - South Yuba	High
5-021.62	Sacramento Valley - Sutter	Medium
5-021.64	Sacramento Valley - North American	High
5-021.65	Sacramento Valley - South American [a]	High
5-021.66	Sacramento Valley - Solano [b]	Medium
5-021.67	Sacramento Valley - Yolo [c]	High
5-021.69	Sacramento Valley - Wyandotte Creek	Medium
5-021.70	Sacramento Valley - Butte	Medium

Source: CNRA 2022.
[a] The Sacramento Valley – South American subbasin is primarily within the Sacramento River watershed although portions of it extend into the Delta eastside tributaries and Delta regions.
[b] The Sacramento Valley – Solano subbasin is primarily within the Sacramento River watershed although portions of it extend into the Delta and San Francisco Bay Area regions.
[c] The Sacramento Valley – Yolo subbasin is primarily within the Sacramento River watershed although a portion of it extends into the Delta region.

Based on 2005 to 2015 historical water deliveries data, the total annual water supply of the Sacramento River watershed is approximately 8,050 thousand acre-feet per year (TAF/yr) (see Section 2.8, *Existing Water Supply*). Groundwater supplies constitute approximately 2,679 TAF/yr (33 percent) of the average annual water supply for the region, which includes 2,272 TAF/yr for agricultural use, 387 TAF/yr for municipal use, and 20 TAF/yr for wetland/refuge (see Table 2.8-4 in Section 2.8). Groundwater extractions in the Sacramento River watershed account for approximately 17 percent of total groundwater extraction in California (DWR 2015a). Sacramento/Delta surface water supplies account for approximately 5,320 TAF/yr of the region's total water supply under the baseline condition as estimated by the Sacramento Water Allocation Model (SacWAM), including approximately 4,641 TAF/yr for agricultural uses, 480 TAF/yr for municipal uses, and the remaining 199 TAF/yr for wetland/refuge uses (see Table 2.8-4 in Section 2.8, *Existing Water Supply*).

The extent of surface water–groundwater interaction in the Sacramento River watershed varies geographically and temporally depending on hydrologic conditions. In general, however, the Sacramento and Feather Rivers act as drains and receive groundwater discharge during most of the year. These rivers therefore are considered gaining rivers, except in areas where groundwater levels are lower due to pumping—a situation that induces seepage from the rivers to the aquifer. Tributary streams to the Sacramento River from upland areas generally recharge groundwater in their upper reaches (i.e., losing streams) but may gain water from the groundwater system in their lower reaches closer to their confluences with the Sacramento River (GCID and NHI 2010).

Groundwater modeling studies of the Sacramento Valley basin suggest that, on average, the flux of groundwater discharging to the rivers is approximately equal to the quantity of water that recharges the aquifer system. In average years, stream gains from groundwater and stream losses to groundwater are each about 800 TAF per year (TAF/yr) (GCID and NHI 2010). Important areas of spring recharge from stream losses in the Sacramento Valley basin include Stony Creek, between Corning and Colusa subbasins; Thermalito Afterbay, near where the Feather River enters the Sacramento Valley basin; the Yuba River, adjacent to the North and South Yuba Rivers subbasin divide; the Bear River, along the northern border of the North American subbasin; Cache Creek where it exits the Capay Valley west of Woodland; and Putah Creek near Winters (DWR 2015a). Downstream of Red Bluff, large reaches of the Sacramento River system are gaining reaches during spring months due to shallow groundwater discharge to the river; they become losing reaches during summer, discharging to adjacent aquifers (DWR 2015a).

Groundwater levels tend to vary based on hydrologic conditions and groundwater demand, and generally are declining in several localized areas in the Sacramento River watershed. Between spring 2005 and spring 2010, groundwater elevation changes were within plus or minus 10 feet throughout the valley while groundwater elevations in some subbasins in the Sacramento Valley declined 20 feet or more. (DWR 2015a). Some areas in the Sacramento Valley basin with a high demand for groundwater supplies are experiencing somewhat persistent drawdown in groundwater levels, including areas in Glenn County, northern Sacramento County, and areas near Chico (^DSC 2011). The western portion of the Sacramento Valley generally exhibits greater groundwater overdraft and groundwater level declines compared with areas east of the Sacramento River due to differences in aquifer properties and surface water availability. Figure 7.12.2-3 illustrates the change in groundwater elevation from 2010 to 2020 and shows a groundwater level change decrease of greater than 10 feet along the western valley margin based on information available through DWR's SGMA Data Viewer. Figure 7.12.2-4 shows spring 2020 groundwater elevations in the Sacramento River watershed and Delta eastside tributaries regions and shows several cones of depression. Areas of declining groundwater elevations generally overlie areas not served by water districts as well as areas served by the Orland-Artois and Colusa County Water Districts and the South Sutter Water District. Some of the challenges facing these areas include expansion of agriculture into new areas, conversion of annual crops to permanent crops, and groundwater pumping by non-district entities. In the Davis-Woodland area, a significant increase in groundwater elevation reflects the change in municipal water source from groundwater to surface water in 2016.

Groundwater Quality

In general, groundwater quality in the Sacramento River watershed is adequate for agricultural irrigation and municipal uses, although there are areas with compromised local groundwater quality due to naturally occurring water quality impairments as well as anthropogenic impairments. For example, naturally occurring groundwater quality impairments occur in the Redding Area and Sacramento Valley basins due to high levels of total dissolved solids (TDS) (salts, chlorides, iron, and manganese). In some volcanic and geothermal areas of the region, groundwater quality is impaired due to hydrogen sulfide. High concentrations of arsenic have been identified in wells in the center of the Sacramento Valley basin along the Sacramento and Feather Rivers. Boron has been identified at concentrations greater than the human-health notification level of 1,000 micrograms per liter in the southern and middle portions of the Sacramento Valley basin along Cache and Putah Creeks (DWR 2015a).

Among approximately 1,200 active community water system (CWS) wells in the Sacramento River watershed, approximately 8 percent were affected by one or more chemical contaminants that exceeded an MCL during the 2002 to 2010 period (^SWRCB 2013; DWR 2015a). Many of these wells are in urban areas such as Sacramento and its surroundings and the Marysville area; others are in rural areas throughout the region (^SWRCB 2013). Arsenic, nitrate, tetrachloroethylene, and gross alpha-particle activity[4] are among the most prevalent groundwater contaminants in CWS wells in the region (DWR 2015a).

Although the majority of the Sacramento River watershed's groundwater supply is used for agricultural irrigation, domestic wells are far more numerous than agricultural irrigation wells. Domestic wells represent approximately 72 percent of all wells installed in the region (1977–2010); whereas public supply wells, irrigation wells, and monitoring wells account for approximately 2 percent, 6 percent, and 15 percent, respectively (DWR 2015a). Nevada, Placer, El Dorado, Butte, Tehama, and Shasta Counties have the most domestic groundwater wells in the region; Sacramento, Yolo, and Solano Counties have a lower than average percentage of domestic wells relative to the total number of wells for each county in the region (DWR 2015a). As part of the State Water Board's GAMA Program Domestic Well Project, wells have been sampled in El Dorado, Tehama, and Yuba Counties. In these three counties, multiple wells are affected by one or more chemical contaminants (e.g., arsenic, nitrate, aluminum) that exceed an MCL for drinking water standards (SWRCB 2018c; DWR 2015a).

Delta Eastside Tributaries

Groundwater Hydrology

Table 7.12.2-3 lists the medium- and high-priority basins and subbasins for which the majority of the basin underlies the Delta eastside tributaries region and identifies that one of the basins is designated as critically overdrafted (also see Figure 7.12.2-1a). There are no low- or very low-priority groundwater basins in this region. (CNRA 2022.)

Table 7.12.2-3. Medium-Priority and High-Priority Groundwater Subbasins—Delta Eastside Tributaries Region

Basin Number	Basin - Subbasin Name	Basin Priority
5-022.01	San Joaquin Valley - Eastern San Joaquin [a]	High (critically overdrafted)
5-022.16	San Joaquin Valley - Cosumnes [b]	Medium

Source: CNRA 2022.
[a] The San Joaquin Valley - Eastern San Joaquin subbasin is primarily within the Delta eastside tributaries region although portions of it extend into the Delta and San Joaquin Valley regions.
[b] The San Joaquin Valley - Cosumnes subbasin is primarily within the Delta eastside tributaries region although a portion of it extends into the Delta region.

Based on 2005 to 2015 historical water deliveries data, the average annual total water supply of the Delta eastside tributaries region is approximately 986 TAF/yr (see Section 2.8, *Existing Water*

[4] Gross alpha particle activity is a measure of the total radioactivity in a water sample attributable to the radioactive decay of alpha-emitting elements.

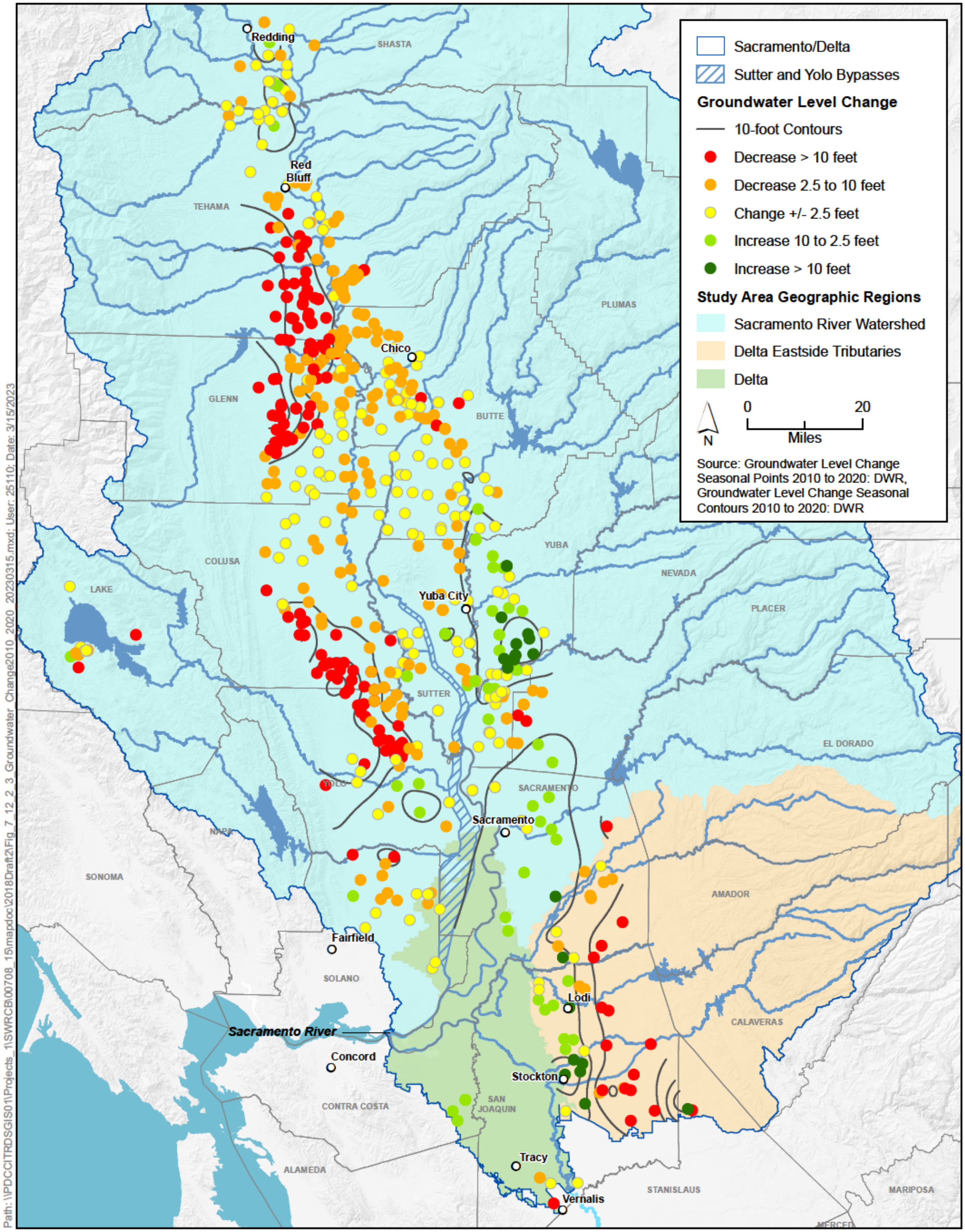
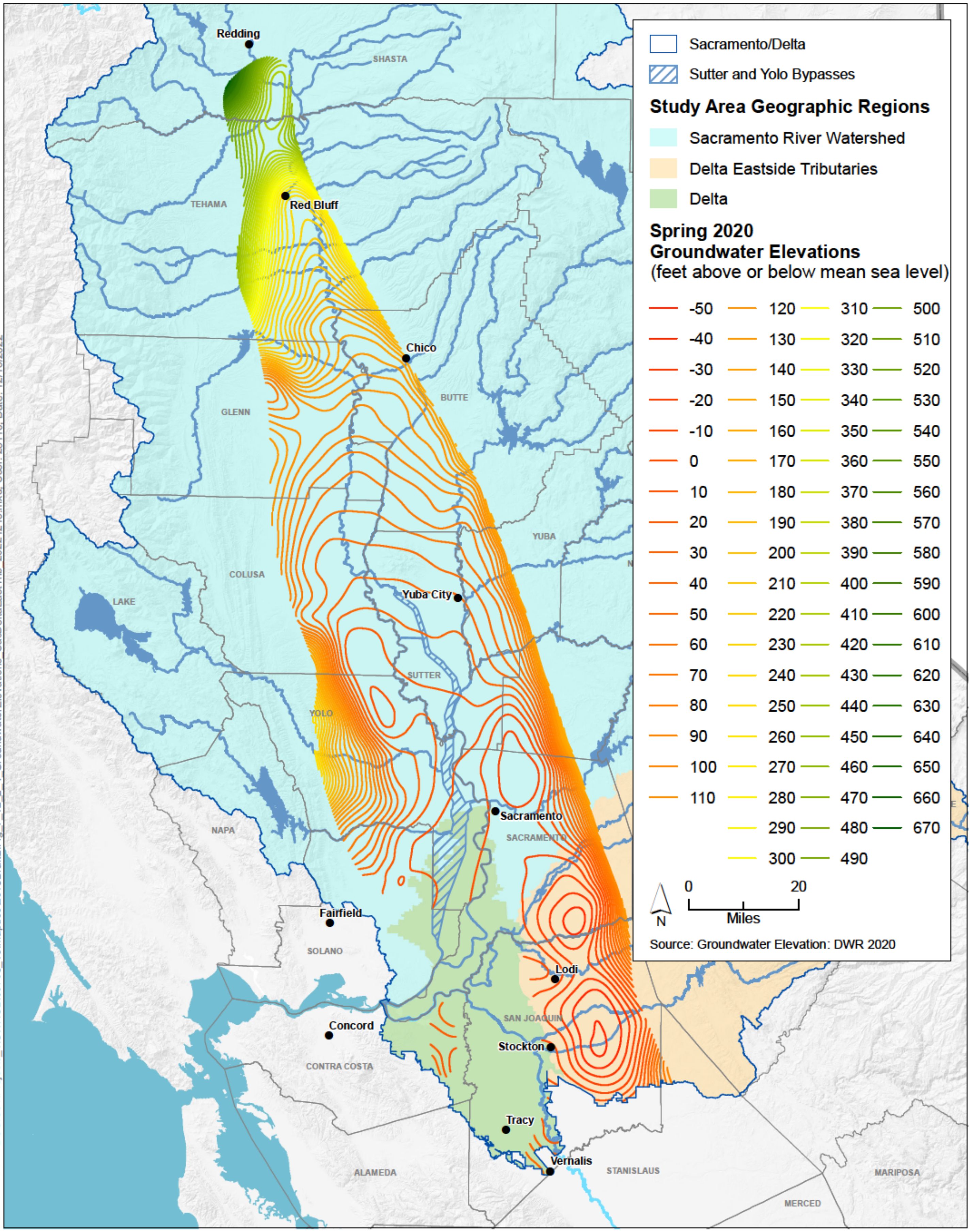


Figure 7.12.2-3
Change in Groundwater Elevation from Spring 2010 to Spring 2020 in the Sacramento/Delta



Path: \\PDCCITRDSGIS01\Projects_1\SWRCB\00708_15\mapdoc\2018Draft2\Fig_7_12_2_4_GroundwaterElevations_SacDeltaEastTrib_20221215.mxd; User: 25110; Date: 12/15/2022

Figure 7.12.2-4
Groundwater Elevations in the Sacramento/Delta

Supply). Groundwater supplies constitute approximately 597 TAF/yr (61 percent) of the average annual water supply for the region, which includes approximately 545 TAF/yr for agricultural use, 53 TAF/yr for municipal use, and less than 1 TAF/yr for wetland/refuge use (see Table 2.8-5 in Section 2.8). Sacramento/Delta surface water supplies account for approximately 205 TAF/yr of the region's total supplies under the baseline condition as estimated by SacWAM, including approximately 124 TAF/yr for agricultural uses and approximately 81 TAF/yr for municipal uses (see Table 2.8-5 in Section 2.8, *Existing Water Supply*). The region also uses some surface water supplies that originate outside of the Sacramento/Delta.

Several substantial areas of depressed groundwater elevations (cone of depression or localized overdraft) exist in the Delta eastside tributaries region, centered between Elk Grove and Stockton (see Figures 7.12.2-3 and 7.12.2-4). Portions of these cones of depression underlie the Cosumnes, Mokelumne, and Calaveras Rivers; and streambed seepage (stream loss to groundwater) occurs as the water courses pass over the aquifer. Groundwater elevation data from the DWR Groundwater Information Center indicate that the magnitude of the cones of depression varies seasonally, with substantial water level recovery beneath the Mokelumne River during winter and substantially less recovery near the Calaveras and Cosumnes Rivers.

Studies of surface water–groundwater interactions in the lower Cosumnes River indicate average summer and fall flow losses in the 36-mile reach between Rancho Murieta and the confluence with the Mokelumne River of 1 to 2 cubic feet per second per river mile (Mount et al. 2011). During low-flow periods, this depletion can fully dewater the overlying river. Groundwater levels in this vicinity range from 7 to 20 feet below ground surface (bgs) near Rancho Murieta, decrease to approximately 35 to 55 feet bgs near Wilton, and then increase to 3 to 15 feet bgs near Twin Cities Road (Mount et al. 2011). The Cosumnes River is considered a losing reach and is disconnected from the underlying aquifer across most of the lower 36-mile reach.

Generally, groundwater movement in the Eastern San Joaquin subbasin is coincidental with area surface water flows, which move toward the Delta (^DSC 2011). In several areas, however, groundwater flows toward localized pumping depressions, such as those in the Eastern San Joaquin subbasin below Stockton, east of Stockton, and east of Lodi (DWR 2015a). In areas such as eastern San Joaquin County, groundwater levels have continuously declined over the past 40 years (^DSC 2011). Current and historical groundwater pumping rates exceed the sustainable yield of the underlying groundwater basin on an average annual basis (San Joaquin County Department of Public Works 2004). Based on information obtained through DWR's Groundwater Information Center Interactive Map Application, groundwater levels in the Delta eastside tributaries region declined between spring 2010 and spring 2015 by up to approximately 17 feet in some areas in the Cosumnes subbasin and up to approximately 25 feet in some areas in the Eastern San Joaquin subbasin (DWR 2016a). Because of existing groundwater overdraft, some water suppliers in the region have diversified their supply sources in recent years and reduced their reliance on groundwater, including using surface water supplies from New Melones Reservoir, accessing supplies from the Delta through the Stockton Delta Water Supply Project, and implementing recharge projects such as the Farmington Groundwater Recharge Program (SEWD 2016; City of Stockton 2016).

Groundwater Quality

Groundwater quality in the Cosumnes and Eastern San Joaquin subbasins is generally adequate for agricultural irrigation and municipal uses The Eastern San Joaquin subbasin underlies both agricultural areas, such as Lodi, and urbanized areas, such as Stockton; relatively large areas of elevated nitrate in the groundwater have been identified in the subbasin southeast of Lodi and south of Stockton and east of Manteca, extending toward the San Joaquin–Stanislaus County line (DWR 2015a). In this area, groundwater pumping is much higher for agricultural uses than for municipal uses (City of Stockton 2016).

High concentrations of some contaminants, such as arsenic, manganese, TDS, and nitrate have been detected in some Eastern San Joaquin subbasin wells (USGS 2010). In the Eastern San Joaquin subbasin, lateral inflow of higher salinity water from the west has occurred as a result of declines in groundwater levels and could render parts of the aquifer unusable (San Joaquin County Department of Public Works 2004). Degradation of water quality due to TDS or chloride contamination threatens the long-term sustainability of this resource because water high in TDS and/or chloride is unusable either for drinking water needs or for irrigating crops. Damage to the aquifer system could be irreversible due to saline water intrusion, withdrawal of groundwater from storage, and potentially subsidence and aquifer consolidation. Additional sampling of public water supply wells in the Eastern San Joaquin subbasin indicated arsenic levels above the MCL in over 20 grid wells; manganese concentrations above the secondary MCL in over 20 grid wells; and concentrations of above MCLs in over 20 grid wells sampled (USGS 2010).

Delta

Groundwater Hydrology

Table 7.12.2-4 lists the medium-priority basins and subbasins for which the majority of the basin underlies the Delta region (also see Figure 7.12.2-1a). There are no low- or very low-priority basins in the region. (CNRA 2022.)

Table 7.12.2-4. Medium-Priority Groundwater Subbasins—Delta Region

Basin Number	Basin - Subbasin Name	Basin Priority
5-022.15	San Joaquin Valley - Tracy [a]	Medium
5-022.19	San Joaquin Valley - East Contra Costa [b]	Medium

Source: CNRA 2022.
[a] The San Joaquin Valley - Tracy subbasin is primarily within the Delta region although small portions of it extend into the Delta eastside tributaries, San Francisco Bay Area, and San Joaquin Valley regions.
[b] The San Joaquin Valley – East Contra Costa subbasin is primarily within the Delta region although a portion of it extends into the San Francisco Bay Area region.

Groundwater levels vary seasonally in the Delta; levels are influenced by precipitation, drainage, soil texture, and proximity to and levels of adjoining surface waters (^2013 Water Plan V2, Sacramento-San Joaquin Delta). In the central Delta, groundwater levels are shallow and close to the surface on several Delta islands because of land subsidence resulting from land reclamation and farming, which exposed previously wet peat soils to air and caused them to decompose. In areas where shallow groundwater levels encroach on crop root zones, groundwater pumping is used to drain waterlogged agricultural fields (^DSC 2011). Increased spring flows in the Sacramento and San Joaquin Rivers and their tributaries result in an increase in groundwater levels near these rivers. Groundwater levels also are influenced by the tidal flows.

Based on 2005 to 2015 historical water deliveries data, the total annual water supply of the Delta is approximately 1,368 TAF/yr (see Section 2.8, *Existing Water Supply*). Groundwater supplies constitute approximately 74 TAF/yr (5 percent) of the average annual water supply for the region, which includes approximately 34 TAF/yr for agricultural use and approximately 40 TAF/yr for municipal use (see Table 2.8-6 in Section 2.8). Groundwater in the Delta is not used for wetlands/refuges. While some groundwater is used for agriculture, the ease of diverting surface water from adjacent water sources makes the use of groundwater much less than in other agricultural regions (^2013 Water Plan V2, Sacramento-San Joaquin Delta). Residential water supplies primarily are drawn through private wells, although several CWS wells serve a small fraction of Delta residential water use (^2013 Water Plan V2, Sacramento-San Joaquin Delta).

Sacramento/Delta surface water supplies account for approximately 1,154 TAF/yr of the region's total supplies under the baseline condition as estimated by SacWAM, including approximately 1,136 TAF/yr for agricultural uses and approximately 18 TAF/yr for municipal uses (see Table 2.8-6 in Section 2.8, *Existing Water Supply*).

Groundwater Quality

Groundwater quality in the Delta region varies by geography and depth, with the following contaminants present in some locations: arsenic, organic compounds, nitrates, and hexavalent chromium (^2013 Water Plan V2, Sacramento-San Joaquin Delta). Arsenic primarily is naturally occurring in groundwater in the Delta. Groundwater quality typically reflects the water quality in the channels that surround the Delta islands. For example, groundwater under the islands farthest west is more likely to have slightly higher concentrations of salt, as exemplified by elevated TDS and chloride concentrations, because these islands are closer to the San Francisco Bay. At shallow groundwater depths, water often is saline and not suitable for most beneficial uses (^DSC 2011). Areas of elevated chloride also occurs in several areas of the Tracy subbasin (USGS 2010). Organic constituents in the peat soils of the Delta islands also can be found in the groundwater. Groundwater quality generally is suitable for agricultural irrigation and municipal uses, with local water quality issues that may affect specific uses. Likewise, the quality of the groundwater is suitable for drinking water, with localized spots where quality is impaired by naturally occurring compounds or by anthropogenic sources. Over 20 CWSs, mostly small systems (fewer than 3,300 people), have been identified as relying on at least one contaminated groundwater well, with arsenic the most common pollutant (^SWRCB 2013; ^2013 Water Plan V2, Sacramento-San Joaquin Delta).

Nitrate is elevated near the southern part of Tracy (USGS 2010). Water quality monitoring of groundwater wells in the Tracy subbasin indicate that arsenic and boron are present in concentrations exceeding the primary MCL for these constituents. Manganese, iron, TDS, chloride, and sulfate are present in concentrations that exceed the secondary MCL (USGS 2010).

San Francisco Bay Area

Groundwater Hydrology

Table 7.12.2-5 lists the medium-priority basins and subbasins for which the majority of the basin underlies the San Francisco Bay Area (Bay Area) region. There are also low- and very low-priority groundwater basins within the region (Figure 7.12.2-1a). There are no critically overdrafted groundwater basins underlying the region. (CNRA 2022.)

Table 7.12.2-5. Medium-Priority and High-Priority Groundwater Subbasins—San Francisco Bay Area Region

Basin Number	Basin - Subbasin Name	Basin Priority
1-055.01	Santa Rosa Valley - Santa Rosa Plain	Medium
2-001	Petaluma Valley	Medium
2-002.01	Napa-Sonoma Valley - Napa Valley	High
2-002.02	Napa-Sonoma Valley - Sonoma Valley	High
2-009.01	Santa Clara Valley - Niles Cone	Medium
2-009.02	Santa Clara Valley - Santa Clara [a]	High
2-009.04	Santa Clara Valley - East Bay Plain	Medium
2-010	Livermore Valley	Medium

Source: CNRA 2022.
[a] The Santa Clara Valley - Santa Clara subbasin is primarily within the San Francisco Bay Area region although a small portion of it extends into the Central Coast region.

Based on 2005 to 2015 historical water deliveries data, the total annual water supply of the Bay Area is approximately 1,251 TAF/yr (see Section 2.8, *Existing Water Supply*). Groundwater supplies constitute approximately 264 TAF/yr (21 percent) of the average annual water supply for the region, which includes approximately 80 TAF/yr for agricultural use and 184 TAF/yr for municipal use (see Table 2.8-7 in Section 2.8). Groundwater in this region is not used for managed wetlands (wetland/refuge).

Sacramento/Delta surface water supplies account for approximately 698 TAF/yr (55 percent) of the region's total supplies under the baseline condition as estimated by SacWAM, including approximately 670 TAF/yr (96 percent) for municipal uses and 27 TAF/yr (4 percent) for agricultural use (see Table 2.8-7 in Section 2.8, *Existing Water Supply*).

Sacramento/Delta surface water supplies are delivered to portions of Napa, Solano, Contra Costa, Alameda, and Santa Clara Counties, primarily through SWP and CVP conveyances and East Bay Municipal Utilities District's (EBMUD's) Mokelumne Aqueduct (Figure 2.8-3a). Major municipal users in the Bay Area that receive Sacramento/Delta water supplies under CVP or SWP contracts include Santa Clara Valley Water District (Valley Water, formerly referred to as SCVWD), Contra Costa Water District, and Alameda County Water District (ACWD) and Alameda County Flood Control and Water Conservation District (Zone 7) (see Section 2.8, *Existing Water Supply*). Contra Costa Water District also pumps Delta water through its own facilities, and all of these agencies have other sources of water in addition to their CVP and SWP contracts. EBMUD uses the Mokelumne River as its primary water source, which can be supplemented with CVP contract supplies taken at Freeport on the Sacramento River during drought periods. Sacramento/Delta water supplies are not delivered to Sonoma, Marin, San Francisco, or San Mateo Counties.

EBMUD's service area is in the Bay Area region. EBMUD's water supply service area overlies the Santa Clara Valley, Ygnacio Valley, San Ramon Valley, Livermore Valley, and Castro Valley basins. Prior to 1930, groundwater supplies accounted for a significant portion of the East Bay Area's water supply, which resulted in groundwater overdraft as water demands increased into the 1920s. Most wells were abandoned as overdraft of individual well fields resulted in seawater intrusion into the shallow aquifers. EBMUD began to import water from Mokelumne River water at Pardee Dam in 1929, and EBMUD's reliance on groundwater diminished rapidly in most areas (EBMUD 2013).

At the south end of the San Francisco Bay, Valley Water manages the Santa Clara subbasin, a high-priority groundwater subbasin that is not critically overdrafted. The history of groundwater use within the Santa Clara subbasin is similar to that of EBMUD's service area (described above) and includes reliance on groundwater following the Gold Rush, increasing demands in the early 1900s; saline water intrusion resulting from groundwater overdraft; and, more recently, acquisition of imported surface water to supplement local supplies. Between 1915 and 1970, land in the Valley Water service area subsided approximately 13 feet due to groundwater overdraft and compaction of fine-grained sediments in the aquifer (^SCVWD 2016). Local surface water storage completed in the early 1930s enabled Valley Water to begin to manage groundwater recharge into the overdrafted aquifer, allowing groundwater levels to increase through 1947 and subsidence to nearly cease. Dry conditions in the late 1940s coupled with rapid population growth in the 1950s led to increased subsidence and overdraft, which continued until SWP deliveries to Valley Water began in the 1960s. CVP deliveries to Valley Water began in 1987.

Surface water and precipitation in the Santa Clara Valley now are used to recharge the aquifer through groundwater infiltration basins. Sacramento/Delta surface water supplies also are used to recharge aquifers in this area. Although groundwater remains a significant source of supply for communities in the Santa Clara Valley, in recent decades, groundwater levels have recovered from overdraft; levels tend to follow the hydrologic cycle, with increasing groundwater storage and levels during wet periods and declining storage and levels during dry periods. Valley Water, under its former name of Santa Clara Valley Water District, is designated in SGMA as the exclusive local agency to manage groundwater within its boundaries (Wat. Code, § 10723(c)(1)(P)). Valley Water currently uses a groundwater recharge and conjunctive use program, where water supplied from the Sacramento/Delta watershed and other surface water sources are used for recharge to support groundwater levels and minimize saltwater intrusion and land subsidence. Valley Water also relies on groundwater banking facilities outside the district, including the Semitropic Water Storage District (see *San Joaquin Valley* discussion below).

ACWD manages and receives a significant portion of its water supply from the Santa Clara Valley-Niles Cone subbasin, which is identified as a medium-priority groundwater basin but not critically overdrafted in the SGMA 2019 Basin Prioritization. Similar to Valley Water's subbasins, this groundwater subbasin was severely overdrafted by the 1960s but rebounded through use of imported SWP water for groundwater recharge. Like Valley Water, ACWD is designated in SGMA as the exclusive local agency to manage groundwater within its jurisdiction (Wat. Code, § 10723(c)(1)(B)). The subbasin is conjunctively managed with local runoff and imported water used for groundwater recharge. ACWD also operates the Newark Desalination Facility. This facility overlies the Santa Clara Valley-Niles Cone subbasin and treats up to 10 million gallons per day of brackish groundwater for blending into the municipal water supply (^ACWD 2015).

Groundwater also is used in the Bay Area for agricultural irrigation. In Santa Clara County, most agricultural water is supplied from groundwater (SCVWD 2017) (also see Table 7.4-2 in Section 7.4, *Agriculture and Forest Resources*). In Napa County, groundwater constitutes approximately 80 percent of the county's agricultural water supply (^West Yost & Associates 2005).

Suisun Marsh overlies the Suisun-Fairfield Valley basin (a low-priority basin), which is bounded on the north by the Vaca Mountains, on the west by the Coast Ranges foothills, and on the east by low ridges of consolidated rock near Vacaville extending southeast to the Montezuma Hills (DWR 2015a). Due to poor water quality and low yield, the Suisun-Fairfield Valley basin is not used in a major capacity (Luhdorff & Scalmanini Consulting Engineers 2014).

Groundwater Quality

Groundwater quality in the Bay Area is variable, with water quality suitable for most agricultural irrigation and municipal uses in some areas, along with some local impairments. The primary constituents of concern are elevated TDS, nitrate, boron, and organic compounds. The areas of elevated TDS and chloride concentrations typically are found in the shallow aquifers surrounding the San Francisco Bay, such as the southern Sonoma Valley and Napa Valley subbasins, and the northern Santa Clara Valley and Petaluma Valley basins (DWR 2015a). Seawater intrusion has occurred along the perimeter of the San Francisco Bay, in part due to the placement of artificial fill soils in the bay for development purposes over many decades and due to groundwater production in excess of natural and artificial recharge. For example, saltwater intrusion has occurred in the Niles Cone subbasin during historical periods of overdrafting, which has degraded groundwater quality in some areas (^ACWD 2015).

The shallow aquifer zone in the Petaluma Valley basin shows widespread and serious nitrate contamination (DWR 2014b). Groundwater with high TDS, iron, and boron concentrations is present in the Calistoga area of the Napa Valley; and elevated boron levels in other parts of the Napa Valley subbasin make the water unfit for agricultural uses in these areas (^DWR 2003). Boron has been identified at concentrations greater than the human-health notification level of 1,000 micrograms per liter in wells near the outlet of the Delta to Suisun Bay, likely associated with estuarine sediments in that area (DWR 2015a).

VOCs, semi-volatile organic compounds (SVOC), and other organic contaminants have affected groundwater at sites such as the former Hunter's Point Naval Shipyard in San Francisco County, Moffett Field in Santa Clara County, and brownfield sites. As of 2010, there were over 800 active groundwater clean-up sites in the region (DWR 2015a). For the period of 2002 to 2010, approximately 28 public supply wells serving 18 CWSs were identified as affected by various forms of groundwater contamination (^SWRCB 2013; DWR 2015a). Releases of fuel hydrocarbons from leaking underground storage tanks and spills/leaks of organic solvents at industrial sites have caused minor to significant effects on groundwater in many basins throughout the region. Methyl tertiary-butyl ether and chlorinated solvent releases to soil and groundwater continue to be problematic. Environmental oversight for many of these sites is performed either by local city and county enforcement agencies, the regional water boards, the Department of Toxic Substances Control, and/or the U. S. Environmental Protection Agency.

In Suisun Marsh, groundwater in an area east of Fairfield has elevated levels of boron (DWR 2014c), and VOC contamination has been identified near Travis Air Force Base (^DWR and Reclamation 2016). Additionally, in an area south of Fairfield near the tidal marsh, brackish groundwater could intrude if groundwater drawdown occurs (DWR 2014c).

San Joaquin Valley

Groundwater Hydrology

There are numerous groundwater basins and subbasins within the San Joaquin Valley region, including the very large San Joaquin Valley basin, which also underlies most of the Delta eastside tributaries region. The San Joaquin Valley basin is divided into several subbasins, primarily using surface water features as the boundaries; the San Joaquin River separates the eastern from western portions of the valley floor, and major Sierra Nevada rivers subdivide the basin east of the San

Joaquin River. There are three adjudicated judgement areas in the San Joaquin Valley region; one area (A18) is also within the Southern California region (Figure 7.12.2-2 and Table 7.12.2-1).

Table 7.12.2-6 lists the medium- and high-priority basins and subbasins for which the majority of the basin underlies San Joaquin Valley region and identifies the basins that are critically overdrafted. There are also low- and very low-priority groundwater basins within the region (Figures 7.12.2-1a and 7.12.2-1b). (CNRA 2022.)

Table 7.12.2-6. Medium-Priority and High-Priority Groundwater Subbasins—San Joaquin Valley

Basin Number	Basin - Subbasin Name	Basin Priority
5-022.02	San Joaquin Valley - Modesto	High
5-022.03	San Joaquin Valley - Turlock	High
5-022.04	San Joaquin Valley - Merced	High (critically overdrafted)
5-022.05	San Joaquin Valley - Chowchilla	High (critically overdrafted)
5-022.06	San Joaquin Valley - Madera	High (critically overdrafted)
5-022.07	San Joaquin Valley - Delta-Mendota [a]	High (critically overdrafted)
5-022.08	San Joaquin Valley - Kings	High (critically overdrafted)
5-022.09	San Joaquin Valley - Westside	High (critically overdrafted)
5-022.10	San Joaquin Valley - Pleasant Valley	Medium
5-022.11	San Joaquin Valley - Kaweah	High (critically overdrafted)
5-022.12	San Joaquin Valley - Tulare Lake	High (critically overdrafted)
5-022.13	San Joaquin Valley - Tule	High (critically overdrafted)
5-022.14	San Joaquin Valley - Kern County	High (critically overdrafted)
5-022.18	San Joaquin Valley - White Wolf	Medium

Source: CNRA 2022.
[a] The San Joaquin Valley-Delta-Mendota subbasin is primarily within the San Joaquin Valley region although a small portion of it extends into the Delta region.

The floor of the San Joaquin Valley consists of alluvium originating from adjacent mountain ranges and distributed primarily by fluvial action. Some clay layers, including the Corcoran Clay layer that underlies much of the southern and western portion of the San Joaquin Valley, are laterally extensive and divide the groundwater flow system into an upper semi-confined aquifer zone and a lower confined aquifer zone. Beneath the Corcoran Clay layer lies more homogeneous alluvium, which serves as the primary aquifer in the southern and western valley floor. Most water entering the upper soil layers leaves through evapotranspiration or is actively drained to protect crops from standing water in their root zones. Groundwater recharge in the semi-confined aquifer of the basin varies by geology and land use but generally originates from stream seepage, rainfall percolation, and subsurface flow along basin boundaries. Groundwater recharge also occurs from conveyance losses, deep percolation of applied water, and groundwater storage and recovery programs (DWR 2015a).

On the west side of the San Joaquin Valley, the nature of recharge to the confined aquifer below the Corcoran Clay has changed significantly from pre-development to post-development conditions. Under pre-development conditions, because of the impermeable nature of the Corcoran Clay, recharge to the confined zone primarily was lateral flow of water from the east originating as runoff in the Sierra Nevada (USGS 1999). However, construction of irrigation wells that traverse the confining layer has greatly increased hydraulic connectivity and leakage between the upper and lower zones of the aquifer (Faunt 2009; Davis et al. 1964) estimated that 100 TAF/yr flowed between these two zones in the western part of the San Joaquin Valley in the early 1960s; more recent modeling, though not providing an exact estimate for the same area, also estimated that such leakage is significant (Faunt 2009). Hence on the west side of the San Joaquin Valley, irrigation with groundwater and imported surface water has become a significant source of recharge (USGS and SWRCB 2017). Artificial recharge programs using surface water supplies also are widespread in Kern County and the southeast portion of the valley (PPIC 2018).

Based on 2005 to 2015 historical water deliveries data, the total water supply in the San Joaquin Valley region is approximately 18,437 TAF/yr (see Section 2.8, *Existing Water Supply*). Groundwater supplies constitute approximately 10,107 TAF/yr (55 percent) of the average annual water supply for the region, which includes approximately 9,034 TAF/yr for agricultural use, 823 TAF/yr for municipal use, and 251 TAF/yr for wetland/refuge use (see Table 2.8-8 in Section 2.8). Between 1977 and 2010, domestic wells accounted for approximately 65 percent of the total number of wells in the region (DWR 2015a).

Sacramento/Delta surface water supplies account for approximately 2,819 TAF/yr (15 percent) of the region's total water supplies under the baseline condition as estimated by SacWAM, including approximately 2,422 TAF/yr for agricultural use, 99 TAF/yr for municipal use, and 298 TAF/yr for wetland/refuge use (see Table 2.8-8 in Section 2.8, *Existing Water Supply*).

The San Joaquin Valley has a history of high groundwater use, which has resulted in overdraft. Prior to the 1960s, groundwater discharged to streams in much of the San Joaquin River watershed; with increased groundwater pumping over the years, however, the hydraulic gradient between surface water and groundwater systems reversed such that surface water recharges the underlying aquifer (^DSC 2011). Long-term groundwater pumping has lowered groundwater levels, and most streams lose water to the underlying aquifers (^DSC 2011). Groundwater generally moves from high ground down toward the San Joaquin River and Delta. However, groundwater also may move into areas of substantial drawdown, such as toward the cone of depression in the eastern half of the Turlock subbasin or the high groundwater pumping areas west of the San Joaquin River (^USGS 2015).

Sacramento/Delta Supplies

Sacramento/Delta water supplies are delivered to the western and southern portions of the San Joaquin Valley. In addition, Sacramento/Delta supply can affect the CVP Friant Division service area. Groundwater use in these areas is described separately in the following subsections.

Western San Joaquin Valley

Several CVP contractors, including Westlands Water District, are located in the western portion of the San Joaquin Valley, west of the San Joaquin River. Conditions in the Westlands Water District service area are generally representative of conditions in this portion of the San Joaquin Valley and provide an example of the effects of groundwater pumping in this portion of the San Joaquin Valley. Of the numerous CVP contractors receiving Sacramento/Delta surface water supplies, the Westlands Water District has the largest CVP allocation dedicated to agricultural users.

An extensive confining clay layer separates the shallow semi-confined portion of the aquifer from the deeper confined portion of the aquifer throughout much of the Tulare Lake area and western San Joaquin Valley (Westlands Water Quality Coalition 2015). Most groundwater pumping in the Westlands Water District service area comes from the lower zone below the clay layer, and recharge enters the lower zone laterally from the Coast Ranges and areas east of the San Joaquin River. Percolating precipitation and applied irrigation water build up in the upper zone, leading to both water quality problems and issues with perched water in crop root zones. Farmers use tile drains and other active drainage techniques to maintain the water table beneath the crop root zone. Also, water is applied to crops in excess of the crop water needs in order to maintain naturally occurring and anthropogenic-derived salt levels in the root zone at a level that does not affect crop yields. Areas within this portion of the San Joaquin Valley have a history of high groundwater pumping rates. Groundwater pumping levels increased drastically from 1935 through the early 1950s and stayed at high levels through the late 1960s, causing groundwater elevations to fall to 156 feet below mean sea level by 1967 and leading to compaction in the aquifer and subsidence of up to 24 feet (Westlands Water District 2013). Beginning in 1968, delivery of CVP water supplies to the Westlands Water District area allowed for aquifer level recovery such that, by 1987, local groundwater elevations had reached 89 feet above mean sea level. However, the impact of subsidence and overdraft on sustainable yield of the aquifer has been considerable, and it is estimated that sustainable yields of the confined aquifer in this area have been greatly reduced.

Water demand in this area remains high. Westlands Water District has CVP contracts for approximately 1.2 MAF (Reclamation 2016), although actual CVP deliveries typically are lower than the maximum contract amount. Growers in the district attempt to make up the water demand deficit with groundwater pumping, water transfers, user-acquired supplies, other district supplies, and land fallowing. Groundwater use tends to be higher during drier periods when surface water is generally less available. While subsidence has been greatly reduced since the late 1960s, it still occurs during periods of heavy groundwater pumping (see Section 7.9, *Geology and Soils*, for additional information on subsidence).

Southern San Joaquin Valley

Several SWP contractors in the southern portion of the San Joaquin Valley (e.g., Kern County area) receive Sacramento/Delta water supplies. Because most groundwater subbasins in this area are already overdrafted, the aquifers have a substantial amount of storage space to capture recharge water. The storage of excess water (or *surplus water*) supplies in aquifers during wet periods for withdrawal and use during dry periods, or *groundwater banking* (groundwater storage and recovery), takes place in this region.

Several groundwater banking projects in the Kern County subbasin, such as the Kern Water Bank and Semitropic Groundwater Bank, store excess water when it is available and extract the water for later use. The Kern Water Bank, operated by the Kern Water Bank Authority, is the largest water banking program in the world, with 7,000 acres of recharge ponds (^DSC 2011). In a 10-month recovery program, about 240 TAF of water could be recovered (Kern Water Bank Authority 2017). The Semitropic Groundwater Bank, operated by the Semitropic Water Storage District, is the second largest groundwater bank in Kern County and currently stores approximately 700 TAF with a 1.65-MAF storage capacity (^DSC 2011). When water bank members have supplies exceeding demands, the surplus water supplies that are not sold or transferred to other parties can be stored in the groundwater banks. Multiple water sources, including local water supplies and Sacramento/Delta water, can be stored in these water banks. Participating water users, including districts, agencies, and mutual water companies, have complex water portfolios and publish little data on the volumes or sources of water entering the banks. SWP and CVP infrastructure, such as the California Aqueduct, are used to move water acquired through settlements, rights, claims, transfers, exchanges, and purchases to local canals or conveyances that move the water to the groundwater recharge areas. Local surface waters also are used for recharge. The same canals that transfer water from the California Aqueduct to the water banks during wet periods are used to transfer water from the banks back to the California Aqueduct during dry periods when the water is made available to water bank members.

Friant Division

The Friant Division service area is located in the eastern portion of the San Joaquin Valley, extending from the Chowchilla River in Madera County in the north to the Arvin-Edison Water Storage District in Kern County in the south. Groundwater subbasins in the Friant Division service area include the Chowchilla, Madera, Kings, Kaweah, Tule, and Kern County subbasins; several groundwater basins in this area are critically overdrafted and are ranked as high priority (CNRA 2022) (DWR 2020) (also see Table 7.12.2-6 and Figure 7.12.2-1b). The Friant Division service area includes more than 1 million acres of irrigable farmland, much of which is planted in permanent crops from approximately Chowchilla in the north to the Tehachapi Mountains in the south (Friant Water Authority 2016). The Friant Division impounds or diverts the entire headwaters of the San Joaquin River at Friant Dam, except for flood control releases and irrigation releases to meet the needs of riparian water-right holders immediately below the dam.[5] As a result, the headwaters of the San Joaquin River are, for the most part, hydrologically disconnected from the Lower San Joaquin River and not part of the Sacramento/Delta supply.

The water impounded in Millerton Lake is gravity-fed south through the approximately 152-mile-long Friant-Kern Canal and north through the approximately 36-mile-long Madera Canal. Construction of the Friant Division was meant to help address decades of groundwater overpumping dating back to the early 1900s by delivering surface water supplies to augment groundwater and local surface water supplies. Nevertheless, severe overdrafting of the groundwater basin has continued, resulting in subsidence and a reduction of capacity in the Friant-Kern Canal (Friant Water Authority, 2016).

Friant Division contractors do not directly receive Sacramento/Delta water supply under CVP Friant Division water service contracts. However, in order to build the Friant Division, the U.S. Bureau of Reclamation (Reclamation) entered into contracts with senior water right holders on the San

[5] In 2006, in response to litigation over the impacts of dry reaches on the condition of fish in the San Joaquin River below Friant Dam, the Department of Interior, the Natural Resources Defense Council, and the Friant Contractors reached a Settlement (2006 Stipulation of Settlement in *Natural Resources Defense Council et al. v. Rodgers et al.*) to restore and maintain fish in "good condition" below Friant Dam, including naturally-reproducing and self-sustaining populations of salmon and other fish. In addition, the parties to the Settlement agreed to reduce or avoid adverse water supply impacts on the Friant Contractors that could result from the implementation of interim and Restoration Flows. The Settlement was later authorized by Congress under the San Joaquin River Restoration Settlement Act (Settlement Act), Public Law No. 111-11, § 10001 et seq., 123 Stat. 991, 1349 (2009), and the San Joaquin River Restoration Program (SJRRP) was established to implement the Settlement. In 2013, to facilitate implementation of the SJRRP, the State Water Board approved changes for long-term instream flow dedication of Restoration Flows and the rediversion of those flows at specified locations pursuant to Water Code section 1707. The 2013 Order added preservation and enhancement of fish and wildlife as an authorized purpose of use under the permits and license and added various points of rediversion for Restoration Flows located between Friant Dam and the Merced River, with additional points of rediversion for Restoration Flows at the Banks Pumping Plant and the Jones Pumping Plant. While the Restoration Goal has yet to be fully achieved because of funding constraints that have delayed necessary channel and structural modifications, the SJRRP has released some Restoration Flows downstream of Friant Dam and has re-introduced juvenile spring-run Chinook salmon to the San Joaquin River since 2015.

Joaquin River who would be cut off by Friant Dam from receiving flows. These contracts entitled the senior water rights holders to receive water conveyed from the Sacramento/Delta via the Delta-Mendota Canal in exchange for the foregone San Joaquin River supplies. These “exchange contractors” retained a provision in their contracts that, if Reclamation is unable to deliver the entire allocated amount from Sacramento/Delta supply, then Reclamation is required to release additional water from Friant Dam to meet the entitlements. This call on Friant Division water for San Joaquin River senior water right holders results in curtailments of deliveries to lower-priority water right holders in the Friant Division service area.

Communities that rely on groundwater for drinking water supply face challenges from declining groundwater levels, with dry wells occurring in some areas during prolonged drought periods. Numerous DACs are wholly reliant on groundwater for their water supply, and reductions in Friant Division deliveries during drought periods can result in both increased local groundwater pumping and less incidental recharge from excess irrigation and canal loss. For example, because of drought conditions in 2014 and 2015, there was no allocation to Friant Division water contractors for those contract years. Because of insufficient water supplies in the Friant Division service area during this period, many domestic groundwater wells went dry (Friant Water Authority 2016). Friant Water Authority also has a 60-TAF contract for delivery of municipal water to the city of Fresno, which could be reduced if a call was made on the Friant Division for San Joaquin River exchange contractor supply.

USGS Central Valley drought indicator maps show areas of subsidence based on data from 2008 to 2010 (^USGS 2018). One area of subsidence, located south of Merced and east of Firebaugh, has experienced more than 1.5 feet of subsidence since 2008. A second area of subsidence, broadly centered on a geographic area northwest of Delano, has experienced several inches of subsidence since 2008. These areas of subsidence are likely the result of expanded groundwater pumping during the last several decades. Additionally, as discussed in Section 7.9, *Geology and Soils*, areas of the San Joaquin Valley region, including the Friant Division service area, continue to experience high subsidence rates related to groundwater use. Increased groundwater use such as during the 2012–2016 drought, when surface water deliveries were reduced, can exacerbate these conditions (see Section 7.9, *Geology and Soils*, for further discussion of subsidence).

Groundwater Quality

Groundwater quality in the San Joaquin Valley varies depending on land use and substrate material. Natural and anthropogenic impairments exist throughout the region. Naturally occurring impairments in the San Joaquin Valley region include arsenic, salinity, selenium, radioactivity, and hexavalent chromium. Anthropogenic sources of contamination include localized areas of elevated salinity such as TDS, chloride, and sulfate; nitrates; pesticides (e.g., 1, 2-Dibromo-3-chloropropane); and VOCs such as trichlorethene and tetrachloroethene. Higher-salinity groundwater, with elevated boron and selenium concentrations, occurs in the western portion of the region.

Salinity management has been identified as the most serious long-term water quality issue in the San Joaquin Valley (DWR 2015a; DWR 2015a). The sources of the salts are the native salt-laden soils, the influx of salt in Delta irrigation water, and salts present in fertilizer applied during agricultural practices (CDFA 2009).

In the west side of the southern San Joaquin Valley, notably a portion of the CVP’s San Luis Unit that includes the Westlands Water District, an impermeable layer separates an upper aquifer (the upper 20 to 200 feet of the saturated groundwater zone) from a lower aquifer. Water in the upper aquifer is generally not adequate for agriculture (Reclamation 2005a) because of high salt concentrations due in part to ongoing agricultural practices. The layer of impermeable soils reduces percolation of agricultural drainage, which is high in salts, to the lower aquifer, resulting in high salt concentrations in the upper aquifer. This area continues to be in need of salt management to provide sustainable agriculture (Reclamation 2007).

Specifically, the area needs drainage to remove salt-laden high groundwater from the upper aquifer (Westlands Water District n.d.(a)). A series of attempted solutions have led to a land-retirement program that would result in significant conversion of agricultural land to nonagricultural uses with or without the proposed Plan amendments. In the 1960s, the federal government began building a drain that was intended to reach from the CVP San Luis Unit to the Delta, to convey drainage from approximately 300,000 acres of irrigated land through the Delta into the Pacific Ocean (DWR 1998). Instead, the drain was built only to Kesterson Reservoir, where these salts were deposited along with heavy metals, including selenium, which had leeched from the soil. This caused the pollutants to concentrate in the reservoir. In 1983, it was determined that deaths, reduced fertility, and deformities in bird populations at Kesterson Reservoir were caused by those pollutants (DWR 1998). In 1984, a joint federal and state effort, the San Joaquin Valley Drainage Program, was convened to investigate drainage and related problems and develop solutions. Several lawsuits between irrigators, the Westlands Water District, and state and federal agencies have led to a settlement requiring Westlands Water District to retire a minimum of 100,000 acres of land from agricultural production (^Reclamation 2015). Additionally, the 2003 Westside Regional Drainage Plan includes land retirement of up to 200,000 acres and other measures, such as adaptive management for drainage, groundwater management, regional reuse, and salt disposal.

As of 2017, Westlands Water District had retired approximately 40,000 acres of farmland because the soil had become too saline for growing food. Another 50,000 acres of land are no longer irrigated but can be farmed with dryland farming methods (^Benson 2017). Westlands Water District growers manage salinity through irrigation management, crop rotation, and salinity testing (Westlands Water District n.d.(b)). In contrast to the salty upper aquifer, the lower aquifer in the Westlands Water District area contains high-quality water for irrigation.

The Westlands Water District; Broadview, Panoche, and Pacheco Water Districts; and the southern portion of the San Luis Water District lie within the San Luis Unit (Reclamation 2007). The presence of poor-quality groundwater in the upper aquifer has had the greatest effect on Westlands Water District, although groundwater quality in the upper aquifer in the Broadview, Panoche, and Pacheco Water Districts also is currently impaired to a certain degree (Reclamation 2005b).

Salt concentrations greater than the primary drinking water standard are a particular problem in the western portion of the Tulare Lake area (Kern County Water Agency 2011). The high clay content of the soils there limits drainage in the upper aquifer. Studies indicate that the upper 20 to 200 feet of the saturated groundwater zone have been affected by crop irrigation and drainage issues, and the usable average life of the Westside subbasin, for example, is approximately 110 to 114 years (Reclamation 2005a). The eastward movement of saline groundwater also affects the groundwater in other areas, such as in the city of Mendota and Fresno Slough (Reclamation 2005a). Because the irrigation water in the Tulare Lake subbasin does not have an outlet, agricultural drainage is contained and evaporated in 4,470 acres of evaporation ponds (C-WIN n.d.). In addition to salts, high concentrations of nitrate and arsenic have been documented throughout the southern San Joaquin Valley (DWR 2015a).

The Central Valley Water Board, in conjunction with the CV-SALTS initiative, adopted an amendment to its basin plan, removing MUN and AGR beneficial use designations from a delineated portion of the groundwater in the historic Tulare Lakebed. The amendment subsequently was approved by the State Water Board on September 6, 2017 (State Water Board Resolution No. 2017-0048), and by the Office of Administrative Law in December 2017 (Notice of Approval OAL Number: 2017-1173-01).

For the period of 2002 to 2010, approximately 550 of 2,200 CWS wells in the region were affected by natural and anthropogenic contaminants that exceeded MCLs (^SWRCB 2013). Contaminated wells were located in or near urban areas such as Fresno, Bakersfield, and Stanislaus County, as well as in rural areas (^SWRCB 2013). Naturally occurring contaminants included arsenic, uranium, fluoride, and radioactivity; anthropogenic contaminants included 1, 2-Dibromo-3-chloropropane, nitrate, and tetrachloroethene (^SWRCB 2013). From 1993 to 1995, domestic wells were sampled for nitrates and pesticides as part of a regional study along the east side of the valley. The results of the study revealed that nearly one-fourth of the wells sampled had nitrate concentrations exceeding the MCL. Pesticides also were detected in over half of the wells sampled, but most of the concentrations were low (DWR 2015a). TDS concentrations in the western San Joaquin Valley Delta-Mendota subbasin have exceeded the health-based threshold 39 times, as documented by the State Water Board's GAMA Program (DWR 2015a).

Groundwater quality in the subbasins underlying the Friant Division service area is suitable for domestic and agricultural needs. Anthropogenic impairment in the Friant Division service area portions of the Chowchilla, Madera, Kings, Kaweah, Tule, and Kern County subbasins occurs for TDS, nitrates, pesticides, VOCs, boron, iron, and radioactive materials. Most of the anthropogenic impairment is localized, except for nitrate and pesticides, which appear to occur along the east side of the affected groundwater subbasins near the foothills of the Sierra Nevada. These impairments may be related to lowering of the groundwater levels in this area.

Central Coast

Groundwater Hydrology

Table 7.12.2-7 lists the medium- and high-priority basins and subbasins for which the majority of the basin underlies the Central Coast region and identifies the basins that are critically overdrafted. There are also very low-priority groundwater basins within the region (Figures 7.12.2-1a and 7.12.2-1b). (CNRA 2022.) There are six adjudicated judgment areas in the Central Coast region (Figure 7.12.2-2 and Table 7.12.2-1).

Table 7.12.2-7. Medium-Priority and High-Priority Groundwater Subbasins—Central Coast

Basin Number	Basin - Subbasin Name	Basin Priority
3-001	Santa Cruz Mid-County	High (critically overdrafted)
3-002.01	Corralitos - Pajaro Valley	High (critically overdrafted)
3-003.01	Gilroy-Hollister Valley - Llagas Area	High
3-003.05	Gilroy-Hollister Valley - North San Benito	Medium
3-004.01	Salinas Valley - 180/400 Foot Aquifer	High (critically overdrafted)
3-004.02	Salinas Valley - East Side Aquifer	High
3-004.04	Salinas Valley - Forebay Aquifer	Medium

Basin Number	Basin - Subbasin Name	Basin Priority
3-004.05	Salinas Valley - Upper Valley Aquifer	Medium
3-004.06	Salinas Valley - Paso Robles Area [a]	High (critically overdrafted)
3-004.09	Salinas Valley - Langley Area	High
3-004.10	Salinas Valley - Monterey	Medium
3-007	Carmel Valley	Medium
3-009	San Luis Obispo Valley	High
3-013	Cuyama Valley [b]	High (critically overdrafted)
3-014	San Antonio Creek Valley	Medium
3-015	Santa Ynez River Valley	Medium
3-018	Carpinteria	High

Source: CNRA 2022.
[a] The Salinas Valley - Paso Robles Area subbasin is primarily within the Central Coast region although a small portion of it extends into the San Joaquin Valley region.
[b] The Cuyama Valley basin is primarily within the Central Coast region although a small portion of it extends into the San Joaquin Valley region.

Based on 2005 to 2015 historical water deliveries data, the total annual water supply in the Central Coast region is approximately 1,334 TAF/yr (see Section 2.8, *Existing Water Supply*). Groundwater supplies constitute approximately 1,164 TAF/yr (88 percent) of the average annual water supply for the region, which includes approximately 968 TAF/yr for agricultural use and 196 TAF/yr for municipal uses (see Table 2.8-9 in Section 2.8). Groundwater supplies in this region are not used for wetlands/refuges.

The Central Coast region relies heavily on groundwater supply. The greatest amount of the groundwater use occurs in the Salinas Valley, Santa Maria River Valley (a very-low priority basin), Santa Ynez River Valley and Cuyama Valley basins, and the Pajaro Valley subbasin (DWR 2015a). Portions of San Benito and Santa Clara Counties in the region rely on imported water from the CVP's San Felipe Unit, groundwater from the Santa Clara Valley basin (located primarily within the Bay Area region, see Table 7.12.2-5) and the Gilroy-Hollister Valley basin, recycled water, and local surface water (SCVWD 2015). The region now uses wastewater reclamation to augment groundwater aquifers and prevent saltwater intrusion, and the region has actively participated in water conservation efforts. Santa Barbara has four injection wells that are used to augment natural recharge with injection of treated surface water (City of Santa Barbara 2016); San Benito County also percolates municipal wastewater, primarily in the Hollister area (San Benito County Water District 2017).

Sacramento/Delta surface water supplies account for approximately 86 TAF/yr of the region's total supplies under the baseline condition as estimated by SacWAM, including approximately 49 TAF/yr for municipal uses and approximately 37 TAF/yr for agriculture use (see Table 2.8-9 in Section 2.8, *Existing Water Supply*). Most of the groundwater basins in the Central Coast region serve both agricultural and municipal water users.

Irrigated agriculture began in the Salinas Valley around 1773, with the first recorded surface water diversions from the Salinas River occurring around 1797 (Brown and Caldwell 2014). Groundwater pumping began as early as 1890 and expanded significantly through the 1920s. By the 1930s, seawater intrusion was occurring along the coast from overdraft of inland portions of the basin; by 2014, seawater intrusion had spread approximately 8 miles inland toward the city of Salinas (Brown and Caldwell 2014). Due to confining subsurface clay layers, recharge of the usable aquifers does not occur in the lower Salinas Valley but occurs in upstream areas (augmented by dam releases) and flows laterally into the lower basin aquifers. Seawater intrusion helps maintain relatively high groundwater elevations along the coast; however, overdraft of multiple aquifers north and east of Salinas since the 1970s influences groundwater flow such that the predominant groundwater flow direction along the coast is inland, and around Salinas is toward the northeast (DWR 2004). Land subsidence has not been a significant issue in the lower Salinas Valley; however, studies of the Paso Robles subbasin in the upper Salinas Valley indicate that the area is susceptible to subsidence and may have experienced low levels of localized inelastic compaction during prolonged dry periods over the last decade (^DWR 2014b). Sacramento/Delta surface water supplies do not directly provide a water source to the Salinas Valley.

Groundwater Quality

Groundwater quality varies throughout the Central Coast region. Some groundwater is generally suitable for most agricultural irrigation and municipal uses, while local impairments associated with salinity, naturally occurring contaminants, and anthropogenic contaminants have degraded groundwater quality in locations throughout the region. Anthropogenic impairments have occurred along Monterey Bay due to excessive groundwater use, creating seawater intrusion that extends more than 5 and 7 miles inland in places in the 400-foot aquifer and 180-foot aquifer, respectively (Monterey County Water Resources Agency 2018). In addition, past agricultural and waste disposal practices have caused local impairments of elevated nitrates, pesticides, VOCs, and SVOCs. Naturally occurring impairments include iron and manganese and, potentially, hexavalent chromium. Among the 840 CWS wells in the Central Coast region, 112 (13 percent) were affected by chemical contaminants that exceeded an MCL during the period from 2002 to 2010. These contaminated wells primarily were located in or near urban areas, especially near San Luis Obispo and Santa Barbara (^SWRCB 2013). The most prevalent groundwater contaminants affecting CWS wells in the region include nitrate, arsenic, selenium, and gross alpha particle activity (DWR 2015a).

Groundwater overdraft has resulted in seawater intrusion in the coastal aquifers, which can adversely affect groundwater such that it is unsuitable for agricultural irrigation or municipal uses. Groundwater with elevated nitrate concentrations is observed throughout the Central Coast due to agricultural activity. Groundwater with elevated nitrate concentrations has been reported in both domestic and agricultural wells in the northern, central, and eastern areas of the Salinas Valley (DWR 2015a). Nitrate impairment in excess of the MCL is widespread in the Salinas Valley, with more localized areas in the central, northern, and eastern portions of the valley. Elevated nitrate concentrations also occur in the Gilroy-Hollister and Santa Maria River Valley basins. Elevated nitrate concentrations in the Los Osos Valley (a very low-priority basin) and Santa Ynez River Valley basins are believed to be localized where septic tank densities are high (DWR 2015a). Elevated concentrations of nitrate have been detected in a large percentage of private wells tested in the Llagas Area subbasin of the Gilroy–Hollister Valley basin (SCVWD 2001).

Southern California

Groundwater Hydrology

The Southern California region is very large, stretching from the ocean near Los Angeles to the desert near Palm Springs. Alluvial groundwater basins underlie over half of the Southern California region, and dozens of groundwater basins are used for water supplies—some to the extent of groundwater overdraft.

Table 7.12.2-8 lists the medium- and high-priority basins and subbasins for which the majority of the basin underlies the Southern California region and identifies the basins that are critically overdrafted. There are also low- or very low-priority groundwater basins within the region (Figure 7.12.2-1b). (CNRA 2022.) There are 20 adjudicated judgement areas in the region; one area (A18) is also within the San Joaquin Valley region(Figure 7.12.2-2 and Table 7.12.2-1).

Table 7.12.2-8. Medium-Priority and High-Priority Groundwater Subbasins—Southern California

Basin Number	Basin - Subbasin Name	Basin Priority
4-002	Ojai Valley	High
4-003.01	Ventura River Valley - Upper Ventura River	Medium
4-004.02	Santa Clara River Valley - Oxnard	High (critically overdrafted)
4-004.03	Santa Clara River Valley - Mound	High
4-004.05	Santa Clara River Valley - Fillmore	High
4-004.06	Santa Clara River Valley - Piru	High
4-004.07	Santa Clara River Valley - Santa Clara River Valley East	High
4-006	Pleasant Valley	High (critically overdrafted)
4-008	Las Posas Valley	High
4-011.01	Coastal Plain Of Los Angeles - Santa Monica	Medium
6-054	Indian Wells Valley	High (critically overdrafted)
7-021.01	Coachella Valley - Indio	Medium
7-021.02	Coachella Valley - Mission Creek	Medium
7-021.04	Coachella Valley - San Gorgonio Pass	Medium
7-024.01	Borrego Valley - Borrego Springs	High (critically overdrafted)
8-001	Coastal Plain Of Orange County	Medium
8-002.07	Upper Santa Ana Valley - Yucaipa	High
8-002.09	Upper Santa Ana Valley - Temescal	Medium
8-004.01	Elsinore - Elsinore Valley	Medium
8-005	San Jacinto	High
9-007.01	San Luis Rey Valley - Upper San Luis Rey Valley	Medium

Source: CNRA 2022.

Based on 2005 to 2015 historical water deliveries data, the total annual water supply of the Southern California region is approximately 9,449 TAF/yr (see Section 2.8, *Existing Water Supply*). Groundwater supplies constitute approximately 2,382 TAF/yr (25 percent) of the average annual water supply for the region, which includes approximately 792 TAF/yr for agricultural use and 1,590 TAF/yr for municipal uses (see Table 2.8-10 in Section 2.8). Groundwater supplies in this region are not used for wetland/refuge supply.

Sacramento/Delta water supplied to Southern California is mostly for municipal uses, with some very small deliveries for agricultural uses. Sacramento/Delta surface water supplies account for approximately 1,675 TAF/yr of the region's total supplies under baseline conditions as estimated by

SacWAM, including approximately 1,661 TAF/yr for municipal uses and approximately 14 TAF/yr for agricultural use (see Table 2.8-10 in Section 2.8, *Existing Water Supply*).

Sacramento/Delta surface water supply is delivered to portions of Kern, San Bernardino, Ventura, Los Angeles, Orange, Riverside, San Diego, and Imperial Counties (Figures 2.8-3a through 2.8-3c). Water agencies in the Southern California region that receive Sacramento/Delta surface water supplies use Sacramento/Delta water for direct deliveries, groundwater storage and recovery, and in-lieu recharge to provide for deliveries that would otherwise be met through groundwater pumping. In some cases (Coachella Valley Water District, Desert Water Agency) Sacramento/Delta surface water supplies are not actually received; instead, those supplies are exchanged with other agencies for water from other sources such as imports from the Colorado River. Imported water supplies in many urban areas in this region are augmented with recycled water, local surface water stored in reservoirs, and groundwater. In addition, transfers and groundwater-banked water supplies make up a portion of many water purveyors' water portfolios in urban areas.

Groundwater conditions in much of the Southern California region are driven by high population density, low precipitation, and reliance on imported surface water. Sources of imported water to this region include Sacramento/Delta surface water supplies (SWP deliveries), Colorado River supplies, and Mono Lake basin and Owens Valley supplies. Groundwater storage and recovery projects in the Southern California region use imported water to reduce seawater intrusion, maintain groundwater levels, and augment the overall water supply. Groundwater basins along the coast historically have experienced seawater intrusion due to inland overdraft; however, seawater barriers consisting of injected fresh water in several basins reduce or eliminate seawater intrusion. The increased use of recycled water, desalination (both marine and saline groundwater), and blending of imported water are strategies used to manage groundwater resources in the region. The region currently uses recycled water to augment groundwater aquifers and to replace other potable sources. The Santa Ana River is well known as a reclaimed water recharge area where water is used, treated, infiltrated to the groundwater, and used again a few times before being released to the ocean. The populous South Coast portion of Southern California also has undertaken various water use efficiency projects (^2013 Water Plan V2, South Coast Region). These efforts have included replacement of less efficient toilets, faucets, and showerheads; installation of low water-use appliances; and replacement of turf lawns with native and drought-tolerant plants.

Groundwater overdraft historically has occurred in some basins in Southern California, and land subsidence has occurred in some areas as a result. For example, heavy reliance on groundwater has caused long-term declines in groundwater levels in the Antelope Valley groundwater basin (a very low-priority basin), which has resulted in more than 6 feet of land subsidence and permanent loss of groundwater storage in some areas (DWR 2015a). Local subsidence in the Coachella Valley basin also has occurred as a result of groundwater overdraft. However, recent efforts to recharge the aquifer via percolation ponds has resulted in local rebound in some locations and has slowed the rate of subsidence in other portions of the valley (Sneed et al. 2014).

Groundwater Quality

Geology and groundwater quality vary throughout Southern California, and various natural and anthropogenic groundwater impairments occur in the region. Common contaminants include VOCs and anthropogenic solvents, legacy nutrient and salt contamination from dairy and agricultural activities, naturally occurring contaminants, salt accumulation from recycled water application, and pesticide contamination from urban and legacy agricultural applications. Anthropogenic impairments throughout the urbanized areas as well as some agricultural areas are due to past agricultural and waste handling and disposal practices. Localized areas of nitrate, pesticides, VOCs, SVOCs, and emerging contaminants have affected groundwater supplies locally. In areas of seawater intrusion, elevated salinity (e.g., TDS and chloride) limits the use of local groundwater. Naturally occurring impairments include iron, manganese, arsenic, and boron.

Some CWS wells in the region are affected by chemical contaminants. Among the 3,106 CWS wells in the Southern California region, 815 (26 percent) were affected by chemical contaminants that exceeded an MCL during the period from 2002 to 2010. Contaminated wells were located mostly in or near urban areas, with a large number in Los Angeles and San Bernardino Counties. During this period, the most prevalent groundwater contaminants affecting CWS wells in the region were nitrate, perchlorate, tetrachloroethene, trichlorethene, gross alpha particle activity, carbon tetrachloride, arsenic, uranium, and fluoride (DWR 2015a; DWR 2015a; DWR 2015a).

Due to past overpumping of groundwater supplies, seawater intrusion has occurred in multiple coastal areas in Southern California, such as the Santa Monica Bay and San Pedro-Long Beach areas in the Coastal Plain of Los Angeles basin; coastal lowland areas in the Coastal Plain of Orange County basin; and the San Luis Rey Valley, San Diego River Valley (a very low-priority basin), and Coastal Plain of San Diego (a low-priority basin) basins in the San Diego County area. Seawater intrusion also has been reported in the Oxnard Plain subbasin and the Malibu Valley basin (MWD 2007). Seawater intrusion has resulted in elevated salinity and chloride concentrations in many of these coastal areas.

Outside the coastal watersheds of the Southern California region, groundwater quality and natural and anthropogenic groundwater impairments vary greatly depending on location, but groundwater quality is generally suitable for most municipal, agricultural, and domestic uses. However, a number of groundwater quality impairments exist in localized areas. For example, several groundwater basins are known to have water quality impairments, such as fluoride, boron, sodium, salts, nitrates, and TDS (DWR 2015b). Perchlorate contamination recently was a concern in Barstow. The addition of salt loading from recharge using Colorado River water also is a reported issue in portions of Southern California.

7.12.2.3 Impact Analysis

The proposed Plan amendments would increase instream flows for the protection of fish and wildlife, resulting in changes in hydrology and decreases in Sacramento/Delta surface water supplies. These changes are described in detail in Chapter 6, *Changes in Hydrology and Water Supply*. Potential impacts on groundwater from the proposed Plan amendments primarily would result from individual water users' personal and professional decisions in response to reduced Sacramento/Delta supply. These responses likely include increased groundwater pumping as a substitute supply where available and not locally restricted, and reductions in applied irrigation water, including from increased water use efficiencies, which would reduce incidental groundwater recharge.

There is no common and agreed upon understanding regarding groundwater pumping, groundwater recharge rates, and stream-aquifer interactions in many parts of the study area. In addition, precisely how these physical processes may change, and how water users may respond to reduced Sacramento/Delta surface water supplies is uncertain. In some areas, groundwater pumping may be limited by regulatory requirements (e.g., groundwater adjudications, SGMA implementation). In other areas, it may be locally unrestricted. Finally, modeling results cover only portions of the study area, which creates further challenges in attempts to quantify the precise changes in groundwater levels that could occur as a result of the proposed Plan amendments. For these reasons, the impact analysis is presented qualitatively, with modeling results presented for context and support of the qualitative conclusions.

This section first describes changes in groundwater levels (Impact GW-b) that could occur from responses to decreased Sacramento/Delta surface water supply availability. Actions associated with changes in hydrology and changes in water supply are interconnected in this analysis and are addressed together. Water quality impacts, including drinking water quality impacts (Impact GW-a and Impact GW-f), are then evaluated together based on the identified possible changes in groundwater quantity.

Section 7.21, *Habitat Restoration and Other Ecosystem Projects*, and Section 7.22, *New or Modified Facilities*, describe and analyze potential impacts on groundwater from various actions that involve construction.

Impact GW-b: Substantially deplete groundwater supplies or interfere substantially with groundwater recharge, such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted)

Impacts on groundwater levels could occur as a result of changes in groundwater pumping, applied irrigation water, urban return flows, overlying stream hydrology, and reservoir levels. Responses by individual farmers and ranchers, municipalities, water districts, and other surface water users to a reduction in Sacramento/Delta surface water supply may affect groundwater if those users increase groundwater pumping to replace lost surface water supplies or change irrigation practices (e.g., reduce the number of irrigated acres or increase irrigation efficiencies), thus reducing incidental recharge from applied irrigation water.

The proposed Plan amendments likely would reduce the availability of Sacramento/Delta water for diversion by some users. In the past, irrigators, municipalities, and other surface water users with access to groundwater have responded to reductions in surface water supplies by substituting groundwater pumping for some or all of the reduced supply. If, for example, a farmer or rancher responded by fully substituting groundwater, there likely would be little or no change to the amount of water applied to irrigated fields, and the volume of incidental recharge from irrigation water application would remain relatively constant. However, the increased groundwater pumping would result in lower groundwater levels. Since only a portion of the applied water results in recharge (with a considerable amount of the total volume of pumped groundwater lost through evapotranspiration), there would be a larger reduction in groundwater levels if substitute groundwater pumping is assumed.

The Statewide Agricultural Production (SWAP) model is an agricultural production model designed to simulate decisions that Central Valley growers would make regarding crops to grow, the use of water supplies, and other inputs that would maximize profit—subject to resources constraints, agronomic production relationships, cropping opportunities, and market conditions. When faced with reduced surface water supplies, growers may replace some of that reduction with groundwater and/or local surface water supplies; however, there is often uncertainty about how much groundwater is available. Growers will also weigh the generally higher cost of groundwater against other cropping alternatives that require less water. In cases with little or no available groundwater or profitable crop alternatives, growers may instead choose to fallow lands that had been farmed under baseline conditions. To summarize, growers facing reduced surface water supplies may replace all, some, or none of the reduction with groundwater, depending upon a variety of economic or supply factors and regulatory constraints, including SGMA.

As discussed above, it is uncertain how all water users may respond to reduced Sacramento/Delta water supply regarding groundwater pumping. The dynamic between potential groundwater resources impacts and potential agricultural impacts creates a challenge for the impact analyses since the majority of groundwater pumping in many areas is for agricultural irrigation. In other words, modeling lower groundwater replacement pumping by farmers and ranchers in response to decreased surface water supplies will result in lower impact conclusions for groundwater resources but will increase the severity of impact conclusions for agricultural resources (e.g., levels of potential permanent conversion of Important Farmland). Conversely, modeling higher groundwater replacement pumping by farmers and ranchers increases the severity of impact conclusions for groundwater resources but assumes that more water is available for agriculture, which reduces the severity of impact conclusions for agricultural resources. Importantly, the analysis cannot assume both "worst-case" scenarios simultaneously: there cannot be both maximum potential impacts on groundwater resources from replacement pumping and maximum potential impacts on agricultural resources.

For this reason, two bookends related to reduced Sacramento/Delta surface water supplies are discussed below: *maximum replacement groundwater pumping* and *no replacement groundwater pumping*. Under maximum replacement groundwater pumping, it was assumed that growers could use groundwater in addition to local water supplies to offset some or all Sacramento/Delta supply reductions. Importantly, this is not a directive that farmers and ranchers should or would replace Sacramento/Delta reductions with groundwater pumping, especially in light of requirements to achieve sustainability in basins subject to SGMA, but a good faith attempt to capture the potential maximum impacts on the groundwater basin from replacement pumping. For no replacement groundwater pumping, it was assumed that groundwater would not be available to replace reductions in surface water availability beyond current use under the baseline condition. Similarly, this is not an assumption about groundwater demand management in any particular basin, for example under SGMA, but a good faith attempt to model the potential lower limit of groundwater pumping. In this way, the analysis captures the breadth of likely responses, which would be somewhere in between—meaning that water users likely would increase groundwater pumping to replace some amount of the reduced surface water supplies, but not at volumes sufficient to replace all of the reduced surface water supplies.

When water is applied to agricultural lands or for outdoor municipal uses (e.g., landscaping), some of the applied water infiltrates deep into the ground, resulting in incidental recharge to the underlying groundwater basin. The portion of applied irrigation water that results in incidental recharge varies based on the underlying geology of specific regions, crop types, and irrigation methods and practices. As described in Section 7.12.2.2, *Environmental Setting*, if the geology consists of coarse grains, the ground is more permeable, resulting in higher recharge rates. If layers of fine sediment such as clay exist in a particular region, the recharge rates are much lower. The roots of some crops are more efficient at utilizing soil moisture and therefore result in lower recharge rates. Additionally, some crops such as rice require saturated soils and therefore are grown in areas where recharge rates are low. Lastly, more efficient irrigation methods such as drip irrigation result in lower incidental recharge rates than less efficient irrigation methods such as flood irrigation. Many of these factors vary across regions and within regions. Therefore, it is not possible to accurately quantify how a change in Sacramento/Delta supply would result in a change in incidental groundwater recharge because a user could respond to a reduced Sacramento/Delta supply in a number of ways, such as by changing irrigation methods or crop types. In general, however, a reduction in applied irrigation water could locally result in a reduction in incidental groundwater recharge.

Groundwater recharge mechanisms associated with municipal uses differ from those for agricultural uses. For municipal use, most incidental groundwater recharge is associated with stream-aquifer interactions that occur when wastewater treatment plants (WWTPs) release treated water to streams (streambed seepage). In addition, municipalities may recharge groundwater intentionally (e.g., through injection wells and infiltration basins) or incidentally (e.g., from retention ponds and land application). Conservation measures could be required for municipalities if reductions in Sacramento/Delta supplies were significant enough to affect a municipality's water supply. A reduction in municipal gross per capita consumption also could result in lower WWTP inflow/outflow that, depending on the time of year and location of the surface water discharge, could have coincident effects on stream-aquifer interactions and incidental groundwater recharge. However, the magnitude of such an effect on groundwater levels is expected to be minimal. Changes in WWTP influent and effluent from changes in hydrology and supply are evaluated in Section 7.12.1, *Surface Water*.

Chapter 6, *Changes in Hydrology and Water Supply*, summarizes the potential reductions in Sacramento/Delta water supplies from protecting instream flows in 10-percent increments ranging from 35 to 75 percent of unimpaired flow scenarios for each of the study area regions and summarizes the results (see Table 6.4-1 in Chapter 6, *Changes in Hydrology and Water Supply*). Reductions in Sacramento/Delta surface water supplies under the proposed Plan amendments and related potential changes to groundwater resources would vary by region. The following sections provide regional descriptions of the potential for changes in groundwater pumping and changes in incidental and intentional groundwater recharge, and the resulting changes in groundwater levels that could occur as water users respond to the proposed Plan amendments. The following sections also provide SacWAM and SWAP model results for groundwater hydrology at the regional level, as available. As discussed further below, groundwater availability is limited in some parts of the study area, including portions of the Southern California region. Groundwater adjudications, SGMA, and other existing requirements may limit how much groundwater pumping can increase in response to the proposed Plan amendments in some locations. In the highly populated Bay Area region and the South Coast portion of the Southern California region, water use is mostly municipal; these areas generally are recognized as using municipal water supplies more efficiently than the other regions (see Section 2.8, *Existing Water Supply*). Because a large portion of the total water supply to the Bay Area and Southern California regions is used for municipal purposes, a reduction in Sacramento/Delta surface water supply likely would not result in a large change in incidental recharge from excess irrigation. The impacts on groundwater levels from changes in incidental groundwater recharge likely would be largest in the Sacramento River watershed and San Joaquin Valley regions.

Changes in Hydrology and Water Supply

Sacramento River Watershed and Delta Eastside Tributaries

The distribution of groundwater impacts across the large area of the Sacramento River watershed and Delta eastside tributaries regions would vary depending on several factors, such as local groundwater basin characteristics, local land use and irrigation practices, proximity to rivers and streams where stream-aquifer interactions would be affected, reservoirs and conveyance infrastructure, and locations of groundwater wells. Impacts would be caused by an increase in substitute groundwater pumping and a reduction in groundwater recharge from transmission losses and deep percolation of applied irrigation water. Groundwater recharge from stream-aquifer interactions would increase from baseline conditions, but at the regional level would not offset the reductions in recharge from transmission losses and deep percolation.

Groundwater Pumping

Under the proposed Plan amendments, the Sacramento River watershed and Delta eastside tributaries regions would experience reductions in Sacramento/Delta surface water supplies as modeled by SacWAM. Under the proposed Plan amendments (45 to 65 scenarios), the Sacramento River watershed would experience an average reduction in Sacramento/Delta water supplies of 333 to 1,086 TAF/yr. The Delta eastside tributaries region would experience an average reduction in Sacramento/Delta water supplies of 28 to 63 TAF/yr. (See Tables 6.4-4 and 6.4-8, respectively, in Chapter 6, *Changes in Hydrology and Water Supply*.)

Increased groundwater pumping to replace reduced Sacramento/Delta surface water supply was estimated for the Sacramento River watershed and Delta eastside tributaries regions using the SWAP model. SWAP model results are presented in Table 7.12.2-9 and Table 7.12.2-10 for the average and dry water year model runs, respectively. Because SWAP models how agricultural producers shift water from lower net revenue crops to higher net revenue crops when surface water supplies are reduced, the results are limited to agricultural groundwater use on the valley floor and do not include groundwater use for municipal or other uses. The upper limit on the amount of increased groundwater pumping that could occur because of changes in water supply was based on the highest estimated annual pumping amounts over the hydrologic period of record for each SacWAM-modeled groundwater location. (For more information on the SWAP model simulations and the underlying model assumptions, see Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results.*) SWAP model results indicate that agricultural users in the valley floor of the Sacramento River watershed and Delta eastside tributaries regions could replace much or all of the reduced Sacramento/Delta surface water supply with groundwater, excluding consideration of SGMA that may place limits on groundwater pumping in some locations (Tables 7.12.2-9 and 7.12.2-10).

Table 7.12.2-9. SWAP Model Results for Increased Agricultural Groundwater Use Compared with Baseline Condition, Maximum Replacement Groundwater Pumping—Sacramento River Watershed (thousand acre-feet)

	Flow Scenarios				
Water Year Condition	35	45	55	65	75
Average water year	125	200	361	624	878
Dry water year	254	355	480	656	943

Source: SWAP model results.

Table 7.12.2-10. SWAP Model Results for Increased Agricultural Groundwater Use Compared with Baseline Condition, Maximum Replacement Groundwater Pumping—Delta Eastside Tributaries (thousand acre-feet)

	Flow Scenarios				
Water Year Condition	35	45	55	65	75
Average water year	11	14	24	35	43
Dry water year	13	15	20	31	39

Source: SWAP model results.

Both the average water year and dry water year SWAP model results for the 55 scenario estimate that agricultural groundwater use would increase for the valley floor of the Sacramento River watershed (Table 7.12.2-9) and the Delta eastside tributaries region (Table 7.12.2-10) if increased groundwater pumping is used to offset Sacramento/Delta supply reductions. The dry water year SWAP model results indicate a higher baseline groundwater use than the average water year SWAP model results; total groundwater use in dry water years is higher than in average water years under all scenarios in the Sacramento River watershed and in the lowest scenarios in the Delta eastside tributaries.

The maximum replacement groundwater pumping limits used in the SWAP analysis would likely overstate the actual amount of substitute groundwater pumping that would occur as a result of the proposed Plan amendments. While water users could respond to the proposed Plan amendments by increasing some level of substitute groundwater pumping to offset reduced Sacramento/Delta surface water supplies, the specific levels of substitute pumping would vary throughout the Sacramento River watershed and Delta eastside tributaries regions. In localized areas with existing groundwater quantity (e.g., overdraft, low well yields) or quality issues, including in the high- and medium-priority basins identified by the SGMA 2019 Basin Prioritization, substitute groundwater pumping would be less likely to increase substantially above the baseline condition. However, in low- or very low-priority groundwater basins, which are not subject to SGMA's mandatory requirements, and in other areas with relatively stable groundwater conditions, it is possible that water users could respond to the proposed Plan amendments by increasing groundwater substitute pumping if no additional restrictions are enacted.

Note that if groundwater pumping increases are assumed to replace reduced surface supply, reductions in incidental groundwater recharge would likely be less than suggested by the SacWAM results (discussed below). As a result, a comparable amount of irrigation water would be applied to agricultural fields under the proposed Plan amendments compared with baseline conditions. However, an increase in groundwater pumping would cause larger reductions in groundwater levels. Water user shifts to increased groundwater pumping could exacerbate groundwater overdraft in the Sacramento River watershed and Delta eastside tributaries regions, particularly in groundwater basins where groundwater storage volumes are already in decline. This would be a potentially significant impact. Mitigation measures to reduce this impact are identified below.

Groundwater Recharge

Changes in streamflows and reduced incidental groundwater recharge from irrigation can also affect groundwater levels. SacWAM simulates groundwater pumping and groundwater recharge, albeit in a simplified fashion, in the valley floor portions of the Sacramento River watershed and Delta eastside tributaries regions. SacWAM assumes no increase from baseline in groundwater pumping to replace reduced Sacramento/Delta surface supplies in the flow scenarios. As discussed in Chapter 6, *Changes in Hydrology and Water Supply*, SacWAM only simulates the entire water balance in the Sacramento/Delta. In the export regions, SacWAM only represents the water originating from the Sacramento/Delta.

The SacWAM results show that, as the flow requirement increases, Sacramento/Delta surface water diversions decrease (see Chapter 6, *Changes in Hydrology and Water Supply*). These changes in surface water supplies could result in reductions in incidental groundwater recharge, while groundwater recharge from stream-aquifer interactions (i.e., streambed seepage) would increase due to more water remaining in streams in the Sacramento/Delta, but to a lesser degree. The result would be a net reduction in groundwater recharge. With no change to groundwater pumping (i.e., no replacement groundwater pumping) and a net reduction in groundwater recharge, groundwater levels could decrease compared with the baseline condition, as the instream flow requirement increases.

Table 7.12.2-11 shows the SacWAM results for changes in groundwater recharge resulting from stream-aquifer interactions compared with the baseline condition. Table 7.12.2-12 shows the SacWAM results for changes in incidental groundwater recharge resulting from excess irrigation of surface water to fields (deep percolation) and from transmission losses (conveyance seepage) compared with the baseline condition.

Table 7.12.2-11. SacWAM Results for Change in Average Annual Groundwater Recharge from Stream-Aquifer Interactions Compared with Baseline Condition, No Replacement Groundwater Pumping (thousand acre-feet)

	Flow Scenarios				
Region	35	45	55	65	75
Sacramento River watershed	9	10	9	15	26
Delta eastside tributaries	-2	-3	-4	-5	-4

Source: SacWAM results.

Table 7.12.2-12. SacWAM Results for Change in Average Annual Incidental Groundwater Recharge from Deep Percolation and Transmission Losses Compared with Baseline Condition, No Replacement Groundwater Pumping (thousand acre-feet)

	Flow Scenarios				
Region	35	45	55	65	75
Sacramento River watershed	-56	-88	-161	-272	-435
Delta eastside tributaries	-16	-21	-32	-42	-46

Source: SacWAM results.

SacWAM results show that the proposed Plan amendments could result in a decrease in incidental groundwater recharge from excess surface water application and transmission losses that is greater than the increase in groundwater recharge from stream-aquifer interactions (i.e., streambed seepage); therefore, there would be a net decrease in groundwater recharge.

The SacWAM results presented in Table 7.12.2-13 show that average groundwater levels would likely decrease compared with the baseline condition for the Sacramento River watershed and Delta eastside tributaries regions for all flow scenarios under the no replacement groundwater pumping scenario. Although groundwater levels in the Sacramento River watershed and Delta eastside tributaries regions are expected to decrease under the proposed Plan amendments compared with the baseline condition, changes in groundwater would vary year to year based on hydrologic conditions, with increases in wet years and more significant decreases occurring in drier years. Changes in groundwater levels also would vary by location. These decreases in groundwater levels for the valley floor of the Sacramento River watershed and Delta eastside tributaries regions may exacerbate existing groundwater overdraft conditions to some basins and subbasins in these regions. Impacts would be potentially significant.

Table 7.12.2-13. SacWAM Results for Average Annual Change in Groundwater Compared with Baseline Condition, No Replacement Groundwater Pumping—Sacramento River Watershed and Delta Eastside Tributaries Regions (thousand acre-feet)

	Flow Scenarios				
Region	35	45	55	65	75
Sacramento River watershed	-43	-77	-151	-269	-453
Delta eastside tributaries	-13	-197	-24	-207	-34

Source: SacWAM results.

Potential impacts on groundwater levels resulting from substitute groundwater pumping to replace Sacramento/Delta surface water supplies or from reduced incidental recharge could be reduced through implementation of Mitigation Measure MM-GW-b. Local groundwater management under SGMA could reduce or eliminate impacts, particularly in medium- and high-priority groundwater basins. In addition, water users can and should diversify their water supply portfolios in an environmentally responsible manner and in accordance with the law to mitigate groundwater impacts. Diversifying water portfolios may include sustainable use of groundwater and groundwater storage and recovery and conjunctive use, water recycling, water transfers, and water conservation and efficiency upgrades. The State Water Board will continue efforts to encourage and promote environmentally sound groundwater storage and recovery (recharge) projects that use surplus surface water, increased use of recycled water, sustainable water transfers, and conservation. The proposed Bay-Delta Plan program of implementation encourages and allows for voluntary implementation plans. Those voluntary implementation plans would be required to include measures to coordinate implementation of the proposed Plan amendments with groundwater management activities, including with implementation of SGMA. Voluntary implementation plans also may allow flow requirements lower in the range if complementary measures (ecosystem projects) are implemented that provide for equivalent protection of fish and wildlife beneficial uses. Such projects could reduce the potential impacts associated with decreased consumptive water uses, including impacts on groundwater. While the State Water Board can ensure that mitigation is implemented for actions within its authority, other mitigation measures are largely within the jurisdiction and control of other agencies or depend on how water users respond to the proposed Plan amendments. The State Water Board cannot guarantee that measures always will be adopted or applied in a manner that fully mitigates the impact. Therefore, unless and until the mitigation is fully implemented, the impact remains potentially significant.

As discussed in Section 7.9, *Geology and Soils*, reduced groundwater levels may lead to or exacerbate existing subsidence conditions. Land subsidence resulting from groundwater pumping has been documented in some areas in the Sacramento River watershed and Delta eastside tributaries regions, and substitute groundwater pumping could worsen this problem. See Section 7.9, *Geology and Soils*, for additional discussion.

Reduced groundwater storage and declining groundwater levels could result in reductions in overlying surface water flows, although the impacts often are delayed from the start of pumping or groundwater level decline. Many variables influence the magnitude and timing of groundwater pumping impacts on surface streams, including the distance between the well and stream, the properties of the aquifer, and the duration and volume of groundwater pumping. Knowledge of these variables, as well as the geologic structure, dimensions, and hydraulic properties of the groundwater system and the locations and hydrologic conditions along the boundaries of the groundwater system, are key to assessing the significance of any potential impact associated with a delay in surface water flow depletion.

Surface water flow depletion may continue after groundwater pumping or basin overdraft stops because it takes time for groundwater levels to recover from the previous pumping stress and for the depleted aquifer to be recharged to previous levels. Therefore, maximum stream depletion may not occur until after pumping has stopped. Eventually, the aquifer and stream may return to their pre-pumping conditions, but a long period may be required for full recovery. This recovery period may range from a few days in the zone adjacent to the stream to thousands of years for water that moves from the central part of some recharge areas through deeper parts of the groundwater system (Heath 1983). See Section 7.12.1, *Surface Water*, for additional discussion.

Changes in reservoir levels would not significantly affect groundwater recharge rates or groundwater levels. Many reservoirs are built in narrow canyons with rock walls that generally direct groundwater toward the stream channel downstream. To the extent that reservoir operations contribute to groundwater recharge, much of that recharge would mimic recharge from stream-aquifer interactions where higher flows or reservoir levels would be associated with higher recharge rates, and lower flows or reservoir levels would be associated with lower recharge rates. If reservoir levels are reduced and downstream flows are increased, groundwater recharge from stream-aquifer interactions would increase. If changes to reservoir levels are balanced throughout the year (e.g., lower in spring and higher in summer), the net impact on groundwater recharge would be minimal.

Delta

In the Delta, groundwater supplies are continually recharged due to flows in Delta channels; groundwater levels generally are near the land surface and exhibit only minimal seasonal fluctuations (^DWR 2014b). Overall, implementation of the proposed Plan amendments would increase Delta inflows (see Chapter 6, *Changes in Hydrology and Water Supply*). While interior Delta flows may change in response to the proposed Plan amendments, groundwater recharge from stream-aquifer interactions does not depend on the direction of flow in a surface channel if the water elevation does not change. Impacts on groundwater levels in the Delta are unlikely because groundwater levels in the Delta are continually managed through groundwater pumping in order to keep levels below the surface to prevent flooding of interior islands and fields. In addition, much of the variability of surface water elevations is due to tidal influences and would be independent of the effects of the proposed Plan amendments. Therefore, interactions between surface water and groundwater in the Delta would not change substantially as a result of the proposed Plan amendments, and there would be no impact on groundwater levels in this region.

San Joaquin Valley

Under the proposed Plan amendments, the San Joaquin Valley region would experience a reduction in Sacramento/Delta surface water supplies as modeled by SacWAM. Under the proposed Plan amendments (45 to 65 scenarios), the region would experience an average reduction in Sacramento/Delta surface water supplies of 146 to 868 TAF/yr (see Table 6.4-20 in Chapter 6, *Changes in Hydrology and Water Supply*).

Increased groundwater pumping to replace reduced Sacramento/Delta surface water supply was estimated for the San Joaquin Valley using the SWAP model based on the SacWAM Sacramento/Delta surface water availability modeling assumptions. SWAP model results are presented in Table 7.12.2-14 for the average and dry water year model runs. Because SWAP models how agricultural producers shift water from lower net revenue crops to higher net revenue crops when surface water supplies are reduced, the model geographic range is limited to the valley floor; therefore, results are provided for agricultural groundwater use in the same area and do not include groundwater for municipal or other uses. The SWAP crop optimization model allows growers to use local and imported surface water supplies and groundwater. SWAP results indicate that, for the San Joaquin Valley, a large portion of the reduction in Sacramento/Delta supplies might be offset by increased groundwater pumping, even though it tends to be more costly than delivered surface water. However, at the highest flow scenarios, the additional cost of pumping may lead growers to shift to lower water-using crops or fallow existing farmland. This outcome excludes consideration of SGMA, which may place limits on groundwater pumping. For maximum groundwater replacement, annual agricultural groundwater use for the average and dry water year conditions would increase from the baseline condition for the 55 scenario (Table 7.12.2-14). SWAP shows a greater increase in groundwater pumping for the average water year condition compared with the dry year condition because baseline groundwater pumping is higher during the dry water year condition.

Table 7.12.2-14. SWAP Model Results for Increased Groundwater Use Compared with Baseline Condition, Maximum Replacement Groundwater Pumping—San Joaquin Valley (thousand acre-feet)

	Flow Scenarios				
Water Year Condition	35	45	55	65	75
Average water year	84	235	624	911	1,096
Dry water year	97	201	400	477	526

Source: SWAP model results.

Increased groundwater pumping in response to reduced Sacramento/Delta supplies in the San Joaquin Valley region could lower groundwater levels. Table 7.12.2-6 lists the existing medium- and high-priority groundwater basins or subbasins that primarily underlie the San Joaquin Valley region; most of the high-priority basins are critically overdrafted. Under the baseline condition, groundwater storage volumes are decreasing, and groundwater basin levels are declining. Water user response to the proposed Plan amendments likely would exacerbate groundwater overdraft in this region.

This impact would be potentially significant and mitigation measures are discussed below. Water users could take various actions in response to changes in Sacramento/Delta surface water supplies. Because local responses to the proposed Plan amendments are uncertain, the specific magnitude and locations of potential impacts cannot be determined. Actual substitute groundwater pumping could be limited by local implementation of SGMA; however, the full effect of those local actions cannot be predicted at this time. SGMA implementation could reduce or eliminate groundwater impacts, particularly in medium- and high-priority basins. Groundwater pumping also may be limited by groundwater availability or adjudications in some areas in the San Joaquin Valley region.

Reductions in water supply to agricultural areas in the San Joaquin Valley region would have similar effects on groundwater recharge as described above for the Sacramento River watershed and Delta eastside tributaries regions. Reductions in Sacramento/Delta surface water supplies could reduce the volume of incidental recharge that occurs from conveyance seepage and excess irrigation of agricultural fields. On a regional basis, the magnitude of reduced incidental groundwater recharge likely would be proportional to the reduction in Sacramento/Delta surface water supply. However, the effects of reduced groundwater recharge from transmission losses and deep percolation of applied irrigation water would vary spatially within the region. For example, in parts of the western portion of the San Joaquin Valley region, recharge from applied water likely is minimal because of the presence of clay lenses, extensive clay layers, and tile drains.

As discussed in Section 7.9, *Geology and Soils,* reduced groundwater levels may lead to or exacerbate existing subsidence conditions in some locations. The San Joaquin Valley has experienced substantial subsidence related to groundwater use for agriculture, and substitute groundwater pumping could worsen this problem.

Several groundwater storage and recovery projects in the San Joaquin Valley region store excess water, including Sacramento/Delta water, when it is available and extract the water for later use. Because water users have different approaches to allocating active recharge water, no general estimate of reductions can be made in relation to deliveries. However, it can be assumed that, if a unit of Sacramento/Delta water would have been banked through a managed groundwater recharge project and now would be unavailable as a result of reduced Sacramento/Delta supply under the proposed Plan amendments, an equivalent volume of water would not be recharged to the groundwater basins.

A reduction in Sacramento/Delta supplies could result in less surface water being applied to crops and other lands that would decrease incidental and managed groundwater recharge rates, potentially leading to decreased groundwater levels in some portions of the region. This impact would be potentially significant.

Potential impacts on groundwater levels resulting from substitute groundwater pumping to replace Sacramento/Delta supplies or reduced incidental and managed recharge could be reduced through implementation of Mitigation Measure MM-GW-b. Local groundwater management under SGMA could reduce or eliminate impacts, particularly in medium- and high-priority groundwater basins. In addition, water users can and should diversify their water supply portfolios in an environmentally responsible manner and in accordance with the law to mitigate groundwater impacts. Diversifying water portfolios may include sustainable use of groundwater and groundwater storage and recovery, and conjunctive use, water recycling, water transfers, and water conservation and efficiency upgrades. The State Water Board will continue efforts to encourage and promote environmentally sound groundwater storage and recovery (recharge) projects that use surplus surface water, increased use of recycled water, sustainable water transfers, and conservation. The proposed Bay-Delta Plan program of implementation encourages and allows for voluntary implementation plans. Those voluntary implementation plans would be required to include measures to coordinate implementation of the proposed Plan amendments with groundwater management activities, including with implementation of SGMA. Voluntary implementation plans also may allow flow requirements lower in the range if complementary measures (ecosystem projects) are implemented that provide for equivalent protection of fish and wildlife beneficial uses. Such projects could reduce the potential impacts associated with decreased consumptive water uses, including impacts on groundwater. While the State Water Board can ensure that mitigation is implemented for actions within its authority, other mitigation measures are largely within the jurisdiction and control of other agencies or depend on how water users respond to the proposed Plan amendments. The State Water Board cannot guarantee that measures always will be adopted or applied in a manner that fully mitigates the impact. Therefore, unless and until the mitigation is fully implemented, the impact remains potentially significant.

Communities that rely on groundwater for drinking water supplies in the San Joaquin Valley region have been facing challenges from declining groundwater levels under baseline conditions, with critical shortages or dry wells occurring in some areas during prolonged drought periods. The frequency and severity of these challenges likely would increase as a result of the proposed Plan amendments, even with no substitute groundwater pumping. Although impacts on groundwater during wet and above-normal water years would be less than impacts during drier water years, this would be a potentially significant impact. Drinking water impacts from lowered groundwater levels could be reduced through implementation of Mitigation Measures MM-GW-b and MM-GW-a,f. Local groundwater management under SGMA implementation may address some of the supply issues faced by DACs, depending on how GSPs are developed and how GSAs consider impacts on DAC water users from local groundwater management actions. SGMA oversight by the State Water Board will ensure that GSPs are adequate and sufficient.

The State Water Board also will continue its commitment to the human right to water through financial assistance, technical assistance, consolidations, and other means, including for communities that may be affected by reduced groundwater supplies or groundwater quality concerns. The Safe and Affordable Drinking Water Fund established under SB 200 will enable the State Water Board to provide crucial ongoing operations and maintenance support so once-struggling community water systems can provide a sustainable source of safe drinking water. The LIRA program provides rate relief for low-income ratepayers of water utilities. While these efforts are expected to help reduce impacts on communities that rely on groundwater for drinking water supplies, it is not certain that these efforts always will fully mitigate impacts.

Private domestic well owners may be less able to absorb costs associated with declining groundwater elevations or degraded water quality. The State Water Board has provided funding for replacement or deepening of private domestic wells affected by the 2012–2016 drought through its Cleanup and Abatement Account. SB 108 also provided limited funding for replacement of private domestic wells that could no longer be used due to declining groundwater elevations. The State Water Board will promote and support future funding sources as appropriate. The State Water Board cannot guarantee that measures always will be adopted or applied in a manner that would fully mitigate impacts. Therefore, unless and until the mitigation is fully implemented, the impact of reduced groundwater levels on drinking water supplies remains potentially significant.

San Francisco Bay Area, Central Coast, and Southern California

SacWAM estimates of Sacramento/Delta surface water supplies delivered to the Bay Area, Central Coast, and Southern California regions informs this qualitative analysis. These regions are outside of the geographic range of the SWAP agricultural production model. While some Sacramento/Delta supplies are used for agriculture, such as the CVP San Felipe Unit in southern Santa Clara and San Benito Counties of the Central Coast region, Sacramento/Delta supplies primarily are used for municipal water in these regions. Water users in these regions could choose to increase groundwater pumping in response to changes in Sacramento/Delta surface water supplies.

Groundwater pumping to replace reduced Sacramento/Delta surface water supplies could lead to significant localized impacts on groundwater levels.

Localized impacts also may occur on groundwater levels in areas where Sacramento/Delta surface water supplies are used for groundwater storage and recovery projects. For groundwater storage and recovery projects, water is purposefully applied to recharge a basin either passively or by injection. In these areas, managed groundwater recharge and groundwater levels could be reduced as a result of decreased Sacramento/Delta supplies.

Effects on groundwater levels would be potentially significant. These impacts could be reduced through implementation of Mitigation Measure MM-GW-b. Local groundwater management under SGMA could reduce or eliminate impacts, particularly in medium- and high-priority groundwater basins. In addition, water users can and should diversify their water supply portfolios in an environmentally responsible manner and in accordance with the law to mitigate groundwater impacts. Diversifying water portfolios may include sustainable use of groundwater and groundwater storage and recovery, and conjunctive use, water recycling, water transfers, and water conservation and efficiency upgrades. The State Water Board will continue efforts to encourage and promote environmentally sound groundwater storage and recovery (recharge) projects that use surplus surface water, increased use of recycled water, sustainable water transfers, and conservation. While the State Water Board has some authority to ensure that mitigation is implemented for some actions, other mitigation measures are largely within the jurisdiction and control of other agencies or depend on how water users respond to the proposed Plan amendments. The State Water Board cannot guarantee that measures always will be adopted or applied in a manner that would fully mitigate impacts. Therefore, unless and until the mitigation is fully implemented, the impact remains potentially significant.

Because of the limited use of Sacramento/Delta surface water supplies for agricultural irrigation in these regions, changes in incidental groundwater recharge from excess irrigation of agricultural fields would be minimal and localized.

Surface water flows could be reduced downstream of export reservoirs that receive Sacramento/Delta supply (e.g., Diamond Valley Lake, Lake Cachuma, Castaic Lake). Such reductions in conveyance facility flows or reservoir levels likely would result in decreases in groundwater recharge stream-aquifer interactions. However, in response to changes in Sacramento/Delta supplies, the agencies that operate these reservoirs likely would change their water supply portfolios to minimize the effect on reservoir storages. Other sources of supply obtained through direct delivery or exchange could be used to minimize any change in reservoir storages from the proposed Plan amendments, such that impacts on groundwater levels in these areas would be less than significant.

San Francisco Bay Area

The Bay Area region could experience changes in municipal water supplies as a result of changes in water supply, some of which may be replaced with groundwater. However, the Bay Area is unlikely to see a significant increase in new groundwater development, based on the actions and proposed plans of the area's water agencies serving most of the population. For example, several Bay Area agencies are working together in a planning effort known as Bay Area Regional Reliability to develop a regional solution to improve water supply reliability across the region. Potential projects include interagency interties and pipelines, treatment plant improvements and expansion, groundwater management and recharge, potable reuse, desalination, and water transfers.

Some agencies, such as Valley Water, are more reliant on Sacramento/Delta supply compared with the region overall. For agencies that are more reliant on Sacramento/Delta supply, the percent of the agency's total supply affected would be higher. Because agencies such as Valley Water and ACWD rely on groundwater for some of their water supplies and operate in subbasins where subsidence has occurred historically, groundwater pumping to replace reduced Sacramento/Delta surface water supplies could lead to significant localized impacts on groundwater levels. Valley Water also receives water under an agricultural service contract with Reclamation (CVP); deliveries under this contract are of a sufficient magnitude that impacts on local groundwater levels could be potentially significant if increased groundwater pumping is used to offset Sacramento/Delta supply reductions.

Several of the agencies in the Bay Area region have both a history of effort and plans for expanding the use of groundwater management to include purposeful recharge of both local and imported waters for storage and reuse. They also utilize storage in groundwater banks in the southern San Joaquin Valley. Nonetheless, the potential remains for the proposed Plan amendments to result in depletion in groundwater supplies at the local level.

Central Coast

Groundwater reliance and use on the Central Coast vary within the region. Individual communities depend upon groundwater wells supplemented by local sources and Sacramento/Delta supply. Water agencies in southwestern San Luis Obispo County and northwestern and southern Santa Barbara County that receive Sacramento/Delta supplies also rely on groundwater; therefore, maximum substitute groundwater pumping could have significant impacts on groundwater levels in these local areas. However, new groundwater development is not anticipated except in limited cases, as regional agencies currently utilize, and plan to increase use of, groundwater banking and exchanges in Kern County and Southern California as the primary source of new supplies. This is in addition to intraregional exchanges between San Luis Obispo County (with underutilized SWP allocations) and Santa Barbara County, and exploration of new desalination plants. As a result, only a portion of the reduced Sacramento/Delta water supplies likely would be replaced by increased groundwater pumping. Nonetheless, the potential remains for the proposed Plan updates to result in depletion in groundwater supplies at the local level.

Southern California

In the Southern California region, although most municipal agencies have varied water supply portfolios, those that rely heavily on Sacramento/Delta surface water supplies could be affected by the changes in supply under the proposed Plan amendments. Some of the reduced Sacramento/Delta surface water supplies could be replaced by increased groundwater pumping. However, major new groundwater supply development is unlikely in Southern California except in limited circumstances. Many groundwater basins in this region are adjudicated (Figure 7.12.2-2 and Table 7.12.2-1); and in many coastal or estuarine areas with overdraft issues, groundwater levels remain relatively stable, indicating that seawater is replacing the fresh water deficit (DWR 2015a). Because of adjudications and historical groundwater management practices, groundwater overdraft is not a widespread long-term issue in much of the Southern California region. Nevertheless, surface water supply reductions could lead to increased groundwater pumping, and the potential remains for depletion in groundwater supplies at the local level. MWD and its member agencies are actively exploring and pursuing storm water centralized recharge projects, groundwater storage and recovery, and water recycling as a strategy for addressing future water needs—in addition to conservation, water exchanges, local storage, desalination, and other measures. Furthermore, MWD and Eastern Metropolitan District have initiated a major program of recycled water treated specifically for irrigation use by farmers in order to relieve demand pressure on urban supplies.

Mojave Water Agency and Coachella Valley Water District use Sacramento/Delta surface water supplies for active groundwater recharge. All of Mojave Water Agency's direct supply is from groundwater pumping. Sacramento/Delta water accounts for about one-third of the Mojave Water Agency's water supplies, all of which is used for active groundwater recharge to be extracted when supply is needed. The Coachella Valley Water District has an SWP contract for Sacramento/Delta surface water supplies but lacks the infrastructure to receive these supplies directly; instead, Coachella Valley Water District exchanges these supplies for Colorado River water under an agreement with MWD, which is then used for active groundwater recharge to be extracted later for municipal use. These supplies can meet more than 50 percent of the total municipal demands, depending on SWP allocation (CVWD 2016). Because of the region's use of Sacramento/Delta surface water supplies for active groundwater recharge, groundwater levels could be affected as a result of reduced Sacramento/Delta supply, but it is difficult to quantify how operators of these projects may respond.

Other Water Management Actions

Several strategies could be implemented at the local or regional level using existing infrastructure to reduce the potential impacts from reduced Sacramento/Delta surface water supplies, including groundwater storage and recovery, water transfers, water recycling, and conservation measures. These actions could help water agencies maximize water supplies and reduce the potential for increased groundwater pumping. While these measures are likely to have positive effects on some groundwater basins, local conditions would determine which measures are most effective. These responses to reduced Sacramento/Delta supply may have additional impacts on groundwater and are addressed below. Responses may affect groundwater in multiple or all regions. Other possible response actions involving construction are discussed in Section 7.22, *New or Modified Facilities*.

Groundwater Storage and Recovery

In many areas, groundwater storage and recovery strategies could offset the impacts of reduced Sacramento/Delta surface water supply. By capturing local precipitation, storm water, and flood flows and routing that water to locations suitable for recharging the local aquifers, natural processes can be augmented, and water can be efficiently stored and extracted through existing wells for local use. The extent to which managed groundwater recharge can offset reduced Sacramento/Delta surface water supplies depends greatly on the availability of runoff and surface water supplies, as well as the geology of the aquifer and its overlying materials. Areas with greater precipitation and water supplies available for groundwater storage and recovery efforts and coarser soils are more likely to be able to offset or increase groundwater supplies through groundwater storage and recovery strategies. Areas with low precipitation and water supplies available for groundwater storage and recovery efforts and fine-grained soils would be less likely to be able to offset reduced Sacramento/Delta surface water supply through groundwater storage and recovery efforts.

Groundwater storage and recovery projects often are located near canals or other conveyances that can be used to deliver available water to the aquifer for storage or distribute stored water to users. Groundwater storage and recovery projects, including groundwater banking in facilities such as the Kern Water Bank, may increase as a response to SGMA as users move toward achieving long-term water balance. Groundwater storage and recovery programs are designed to enhance groundwater levels. Some programs are intended to provide a consistent volume of water for groundwater replenishment, while other programs aim to capture infrequent high-volume flows (e.g., storm water capture). However, decreases in Sacramento/Delta supplies also could reduce water supplies for groundwater storage and recovery projects to some extent. As discussed above for the San Joaquin Valley region, for each unit of Sacramento/Delta water destined for groundwater storage and recovery projects that would not be delivered as a result of the proposed Plan amendments, an equivalent volume of water would not be recharged to the groundwater basins.

Water Transfers

More surface water transfers could result in a reduction of water in the source region and an increase of water in the destination region, potentially shifting the location of groundwater impacts from one area to another. In areas that receive transfer water, the potential for increased groundwater pumping and associated impacts could be reduced; in the areas providing transfer water, impacts could be exacerbated. If surface water is sold or transferred out of a basin that is subject to groundwater overdraft, the reduction in water supply to that basin could be potentially significant.

Surface water transfers implemented through groundwater substitution also could result in lowering of groundwater levels in the source groundwater basin. Potential impacts from groundwater substitution water transfers would depend on the specific circumstances of the transfer. Groundwater substitution water transfers could affect both total pumping and total recharge.

Groundwater substitution water transfers also could affect in-lieu groundwater recharge activities. Under in-lieu recharge programs, water users increase their surface water use to temporarily decrease the amount of groundwater they pump from the aquifer. Decreased pumping allows natural recharge to accumulate in the underground aquifer for use during dry years. If water that otherwise would have been used to facilitate in-lieu recharge were to be transferred, groundwater would still be pumped, which could result in a lowering of groundwater levels. Impacts on groundwater from water transfers would be potentially significant.

Implementation of Mitigation Measure MM-GW-b will avoid or reduce these impacts. As discussed in Section 7.1, *Introduction, Project Description, and Approach to Environmental Analysis,* transfers generally require environmental review and approval by different agencies that would be expected to address any water quality impacts (DWR 2016c). Transfers approved by the State Water Board and/or facilitated by Reclamation or DWR are required to avoid unreasonable impacts on fish and wildlife and prevent injury to other legal users of water. Groundwater overdraft is a consideration in determining whether a transfer would result in injury to a legal user or unreasonable impacts on fish and wildlife. To avoid or minimize impacts when processing petitions for transfers that involve groundwater substitution, the State Water Board will require petitioners to show that subsequent groundwater use resulting from the transfer is consistent with implementation of SGMA or other local groundwater management efforts. The State Water Board cannot guarantee that mitigation will be implemented for transfers not subject to State Water Board approval. Unless and until the mitigation is fully implemented, the impacts remain potentially significant.

Water Recycling

Water recycling provides another strategy to help water users maximize existing water supplies and reduce the potential for increasing groundwater pumping in response to reduced Sacramento/Delta surface water supplies. Water recycling strategies include treatment or reuse of water already beneficially used for another purpose. In some areas, effluent from WWTPs is increasingly being routed into "purple pipe" systems where the water is used for irrigation of landscapes, golf courses, and some crops. Agricultural discharges from tailwater recovery systems, subsurface drainage systems, or other excess waters can be captured and reused for irrigation or other uses compatible with the quality of the recycled water. Recycling of water is anticipated to have a minimal impact on groundwater levels in most areas and could increase groundwater levels in some areas if a portion of the recycled water reaches the aquifer or if the recycled water offsets a use that previously was supplied by groundwater. Operation of recycled water facilities could contribute to managed groundwater recharge if the water is used to augment groundwater basins. Users of recycled water (e.g., golf courses) may reduce their use of groundwater because recycled water would provide an alternative source of water. Impacts of the proposed Plan amendments on recycled water production and the impact of recycled water on groundwater levels would be less than significant.

Water Conservation

Implementation of agricultural water use efficiency measures is another strategy to reduce overall water demand. Conveyance facility improvements, including lining canals, can reduce the volume of water lost to evaporation, spills, and seepage. Transitioning from less-efficient irrigation measures, such as flood or furrow irrigation, to micro-sprinklers or drip irrigation can reduce irrigation demands. Improvements to tailwater drainage and recovery systems that then recycle that water also can lessen total water demand. While reductions in agricultural demand can help to maximize existing water supplies, a reduction in incidental groundwater recharge from conveyance seepage and excess irrigation of agricultural fields can lead to reduced groundwater levels in some areas such as the Friant Division service area, where municipal water supplies are drawn from groundwater that is recharged incidentally from applied irrigation water. Runoff from excess water application is not considered an appropriate or efficient mechanism for sustainable groundwater management. Potential impacts on groundwater levels from reduced incidental recharge would be potentially significant.

Effects on groundwater levels could be reduced through implementation of Mitigation Measure MM-GW-b. Specifically, impacts on groundwater levels and quality can be mitigated through implementation of sustainable groundwater management through local SGMA and other management efforts, groundwater storage and recovery, and conjunctive use. While these efforts are expected to help reduce impacts on groundwater levels, the State Water Board cannot guarantee that measures always will be adopted or applied in a manner that would fully mitigate impacts. Therefore, unless and until the mitigation is fully implemented, the impacts remain potentially significant.

Conversion to low-water landscaping, water-efficient appliance and fixture updates, water system audits, leak detection and repair, plumbing retrofits, commodity rate metering, and large landscape conversion programs and incentives are measures that municipalities can implement to reduce overall water demand. While the water savings from these activities often are relatively low compared with agricultural efficiency measures, the actions can be locally significant. During the 2012–2016 drought, numerous water agencies developed incentive programs for various municipal conservation measures, including incentives for replacing turf with low-water landscaping. Reductions in municipal water use because of these measures were substantial. For example, in response to drought water conservation regulations, from June 2015 to December 2016, municipal water suppliers conserved 2.4 MAF of water in California, a 22.5-percent reduction in water use compared with water use rates in 2013 (SWRCB 2017). Municipal water use recharges groundwater through percolation of applied irrigation water and from discharges of treated wastewater. Even though outdoor water use can account for half of domestic water use, the volume of recharge resulting from landscape irrigation is minor compared with agricultural recharge. Reductions in landscape watering or WWTP releases can cause a minor reduction in recharge of the underlying aquifers. Impacts would be less than significant.

Impact GW-a: Violate any water quality standards or waste discharge requirements

Impact GW-f: Otherwise substantially degrade water quality

The analyses of potential violations of water quality standards and WDRs (Impact GW-a) and other sources of water quality degradation (Impact GW-f) are sufficiently related and therefore are addressed together in the evaluation of potential impacts.

Changes in hydrology and water supply under the proposed Plan amendments have the potential to affect groundwater levels as discussed above under Impact GW-b. As discussed in Chapter 6, *Changes in Hydrology and Water Supply,* and under Impact GW-b, the proposed Plan amendments would result in increased instream flows during many months on many Sacramento/Delta tributaries and could lead to increased groundwater pumping in response to reduced Sacramento/Delta supplies, greater infiltration of surface water to groundwater (stream-aquifer interactions), and a reduction in incidental groundwater recharge from excess irrigation of agricultural fields. This section discusses how the proposed Plan amendments may affect groundwater quality in the study area.

Increased infiltration from stream-aquifer interactions in the Sacramento/Delta watershed could improve groundwater quality because rivers and streams in these regions tend to contain waters that are of high quality.

As discussed under Impact GW-b, water users may choose to increase groundwater pumping in response to the proposed Plan amendments to replace reduced Sacramento/Delta surface water supplies. These changes would not directly affect the concentration of groundwater contaminants. At the local scale, however, increased groundwater pumping has the potential to cause a change in the groundwater flow gradient, which could affect groundwater quality through exacerbating the migration of natural and anthropogenic groundwater contaminants.

Groundwater quality degradation from groundwater pumping can arise via two mechanisms: the migration of degraded groundwater caused by local pumping or the drawdown of salt-rich shallow groundwater into deeper, more pristine portions of the aquifer. Increased groundwater pumping in basins that are already in overdraft or in basins that are salt sinks may concentrate salts in groundwater over time. Additional contaminant loading could occur through application of fertilizers and pesticides via agricultural or municipal activities. Changing irrigation volumes and processes can have various results on groundwater quality.

Decreased irrigation water application can result in fewer soil-flushing events, causing levels of salts and nutrients to build up in soil over time; when a flushing event does occur (either through precipitation or excess irrigation water), the water that percolates into the aquifer can be highly concentrated in those salts and nutrients that were previously concentrated in the soil. However, the effects on shallow groundwater quality can be mitigated if there is a concomitant reduction in contaminant loading with the reduction in irrigation water. Excess irrigation sometimes can dilute existing salt and nutrients in the soil but can cause additional groundwater degradation where excess nutrients are applied as part of agricultural practices. Agricultural land is already being taken out of production due to these water quality issues.

The effects on groundwater quality from water user responses to the proposed Plan amendments are expected to be highly variable, with some areas experiencing degraded groundwater quality over time and some areas experiencing little or no change in groundwater quality. Changes to applied water and from transmission losses may result in degraded groundwater quality. Increased nutrient loading and possible changes in flow direction and gradient of contaminated groundwater could lead to increased groundwater degradation, which could affect drinking water wells. The outcome depends on the volume of water applied; precipitation; and loading of nutrients, salts, and pesticides on individual fields. For coastal aquifers, an undesirable effect of groundwater overdraft has been seawater intrusion. Impacts would be greater in the areas west (Bay Area region) and south (San Joaquin Valley, Central Coast, and Southern California regions) of the Delta where existing groundwater quality issues are more widespread. If Sacramento/Delta surface water supplies are replaced by other supplies that may be of poor quality (such as hydrologic fracturing wastewater in some locations, such as Kern County) for agricultural or other non-potable purposes, it is possible that poor-quality alternative supplies could affect underlying groundwater quality over time. Overall, the impacts on groundwater quality associated with changes in groundwater levels would be potentially significant.

Some communities may develop replenishment projects to ensure additional higher-quality drinking water supplies. Regulations are in place to protect consumers from unsafe drinking water; however, communities with degraded groundwater quality could experience additional costs and financial burdens. Communities dependent on groundwater supplies could face additional costs for wellhead treatment efforts, replacement wells, deepening wells, consolidations, or connecting to surface water sources. Groundwater quality and associated drinking water impacts could be reduced through implementation of Mitigation Measures MM-GW-b and MM-GW-a,f. Local groundwater management under SGMA implementation may address some of the supply issues faced by DACs, depending on how GSPs are developed and how GSAs consider impacts on DAC water users from local groundwater management actions. SGMA oversight by the State Water Board will ensure that GSPs are adequate and sufficient. The State Water Board also will continue its commitment to the human right to water through financial assistance, technical assistance, consolidations, and other means, including for communities that may be affected by reduced groundwater supplies or groundwater quality concerns. The Safe and Affordable Drinking Water Fund established under SB 200 will enable the State Water Board to provide crucial ongoing operations and maintenance support so once-struggling community water systems can provide a sustainable source of safe drinking water. The LIRA program provides rate relief for low-income ratepayers of water utilities. While these efforts are expected to help reduce impacts on communities that rely on groundwater for drinking water supplies, it is not certain that these efforts will always fully mitigate impacts.

Private domestic well owners may be less able to absorb costs associated with declining groundwater elevations or degraded groundwater quality. The State Water Board has provided funding for replacement or deepening of private domestic wells affected by the 2012–2016 drought through its Cleanup and Abatement Account. SB 108 also provided limited funding for replacement of private domestic wells that could no longer be used due to declining groundwater elevations. At this time, however, there are limited funding opportunities from the State Water Board or from other funding entities for private well replacement or treatment of poor water quality. The State Water Board will promote and support future funding sources, as appropriate.

The State Water Board cannot guarantee that measures always will be adopted or applied in a manner that would fully mitigate impacts. Therefore, unless and until the mitigation is fully implemented, the impacts of reduced groundwater levels on groundwater quality and drinking water remain potentially significant. See Section 7.20, *Utilities and Service Systems*, for further discussion on municipal water supply.

Because the study area covers a very large geographic area and the potential groundwater quality effects would be localized, it is not possible to predict all of the locations where groundwater quality could become more impaired as a result of the proposed Plan amendments. However, the following sections present the general patterns that may persist under the proposed Plan amendments by region and some examples of potential local effects.

Changes in Hydrology and Water Supply

Sacramento River Watershed and Delta Eastside Tributaries

As described under Impact GW-b, increased groundwater pumping and reductions in groundwater recharge could contribute to groundwater overdraft in the Sacramento River watershed and Delta eastside tributaries regions, particularly in groundwater basins where groundwater storage volumes already are in decline. The impact on groundwater quality in these regions would vary depending on groundwater pumping responses to reduced Sacramento/Delta surface water supplies. Should increased groundwater pumping occur in these regions, existing groundwater quality impairments could be exacerbated in localized areas if the increased groundwater pumping results in a change in the groundwater flow direction and gradient, leading to the spread of groundwater contaminant plumes. Replacement pumping also could cause increased salt and nutrient loading. If there is no substitute groundwater pumping, impacts on groundwater quality likely would be minimal because the groundwater supplies in these basins are generally of good water quality, although some groundwater impairments exist under the baseline condition. Additionally, as discussed above, increased groundwater recharge from stream-aquifer interactions (streambed seepage) in the Sacramento River watershed and Delta eastside tributaries regions could improve groundwater quality in some areas because rivers and streams in these regions tend to contain waters that are of high quality.

In the Sacramento River watershed, increased groundwater pumping could exacerbate existing groundwater quality impairments, such as salinity, boron, arsenic, iron, and manganese impairments in several medium-priority subbasins (e.g., Anderson, Enterprise, Solano, Butte subbasins) and high-priority subbasins (e.g., Colusa, Antelope, Vina, North American, Yolo subbasins). Likewise, inorganic anthropogenic impairments such as nitrates could be exacerbated in several of the medium-priority and high-priority subbasins (e.g., Anderson, Antelope, Colusa, Enterprise, Vina, Butte subbasins). Anthropogenic organic impairments, such as various VOCs, SVOCs, and pesticides that occur in localized areas in the North American and South American subbasins could be exacerbated by increased groundwater pumping.

In the Delta eastside tributaries region, increased groundwater pumping could exacerbate existing naturally occurring groundwater quality impairments such as salinity and radiological constituents; inorganic anthropogenic impairments such as nitrates; and anthropogenic organic impairments such as VOCs, SVOCs, and pesticides. The development of a groundwater depression immediately east of the Delta, in the Eastern San Joaquin subbasin, has caused salinization of supply wells due to chloride-rich water from deep Delta sediments intruding into native groundwater (O'Leary et al. 2015); increased groundwater pumping could exacerbate this existing issue.

The proposed Plan amendments would result in changes in municipal water supply, which could affect drinking water supplies. Based on 2005 to 2015 historical water deliveries data, approximately 826 TAF/yr of water is used for municipal purposes in the Sacramento River watershed, of which approximately 387 TAF/yr is supplied by groundwater; and approximately 154 TAF/yr of municipal water is used in the Delta eastside tributaries region, of which approximately 53 TAF/yr is supplied by groundwater (see Tables 2.8-4 and 2.8-5 in Section 2.8, *Existing Water Supply*). Under the proposed Plan amendments (45 to 65 scenarios), SacWAM results indicate that the Sacramento River watershed could experience an average annual reduction of municipal Sacramento/Delta surface water supplies of 29 to 83 TAF/yr, and the Delta eastside tributaries region could experience an average annual reduction of municipal water supplies of 11 to 22 TAF/yr (see Tables 6.4-6 and 6.4-10 in Chapter 6, *Changes in Hydrology and Water Supply*).

Decreased groundwater recharge, along with increased nutrient loading and possible changes in flow direction and gradient of contaminant plumes could lead to increased groundwater degradation, which could affect drinking water wells. As described in Section 7.12.2.2, *Environmental Setting*, under the discussion of *Overview of Groundwater Quality, Domestic Water Supplies*, regulations are in place to protect consumers from unsafe drinking water; however, communities with degraded groundwater quality could face additional costs and financial burdens. Communities could respond by implementing wellhead treatment efforts, constructing replacement wells, deepening existing wells, or obtaining other water supplies. Some communities may develop replenishment projects to ensure additional higher-quality water supplies. Costs for community water districts associated with groundwater use sustainability and replacement of lost groundwater supplies with more costly options could result in rate increases for consumers, which may affect low-income water users. The State Water Board's LIRA program could lessen the impact of rate increases on DACs, and the Safe and Affordable Drinking Water Fund will enable the State Water Board to provide crucial ongoing operations and maintenance support for small community water systems that are unable to meet safe drinking water standards (see also the *Economically Disadvantaged Communities* subsection of Section 7.12.2.2, *Environmental Setting*). Private domestic well owners may be less able to absorb costs associated with declining groundwater elevations or degraded groundwater quality. The State Water Board has provided funding for replacement or deepening of private domestic wells affected by the 2012–2016 drought through its Cleanup and Abatement Account. SB 108 also provided limited funding for replacement of private domestic wells that could no longer be used due to declining groundwater elevations. At this time, however, there are limited funding opportunities from the State Water Board or from other funding entities for private well replacement or treatment of poor water quality. The State Water Board will promote and support future funding sources, as appropriate.

Delta

As described under Impact GW-b, interactions between surface water and groundwater in the Delta would not change substantially as a result of the proposed Plan amendments, and any changes that do occur would not negatively affect groundwater levels. As a result, increased groundwater pumping from shallow levels in the Delta would not likely result in a change in the groundwater flow direction and gradient, leading to the spread of groundwater contaminant plumes, especially at shallower depths. Increased groundwater pumping from deeper levels could result in seawater intrusion; however, little groundwater pumping occurs in the Delta, and groundwater pumping that does occur is assumed to be from shallower levels.

San Francisco Bay Area

As described under Impact GW-b, Sacramento/Delta surface water supplies primarily are used for municipal water in the Bay Area, and potential impacts on groundwater levels in this region primarily would be related to the effects of local substitute groundwater pumping that might be implemented to replace lost surface water supplies. Increased groundwater pumping could have potentially significant impacts on groundwater quality in localized areas if increased groundwater pumping results in a change in the groundwater flow direction and gradient, leading to the migration of groundwater contaminant plumes, such as nitrates and VOCs plume migration, or seawater intrusion.

Groundwater quality impacts could affect drinking water supplies in the region. Changes in municipal water supply in the Bay Area could result in changes in drinking water quality if substitute groundwater pumping replaces reduced Sacramento/Delta supplies. Based on 2005 to 2015 historical water deliveries data, approximately 1,089 TAF/yr of water is used for municipal purposes in the Bay Area, of which approximately 184 TAF/yr is supplied by groundwater (see Table 2.8-7 in Section 2.8, *Existing Water Supply*). Under the proposed Plan amendments (45 to 65 scenarios), SacWAM results indicate that the Bay Area could experience an average annual reduction of municipal Sacramento/Delta supplies of 105 to 238 TAF/yr (see Table 6.4-16 in Chapter 6, *Changes in Hydrology and Water Supply*).

While the region has diverse supply options that can be relied upon, increased groundwater pumping could affect groundwater quality and drinking water supplies in some portions of the Bay Area region, particularly areas that rely on groundwater supplies and groundwater storage and recovery programs to prevent seawater intrusion and subsidence. As described in Section 7.12.2.2, *Environmental Setting*, under the discussion of *Overview of Groundwater Quality, Domestic Water Supplies*, regulations are in place to protect consumers from unsafe drinking water; however, communities with degraded groundwater quality could face additional costs and financial burdens. Communities could respond by implementing wellhead treatment efforts, constructing replacement wells, deepening existing wells, or obtaining other water supplies. Some communities may develop replenishment projects to ensure additional higher-quality water supplies. Larger water systems may be better able to absorb these costs than smaller water systems, and many water suppliers in the Bay Area region may be better able to fund efforts to address degraded groundwater supplies than water suppliers in the Central Valley and Central Coast. However, costs for community water districts associated with groundwater use sustainability and replacement of lost groundwater supplies with more costly options could result in rate increases for consumers, which may affect low-income water users. The State Water Board's LIRA program could lessen the impact of rate increases on DACs, and the Safe and Affordable Drinking Water Fund will provide crucial support for operations and maintenance so once-struggling community water systems can provide a sustainable source of safe drinking water (also see the *Economically Disadvantaged Communities* subsection of Section 7.12.2.2, *Environmental Setting*).

Private domestic well owners may be less able to absorb costs associated with declining groundwater elevations or degraded groundwater quality. The State Water Board provided funding for replacement or deepening of private domestic wells affected by the 2012–2016 drought through its Cleanup and Abatement Account. SB 108 also provided limited funding for replacement of private domestic wells that could no longer be used due to declining groundwater elevations. At this time, however, there are limited funding opportunities from the State Water Board or other funding entities for private well replacement or treatment of poor water quality. The State Water Board will promote and support future funding sources, as appropriate.

San Joaquin Valley

As described under Impact GW-b, groundwater levels and groundwater recharge rates could be affected by the proposed Plan amendments in areas of the San Joaquin Valley that receive Sacramento/Delta surface water supplies. Most subbasins in the San Joaquin Valley region contain one or more naturally occurring or anthropogenic groundwater quality impairment as well as anthropogenic organic impairments, such as pesticides. Increased groundwater pumping in the region could result in possible changes in flow direction and gradient of contaminant plumes, which could result in increased concentrations of salinity (e.g., TDS, chloride, sulfate), trace metals (e.g., selenium, arsenic, boron), radioactivity (e.g., gross alpha particle activity, uranium) or pesticides (e.g., 1,2-Dibromo-3-chloropropane) in some areas. Replacement pumping also could cause increased salt and nutrient loading, as described in the preceding *Sacramento River Watershed and Delta Eastside Tributaries* subsection.

A reduction in the application of surface water for agricultural irrigation without increased groundwater pumping could reduce existing groundwater salinity concerns in the San Joaquin Valley. However, additional groundwater pumping is possible that would result in significant groundwater quality impacts. Because of the high level of impairment and overdraft conditions in this region, potentially significant impacts on groundwater quality could result from even a limited amount of substitute groundwater pumping; and even more significant impacts would occur if increased groundwater pumping is used to completely offset Sacramento/Delta supply reductions.

The proposed Plan amendments would result in changes in municipal water supply in the San Joaquin Valley, which could result in changes in drinking water quality if substitute groundwater pumping replaces reduced Sacramento/Delta supplies or changes in recharge rates occur. Based on 2005 to 2015 historical water deliveries data, approximately 1,053 TAF/yr of water is used for municipal purposes in the San Joaquin Valley, of which approximately 823 TAF/yr is supplied by groundwater (see Table 2.8-8 in Section 2.8, *Existing Water Supply*). Under the proposed Plan amendments (45 to 65 scenarios), the San Joaquin Valley region could experience an average annual reduction in Sacramento/Delta municipal water supplies of 11 to 35 TAF/yr as estimated by SacWAM (see Table 6.4-22 in Chapter 6, *Changes in Hydrology and Water Supply*).

Many DACs in the San Joaquin Valley region relying on groundwater could be affected by degraded groundwater quality conditions and reduced groundwater supplies that could occur as a result of the proposed Plan amendments. The types of impacts that occurred to DACs and others during the 2012–2016 drought, when many wells in the San Joaquin Valley went dry and needed to be reconfigured or replaced, could be exacerbated. Costs for community water districts associated with groundwater use sustainability and replacement of lost or degraded groundwater supplies with more costly options could result in rate increases for consumers, which may affect low-income water users. The State Water Board's LIRA program could lessen the impact of rate increases on DACs, and the Safe and Affordable Drinking Water Fund will enable the State Water Board to provide crucial ongoing operations and maintenance support so once-struggling community water systems can provide a sustainable source of safe drinking water (also see the *Economically Disadvantaged Communities* subsection of Section 7.12.2.2, *Environmental Setting*).

Private domestic well owners may be less able to absorb costs associated with declining groundwater elevations or degraded groundwater quality. The State Water Board provided funding for replacement or deepening of private domestic wells affected by the 2012–2016 drought through its Cleanup and Abatement Account. SB 108 also provided limited funding for replacement of private domestic wells that could no longer be used due to declining groundwater elevations. However, at this time, there are limited funding opportunities from the State Water Board or other funding entities for private well replacement or treatment of poor water quality. The State Water Board will promote and support future funding sources, as appropriate.

Central Coast

As described under Impact GW-b, Sacramento/Delta surface water supplies primarily are used for municipal water in the Central Coast region, and potential impacts on groundwater levels in this region would be related primarily to the effects of local substitute groundwater pumping that might be implemented to replace lost surface water supplies. Increased groundwater pumping could have potentially significant impacts on groundwater quality in the region if increased groundwater pumping results in a change in the groundwater flow direction and gradient, leading to migration of groundwater contaminant plumes. Groundwater quality impairments that occur in some portions of the Central Coast region include various naturally occurring impairments and anthropogenic impairments such as nitrates. The Central Coast region also currently struggles with seawater intrusion in some groundwater basins. Examples of potential groundwater quality impairments that could be exacerbated by increased groundwater pumping include seawater intrusion in some coastal areas such as the Morro Valley and Santa Maria River Valley basins (both very low-priority basins) where seawater intrusion is one of the predominate water quality concerns; and salinity and nitrate impairments in agricultural areas such as the Santa Maria River Valley–Santa Maria subbasin (a very low-priority basin).

The proposed Plan amendments would result in changes in municipal water supply in the Central Coast region, which could result in changes in drinking water quality if substitute groundwater pumping replaces the reduced Sacramento/Delta surface water supplies. Based on 2005 to 2015 historical water deliveries data, approximately 279 TAF/yr of water is used for municipal purposes in the Central Coast, of which approximately 196 TAF/yr is supplied by groundwater. Sacramento/Delta supply accounts for approximately 49 TAF/yr of the Central Coast region's municipal water supply as estimated by SacWAM. (See Table 2.8-9 in Section 2.8, *Existing Water Supply.*) Under the proposed flow requirements, the Central Coast region could experience an average annual reduction of Sacramento/Delta municipal water supplies of 6 to 17 TAF/yr as estimated by SacWAM (see Table 6.4-19 in Chapter 6, *Changes in Hydrology and Water Supply*).

Among hydrologic regions in California, the Central Coast is the most reliant on groundwater for its water supply (^2013 Water Plan V2, Central Coast Hydrologic Region). Many communities in the Central Coast rely on groundwater supplies; these communities could be affected by degraded groundwater quality conditions and reduced groundwater supplies that could occur as a result of the proposed Plan amendments. As described above, regulations are in place to protect consumers from unsafe drinking water; however, communities with degraded groundwater quality could face additional costs and financial burdens. Communities could respond by implementing wellhead treatment efforts, constructing replacement wells, deepening existing wells, or obtaining other water supplies. Costs for community water districts associated with groundwater use sustainability and replacement of lost groundwater supplies with more costly options could result in rate increases for consumers, which may affect low-income water users. The State Water Board's LIRA program could lessen the impact of rate increases on DACs, and the Safe and Affordable Drinking Water Fund will enable the State Water Board to provide crucial ongoing operations and maintenance support so once-struggling community water systems can provide a sustainable source of safe drinking water (see also the *Economically Disadvantaged Communities* subsection of Section 7.12.2.2, *Environmental Setting*).

Private domestic well owners may be less able to absorb costs associated with declining groundwater elevations or degraded groundwater quality. The State Water Board provided funding for replacement or deepening of private domestic wells affected by the 2012–2016 drought through its Cleanup and Abatement Account. SB 108 also provided limited funding for replacement of private domestic wells that could no longer be used due to declining groundwater elevations. At this time, however, there are limited funding opportunities from the State Water Board or other funding entities for private well replacement or treatment of poor water quality. The State Water Board will promote and support future funding sources, as appropriate.

Southern California

As described under Impact GW-b, Sacramento/Delta surface water supplies primarily are used for municipal water in Southern California, and potential impacts on groundwater levels in this region would be related primarily to the effects of local substitute groundwater pumping that might be implemented to replace lost surface water supplies. Increased groundwater pumping could have potentially significant impacts on groundwater quality in the region if increased groundwater pumping results in a change in the groundwater flow direction and gradient, leading to migration of groundwater contaminant plumes. Common groundwater impairments that occur in Southern California include VOCs and anthropogenic solvents, nutrients, salts, and pesticides. In addition, seawater intrusion that has occurred in multiple coastal areas could be exacerbated by increased groundwater pumping.

The proposed Plan amendments would result in changes in municipal water supply in Southern California, which could result in changes in drinking water quality if substitute groundwater pumping replaces reduced Sacramento/Delta supplies. Based on 2005 to 2015 historical water deliveries data, approximately 4,518 TAF/yr of water is used for municipal purposes in Southern California, of which approximately 1,590 TAF/yr is supplied by groundwater (see Table 2.8-10 in Section 2.8, *Existing Water Supply*). Under the proposed Plan amendments (45 to 65 scenarios), the region could experience an average annual reduction of municipal water supplies of 238 to 651 TAF/yr as estimated by SacWAM (see Table 6.4-26 in Chapter 6, *Changes in Hydrology and Water Supply*).

As described in Chapter 6, *Changes in Hydrology and Water Supply*, many Southern California municipal water suppliers have varied portfolios of water supplies. Imported water supplies in many urban areas in this region are augmented with recycled water, local surface water supplies, and groundwater. In addition, water transfers and water supplies associated with groundwater storage and recovery projects make up a portion of many water purveyors' water supply portfolios in municipal areas. While most agencies have varied portfolios of supplies, those that rely heavily on Sacramento/Delta water supplies could be substantially affected by supply reductions.

Increased groundwater pumping to offset reductions in Sacramento/Delta surface water supplies may have potentially significant impacts on public water systems and other drinking water systems in the region. Increased groundwater pumping may draw groundwater contaminant plumes into more pristine portions of an aquifer, or communities may need to use degraded groundwater as a drinking water source if Sacramento/Delta surface water supplies are reduced. While regulations protect consumers from unsafe drinking water, customers within those public water systems may face higher costs for treatment, procurement of alternative sources (such as desalination plants), and other management efforts to secure safe and reliable drinking water supplies.

Implementing more expensive conservation and wastewater reclamation projects might disproportionally affect low-income ratepayers that may be masked by the relatively high-income levels and overall high costs of living in this region. While costs associated with conservation or replacement of water sources with more costly options can be borne by the community water districts, low-income water users may be affected disproportionately by higher rates. Costs for community water districts associated with groundwater use sustainability and replacement of lost groundwater supplies with more costly options could result in rate increases for consumers that may affect low-income water users. The State Water Board's LIRA program could lessen the impact of rate increases on DACs, and the Safe and Affordable Drinking Water Fund will enable the State Water Board to provide crucial ongoing operations and maintenance support so once-struggling community water systems can provide a sustainable source of safe drinking water (see also the *Economically Disadvantaged Communities* subsection of Section 7.12.2.2, *Environmental Setting*).

Other Water Management Actions

Water users often rely on a variety of water sources (water portfolios), including groundwater, water transfers, and water recycling (see Section 7.1, *Introduction, Project Description, and Approach to the Environmental Analysis*, for additional discussion of other water management actions). Significant decreases in water demand can be achieved through water conservation and water use efficiency efforts. Reducing reliance on the Delta is state policy, along with an associated mandate for improving regional self-reliance (Wat. Code, § 85021). In response to reductions in surface water supplies attributable to the proposed Plan amendments, water users may further expand and modify their water portfolios by implementing groundwater storage and recovery, water recycling, water transfers, and water conservation. The use of other water management actions can reduce the magnitude of impacts associated with changes in Sacramento/Delta surface water supply but also could result in environmental impacts that must be evaluated.

Groundwater Storage and Recovery

Groundwater storage and recovery projects that use high-quality water to recharge groundwater basins may provide an effective strategy to maintain or improve groundwater quality for some agencies. In some areas, existing infrastructure may be sufficient to perform groundwater storage and recovery. By capturing local precipitation, storm water, and flood flows and routing that water to locations suitable for recharging the local aquifers, natural processes can be augmented, and water can be efficiently stored and extracted through existing wells for local use. Groundwater storage and recovery projects may help to minimize seawater intrusion in coastal areas or the spread of contaminants that may occur as a result of a change in groundwater flow direction and gradient. While groundwater storage and recovery projects would benefit groundwater levels and may benefit groundwater quality, groundwater storage and recovery projects that use poor-quality water to recharge groundwater basins could contribute to salt and nutrient loading or could introduce contaminants to the underlying aquifer.

Groundwater storage and recovery could affect groundwater quality if poor-quality water were used for passive or injection well recharge. Water sources of concern include tertiary-treated water and treated water containing disinfection byproducts (chloroform) or fluoride. Constituents in these water sources could percolate into the groundwater and degrade the water quality. Salt loading is another concern in certain parts of the state where water can contain elevated levels of salts or where the hydrologic basin is closed and therefore does not allow flushing out of accumulated salts. Measures may not be available to address salt loading in closed basins. Passive recharge also could cause groundwater quality degradation if it occurs in areas where high nitrate levels are present because recharge may increase the migration of the nitrate into the aquifer. Much of this nitrate is a remnant of earlier farming practices in which excessive amounts of fertilizer were used. Typically, in these circumstances, nitrate levels initially increase in the groundwater and then drop to acceptable levels after the excess nitrate has been moved through the system. Operation of groundwater storage and recovery facilities would not otherwise result in a substantial degradation of water quality.

In addition, decreases in Sacramento/Delta supplies could reduce water supplies for groundwater storage and recovery projects to some extent. In some locations, decreases in Sacramento/Delta supplies could exacerbate existing groundwater quality concerns.

Impacts from groundwater storage and recovery actions on groundwater quality could be potentially significant. Implementation of Mitigation Measures MM-GW-b: 4 and MM-GW-a,f will reduce impacts to a less-than-significant level. The State Water Board will continue efforts to encourage and promote environmentally sound groundwater storage and recovery (recharge) projects that use surplus surface water. In processing water right applications that involve groundwater storage, the State Water Board will ensure that water used for groundwater recharge will comply with water quality parameters set by the regional water board for groundwater replenishment, which require treatment, retention, blending, and other measures. The State Water Board also will continue its commitment to the human right to water through financial assistance, technical assistance, consolidations, and other means, including for communities that may be affected by reduced groundwater supplies or groundwater quality concerns.

Water Transfers

The effects of water transfers on groundwater quality would be highly variable. Surface water transfers implemented through groundwater substitution could result in a lowering of groundwater levels in the source groundwater basin if groundwater is pumped in substitution for surface water transferred out of the basin, which could exacerbate groundwater quality impairments in localized areas if the increased groundwater pumping results in a change in the groundwater flow direction and gradient leading to the spread of groundwater contaminant plumes. Surface water transfers through cropland idling could also affect groundwater quality. As described previously, changing irrigation volumes and processes that may occur as a result of water transfers can have various results on groundwater quality. Excess irrigation water can sometimes dilute existing salt and nutrients in the soil but also can cause additional groundwater degradation where excess nutrients are applied as part of agricultural practices. Additional contaminant loading could occur in localized areas. The impacts on groundwater quality from transfers would be potentially significant.

Implementation of Mitigation Measures MM-GW-b: 6 and MM-GW-a,f will avoid or reduce these impacts. Transfers approved by the State Water Board and/or facilitated by Reclamation or DWR are required to avoid unreasonable impacts on fish and wildlife and prevent injury to other legal users of water. Groundwater quality is a consideration in determining whether a transfer would result in injury to a legal user or unreasonable impacts on fish and wildlife. To avoid or minimize impacts, when processing petitions for transfers, the State Water Board will ensure that the transfer would not result in groundwater quality impacts. The State Water Board cannot guarantee that mitigation will be implemented for transfers not subject to State Water Board approval. Unless and until the mitigation is fully implemented, the impacts remain potentially significant.

Water Recycling

Water recycling provides a strategy to lessen the impact of reduced Sacramento/Delta surface water supplies. Recycling strategies include the treatment and or reuse of water already beneficially used for another purpose. Effluent from WWTPs is increasingly being routed into "purple pipe" systems where the water is used for irrigation of landscapes, golf courses, and some crops. Agricultural discharges from tailwater recovery systems, subsurface drainage systems, or other excess waters can be captured and reused for irrigation or other uses compatible with the quality of the recycled water. When used for agricultural irrigation or outdoor municipal use, recycled water may percolate into the underlying groundwater basin, and could potentially affect groundwater quality. While untreated wastewater may contain a variety of constituents (e.g., CECs), water recycling projects are subject to regulatory oversight. For example, the use of treated wastewater derived from municipal sources requires a permit from the State Water Board. Recycled water facilities are required to comply with all regulations pertaining to water quality standards and regulations to prevent degradation of water quality in receiving waters. Users of recycled water (e.g., golf courses) must prepare plans and undergo inspections by the municipality operating the WWTP and prepare management plans to limit and control runoff into receiving waters. Impacts on groundwater quality would be less than significant.

Water Conservation

As described under Impact GW-b, reductions in Sacramento/Delta surface water supplies likely would lead to implementation of water conservation strategies. Increased demand on groundwater supplies, coupled with the impacts of conservation strategies on groundwater recharge, could locally result in net decreases in groundwater storage. These impacts would be most substantial in basins more reliant on groundwater or Sacramento/Delta surface water supplies, as well as those already subject to conditions of groundwater overdraft. These impacts could locally affect groundwater quality.

Implementation of agricultural and municipal water conservation measures could affect groundwater quality if water conservation measures reduce existing groundwater recharge rates. Potential groundwater quality impacts associated with agricultural water conservation measures vary depending on characteristics such as the crop grown, soil characteristics, depth to groundwater, and irrigation methods. In some areas, reduction in applied irrigation water could improve groundwater quality by reducing the potential for groundwater recharge to induce the migration of salts, fertilizers, or pesticides to the underlying groundwater aquifer. However, in areas with existing groundwater quality impairments, a reduction in groundwater recharge resulting from increased irrigation efficiencies could worsen existing groundwater contamination by potentially concentrating pollutants. Similarly, implementation of municipal water conservation measures such as more efficient landscape irrigation practices could improve groundwater quality by reducing the potential for groundwater recharge to include the migration of salts, fertilizers, pesticides, or urban contaminants—or could worsen existing groundwater contamination by potentially concentrating pollutants. The impact of agricultural and municipal water conservation measures on groundwater quality would be potentially significant in localized areas. Implementation of Mitigation Measures

MM-GW-b and MM-GW-a,f will reduce impacts on groundwater quality. Unless and until mitigation measures are implemented, the impacts remain potentially significant.

7.12.2.4 Mitigation Measures

MM-GW-b: Mitigate the substantial depletion of groundwater supplies or the substantial interference with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level

1. **Implement the Sustainable Groundwater Management Act (SGMA):** Local SGMA implementation will help mitigate the effects of the proposed Plan amendments by minimizing groundwater overdraft, protecting drinking water supplies and other high-quality water from contamination by plume migration, and protecting interconnected surface water from stream depletion caused by groundwater pumping. GSAs in high- and medium-priority basins must develop and implement GSPs that achieve groundwater sustainability within 20 years of GSP adoption. SGMA required that critically overdrafted high- and medium-priority basins adopt GSPs by January 31, 2020, and that all other high- or medium-priority basins adopt GSPs by January 31, 2022 (Wat. Code, § 10720.7). Each GSP also must include measurable objectives, as well as milestones in increments of 5 years, to achieve the sustainability goal in the basin within 20 years of the implementation of the GSP. (Wat. Code, § 10727.2.) Under a GSA's SGMA authority, GSAs can and should manage groundwater subbasins to prevent overpumping and groundwater quality degradation from migrating contaminants.

   In developing and implementing a GSP, GSAs are required to avoid unreasonable results, including significant and unreasonable seawater intrusion, land subsidence that substantially interferes with surface land uses, and depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

   GSPs must include elements detailed in Water Code section 10727.2, including a description of the physical setting and characteristics of the aquifer system underlying the basin, measurable objectives, and a description of how the plan helps meet each objective and how each objective is intended to achieve the sustainability goal for the basin for long-term beneficial uses of groundwater. The GSPs must specifically include monitoring, mitigation of overdraft, and identification of potential recharge areas in the basin and areas that contribute to the replenishment of the groundwater basin.

   DWR is responsible for establishing requirements and reviewing GSPs and must make a determination whether the GSP is likely to achieve the sustainability goal for the basin (Wat. Code, § 10733). In evaluating a GSP under SGMA, DWR will ensure that the GSP is likely to prevent undesirable results and ensure that the basin is operated within its sustainable yield. The assessment may include recommended corrective actions to address deficiencies identified by the Department (Wat. Code, § 10733.4). DWR is required to review plans and issue an assessment of the plan every 5 years following submittal to DWR (Wat. Code, § 10733.8).

2. **SGMA Oversight:** A number of triggers could result in the referral of a SGMA-applicable groundwater basin to the State Water Board for additional management actions, including failure to submit a GSP or a DWR finding that a GSP is inadequate or unlikely to meet the sustainability goal (Wat. Code, § 10735.2). The State Water Board ultimately may design an interim plan for a basin that may include restrictions on groundwater extraction, a physical

solution to groundwater extraction, and principles and guidelines for administration of rights to surface waters that are connected to the basin.

SGMA oversight will help ensure that GSPs are adequate and sufficient, and consequently will mitigate potentially significant effects of the proposed Plan amendments associated with groundwater depletion and associated water quality concerns. The administration of a basin by the State Water Board will directly address declining groundwater levels and degraded water quality, likely through reduced groundwater extractions.

In areas outside of SGMA jurisdictions, local governments should use their authorities to manage groundwater extraction and overdraft, and to protect groundwater quality. For example, a county could implement a well installation moratorium, require programmatic CEQA level review of new well installations, require setbacks between wells and surface waters, and other actions that could effectively minimize the rate or magnitude of decreasing groundwater elevations. The same actions also would be effective in minimizing the effect of contaminant plume migration.

3. **Diversify Water Portfolios:** Water users can and should diversify their water supply portfolios in an environmentally responsible manner and in accordance with the law, to mitigate groundwater impacts. This includes sustainable use of groundwater and groundwater storage and recovery and conjunctive use, water recycling, water transfers, and water conservation and efficiency upgrades. While water conservation does not generate new water, it can extend the utility of existing supplies and therefore is considered another source of supply. Water conservation measures, such as increased efficiency for municipal uses or conversion of irrigated landscapes to vegetation that requires less water, can reduce groundwater pumping.

4. **Support and Approval of Groundwater Storage and Recovery:**

   i. The State Water Board will continue efforts to encourage and promote environmentally sound groundwater recharge projects that use surplus surface water, including prioritizing the processing of temporary and long-term water right permits for projects that enhance the ability of local and state agencies to capture high-runoff events for groundwater storage and recharge. In processing water right applications that involve groundwater storage, the State Water Board will consider the need to preserve ecological functions of high-flow events and other relevant factors in accordance with the Water Code.

   ii. The State Water Board will consider adding a generally applicable provision to the Declaration of Fully Appropriated Streams (State Water Board Order WR 98-08) to specify conditions under which water right applications may be accepted to allow for capture of flood flows for groundwater recharge.

   iii. Water used for groundwater recharge will comply with water quality parameters set by the regional water board for groundwater replenishment, which require treatment, retention, blending, and other measures.

5. **Support and Approval of Water Recycling Projects:** The State Water Board will continue efforts to encourage and promote water recycling projects, including projects that involve use of recycled water for groundwater recharge, through expediting permit processes and funding efforts.

6. **Oversight and Approval of Water Transfers:** In processing petitions for transfers that involve groundwater substitution, the State Water Board will require petitioners to show that subsequent groundwater use resulting from the transfer is consistent with implementation of SGMA or other local groundwater management efforts and plans to ensure that transfers do not contribute to groundwater-related impacts.

   In processing transfers that involve groundwater substitution, DWR, Reclamation, and other entities should require transferors to show that subsequent groundwater use resulting from the transfer is consistent with implementation of SGMA or other local groundwater management efforts and plans to ensure that transfers do not contribute to groundwater-related impacts.

   Water users proposing to export groundwater from the "combined Sacramento and Delta-Central Sierra basin" must comply with the provisions of Water Code section 1220 where the groundwater pumping was initiated after January 1, 1985. Water Code section 1220 prohibits the export of groundwater from these basins unless (1) the pumping is in compliance with an adopted groundwater management plan; and (2) the plan is approved by a vote in the county or portions of counties that overlie the groundwater basin.

7. **Voluntary Implementation Plans:** Voluntary implementation plans are required to include measures to coordinate the implementation of the proposed Plan amendments with groundwater management activities, including implementation of SGMA, to ensure that implementation activities do not contribute to groundwater-related impacts.

   As additional information and data are gathered regarding groundwater pumping in the subbasins, SGMA milestones, and SGMA compliance, the State Water Board can and will revisit and analyze groundwater conditions during the periodic review of the Bay-Delta Plan. Where and when appropriate, it also will exercise its independent but complementary authorities under SGMA to ensure sustainable management of groundwater basins. The State Water Board has several authorities that are independent of SGMA, including authority to act to prevent waste, unreasonable use, unreasonable method of use, and unreasonable method of diversion of water. The State Water Board may exercise this authority through quasi-adjudicative or quasi-legislative proceedings as appropriate and necessary. The State Water Board also could act under its public trust authority to regulate depletion of interconnected surface water by groundwater pumping.

MM-GW-a,f: Mitigate impacts on groundwater quality from depletion of groundwater supplies or the substantial interference with groundwater recharge

1. **Drinking Water Programs:**

   i. Drinking Water Standards: Municipal water suppliers are required to take actions to ensure that water supplies meet relevant drinking water standards before that water is delivered to the public, including supplies that come from groundwater. Wellhead treatment, wellhead protection efforts, and well relocation/deepening will mitigate the effect of degraded groundwater quality on residents that rely on public water systems for their drinking water. The Safe and Affordable Drinking Water Fund established under SB 200 will enable the State Water Board to provide critical ongoing operations and maintenance support for small community water systems that are unable to meet safe drinking water standards.

ii. Human Right to Water: The State Water Board will continue its commitment to the human right to water through financial assistance, technical assistance, consolidations, and other means, including for communities that may be affected by reduced groundwater supplies or groundwater quality concerns. The LIRA program provides rate relief for low-income ratepayers of water utilities. The program offers cost-effective methods of assistance to low-income water customers besides rate assistance, including billing alternatives, installation of water conservation devices, and leak repair. The Drinking Water State Revolving Fund and Proposition 1 can provide funding for projects to assist publicly owned water systems (e.g., counties, cities, districts), privately owned community water systems (e.g., for-profit water utilities, nonprofit mutual water companies), and nonprofit or publicly owned noncommunity water systems (e.g., public school districts) with planning, design, and construction of drinking water infrastructure projects that will improve communities' water efficiency and ensure a drought-resilient water supply, including for communities that may be affected by reduced groundwater supplies or groundwater quality concerns. In addition, the Safe and Affordable Drinking Water Fund will enable the State Water Board to provide crucial ongoing operations and maintenance support so once-struggling community water systems can provide a sustainable source of safe drinking water.

iii. Consolidation of Public Water Systems: SB 88 authorizes the State Water Board to require public water systems that consistently fail to meet standards to consolidate with, or obtain service from, a public water system, including for communities that may be affected by reduced groundwater supplies or groundwater quality concerns. Consolidating public water systems and extending service from existing public water systems to communities and areas, such as DACs, that currently rely on under-performing or small, failing water systems, as well as domestic wells, can reduce costs and improve reliability (^SWRCB 2015).

iv. Funding: The State Water Board will promote and support funding sources for replacement of wells or for treatment of poor water quality in private domestic wells as appropriate.

v. Cleanup and Abatement Orders: Pursuant to Water Code section 13304, the State or regional water board may issue a cleanup and abatement order requiring a discharger to clean up and abate waste, "where the discharger has caused or permitted waste to be discharged or deposited where it is or probably will be discharged into waters of the State and creates or threatens to create a condition of pollution or nuisance." A cleanup and abatement order may require replacement water for domestic wells affected by pollution.

2. **Implement the State and Regional Board's Irrigated Lands Regulatory Program:** Implementation of the ILRP will help manage long-term nutrient loading to groundwater and, over time, will help mitigate water quality issues associated with lower groundwater levels primarily by controlling salt and nutrient accumulation in soils that could be carried into shallow groundwater.

3. **Reduce Impacts on Groundwater:** Implement Mitigation Measures GW-b to reduce impacts of lowered groundwater levels on groundwater quality.

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