

7.0 Summary Comparison of Alternatives

A summary comparison of important groundwater impacts is provided in Figure 7-0. This figure provides information on the magnitude of the most pertinent and quantifiable groundwater impacts that are expected to result from implementation of alternatives. Important impacts to consider include depletion of groundwater supplies during the construction and operation of the water conveyance facilities.

As depicted in Figure 7-0, each alternative, with the exception of the No Action Alternative and Alternative 9, would reduce local groundwater supplies during the construction of the water conveyance facilities as a result of temporary dewatering. Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 6A, 6B, 6C, and 7 would reduce groundwater levels in the vicinity of intakes by an estimated 10 feet and in the vicinity of Clifton Court Forebay by an estimated 20 feet. Dewatering required to construct Alternatives 3, 4, 5, 8, 4A, 2D, and 5A would result in slightly less impact on the groundwater table than under the other alternatives. Construction of Alternative 9 is not expected to result in adverse impacts on groundwater levels. Groundwater levels would return to preproject conditions within months of dewatering cessation.

Each action alternative would also have impacts on groundwater levels in the water delivery areas during operation of the water conveyance facilities. Under the No Action Alternative, 4,043 thousand acre-feet per year (TAF/year) would be delivered to regions south of the Delta. Among the action alternatives, Alternative 8 would result in the lowest deliveries, at 2,899 total TAF/year, resulting in more groundwater pumping; Alternatives 1A, 1B, and 1C would result in the greatest deliveries, at 4,974 TAF/year, resulting in less groundwater pumping. Alternatives 4, 4A, 2D, and 5A would all result in more deliveries and less groundwater pumping than under the No Action Alternative, by delivering 4,782 TAF/year under Alternative 4 (Operational Scenario 1); 4,470 TAF/year under Alternative 4A; 4,886 TAF/year under Alternative 2D; and 4,704 TAF/year under Alternative 5A.

Table ES-8 in the Executive Summary provides a summary of all impacts disclosed in this chapter.

7.1 Environmental Setting/Affected Environment

This section provides a description of the environmental setting/affected environment (as of the 2009 release date for the Notice of Preparation and Notice of Intent) related to groundwater resources that may be influenced by implementation of the Bay Delta Conservation Plan (BDCP) or other action alternatives.

Groundwater provides about 35% of the state's water needs, and 40% or more during droughts. (California Department of Water Resources 2009a). With the growing limitations on available surface water exported through the Delta, and the potential impacts of climate change, reliance on groundwater through conjunctive management would become increasingly more important in meeting the state's future water uses.

1 For the purposes of this analysis, the groundwater study area (the area in which impacts may occur)
 2 specifically consists of the Delta Region, which also includes the Plan Area (the area covered by the
 3 action alternatives) shown in Figure 7-1, the Upstream of the Delta Region, and the State Water
 4 Project (SWP) and Central Valley Project (CVP) Export Service Areas (Export Service Areas) Region.
 5 Groundwater supply impacts are directly linked to potential changes in surface water supply
 6 availability, which are discussed in Chapter 5, *Water Supply*.

7 **7.1.1 Potential Environmental Effects Area**

8 The Delta, Suisun Marsh, and the Central Valley overlie parts of several extensive groundwater basins
 9 that play key roles in local and regional water supply. The groundwater basins are influenced to
 10 various degrees by complex physical relationships in the affected areas.

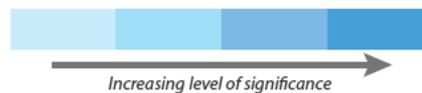
- 11 • Rivers draining the Coast Ranges, the Cascade Ranges, and the Sierra Nevada convey water into
 12 the Central Valley and Suisun Marsh, interconnect with the underlying groundwater basins, and
 13 eventually flow into San Francisco Bay. The Sacramento River Hydrologic Region overlies the
 14 Sacramento Valley groundwater basin. The San Joaquin River and Tulare Lake Hydrologic Regions
 15 overlie the San Joaquin Valley groundwater basin, and the San Francisco Bay Hydrologic Region
 16 (including the Suisun Marsh) overlies the Suisun-Fairfield Valley groundwater basin.
- 17 • Private individual groundwater wells provide for the majority of the residential potable water
 18 source for several of the Delta communities, such as Clarksburg, Courtland, Freeport, Hood,
 19 Isleton, Rio Vista, Ryde, and Walnut Grove, and the largely agricultural San Joaquin Valley is
 20 dependent on groundwater to support agricultural and municipal demands (see Chapter 6,
 21 *Surface Water*).
- 22 • Some water flowing through the Delta is exported by the SWP/CVP to areas outside the Delta (see
 23 Chapter 5, *Water Supply*), and the availability of these water supplies influences the groundwater
 24 use and conditions of those areas. Groundwater basins in the Export Service Areas underlie
 25 several hydrologic regions in central and southern California, including parts of the San Joaquin
 26 River, San Francisco Bay, Tulare Lake, Central Coast, Southern California, and Colorado River
 27 Hydrologic Regions.
- 28 • Throughout the potential effects area, geologic history and conditions strongly influence
 29 groundwater flow and aquifer recharge.
- 30 • Subsidence, such as peat soil compaction, can result from several mechanisms related to
 31 hydrogeologic conditions.

32 The existing groundwater conditions in the Delta Region, the Suisun Marsh, the Upstream of the Delta
 33 Region, and the Export Service Areas are described to support discussions of environmental
 34 consequences (Section 7.3, *Environmental Consequences*) associated with potential changes resulting
 35 from the construction of project water conveyance and related facilities and implementation of
 36 Conservation Measure (CM) 2–CM21, or Environmental Commitments 3, 4, 6–12, 15, 16 under
 37 Alternatives 4A, 2D, and 5A, in the Delta Region, as well as other indirect effects on groundwater
 38 resources stemming from the long-term operations and existence of these facilities and restored
 39 areas.

Chapter 7 – Groundwater		Alternative																			
		Existing Condition	No Action	1A	1B	1C	2A	2B	2C	3	4	5	6A	6B	6C	7	8	9	4A	2D	5A
GW-1: During construction, deplete groundwater supplies or interfere with groundwater recharge, alter groundwater levels, or reduce the production capacity of preexisting nearby wells (Decrease in groundwater in vicinity of intakes / in vicinity of Clifton Court Forebay)		n/a	n/a	10-20 ft/ 20 ft	<10-20 ft/ <20 ft	<10-20 ft/ <20 ft	<10-20 ft/ <20 ft	10-20 ft/ 20 ft	10-20 ft/ 20 ft	10-20 ft/ 20 ft	10-20 ft/ 20 ft	<10-20 ft/ <20 ft	n/a	<10-20 ft/ <20 ft	<10-20 ft/ <20 ft	<10-20 ft/ <20 ft					
		n/a	n/a	SU/A	SU/A	SU/A	SU/A	SU/A	SU/A	SU/A	SU/A	SU/A	LTS/NA	SU/A	SU/A						
GW-8: During operations, deplete groundwater supplies or interfere with groundwater recharge, alter groundwater levels, or reduce the production capacity of preexisting nearby wells (SWP and CVP deliveries [TAF/yr] to hydrologic regions located south of the Delta)	San Joaquin and Tulare	2,964	2,519	3,070	3,070	3,070	2,846	2,846	2,846	3,023	H1: 2,949 H2: 2,767 H3: 2,781 H4: 2,610	2,709	2,285	2,285	2,285	2,272	2,069	2,529	2,762	3,016	2,928
	Central Coast	47	40	51	51	51	49	49	49	50	H1: 49 H2: 40 H3: 48 H4: 39	45	34	34	34	36	27	43	45	51	48
	Southern California	1,647	1,484	1,853	1,853	1,853	1,711	1,711	1,711	1,821	H1: 1,784 H2: 1,491 H3: 1,668 H4: 1,370	1,613	1,136	1,136	1,136	1,162	803	1,410	1,663	1,819	1,728
		n/a	n/a	B	B	B	LTS/NA	LTS/NA	LTS/NA	LTS/B	SU/A	LTS/NA	SU/A	SU/A	SU/A	SU/A	SU/A	SU/A	LTS/B	LTS/B	LTS/B

Key

Level of significance or effect **before** mitigation
(Quantity of impact: number of sites, structures, acres, etc. affected)



n/a not applicable
> greater than
< less than
≈ about equal to

Level of significance or effect **after** mitigation
(CEQA Finding / NEPA Finding)

CEQA Finding
NI No Impact
LTS Less than significant
S Significant
SU Significant and unavoidable

NEPA Finding
B Beneficial
NE No Effect
NA Not Adverse
A Adverse

**Figure 7-0
Comparison of Impacts on Groundwater**

1 **7.1.1.1 Central Valley Regional Groundwater Setting**

2 The California Department of Water Resources (DWR) has delineated 515 distinct groundwater
 3 systems as described in Bulletin 118-03 (California Department of Water Resources 2003). These
 4 basins and subbasins have various degrees of supply reliability considering yield, storage capacity,
 5 and water quality. Figure 7-1 shows the statewide occurrence of groundwater and overlying
 6 hydrologic regions. The Delta overlies subbasins from both the Sacramento Valley and San Joaquin
 7 Valley groundwater basins and Suisun Marsh overlies the Suisun-Fairfield Valley groundwater basin.
 8 Outside the Delta and Suisun Marsh, to the north, the Sacramento River watershed overlies the
 9 Sacramento Valley groundwater basin. To the south, the San Joaquin River watershed overlies the San
 10 Joaquin Valley basin.

11 The large and diverse Sacramento Valley and San Joaquin Valley groundwater basins have been
 12 divided into groundwater subbasins based primarily on surface water features, political boundaries,
 13 or both. The individual groundwater subbasins are not hydraulically distinct, have a high degree of
 14 interconnection, and tend to behave as single extensive alluvial aquifer systems. (California
 15 Department of Water Resources 2003).

16 The Sacramento Valley groundwater basin extends from the Red Bluff Arch south to the Cosumnes
 17 River. The Red Bluff Arch is near the northern end of the Central Valley and separates the Sacramento
 18 Valley groundwater basin from the Redding Area groundwater basin. The southern portion of the
 19 Sacramento Valley groundwater basin underlies the northern portion of the Delta. The Sacramento
 20 Valley groundwater basin is extremely productive and provides much of the water supply for
 21 California's agricultural and urban water needs.

22 The San Joaquin Valley groundwater basin underlies the entire San Joaquin Valley from the south at
 23 the Tehachapi Mountains to the north with its boundary with the Sacramento Valley, where the
 24 basin's northern portion underlies the southern half of the Delta. Two hydrologic regions occur in the
 25 San Joaquin Valley groundwater basin: the San Joaquin River and the Tulare Lake. Overall, the
 26 groundwater basin is continuous, but the surface water regime affects local groundwater conditions.
 27 The agricultural area of San Joaquin Valley is dependent upon groundwater to support agricultural
 28 and municipal demands. According to DWR estimates, slightly more than half of all groundwater use
 29 in the state occurs in the San Joaquin Valley groundwater basin (California Department of Water
 30 Resources 2003).

31 Outside the Delta watershed, other areas that receive surface water from the Delta watershed include
 32 the Central Coast Hydrologic Region and portions of Southern California, which have more
 33 hydraulically distinct groundwater basins than the Central Valley.

34 **Regional Hydrogeology Overview**

35 The geologic history of the Central Valley is summarized in Chapter 9, *Geology and Seismicity*.
 36 The occurrence and movement of potable groundwater within the groundwater basins underlying the
 37 Central Valley is discussed below and is based on findings from the U.S. Geological Survey (1986),
 38 except where noted.

39 Deposition of sediments from the Sierra Nevada and Coast Ranges into and along the margins of the
 40 shallow inland sea that once existed in the Central Valley was succeeded by continental deposition.
 41 Sediment transport from the surrounding uplands into the Central Valley resulted in aquifers with
 42 hydraulic characteristics that vary north to south and east to west. North-to-south variability occurs

1 because sediment transport from the surrounding uplands was controlled by local drainage.
2 East-to-west variability resulted from the different types of exposed bedrock, reworked sediments,
3 and volcanoclastic input (rocks composed of volcanic material that has been transported and
4 reworked by wind and water) between the Coast Ranges to the west and the Sierra Nevada to the east.
5 Hydrogeologic characteristics are discussed in more detail in the sections that follow.

6 **Groundwater-Surface Water Interaction**

7 Rivers play a large role in the hydrogeology of the Central Valley by bringing water from the uplands
8 during the snowpack's spring melt and providing recharge to the underlying aquifers. In areas of
9 shallow groundwater table, rivers also can receive groundwater inflow. The quantity and timing of
10 snowpack melt are the predominant factors affecting surface water and groundwater, and peak runoff
11 typically follows peak precipitation by 1 to 2 months (U.S. Geological Survey 1991). Rivers drain the
12 Coast Ranges and the Sierra Nevada, bringing the water into the valley and converging with the
13 Sacramento and San Joaquin Rivers aligned along the axes of their respective valleys (see Chapter 6,
14 *Surface Water*). The drainage in each valley has a key difference; in the San Joaquin Valley, fewer
15 major rivers drain the Coast Ranges, whereas the Sacramento Valley has several, including Stony,
16 Cache, Putah, and numerous other west side tributary creeks that flow to the Sacramento River.

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

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

40 Historically, rivers have defined the boundaries for most groundwater subbasins in the Sacramento
41 and San Joaquin Valleys. However, in almost all cases, these rivers do not act as hydraulic barriers or
42 groundwater divides. An example is Putah Creek, which delineates the boundary between the
43 Sacramento Valley groundwater basin's Yolo and Solano subbasins. As Putah Creek flows eastward
44 through Solano and Yolo counties toward the Sacramento River, numerous diversions along its course

1 reduce stream flow to minimal levels by the time it reaches the Sacramento River. As the creek passes
 2 through the Yolo Bypass, which has no well-defined channel, the potential for the creek to act as a
 3 hydraulic barrier between the subbasins is further reduced. Although the groundwater system in the
 4 Yolo Bypass has not been well studied, it is likely that it functions as a single alluvial aquifer rather
 5 than the two discrete aquifers as the official subbasin (Yolo and Solano) designations suggest.

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

10 **Regional Groundwater Use Overview**

11 The importance of groundwater as a resource varies regionally. The Central Coast Hydrologic Region
 12 has the most reliance on groundwater to meet its local uses, with more than 80% of its water use
 13 supplied by groundwater in an average year. The Tulare Lake Hydrologic Region meets about 50% of
 14 its local uses with groundwater extraction. The rest of the Central Valley meets between 15 and 35%
 15 of local uses with groundwater. In Southern California, the use of groundwater varies between 15% to
 16 35% of annual use (South Coast Hydrologic Region) and 70% of annual use (South Lahontan
 17 Hydrologic Region). In general, of all the groundwater extracted annually in the state in an average
 18 year, more than 35% is produced in the Tulare Lake Hydrologic Region, and more than 70% occurs in
 19 the Central Valley (California Department of Water Resources 2009a:8–10).

20 **7.1.1.2 Delta and Suisun Marsh Groundwater Setting**

21 The Delta overlies the western portion of the area where the Sacramento Valley and San Joaquin
 22 Valley groundwater basins converge. Underlying the northern Delta within the Sacramento Valley
 23 groundwater basin are the Solano subbasin in the northwest and the South American subbasin to the
 24 northeast bounded by the Sacramento and the Cosumnes Rivers. Within the San Joaquin Valley
 25 groundwater basin, the Tracy subbasin underlies the southern half of the Delta and the Eastern San
 26 Joaquin and Cosumnes subbasins underlie the central and eastern Delta (Figure 7-2). The Suisun
 27 Marsh overlies the Suisun–Fairfield Valley groundwater basin, which is adjacent to but
 28 hydrogeologically distinct from the Sacramento Valley groundwater basin, and is adjacent to the
 29 San Francisco Bay. This basin is bounded by the Coast Ranges to the north and west and the
 30 Sacramento Valley groundwater basin in the east. It is separated from the Sacramento Valley
 31 groundwater basin by the English Hills.

32 Physical and hydrogeologic characterizations of each major groundwater basin underlying the Delta
 33 and Suisun Marsh are presented within DWR Bulletin 118 (California Department of Water Resources
 34 2003), various U.S. Geological Survey (USGS) reports (U.S. Geological Survey 1960, 2006b, 2008), and
 35 other available literature as cited throughout this section. The only comprehensive review of
 36 groundwater conditions in the Suisun-Fairfield Valley groundwater basin was completed in 1960 (U.S.
 37 Geological Survey 1960). More current groundwater information has been collected for numerous
 38 site-specific projects, such as Travis Air Force Base (AFB), the Solano County Landfill
 39 Company/Potrero Hills Landfill site, and the recent USGS Groundwater Ambient Monitoring and
 40 Assessment Program (GAMA) (U.S. Geological Survey 2008), but this information is limited in areal
 41 extent.

1 **Groundwater Basin Hydrogeology**

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

9 Groundwater levels in the central Delta are very shallow, and land subsidence on several islands has
10 resulted in groundwater levels close to the ground surface. Maintaining groundwater levels below
11 crop rooting zones is critical for successful agriculture, especially for islands that lie below sea level,
12 and many farmers rely on an intricate network of drainage ditches and pumps to maintain
13 groundwater levels of about 3 to 6 feet below ground surface. The accumulated agricultural drainage
14 is pumped through or over the levees and discharged into adjoining streams and canals (U.S.
15 Geological Survey 2000a). Without this drainage system, the islands would become flooded.

16 Delta floodplain deposits contain a significant percentage of organic material (peat) ranging in
17 thickness from 0–150 feet. Below the surficial deposits, unconsolidated non-marine sediments occur,
18 above the fresh/saline water boundary at depths as shallow as a few hundred feet near the Coast
19 Range to nearly 3,000 feet near the eastern margin of the basin. These non-marine sediments form the
20 major water-bearing formations in the Delta.

21 In the Suisun-Fairfield Valley basin, freshwater occurs within the alluvium and Sonoma volcanics.
22 Alluvium can be up to 260 feet thick in the western portion of the basin and uncomfortably overlies
23 the volcanics (U.S. Geological Survey 1960). Alluvium near Travis AFB can be up to 70 feet thick,
24 according to information collected during groundwater investigations at the base (Travis Air Force
25 Base 1997).

26 Table 7-1 lists key Sacramento Valley subbasin aquifers near the Delta and Suisun Marsh (the Solano,
27 Yolo, and South American subbasins) and summarizes their general hydrogeologic characteristics. Three
28 subbasins within the San Joaquin Valley groundwater basin—Cosumnes, Eastern San Joaquin, and
29 Tracy—underlie the Delta. Key hydrologic characteristics of these three subbasins are summarized in
30 Table 7-2.

1 **Table 7-1. Freshwater Aquifers of the Southern Sacramento Valley Groundwater Basin**

Aquifer Name	Subbasin Occurrence ^a			Aquifer Age	Thickness (feet)	Estimated Yield ^b (gpm)	General Description	Comments
	South American	Solano	Yolo					
Younger Alluvium	X	X	X	Recent	0–150	Low to moderate, if saturated	Flood basin (with peat in the Delta), dredge tailing (South American subbasin), and stream channel deposits	Poor water quality
Older Alluvium (undifferentiated)		X	X	Pliocene to Pleistocene	60–130	Generally 300–1,000, up to 4,000 adjacent to the Sacramento River, and 50–150 in finer-grained portions of the aquifer	Alluvial fan deposits	
Older Alluvium (differentiated) ^c	X			Pliocene to Pleistocene	100–650		Alluvial fan deposits	
Mehrten Formation	X			Miocene to Pliocene	200–1,200		Reworked volcanoclastics (permeable) and dense tuff breccia (confining units)	
Tehama Formation		X	X	Pliocene	1,500–2,500	Several thousand	Lithic-arkosic fluvial sediments; bioturbated sandstone and mudstone	Base of freshwater

Sources: California Department of Water Resources 2009b; Smith 1987.

gpm = gallon(s) per minute.

^a Only subbasins within the Delta or Yolo Bypass are included.

^b No value indicates that the California Department of Water Resources has not estimated subbasin yield.

^c Differentiated units are the Modesto, Riverbank, Victor, Laguna, and Fair Oaks formations and the Arroyo Seco and South Fork gravels.

2

1 **Table 7-2. Freshwater Aquifers of the Northern San Joaquin Valley Groundwater Basin**

Aquifer Name	Subbasin Occurrence ^a			Aquifer Age	Thickness (feet)	Estimated Yield ^b (gpm)	General Description	Comments
	Cosumnes	Eastern San Joaquin	Tracy					
Younger Alluvium	X		X	Recent	0–100	Can yield significant water	Dredge tailing and stream channel deposits	
Older Alluvium (undifferentiated)			X	Pliocene to Pleistocene	150		Alluvial fan deposits	
Older Alluvium (differentiated) ^c	X			Pliocene to Pleistocene	100–650		Alluvial fan deposits	
Alluvium and Modesto/Riverbank formations		X		Recent to Late Pleistocene	0–150	650+	Alluvial and interfan deposits	
Flood basin deposits (undifferentiated)		X	X	Recent to Pliocene	0–1,400	low	Flood basin deposits	Generally poor water quality with occasional areas of fresh water. Basinward (finer grained) lateral equivalents of the Tulare, Laguna, Riverbank, Modesto, and Recent formations occur within the Delta.
Laguna Formation		X		Pliocene to Pleistocene	400–1,000	Average of 900, but up to 1,500	Fluvial	
Mehrten Formation	X	X		Miocene to Pliocene	200–1,200		Reworked volcanoclastics (permeable) and dense tuff breccia (confining units)	
Tulare Formation			X		1,400	Up to 3,000	Clay, silt and gravel	Poor water quality above the Corcoran Clay, which occurs near the top of the formation.

Source: California Department of Water Resources 2009b.

gpm = gallon(s) per minute.

^a Only subbasins within the Delta or Yolo Bypass are included.

^b No value indicates that the California Department of Water Resources has not estimated subbasin yield.

^c Differentiated units are the Modesto, Riverbank, Victor, Laguna, and Fair Oaks formations and Arroyo Seco and South Fork gravels.

2

1 Groundwater in the South American and Eastern San Joaquin subbasins generally flows from the
2 Sierra Nevada on the east toward the low-lying lands of the Delta to the west. However, a number of
3 pumping areas have reversed this trend, and groundwater inflow from the Delta toward these
4 pumping areas has been observed, primarily in the Stockton area.

5 Groundwater levels in the South American subbasin have fluctuated over the past 40 years, with the
6 lowest levels occurring during periods of drought. From 1987 to 1995, water levels declined by
7 about 10 to 15 feet and then recovered by the same amount until 2000, to levels close to the mid-
8 eighties. Areas affected by municipal pumping show a lower groundwater level recovery than other
9 areas (California Department of Water Resources 2004a:2). Groundwater levels in the East San
10 Joaquin subbasin have continuously declined in the past 40 years due to groundwater pumping.
11 Cones of depression are present near major pumping centers such as Stockton and Lodi (California
12 Department of Water Resources 2006a:2). Groundwater level declines of up to 100 feet have been
13 observed in some wells.

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

19 In the Tracy subbasin, groundwater generally flows south to north and discharges into the San
20 Joaquin River. According to DWR and the San Joaquin County Flood Control and Water Conservation
21 District, groundwater levels in the Tracy subbasin have been relatively stable over the past 10 years,
22 apart from seasonal variations resulting from recharge and pumping (California Department of
23 Water Resources 2006b:2).

24 Underlying the Suisun Marsh, the overall direction of groundwater flow in the Suisun-Fairfield
25 Valley groundwater basin is from the uplands toward Suisun Marsh (U.S. Geological Survey 1960). It
26 is assumed that the cone of depression present in 1950 no longer exists because Fairfield now
27 obtains its water supply from surface water, but no current, comprehensive basinwide assessment
28 of groundwater levels is readily available. Depth to groundwater varies seasonally, with higher
29 groundwater levels occurring during the rainy season (Travis Air Force Base 1997). Few
30 groundwater monitoring sites exist in the basin, and most are near ongoing groundwater
31 investigations. Data from these groundwater investigations suggest that groundwater levels in the
32 basin are generally stable.

33 Municipal and irrigation wells are typically screened deeper in the aquifer (200–400 feet below
34 ground surface [bgs]) than the domestic wells in the basin (100–250 feet bgs). Table 7-3
35 summarizes available information about the depths of the various well types in the Delta.

1 **Table 7-3. Delta and Suisun Marsh Groundwater Basin and Subbasin Wells Summary^{a, b}**

Basin/ Subbasin Name ^c	Area (acres)	Domestic Wells			Municipal and Irrigation Wells			Well Yield (gpm)		Number of Monitoring Wells		
		No. ^d	Depth Range (feet bgs)	Depth Average (feet bgs)	No. ^d	Depth Range (feet bgs)	Depth Average (feet bgs)	Range	Average	Levels	Quality	Title 22
Sacramento Valley Groundwater Basin												
South American (2/27/04)	248,000	422	87-575	247	78	41-1,000	372	-	(Municipal Use) 908 (Industrial Use) 971	105	9	247
Solano (2/27/04)	425,000	-	38-1,070	239	-	62-2,275	510	-	-	123	23	136
Yolo (2/27/04)	256,000	-	40-600	243	-	50-1,500	400	150-4,000+	1,500	127	133	-
San Joaquin Valley Groundwater Basin												
Cosumnes (2/03/06)	281,000	832	10-812	261	48	130-934	473	650-1,500	-	75	13	72
Eastern San Joaquin (1/20/06)	707,000	1,551	25-993	242	224	75-780	349	650-1,500	-	360	26	540
Tracy (1/20/06)	345,000	888	44-665	188	70	60-1,020	352	500-3,000	-	18	6	183

Source: California Department of Water Resources 2009b (Bulletin 118-03).

Note: Title 22 refers to wells installed to monitor groundwater quality associated with groundwater recharge for indirect potable reuse.

bgs = below ground surface.

gpm = gallon(s) per minute.

^a A basin summary for the Suisun-Fairfield Valley groundwater basin was not prepared by DWR for Bulletin 118.

^b A dash indicates that the information was not summarized by DWR for Bulletin 118.

^c Some subbasin descriptions have been revised since the release of Bulletin 118. The date in parentheses indicates the version used to prepare the table. The Suisun-Fairfield Valley groundwater basin was not included in the 2003 version of Bulletin 118.

^d The number of wells is based on the number of logs used to estimate well depth. The number of wells of each type probably varies from the number indicated.

2

1 **Groundwater Quality**

2 A recent groundwater quality study was performed in the southern Sacramento Valley region in
3 which more than 60 wells were sampled (U.S. Geological Survey 2008). As part of GAMA, two wells
4 were sampled in the Delta areas. One is located in the central Delta west of Sherman Island and the
5 Sacramento River and has a depth of 800 feet bgs. The other is located in the eastern Delta near the
6 Delta Cross Channel and has a depth of 244 feet bgs. Both wells were sampled for several chemical
7 constituents. Some of the results from this study are reported below, along with results from other
8 studies and reports.

9 In the South American subbasin, total dissolved solids (TDS) levels range from 24 to 581 milligrams
10 per liter (mg/L), with an average of 221 mg/L based on 462 records (California Department of
11 Water Resources 2004a:3). Seven sites present significant groundwater contamination in this basin,
12 including three Superfund sites near the Sacramento metropolitan area. These sites are in various
13 stages of cleanup.

14 TDS varies more widely in the Eastern San Joaquin subbasin, ranging between 50 and 3,520 mg/L.
15 The high salinity of groundwater is attributed to poor-quality groundwater intrusion from the Delta
16 caused by the decline of groundwater levels. This saline groundwater front has been particularly
17 apparent in the Stockton area since the 1970s (San Joaquin County Flood Control and Water
18 Conservation District 2008). Ongoing studies are attempting to identify the source or sources of
19 chloride in groundwater along a line extending from Manteca to the northern side of Stockton. Initial
20 concern was that long-term overdraft conditions in the eastern portion of the subbasin were
21 enabling more saline water from the Delta to migrate inland. Other possible sources include upward
22 movement of deeper saline formation water and agricultural practices (U.S. Geological Survey
23 2006a).

24 High chloride concentrations have also been observed in well water in the Eastern San Joaquin
25 subbasin. The source of chloride concentrations of up to 1,800 mg/L near the Delta may be due to
26 saline water intrusion from the Delta, but other sources are possible, such as high-chloride water
27 moving upward from the deeper saline formations as a consequence of extensive groundwater
28 pumping and agricultural return flows (U.S. Geological Survey 2006a). In addition, large areas of
29 groundwater with elevated nitrate concentrations exist in several portions of the subbasin, such as
30 southeast of Lodi and south of Stockton. The City of Lodi operates the White Slough Water Pollution
31 Control Facility, a 6.3 million gallon per day (mgd) (average flow) plant on the eastern edge of the
32 Delta on the western side of Interstate 5, approximately 1 mile south of Highway 12. Agricultural
33 and stormwater runoff are returned to unlined holding ponds. Water quality concerns have been
34 evaluated regarding elevated nitrates and salinity by the State Water Resources Control Board (City
35 of Lodi 2006; Stockton Record Staff 2009).

36 Groundwater quality in the Solano subbasin is generally good and is deemed appropriate for
37 domestic and agricultural use (California Department of Water Resources 2004b:3). However, TDS
38 concentrations at levels higher than 500 parts per million have been observed in the central and
39 southern areas of the basin.

40 In the Tracy subbasin, areas of poor water quality exist throughout. Elevated chloride
41 concentrations are found along the western side of the subbasin near the City of Tracy and along the
42 San Joaquin River. Overall, Delta groundwater wells in the Tracy subbasin show levels above the

1 secondary maximum contaminant level for chloride, TDS, arsenic, and boron (U.S. Geological Survey
2 2006b).

3 Groundwater quality issues within the Suisun-Fairfield Valley groundwater basin include boron,
4 TDS, and volatile organic compound contamination present at Travis AFB. In a USGS study of water
5 quality in the area, TDS concentrations were not measured directly, but were inferred from
6 measured specific conductance values (U.S. Geological Survey 1960). The specific conductance is a
7 measure of how well water can conduct an electric current. The specific conductance increases with
8 increasing amount and mobility of dissolved solids in the water. Thus, the higher the TDS
9 concentration (and salinity), the higher the specific conductance. Specific conductance was
10 measured in more than 70 wells, yielding values ranging from 158 to 3,260 micromhos, with most
11 values ranging from about 500 to 1,600 micromhos. These values are similar to those reported in
12 the USGS GAMA Program study, with specific conductance values ranging from 859 to
13 1,300 microsiemens per centimeter (the current equivalent standard for measuring specific
14 conductance, which is comparable to micromhos) in the five wells tested (U.S. Geological Survey
15 2008). The California secondary drinking water standard for specific conductance is recommended
16 at 900 microsiemens per centimeter (taste and odor threshold) and the upper limit is set at 1,600
17 microsiemens per centimeter. The non-regulatory agricultural water quality goal is recommended at
18 700 micromhos per centimeter for the most salt-sensitive crops.

19 Volatile organic compound plumes at Travis AFB are largely contained on base, but volatile organic
20 compound constituents have migrated up to 0.5 mile off base at three sites. Containment and
21 remediation is occurring at each of these sites (Travis AFB 2005).

22 The only other major concern mentioned by existing water quality studies of the Suisun-Fairfield
23 Valley groundwater basin is boron. USGS reported boron data for 62 wells ranging from non-detect
24 to 28 mg/L, but only six detects were greater than 3 mg/L (U.S. Geological Survey 1960). The GAMA
25 Program study data also indicated elevated boron concentrations (5.4 mg/L) for at least one well
26 sample (U.S. Geological Survey 2008).

27 **Groundwater Production and Use**

28 Groundwater is used throughout the Delta through the mechanisms of pumping and plant uptake in
29 the root zone. However, an accurate accounting of groundwater used in the region is not available
30 because wells are not metered. In the upland peripheral Delta areas, average annual groundwater
31 pumping is estimated to range between 100,000 and 150,000 acre-feet, both for domestic and
32 agricultural uses (CALFED Bay-Delta Program 2000:5.4-8). Although information on groundwater
33 yield is limited in the Delta subbasins, available estimates in the northern San Joaquin Valley
34 groundwater basin indicate that maximum well yield varies from around 1,500 to 3,000 gallons per
35 minute (gpm) (Table 7-3).

36 The Stockton metropolitan area uses groundwater in conjunction with surface water for its
37 municipal and industrial water needs. Groundwater use in the Contra Costa Water District (CCWD)
38 service area is approximately 3,000 acre-feet per year with another 500 acre-feet per year produced
39 by the City of Pittsburg. Groundwater is produced at the CCWD's Mallard Wells and wells owned and
40 operated by the City of Pittsburg, Golden State Water Company, and Diablo Water District. In
41 addition, an undetermined number of privately held groundwater wells exist in the CCWD service
42 area (CALFED Bay-Delta Program 2005). Groundwater in this area is primarily produced from the
43 Clayton basin, which has seen a gradual decline in groundwater elevation (Contra Costa Water
44 District 2005).

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

11 Information on groundwater supplies in the Suisun-Fairfield Valley basin is limited. Groundwater
 12 was the primary water source for the Suisun-Fairfield Valley groundwater basin, including the cities
 13 of Fairfield and Suisun City, through the 1950s. This groundwater production resulted in local areas
 14 of depressed groundwater levels. As surface water became available, groundwater use declined.
 15 Studies have shown that the basin provides low well yields and therefore is probably not used as a
 16 major water supply (Bureau of Reclamation et al. 2010:5.3-10). Many private well owners in the
 17 Suisun Marsh basin use groundwater for landscape irrigation. However, the poor quality of the
 18 Suisun Marsh basin groundwater prevents municipal use and potable water is typically imported
 19 (Bureau of Reclamation et al. 2010:5.3-10).

20 **Land Subsidence**

21 Subsidence in the Delta is well-documented and a major source of concern for farming operations.
 22 The oxidation of peat soils is the primary mechanism of subsidence in the Delta, and some areas are
 23 located below sea level (see Chapter 10, *Soils*, and Chapter 9, *Geology and Seismicity*). Subsidence in
 24 the Suisun-Fairfield Valley groundwater basin has not been extensively monitored.

25 **7.1.1.3 Delta Watershed Groundwater Setting**

26 The Delta watershed area includes the Upstream of the Delta Region and portions of the Export
 27 Service Areas in the Sacramento River and San Joaquin River regions and the Tulare Lake Region.

28 **Sacramento River Region**

29 North of the Delta, the Sacramento River Hydrologic Region overlies one of the largest groundwater
 30 basins in the state, the Sacramento Valley groundwater basin. DWR divides the Sacramento Valley
 31 basin into 18 subbasins (Figure 7-3) based on groundwater characteristics, surface water features,
 32 and political boundaries (California Department of Water Resources 2003). However, these
 33 individual groundwater subbasins have a high degree of hydraulic interconnection because the
 34 rivers—the primary method of defining the subbasin boundaries—do not act as barriers to
 35 groundwater flow. Therefore, the Sacramento Valley groundwater basin functions primarily as a
 36 single laterally extensive alluvial aquifer, rather than numerous discrete, smaller groundwater
 37 subbasins. North of the Sacramento Valley basin lies the Redding Area basin, with six subbasins.

38 **Groundwater Basin Hydrogeology**

39 Freshwater in the Sacramento Valley groundwater basin occurs within the continental deposits,
 40 which are generally 2,000–3,000 feet thick. Hydrogeologic units containing freshwater along the
 41 eastern portion of the basin, primarily the Tuscan and Mehrten formations, are derived from the

1 Sierra Nevada. Toward the southeastern portion of the Sacramento Valley, the Mehrten formation is
2 overlain by sediments of the Laguna, Riverbank, and Modesto formations, which also originated in
3 the Sierra Nevada. The primary hydrogeologic unit in the western portion of the Sacramento Valley
4 groundwater basin is the Tehama formation, which was derived from the Coast Ranges. In most of
5 the Sacramento Valley, these deeper units are overlain by younger alluvial and floodplain deposits.

6 The water budget (the components of inflow, outflow, and change in storage) of the Sacramento
7 Valley groundwater basin is dominated by a great annual inflow of water falling as precipitation on
8 the surrounding mountains and on the valley floor. A portion of this water is consumed through
9 evapotranspiration by vegetation and surface evaporation, and most of the remainder becomes
10 runoff and groundwater recharge. The annual total runoff to the Sacramento River Hydrologic
11 Region is 22.4 million acre-feet (MAF), including 850,000 acre-feet estimated to recharge the
12 Redding groundwater basin. Applied annual agricultural water irrigation totals approximately 7.7
13 MAF in the Sacramento Valley groundwater basin (California Department of Water Resources 1998).
14 A portion of this applied water, and the remaining 13.9 MAF of runoff, is potentially available to
15 recharge the basin and replenish groundwater storage depleted by groundwater pumping.
16 Therefore, except during drought, the Sacramento Valley groundwater basin is “full,” and
17 groundwater levels recover to pre-irrigation season levels each spring. Historical groundwater level
18 hydrographs suggest that even after extended droughts, groundwater levels in this basin recovered
19 to pre-drought levels within 1 or 2 years following the return of normal rainfall quantities.

20 Generally, groundwater flows inward from the edges of the basin toward the Sacramento River, then
21 in a southerly direction parallel to the river. Depth to groundwater throughout most of the
22 Sacramento Valley averages about 30 feet bgs, with shallower depths along the Sacramento River
23 and greater depths along the basin margins.

24 As agricultural land use and water demands have intensified over time, groundwater levels in
25 certain areas have declined because increases in pumping have not been matched by increases in
26 recharge. This condition has been the motivating force for development of supplemental surface
27 supplies in a number of locales during the past 30 to 40 years, including Yolo County with its
28 construction of Indian Valley Dam on the North Fork of Cache Creek, South Sutter Water District
29 with its construction of Camp Far West Reservoir on the Bear River, and Yuba County, which
30 constructed New Bullards Bar Dam and Reservoir on the North Yuba River.

31 Today, groundwater levels are generally in balance valley-wide, with pumping matched by recharge
32 from the various sources annually. Some locales show the early signs of persistent drawdown,
33 including the northern Sacramento County area, areas near Chico, and on the far west side of the
34 Sacramento Valley in Glenn County where water demands are met primarily, and in some locales
35 exclusively, by groundwater. These could be early signs that the limits of sustainable groundwater
36 use have been reached in these areas.

37 **Groundwater Quality**

38 Sacramento Valley groundwater basin groundwater quality is generally suitable for municipal,
39 agricultural, domestic, and industrial uses. However, some localized groundwater quality problems
40 exist. Natural groundwater quality is influenced by stream flow and recharge from the surrounding
41 Coast Ranges and Sierra Nevada. Runoff from the Sierra Nevada is generally of higher quality than
42 runoff from the Coast Ranges, where marine sediments affect water quality. Therefore, groundwater
43 quality tends to be better in the eastern half of the Sacramento Valley. Groundwater quality also

1 varies from north to south, with the better water quality occurring in the northern portion of the
2 valley and poorer water quality in the southwestern portion (U.S. Geological Survey 1984).

3 In the southern half of the Valley, the TDS levels are higher because of upwelling of deep saline
4 water; large areas have TDS concentrations exceeding 500 mg/L. TDS concentrations as high as
5 1,500 mg/L have been reported in a few areas (U.S. Geological Survey 1991). Areas that have high
6 TDS concentrations include the south-central part of the Sacramento Valley groundwater basin,
7 south of Sutter Buttes, in the area between the confluence of the Sacramento and Feather Rivers.
8 The area west of the Sacramento River, between Putah Creek and the Delta, also has elevated TDS
9 levels. The area around Maxwell, Williams, and Arbuckle has high concentrations of chloride,
10 sodium, and sulfate (California Department of Water Resources 1978). TDS in this region averages
11 about 500 mg/L, but concentrations exceeding 1,000 mg/L have been reported. The source of
12 salinity in the Maxwell and Putah Creek areas is associated with mineral springs in the hills to the
13 west. High salinity around the Sutter Buttes is believed to be caused by upwelling of saline water
14 from underlying marine sediments (U.S. Geological Survey 1984).

15 Nitrates found in groundwater have various sources, including fertilizer use, wastewater disposal,
16 and natural deposits. Concentrations of nitrate as N exceeding 10 mg/L (which is the maximum
17 contaminant level [MCL]) are found throughout portions of the Central Valley; however,
18 concentrations exceeding 30 mg/L as N are rare and localized. In the Sacramento Valley
19 groundwater basin, the background nitrate concentration is estimated to be less than or equal to
20 3 mg/L. Two areas of elevated (greater than 5.5 mg/L) nitrate concentrations have been identified:
21 one in northern Yuba and southern Butte counties (in the Gridley-Marysville area) and another in
22 northern Butte and southern Tehama counties (in the Corning-Chico area). Approximately 25% to
23 33% of samples from these areas have concentrations exceeding the MCL of 10 mg/L. Elevated
24 nitrate concentrations in these areas are associated with shallow wells, and are thought to be the
25 result of a combination of fertilizers and septic systems.

26 **Groundwater Production and Use**

27 Wells developed in the sediments of the valley provide excellent supply to irrigation, municipal, and
28 domestic uses. Many of the mountain valleys within the region also provide significant groundwater
29 supplies to multiple uses.

30 Approximately 31% of the region's urban and agricultural water needs are met by groundwater
31 (California Department of Water Resources 2003:159). Although surface water supplies provide the
32 majority of water used by the Sacramento Valley's agricultural sector, groundwater provides
33 approximately 10–15% of the total water used to support agricultural uses, depending on water
34 year type. Municipal, industrial, and agricultural water demands in the region total approximately 8
35 MAF, and groundwater provides about 2.5 MAF of this total. The portion of the water diverted for
36 irrigation but not actually consumed by crops or other vegetation becomes recharge to the
37 groundwater aquifer or flows back to surface waterways and contributes to surface supplies either
38 within or downstream of the Sacramento Valley.

39 **Land Subsidence**

40 Land subsidence in the Sacramento Valley has resulted from inelastic deformation (non-recoverable
41 changes) of fine-grained sediments related to groundwater withdrawal (California Department of
42 Water Resources 2009b). Additional evaluation is ongoing in larger areas of the valley to provide a
43 regional assessment of subsidence conditions. Further discussion of soil compaction, which resulted

1 in up to 20 feet of subsidence, is provided in Chapter 10, *Soils*. Areas of subsidence from
 2 groundwater level declines have been measured in the Sacramento Valley. Several studies
 3 performed in the 1990s showed that 4 feet or more of subsidence had occurred since 1954 in some
 4 areas, such as in Yolo County (Ikehara 1994). The initial identification of Sacramento Valley
 5 subsidence occurred when two extensometers (instruments used for measuring the magnitude of
 6 expansion, contraction, or deformation) were installed in Yolo County in 1988 and 1992, and a third
 7 was installed in Sutter County in 1994. Initial data from the Yolo County extensometers indicated
 8 subsidence in the Davis-Zamora area, which has subsequently been confirmed with a countywide
 9 global positioning system network installed in 1999 and monitored in 2002 and 2005. Subsidence
 10 up to 0.4 feet occurred between 1999 and 2005 in the Zamora area (Frame Surveying and Mapping
 11 2006).

12 **San Joaquin River Region**

13 Extending south into the Central Valley from the Delta, DWR has delineated nine subbasins within
 14 the San Joaquin River Hydrologic Region based on groundwater divides, barriers, surface water
 15 features, and political boundaries (California Department of Water Resources 2003): the Cosumnes,
 16 East San Joaquin, and Tracy subbasins that underlie the Delta (described previously), and the Delta-
 17 Mendota, Modesto, Turlock, Merced, Chowchilla, and Madera subbasins (California Department of
 18 Water Resources 2003:169) (Figure 7-3).

19 **Groundwater Basin Hydrogeology**

20 The overall origin of San Joaquin Valley groundwater basin sediments is similar to that of the
 21 Sacramento Valley: variable north-south deposition of alluvial and outwash sediments from
 22 different source areas east and west of the basin. However, depositional conditions in the San
 23 Joaquin Valley varied from those in the Sacramento Valley, resulting in substantial hydrogeologic
 24 differences between the aquifer systems in the two valleys. These differences include thicker
 25 intervals of lacustrine (originating in lakes) and marsh deposits in the San Joaquin Valley
 26 groundwater basin, and variations in deeper marine and continental deposits.

27 Several of the hydrogeologic units in the southern Sacramento Valley extend south into the San
 28 Joaquin Valley. Along the eastern portion of the Central Valley, the Lone, Mehrten, Riverbank, and
 29 Modesto formations are primarily composed of sediments originating from the Sierra Nevada. Along
 30 the western portion of the San Joaquin Valley, the Tulare formation is the primary freshwater unit. It
 31 originated as reworked sediments from the Coast Ranges redeposited in the San Joaquin Valley as
 32 alluvial fan, flood basin, deltaic (pertaining to a delta) or lacustrine, and marsh deposits (U.S.
 33 Geological Survey 1986).

34 The primary difference between the Sacramento Valley and San Joaquin Valley hydrogeologic units
 35 is the presence of thick fine-grained lacustrine and marsh deposits in the San Joaquin Valley. These
 36 fine-grained units can be up to 3,600 feet thick in the Tulare Lake region, but more commonly occur
 37 as regional, laterally extensive deposits tens to hundreds of feet thick that create vertically
 38 differentiated aquifer systems. The most widespread of these units, the Corcoran Clay, occurs in the
 39 Tulare formation. Other clay units in the San Joaquin Valley are identified from youngest to oldest by
 40 the letters A through F. The E-clay is generally considered to be the Corcoran Clay or its equivalent.
 41 These clays are generally thicker and more extensive in the southern portion of the San Joaquin
 42 Valley. The Corcoran Clay, for example, is known to occur as far north as Tracy, but is not uniformly
 43 identified in the extreme northern part of the San Joaquin Valley. Recharge conditions in the San

1 Joaquin Valley groundwater basin are substantially different from those in the Sacramento Valley
2 groundwater basin. Precipitation in the San Joaquin Valley is much lower than in the Sacramento
3 Valley, ranging from 15 inches in the north to 5 inches per year in the south. Precipitation in the
4 Sierra Nevada ranges from 20 to 80 inches per year, falling primarily as snow. Annual precipitation
5 rates in the Coast Ranges vary from 10 to 20 inches per year (U.S. Geological Survey 2009). The
6 lower precipitation, combined with hot, dry summers, creates an overall lower rate of groundwater
7 recharge to the San Joaquin Valley aquifer system than in the Sacramento Valley.

8 Natural recharge to the semi-confined upper aquifer generally occurs from stream seepage, deep
9 percolation of rainfall, and subsurface inflow along basin boundaries. Recharge is augmented with
10 deep percolation of applied agricultural irrigation water and seepage from the distribution systems
11 that convey this water. Recharge to the lower, confined aquifer consists of deep percolation and
12 subsurface inflow from foothill areas east of the Corcoran Clay's eastern boundary. Clay layers,
13 including the Corcoran Clay, are not continuous in some areas and are also penetrated by wells
14 screened above and below the clay. These conditions result in some seepage through the confining
15 layer from the semiconfined aquifer above (Bureau of Reclamation et al. 1999).

16 Surface water and groundwater are hydraulically connected in most areas of the San Joaquin River
17 and tributaries. Historically, groundwater actively discharged to streams in most of the San Joaquin
18 River Hydrologic Region. After the 1950s, increased groundwater pumping in the region lowered
19 groundwater levels and reversed the hydraulic gradient between the surface water and
20 groundwater systems, resulting in surface water recharging the underlying aquifer system through
21 streambed seepage. Areas where this has occurred include eastern San Joaquin and Merced counties
22 and western Madera County. This is especially true in the Gravelly Ford area, where the riverbed is
23 highly permeable and river water readily seeps into the underlying aquifer. In the northern portions
24 of the San Joaquin River, groundwater levels are shallow and groundwater discharges into the river.
25 The direction of groundwater flow generally coincides with the primary direction of surface water
26 flows in the area, which is to the northwest toward the Delta.

27 Groundwater levels have declined in the San Joaquin Valley groundwater basin since extensive
28 agricultural development began in the 1940s. Groundwater level declines of up to 100 feet have
29 been exacerbated by droughts and continued increases in groundwater use. Artificial groundwater
30 recharge programs have been developed to replenish groundwater supplies or create groundwater
31 banking programs, primarily in the southern San Joaquin Valley areas (such as Kern County), but
32 other programs are being considered farther north (such as the Madera Groundwater Bank and the
33 City of Tracy).

34 Prior to the development of the Central Valley, groundwater in the San Joaquin River Hydrologic
35 Region flowed from the valley flanks to the axis, then north toward the Delta. Large-scale
36 groundwater development during the 1960s and 1970s, combined with the introduction of
37 imported surface water supplies, modified the natural groundwater flow pattern. Because of
38 groundwater pumping, groundwater flow largely occurs from areas of recharge toward areas where
39 groundwater pumping has lowered groundwater levels (U.S. Geological Survey 1991).

40 **Groundwater Quality**

41 Groundwater quality varies substantially throughout the San Joaquin Valley groundwater basin. In
42 general, groundwater is of lower quality in this basin compared with the Sacramento Valley
43 groundwater basin. Adverse water quality conditions frequently correlate with the presence of the
44 Corcoran Clay, possibly because the clay restricts vertical flow. Adverse water quality conditions are

1 caused by naturally occurring constituents such as arsenic, molybdenum, iron, and uranium, and by
2 agricultural and industrial contaminants such as perchloroethylene (PCE) and
3 dibromochloropropane (a now-banned nematicide). Each of these constituents can locally or
4 regionally affect the beneficial uses of groundwater in the San Joaquin Valley groundwater basin.
5 Agricultural and industrial contaminants tend to occur in the more urban and southern portions of
6 the San Joaquin Valley groundwater basin. Municipal use of groundwater as drinking water supply is
7 impaired because of elevated TDS concentrations (above the secondary MCL of 500 mg/L) at several
8 locations throughout the San Joaquin River Hydrologic Region (Bureau of Reclamation et al. 1999;
9 California Department of Water Resources 2003).

10 The water quality in the northwestern part of this basin is variable, with better quality generally
11 found in the northern and eastern parts of San Joaquin and Contra Costa counties as compared to
12 the rest of the area (U.S. Geological Survey 1981). The variation in groundwater quality is attributed
13 to the composition of the subsurface and the quality of the surface water interacting with
14 groundwater. Agricultural practices also may contribute to a degradation of groundwater quality.

15 Localized groundwater contamination includes industrial organic contaminants such as
16 trichloroethylene (TCE), dichloroethylene, and other solvents. They can be found in groundwater
17 near airports, industrial areas, and landfills (California Department of Water Resources 2003:170).

18 TDS values vary considerably in the San Joaquin Valley groundwater basin. They are generally lower
19 on the eastern side of the basin than in the west, and are higher in the shallower aquifer than in the
20 deep aquifer. The east-west variability in TDS concentrations reflects the low concentrations of
21 dissolved constituents in recharge water that originates from the Sierra Nevada snowmelt versus
22 the high TDS concentrations of the stream drainage from the Coast Range marine sediments on the
23 western side of the basin. In the trough of the Central Valley, high TDS concentrations result from
24 evaporation and poor drainage, which concentrate salts (California Department of Water Resources
25 2003).

26 In the deeper aquifer on the central and eastern side of the valley, TDS concentrations generally do
27 not exceed 500 mg/L. On the western side, TDS concentrations are generally greater than 500 mg/L,
28 and exceed 2,000 mg/L along the western boundary of the valley (Bureau of Reclamation et al.
29 1999). Concentrations may exceed 2,000 mg/L in the shallow aquifer above the Corcoran Clay
30 throughout the San Joaquin Valley groundwater basin.

31 Molybdenum, boron, and arsenic are commonly detected at elevated concentrations in groundwater
32 above the Corcoran Clay. Agricultural use of groundwater is impaired because of elevated boron
33 concentrations (greater than 0.75 mg/L) in eastern Stanislaus and Merced Counties. Municipal use
34 of groundwater as a drinking water supply is impaired because of elevated arsenic concentrations
35 (greater than the primary MCL of 50 micrograms per liter) in Stanislaus and Merced Counties and in
36 western San Joaquin County (Bureau of Reclamation et al. 1999).

37 **Groundwater Production and Use**

38 Groundwater production in the San Joaquin Valley groundwater basin occurs from both the shallow
39 and deep aquifers, which are generally separated by the Corcoran Clay or other confining clay
40 intervals. In most areas, groundwater pumping occurs in both aquifers unless local groundwater
41 quality issues exist or if one zone is substantially more permeable.

1 Groundwater is a major source of water supply for agricultural, municipal, and domestic water
2 supply in the San Joaquin Valley region, accounting for 30% to 40% of the annual agricultural and
3 municipal supply (California Department of Water Resources 2003). Currently, urban and
4 agricultural users on the valley floor are reliant on groundwater for water supply. In fact,
5 groundwater supplies over 75% of water for users on the valley floor (Madera County 2008).
6 Groundwater is used conjunctively with surface water when those supplies are not sufficient to
7 meet the area's demand for agricultural, industrial, and municipal uses (California Department of
8 Water Resources 2003:169). Most San Joaquin Valley cities rely on groundwater either wholly or
9 partially to meet municipal needs. For example, the Merced area is almost entirely dependent on
10 groundwater for its supply (California Department of Water Resources 2003:169). Groundwater use
11 in the San Joaquin River area is estimated to be between 730,000 and 800,000 acre-feet per year,
12 which exceeds the basin's estimated safe yield of 618,000 acre-feet per year (California Department
13 of Water Resources 2009a). Each groundwater subbasin in this basin has experienced some
14 overdraft (California Department of Water Resources 1994).

15 **Land Subsidence**

16 USGS recognizes four mechanisms of subsidence in the San Joaquin Valley: 1) compaction of fine-
17 grained aquifer materials attributed to groundwater withdrawal; 2) hydrocompaction of
18 unsaturated soils above the water table; 3) oil and gas withdrawal; and 4) neotectonic movement
19 (recent deformation of the earth's crust) (U.S. Geological Survey 1999).

20 The majority of land subsidence in the southern portion of the San Joaquin Valley groundwater
21 basin is considered to have been caused by groundwater pumping where the Corcoran Clay is
22 present. Groundwater withdrawal has lowered groundwater levels, which allows the compression
23 of the Corcoran Clay and other fine-grained units where groundwater supports the aquifer
24 framework, resulting in inelastic subsidence and causing the overlying ground to lower. Once the
25 inelastic compression occurs, it cannot be restored.

26 San Joaquin Valley land subsidence is thought to have begun in the 1920s with the advent of
27 irrigated agriculture. Subsidence was first noted in 1941, and detailed study of the causes and
28 magnitude started in the 1950s (U.S. Geological Survey 1975). Subsequent investigations have
29 identified areas of subsidence throughout the valley, with subsidence of 1 foot or more occurring
30 over half of the San Joaquin Valley groundwater basin. Overall subsidence of up to 28 feet was
31 identified in the Mendota area. Most San Joaquin Valley subsidence was thought to have been caused
32 primarily by deep aquifer system pumping during the 1950s and 1960s, but was considered to have
33 largely abated since 1974 because of the development of more reliable agricultural surface water
34 supplies from the Delta-Mendota Canal and Friant-Kern Canal (U.S. Geological Survey 1999).

35 Results from a recent USGS subsidence monitoring program (U.S. Geological Survey 2013) show that
36 at least 1.8 feet of subsidence occurred near the San Joaquin River and the Eastside Bypass from
37 2008–2010, affecting the southern part of the Delta-Mendota Canal by about 0.8 inches of
38 subsidence during the same period. It was estimated that subsidence rates doubled in 2008 in some
39 areas. The subsidence measured was primarily inelastic (or permanent, not reversible, due to the
40 compaction of fine-grained material). The area of maximum active subsidence is shown to be located
41 southwest of Mendota and extends into the Merced subbasin to the south of El Nido. The USGS study
42 states that “regulatory- and drought-related reductions in surface-water deliveries since 1976 have
43 resulted in increased groundwater pumping and associated land subsidence”. In addition, land use and
44 associated groundwater pumping changes throughout the valley may also affect land subsidence.

1 **Tulare Lake Region**

2 The Tulare Lake Hydrologic Region overlies seven groundwater subbasins, as defined by DWR: the
3 Westside, the Kings, the Tulare Lake, the Kaweah, the Tule, the Pleasant Valley, and the Kern
4 subbasins (Figure 7-3) (California Department of Water Resources 2003:169).

5 **Groundwater Basin Hydrogeology**

6 The aquifer system in the Tulare Lake region of the San Joaquin Valley groundwater basin consists
7 of younger and older alluvium, flood-basin deposits, lacustrine and marsh deposits and
8 unconsolidated continental deposits. These deposits form an unconfined to semi-confined upper
9 aquifer and a confined lower aquifer in most parts of the Basin. These aquifers are separated by the
10 Corcoran Clay (E-Clay) member of the Tulare Formation, which occurs at depths between 200 and
11 850 feet along the central and western portion of the basin. Fine-grained lacustrine deposits can be
12 up to 3,600 feet thick in the Tulare Lake region. Groundwater generally flows from the Sierra
13 Nevada on the east and the Coast Ranges on the west toward the San Joaquin River (California
14 Department of Water Resources 2003).

15 Since Tulare Lake has dried and is no longer able to recharge the Tulare Lake Basin, groundwater
16 recharge from streams is highly variable and only occurs in wet years. Prior to development,
17 groundwater in both the confined and unconfined aquifers generally moved from recharge areas in
18 the upland areas surrounding the Central Valley toward discharge areas in the lowlands.
19 Groundwater flowed largely toward Tulare Lake. Areal recharge from precipitation provided most
20 of the groundwater recharge, and seepage from stream channels provided the remaining
21 groundwater recharge. Most of this occurred as mountain-front recharge in the coarse-grained
22 upper alluvial fans where streams enter the basin (U.S. Geological Survey 2009). In pre-development
23 years, surface water and groundwater exchange occurred in both directions depending upon
24 variations in hydrologic conditions. When groundwater levels declined due to rapid agricultural
25 growth and heavy groundwater development, the primary interaction of surface water with
26 groundwater became stream flow loss to underlying aquifers. In areas of severe overdraft, such as in
27 Kings County, complete disconnection between groundwater and overlying surface water systems
28 has occurred. Some of these losing streams are now also used as conveyance elements for irrigation
29 purposes and to recharge groundwater. Complete disconnection between groundwater and
30 overlying surface water systems has occurred in the Kern County area. Kern River, a losing stream,
31 is used as a conveyance element for irrigation purposes and to recharge groundwater.

32 Groundwater levels in most subbasins in the Tulare Lake region have declined over the last 60
33 years, although in some areas groundwater levels have increased from historic lows in more recent
34 years. Between 1958 and 2006, groundwater levels declined in all subbasins but the Westside.
35 Declines ranged from 20 feet in the Kaweah and Tule subbasins to 140 feet in the southwest area of
36 the Kings subbasin (California Department of Water Resources 2011). In the Westside subbasin,
37 groundwater levels have fluctuated during the past 60 years in response to the availability of surface
38 water deliveries from the CVP. The lowest estimated average groundwater level was 156 feet below
39 sea level and occurred in 1967 (Westlands Water District 2009:9, Table 1). In 2008, however,
40 groundwater levels were estimated at about 11 feet below sea level.

41 Groundwater levels in the Kern County subbasin were quite variable in different portions of the
42 basin between 1970 and 2000 (California Department of Water Resources 2006c:3). Between 1958
43 and 2006, water levels decreased by more than 100 feet in the Bakersfield region (California
44 Department of Water Resources 2011). However, since the late 1970s, groundwater banking

1 operations have helped maintain the groundwater levels fairly static, despite the increase in
2 groundwater extractions in the Bakersfield area. The average change in storage in the Kern County
3 subbasin between 1970 and 1998 was evaluated to be a decrease of 325,000 acre-feet per year
4 (California Department of Water Resources 2006c:4).

5 **Groundwater Quality**

6 Groundwater quality in the region is generally suitable for most urban and agricultural uses. There
7 are some localized impairments, including high TDS (salts), sodium chloride, sulfate, nitrate, organic
8 compounds, and naturally occurring arsenic. Salinity is the most significant issue facing
9 groundwater in the region due to the impacts of agricultural practices as well as naturally occurring
10 salts in local soils. Because the “greatest long-term problem facing the entire Tulare Lake Basin is
11 the increase of salinity in ground water” (Kern County Water Agency 2011), the Central Valley
12 RWQCB is currently leading an effort to address salinity. An estimated 1,206 tons of salt
13 accumulates annually in the region from imported sources (California Department of Water
14 Resources 2009a, Kern County Water Agency 2011:2-35). This accumulation is trapped and builds
15 up in the underlying aquifers because the Tulare Lake is a closed system without any natural outlets.
16 Agricultural practices also add salts to the system when irrigation water high in salts is applied to
17 the land. This water evaporates and crop transpiration removes water from the soil resulting in salt
18 accumulation in the root zone. This accumulation has to be flushed from the root zone so water
19 eventually percolates into the groundwater. High salt concentrations (greater than the primary
20 drinking water standard) are a particular problem in the western portion of the Tulare Lake region.
21 Shallow groundwater occurs in the western and southern portions of the Kern County subbasin,
22 which presents problems for agricultural operations (California Department of Water Resources
23 2006c:4).

24 **Groundwater Production and Use**

25 The Tulare Lake area is heavily groundwater dependent. Groundwater is used conjunctively with
26 surface water when those supplies are not sufficient to meet the region’s demand for agricultural,
27 industrial, and municipal uses (California Department of Water Resources 2003:169). Overdraft is a
28 major concern in some areas. Currently, urban and agricultural users on the Valley floor are reliant
29 on groundwater for water supply. For example, the cities of Fresno and Visalia are almost entirely
30 dependent on groundwater for their water supplies, with Fresno being the second largest city in the
31 United States reliant almost solely on groundwater (California Department of Water Resources
32 2003:177). However, cities in the Tulare Lake area are starting to look for other water sources and
33 some have started groundwater storage programs.

34 Groundwater use is estimated to account for approximately 41% of the total water supply to the
35 Kern County subbasin region (Kern County Water Agency 2011:2-27). Agriculture is the largest user
36 of groundwater in the subbasin. Groundwater extractions include urban extraction of 154,000 acre-
37 feet per year, agricultural extraction of 1,160,000 acre-feet per year, and other extractions (oil
38 industry related) of 86,333 acre-feet per year (California Department of Water Resources 2006c: 4).
39 According to Kern County Water Agency, the total estimated water in storage is 40,000,000 acre-feet
40 and dewatered aquifer storage is 10,000,000 acre-feet (California Department of Water Resources
41 2006c: 3). The City of Bakersfield currently obtains all its delivered water supply through
42 groundwater pumping, which amounts to about 38,700 acre-feet (City of Bakersfield 2007:3.1–3.2).
43 The city water system manages the groundwater basin levels through ongoing recharge projects and
44 has been able to maintain a positive water balance (City of Bakersfield 2007:3.2).

1 Local and imported surface water supplies are both marked by a high degree of variability, making
 2 the region more highly dependent upon groundwater in dry periods (California Department of
 3 Water Resources 2009a:TL-19). However, the basin generally underlying the Tulare Lake has
 4 experienced a net loss of groundwater storage over the last several decades, indicating that
 5 groundwater demands and other outflows have exceeded groundwater inflows in the basin.

6 Most groundwater subbasins in the Tulare Lake watershed are in a state of overdraft as a
 7 consequence of groundwater pumping that exceeds the basin's safe yield (California Department of
 8 Water Resources 2003). As a result, the aquifers in these groundwater basins contain a significant
 9 amount of potential storage space that can be filled with additional recharged water. Groundwater
 10 banking is the storage of excess water supplies into aquifers during wet periods for later withdrawal
 11 and use during dry periods (Kern County Water Agency 2011:2-29). The stored water is used
 12 through conjunctive use programs by users directly overlying the basin, or it is conveyed to users in
 13 regions outside of the groundwater basin. Water for storage may be imported from other regions or
 14 agencies for temporary or long-term storage and subsequent export from the basin.

15 Conjunctive use is an important component of water management in the region, particularly in the
 16 Kern County subbasin. Many groundwater banking facilities supplement water supplies delivered to
 17 customers in dry years, when insufficient surface water supplies are available to meet all the
 18 requirements. The two major groundwater banking programs in Kern County are the Kern Water
 19 Bank operated by the Kern Water Bank Authority and the Semitropic Groundwater Bank, operated
 20 by the Semitropic Water Storage District (Semitropic WSD). More than 30,000 acres of groundwater
 21 recharge ponds are estimated to exist in the Kern County subbasin area. The total groundwater
 22 banking capacity in the region is estimated at 1.5 MAF per year, with maximum annual recovery
 23 estimated at 900,000 acre-feet (Kern County Water Agency 2011:2-30). The long-term storage
 24 potential of the Kern County subbasin is estimated at 8 MAF (Association of Groundwater Agencies
 25 2000:2).

26 **7.1.1.4 Groundwater Setting in the Export Service Areas outside the** 27 **Delta Watershed**

28 Groundwater resources and groundwater use in the Export Service Areas located outside of the
 29 Delta watershed occur in the San Francisco Bay Area, the Central Coast, and Southern California.

30 **San Francisco Bay Area Region**

31 The San Francisco Bay Area covers over 4,600 acres of the coastal plain bounded on the east by the
 32 crest of the Coast Ranges mountains. The San Francisco Bay Area contains 28 groundwater basins,
 33 as defined by DWR (California Department of Water Resources 2003:131). The most heavily used
 34 basins that receive imported water from the Delta Watershed are Santa Clara Valley, Napa Valley,
 35 and Livermore Valley groundwater basins. Santa Clara County water supplies include SWP water via
 36 the South Bay Aqueduct, CVP water via the San Felipe Division of the CVP, and water from San
 37 Francisco Public Utility District's Hetch Hetchy Regional Water System.

38 The Santa Clara subbasin has historically experienced long-term groundwater overdraft, resulting in
 39 large water level declines and up to 13 feet of unrecoverable land subsidence between 1915 and
 40 1969 (Santa Clara Valley Water District 2012). Importation of surface water via the Hetch Hetchy
 41 and South Bay Aqueducts and the San Felipe Division, and the development of an artificial recharge
 42 program have resulted in the rise of groundwater levels since 1965 (California Department of Water

1 Resources 2004c:2). The Niles Cone subbasin was in overdraft condition through the early 1960s. In
2 1962, SWP water was delivered to Alameda County Water District (ACWD) and used to recharge the
3 groundwater subbasin. Since the early 1970s, groundwater levels have risen due to artificial
4 recharge. In the Napa-Sonoma Valley basin, groundwater occurs in confined and unconfined
5 aquifers. Well yields are generally between 10 and 100 gpm, but some areas can yield up to 3,000
6 gpm. Groundwater in the Napa Valley floor generally flows toward the axis of the valley and then
7 south, except in areas where influenced by groundwater pumping, where local cones of depression
8 exist.

9 The Livermore Valley groundwater basin contains groundwater-bearing materials originating from
10 continental deposits from alluvial fans, outwash plains, and lakes. Well yields are mostly adequate
11 and in some areas can produce large quantities of groundwater for all types of wells (California
12 Department of Water Resources 2006d:1). The movement of groundwater is locally impeded by
13 structural features such as faults that act as barriers to groundwater flow, resulting in varying water
14 levels in the basin. Groundwater follows a westerly flow pattern, similar to the surface water
15 streams, along the structural central axis of the valley toward municipal pumping centers (Zone 7
16 Water Agency 2005:3-7). Groundwater levels in the main portion of the Livermore Valley basin
17 started declining in the 1900s, following historical artesian conditions, when groundwater pumping
18 removed large quantities of groundwater. This trend continued through the 1960s. In 1962, Zone 7
19 Water Agency, which provides water service to the Livermore Valley area, began importing SWP
20 water and later captured local runoff and stored it in Lake Del Valle. The import of additional surface
21 water alleviated the pressure on the aquifer, and groundwater levels started to rise in the 1970s.
22 However, historical lows were reached again during periods of drought.

23 In the southern San Francisco Bay Area, Santa Clara Valley Water District (SCVWD) maintains an
24 active recharge program in Santa Clara County to avoid overdrafting of the groundwater basin and
25 resulting land subsidence. Groundwater and surface water are connected through in-stream and off-
26 stream artificial recharge projects. Natural groundwater recharge also occurs from rainfall and
27 stream seepage during the wet season. Surface water is mostly losing to groundwater, as the
28 groundwater basins have been pumped extensively for various uses.

29 Groundwater quality in the San Francisco Bay Area is generally good and suitable for most
30 agricultural and municipal uses, but concerns exist about contamination from spills, leaks, and
31 discharges of solvents and fuels affecting beneficial uses, including potable use (California
32 Department of Water Resources 2009a). In basins located near the ocean or where seawater
33 intrusion has occurred, TDS is an issue. Seawater intrusion has been observed in groundwater
34 basins near San Francisco Bay, northern Santa Clara Valley, and Napa Valley. High TDS and hardness
35 cause pipe scaling and appliance corrosion. Nitrates occur naturally or result from agricultural
36 practices. High Boron levels also occur in the Napa Valley and Livermore Valley basins.
37 Contaminated groundwater from industrial and agricultural chemical spills, underground and above
38 ground storage tank and sump failures, landfill leachate, septic tank failures, and chemical seepage is
39 also a potential threat to groundwater aquifers in the Bay Area (California Department of Water
40 Resources 2009a).

41 In the San Francisco Bay Area as a whole, groundwater accounts for 11% of the total agricultural,
42 urban, and environmental water supplies (California Department of Water Resources 2009a: SF-9).
43 In Santa Clara County, approximately 149,000 acre-feet of groundwater is pumped annually by local
44 water suppliers and private well owners to meet municipal, domestic, agricultural, and industrial
45 water needs (Santa Clara Valley Water District 2012:2-14). Alameda County reports that about

1 31,400 acre-feet of water is pumped annually from the Niles Cone subbasin for a variety of uses
 2 (Alameda County Water District 2011). In Livermore Valley, an average of 25% of the potable water
 3 supply produced by Zone 7 comes from groundwater pumped from the basin that has been
 4 recharged artificially. In addition, other entities also pump groundwater for potable uses. About
 5 12,000 acre-feet per year of the groundwater extractions include evaporative losses to mining water
 6 from the gravel pits (about 3,000 acre-feet per year), municipal pumping by various retailers (about
 7 7,200 acre-feet per year), private pumping, industrial supply and domestic supplies (about 1,200
 8 acre-feet per year), and agricultural pumping for irrigation (about 500 acre-feet per year) (Zone 7
 9 Water Agency 2005:3-9).

10 Treatment of brackish groundwater is allowing previously unused groundwater to be used as a
 11 potable water source. Groundwater desalting is being used to reclaim and improve local brackish
 12 groundwater basins. In 2003, the first groundwater desalter went into production. For example, the
 13 5-mgd ACWD Newark Desalination Facility removes salts and other constituents from the Niles
 14 Cone subbasin groundwater for supply as potable water. Also, in 2009, the Zone 7 Water Agency
 15 began operation of the Mocho Groundwater Demineralization Plant. This plant produces 6.1 mgd of
 16 potable water for blend with other water supply sources.

17 Conjunctive use and groundwater banking programs have been implemented by several agencies to
 18 optimize the use of groundwater and surface water sources. SCVWD operates ten surface water
 19 reservoirs and an extensive system of in-stream and off-stream artificial recharge facilities to
 20 replenish the groundwater basin and provide more flexibility to manage water supplies. SCVWD
 21 releases local reservoir water and imported water through more than 390 acres of recharge ponds
 22 over 90 miles of creeks for artificial recharge to the groundwater basin. Artificial recharge amounts
 23 to approximately 100,000 acre-feet annually (Santa Clara Valley Water District 2012). Recharge in
 24 this subbasin occurs naturally along streambeds and artificially in in-stream and off-stream
 25 managed basins. The operational storage capacity in the basin was estimated with a groundwater
 26 flow model at 350,000 acre-feet, which accounts for the avoidance of adverse impacts such as
 27 inelastic land subsidence and salt water intrusion (Santa Clara Valley Water District 2012:AP-20).
 28 Zone 7 Water Agency artificially recharges the Livermore Valley basin with additional surface water
 29 supplies by releasing water into the Arroyo Mocho and Arroyo Valle (Zone 7 Water Agency 2005:3-
 30 8). The infiltrated water is then pumped from the groundwater basin for various uses.

31 ACWD, SCVWD, and Zone 7 Water Agency currently participate in groundwater banking programs.
 32 SCVWD reached an agreement with Semitropic WSD to bank up to 350,000 acre-feet in Semitropic
 33 WSD's storage facilities. As of January 1, 2014, SCVWD's storage water balance in the Semitropic
 34 banking program was about 263,000 acre-feet (Santa Clara Valley Water District 2010).

35 **Central Coast Region**

36 The Central Coast Hydrologic Region includes 50 delineated groundwater basins, as defined by DWR
 37 (California Department of Water Resources 2003:140). The basins vary from large extensive alluvial
 38 aquifers to small inland valleys and coastal terraces. Groundwater in the large alluvial aquifers
 39 occurs in thick unconfined and confined aquifers. Groundwater in the smaller valleys occurs in
 40 thinner unconfined aquifers (California Department of Water Resources 2009a:CC-15). Only a few of
 41 the DWR groundwater basins underlie areas supplied with Delta water. Most of the groundwater
 42 production occurs in the coastal aquifer, though a few large inland valley groundwater basins also
 43 provide high yields (Cuyama Valley and Paso Robles area). Production from these basins is tied to
 44 groundwater recharge from natural sources (precipitation and stream seepage) and from artificial

1 sources such as reservoir releases to creeks and rivers. The Central Coast Hydrologic Region also
2 includes portions of Santa Clara County, namely the Llagas subbasin.

3 There is significant interaction between surface water and groundwater in the Central Coast,
4 particularly along creeks and rivers. Local agencies operate surface water reservoirs to increase
5 natural recharge by releasing water to recharge downstream groundwater basins. Groundwater
6 recharge is achieved through the operation of several reservoirs: Uvas Reservoir, Chesbro Reservoir,
7 Hernandez Reservoir, Twitchell Reservoir, Lake San Antonio, and Lake Nacimiento. The operation of
8 these reservoirs allows for a continued stream flow over a longer period to increase the infiltration
9 of surface water to the aquifers (California Department of Water Resources 2003:140). For example,
10 Twitchell Reservoir is operated to recharge downstream groundwater basins in the Santa Maria
11 Valley with up to 20,000 acre-feet per year of water (Santa Barbara County 2007:4-17). Lopez
12 Reservoir is operated to supply 4,200 acre-feet per year of water for downstream recharge to
13 groundwater basins. Groundwater recharge occurs primarily from April to October.

14 According to the Santa Barbara Countywide Integrated Regional Water Management Plan, the
15 Cuyama, San Antonio, and Santa Ynez groundwater basins in Santa Barbara County are in a state of
16 overdraft. The Cuyama groundwater basin is in a state of overdraft of approximately 28,525 acre-
17 feet per year based on a 1992 study; the San Antonio groundwater basin is in a state of overdraft of
18 approximately 9,540 acre-feet per year based on a 2003 study. The Santa Ynez Uplands
19 groundwater basin is currently in a state of overdraft of approximately 2,028 acre-feet per year as
20 reported in a 2001 study (Santa Barbara County 2007: 2-21). Other basins are in equilibrium due to
21 management of the basin through conjunctive use by local water districts. For example, the
22 estimated water budget for the Llagas subbasin from 2002 to 2011 shows inflows and outflows
23 were generally balanced (Santa Clara Valley Water District 2012:2-19). The Goleta groundwater
24 basin, which was adjudicated in 1989, generally is near or above historical groundwater conditions
25 (Goleta Groundwater Basin and La Cumbre Mutual Water Company 2010:2-6), with the northern
26 and western portions of the basin having groundwater levels near the ground surface. High
27 groundwater levels may result in degradation to building foundations and agricultural crops (water
28 levels within the crop root zone).

29 Groundwater levels in the Santa Maria Basin have fluctuated significantly since the 1920s, marked
30 by seasonal and long-term trends of decline and recovery. Declines of up to 100 feet in both the
31 shallow and deep aquifer zones were observed between 1945 and the late 1960s. The groundwater
32 levels have generally recovered; however, groundwater declines in the last decade are visible in
33 portions of the Sisquoc Valley and Oso Flaco areas. Recent groundwater level declines can be
34 attributable, at least partially, to reductions in Twitchell Reservoir releases for in-stream
35 supplemental groundwater recharge since 2000 (including no releases in 2009). Coastal
36 groundwater levels remain above sea level, which indicates that enough recharge is occurring to
37 prevent seawater intrusion (Santa Maria Valley Management Area 2010:8-9).

38 Groundwater quality issues in the Central Coast area include nitrates, salinity, hardness, and PCE. In
39 the Santa Maria Valley groundwater basin, sulfate and TDS are the primary constituents of concern.
40 TDS concentrations range from approximately 750 mg/L to 1,300 mg/L, with a median of 1,200
41 mg/L, which exceeds the drinking water standard. All the sulfate concentrations exceeded the
42 recommended drinking water standard of 250 mg/L, and some exceeded the upper limit of 500
43 mg/L. PCE contamination was a major issue for two wells used by the City of San Luis Obispo in the
44 late 1980s (San Luis Obispo County 2011:3-60). State MCLs for nitrates have been exceeded in some
45 areas of Santa Barbara County, Santa Clara County, and other portions of the Central Coast

1 Hydrologic Region, and methyl tertiary butyl ether and chlorinated solvents pose problems for some
 2 wells (Santa Barbara County 2007:2-27). In addition, seawater intrusion has been observed more
 3 than 5 miles inland in some areas, caused by heavy pumping from municipal wells and a
 4 groundwater level drop of up to 100 feet in the late 1970s. (California Department of Water
 5 Resources 2003:140).

6 Groundwater is an important source of water supply for the population of the Central Coast; it is the
 7 region's primary water source. In 1995, groundwater provided approximately 83% of the annual
 8 water supply for agricultural and urban uses (California Department of Water Resources 2003:140).
 9 Groundwater supplies are from the San Luis Obispo, Los Osos, and the Santa Maria groundwater
 10 basins. In Santa Barbara County, over two-thirds of water supplied is from the Santa Ynez River
 11 Valley basin, and the major water user is the City of Santa Barbara. In general, this region uses about
 12 8.4% of the groundwater supply in the state. Groundwater provides over 90% of the water supply
 13 for areas overlying the Llagas subbasin and is the sole source of drinking water. Approximately
 14 44,000 acre-feet is pumped from the Llagas subbasin each year (Santa Clara Valley Water District
 15 2012:2-14).

16 Southern California Region

17 Southern California includes the groundwater basins of the South Coast Hydrologic Region, as well
 18 as portions of the South Lahontan Hydrologic Region, and the Colorado River Hydrologic Region as
 19 defined in DWR Bulletin 118-03. Groundwater occurs in unconfined alluvial aquifers in most of the
 20 basins in the South Coast Hydrologic Region. Confined groundwater conditions exist in areas
 21 underlying the coastal plains, where multiple aquifers might be separated by aquitards (California
 22 Department of Water Resources 2003:149). The South Lahontan Hydrologic Region is sparsely
 23 populated and little groundwater development exists in most areas (California Department of Water
 24 Resources 2003:194). Several fault zones in Southern California impede groundwater flow in certain
 25 areas.

26 Many rivers in Southern California are intermittent streams that are augmented with releases from
 27 reservoirs and treated effluent discharges. Riverbeds are often used to facilitate the recharge of
 28 groundwater basins through the porous alluvial material that lines the natural channel bottoms.
 29 Groundwater recharge helps alleviate overdraft conditions in these basins.

30 Currently, over 758,000 acre-feet per year of groundwater is recharged; however, more than
 31 3.2 MAF of storage is available for recharge (Metropolitan Water District of Southern California
 32 2007). Recharge water sources include stormwater, runoff, recycled, and imported water. Over
 33 1,000 acres of basins as well as 36 groundwater injection wells are used to recharge groundwater
 34 basins in Southern California to halt the decline of groundwater levels and the intrusion of seawater
 35 into aquifers that provide drinking water supplies.

36 Some of the groundwater basins in Southern California are brackish or have other water quality
 37 issues that require additional treatment prior to use. Groundwater quality is degraded through
 38 increased salinity and other constituents (such as nitrate) introduced by agricultural and municipal
 39 activities, past industrial/commercial activities, seawater intrusion, or from naturally existing
 40 conditions. In addition, the use of imported Colorado River water with higher salinities has resulted
 41 in degradation of groundwater quality in much of Southern California. Brackish groundwater exists
 42 primarily in the San Diego region, areas of the Inland Empire, and coastal areas of Los Angeles and
 43 Orange Counties. In addition, high TDS levels are a problem in Coachella Valley. Groundwater quality

1 in the Antelope Valley basin is affected by high levels of nitrate and boron (California Department of
2 Water Resources 2004d:3).

3 Groundwater is the second largest source of supply used in Southern California. In the Metropolitan
4 Water District of Southern California (MWDSC) service area, groundwater supplies meet
5 approximately 40% of the total annual water demand (Metropolitan Water District of Southern
6 California 2007). The major groundwater basins in the region provide an annual average water
7 supply of approximately 1.35 MAF (Metropolitan Water District of Southern California 2010:1–21).
8 Groundwater use in the region tends to be greater in drought years and less in normal and wet
9 years. However, because most groundwater basins in the region are adjudicated, the increase in
10 groundwater pumping during drought years is limited.

11 Groundwater is the largest source of water supply in Ventura County, where groundwater provides
12 about 67% of the locally used water (Ventura County 2011). Groundwater use in the Antelope Valley
13 is currently estimated to be approximately 90,000 acre-feet per year, which exceeds estimated
14 recharge by approximately 40,000 acre-feet per year (Palmdale Water District 2005).

15 The Water Replenishment District of Southern California manages groundwater in some adjudicated
16 basins in this region. The total adjudicated groundwater amounts to approximately 282,000 acre-
17 feet per year. Currently about 250,000 acre-feet of water are pumped by the district every year to
18 meet the users' demands (Water Replenishment District of Southern California 2010).

19 The Coachella Valley (Colorado River Hydrologic Region) relies on a combination of local
20 groundwater, Colorado River water, SWP water, surface water, and recycled water to meet water
21 demands. Coachella Valley Water District supplies all of its domestic water with groundwater and
22 annual sales are nearly 125,000 acre-feet (Coachella Valley Water District 2011).

23 Many water districts in Southern California have entered into agreements with water banks in Kern
24 and Tulare counties in the Tulare groundwater basins to store water as emergency supplies. The
25 SWP water stored in these groundwater banks outside Southern California is then transferred to the
26 receiving water districts. For example, MWDSC is a groundwater banking partner of the Semitropic
27 WSD.

28 Groundwater banking also occurs locally in Southern California. For example, the Irvine Ranch
29 Water District (IRWD) has entered into a 30-year water banking partnership with the Rosedale-Rio
30 Bravo Water Storage District in Kern County. IRWD has purchased land overlying the Kern County
31 groundwater basin in the Rosedale Rio Bravo Water Storage District. Both districts collaborated to
32 build 502 acres of recharge ponds to allow available surface water to percolate into the
33 groundwater basin for later use (Irvine Ranch Water District 2011). Local groundwater banking
34 occurs primarily for storage of Colorado River water, which is conveyed via the Colorado River
35 Aqueduct to the underground storage basins.

1 7.2 Regulatory Setting

2 This section provides the regulatory setting for groundwater resources, including potentially
3 relevant federal, state, and local requirements applicable to the project.

4 Federal laws and regulations that address water quality also may apply to groundwater quality, as
5 presented in Chapter 8, *Water Quality*, and Chapter 10, *Soils*, including Clean Water Act, National
6 Pollutant Discharge Elimination System (NPDES) Program Antidegradation Policy (40 Code of
7 Federal Regulations 131.6); Clean Water Act, Nonpoint Source Management Program (33 United
8 States Code [USC] 1329); Clean Water Act, Municipal Separate Storm Sewer Systems (MS4s) policy
9 (40 Code of Federal Regulations 122.34 and 122.26(d); and Safe Drinking Water Act (42 USC 300f-
10 300j-26). These regulations are federally mandated and implemented in California through the State
11 Water Resources Control Board. State regulations that address water quality also may apply to
12 groundwater quality, including the Order No. 99-08-DWQ, NPDES General Permit No. CAS000002,
13 Waste Discharge Requirements for Discharges of Stormwater Runoff Associated with Construction
14 Permit as presented in Chapter 8, *Water Quality*, and Chapter 10, *Soils*.

15 7.2.1 Federal Plans, Policies, and Regulations

16 Two federal laws, the Safe Drinking Water Act (42 USC 300f) and the Clean Water Act (33 USC
17 1251–1376), might apply to groundwater. Both regulations are discussed in Chapter 8, *Water*
18 *Quality*. Implementation of these laws directly or indirectly affects groundwater conditions.

19 7.2.2 State Plans, Policies, and Regulations

20 California generally does not regulate the overall use, entitlement, and management of groundwater.
21 Although statewide groundwater regulations have been considered several times in the past, the
22 California Legislature considers groundwater management to be a local responsibility (California
23 Department of Water Resources 2007). Several state laws specifically address groundwater, and
24 others include groundwater among other physical units, such as surface water. Most of the
25 regulations that include groundwater among other regulated entities are described in Chapter 8,
26 *Water Quality*. State laws that specifically address groundwater as the primary objective or as a
27 major component are presented below.

28 7.2.2.1 Porter-Cologne Water Quality Control Act (California Water 29 Code, Division 7 and 2009 Amendments)

30 The Porter-Cologne Water Quality Control Act established surface water and groundwater quality
31 guidelines and provided the authority for the State Water Resources Control Board to protect the
32 state's surface water and groundwater. Nine regional water quality control boards have been
33 established to oversee and implement specific water quality activities in their geographic
34 jurisdictions.

35 The Porter-Cologne Water Quality Control Act also requires that each regional water quality control
36 board develop basin plans that establish and periodically review the beneficial uses and water
37 quality objectives for groundwater and surface water bodies within its jurisdiction. Water quality
38 objectives developed by the regional boards provide specific water quality guidelines to protect
39 groundwater and surface water to maintain designated beneficial uses. The State Water Resources
40 Control Board, through its regional water quality control boards, is the permitting authority in

1 California to administer NPDES permits and Waste Discharge Requirements for regulation of waste
2 discharges in their respective jurisdictions.

3 **7.2.2.2 Area of Origin Statute (California Water Code 1220)**

4 California Water Code 1220 prohibits the pumping of groundwater “for export within the combined
5 Sacramento and Delta–Central Sierra Basins...unless the pumping is in compliance with a
6 groundwater management plan that is adopted by [county] ordinance.” The statute enables, but
7 does not require, the board of supervisors of any county within any part of the combined
8 Sacramento and Delta–Central Sierra Basin to adopt groundwater management plans (GWMPs)
9 (Foley-Gannon 1999).

10 **7.2.2.3 California Water Code**

11 Assembly Bill (AB) 3030 (1992, California Water Code Sections 10750–10756) enables water
12 agencies to develop and implement GWMPs to manage the groundwater resources in the
13 jurisdiction of the participating parties. The state does not maintain a statewide program or
14 mandate its implementation, but the legislation provides the guidelines and common framework
15 through which groundwater management can be implemented. Groundwater management
16 legislation was amended in 2002 with the passage of Senate Bill (SB) 1938, which provided
17 additional groundwater management components supporting eligibility to obtain public funding for
18 groundwater projects. In 2000, AB 3030 enabled the development of the Local Groundwater
19 Assistance grant program to support local water agencies developing groundwater management
20 programs.

21 SB 1938, California Water Code Section 10753.7, requires local agencies seeking state funds for
22 groundwater construction or groundwater quality projects to have a minimum required list of
23 actions to be implemented, such as basin management objectives. AB 3030 encourages local water
24 agencies to establish local groundwater management plans and lists 12 elements that can be
25 included within the plans to ensure efficient use, good groundwater quality, and safe production of
26 water (California Water Code Section 10753).

27 Several GWMPs have been developed in the Delta Region (Table 7-4). The plans’ groundwater
28 management components and implementation methods vary.

1 **Table 7-4. Delta Region Groundwater Management Plans**

Groundwater Basin	Entity/Entities	Document Title	GWMP Report Date	Adoption Date
Sacramento Valley Groundwater Basin (southern portion)				
Cosumnes Subbasin	Southeast Sacramento County Agricultural Water Authority	Southeast Sacramento County Agricultural Water Authority GWMP	12/3/2002	
Solano Subbasin	Assembly Bill 3030 GWMP	City of Vacaville	2/28/1995	2/28/1995
Solano Subbasin	Reclamation District 2068	GWMP	12/2005	12/8/2005
Solano Subbasin	Maine Prairie WD	Maine Prairie WD GWMP	1/21/1997	1/21/1997
Solano, Yolo, Colusa, and Capay Valley Subbasins	Yolo County Flood Control and Water Conservation District	Water Management Plan	6/2006	6/6/2006
South American Subbasin	Sacramento Central Groundwater Authority	Central Sacramento County GWMP		11/8/2006
South American, North American, and Cosumnes Subbasins	Sacramento Metropolitan Water Authority	GWMP Initial Phase	3/1994	12/11/2003
Yolo Subbasin	City of Davis, University of California at Davis	Groundwater Management Plan	4/2006	5/16/2006
Yolo Subbasin	Reclamation District 2035	GWMP	4/1995	4/25/1995
San Joaquin Valley Groundwater Basin (northern portion)				
Eastern San Joaquin Subbasin	City of Stockton			
Eastern San Joaquin and Cosumnes Subbasins	North San Joaquin WCD	GWMP	9/1995	5/1996
Eastern San Joaquin and Cosumnes Subbasins	Northeastern San Joaquin County Groundwater Banking Authority. Agencies involved: City of Lodi, Woodbridge ID, North San Joaquin WCD, North San Joaquin WCD, Central San Joaquin WCD, Stockton East WD, Central Delta Water Agency, South Delta Water Agency, SJCFWCWD, California Water Service Company, San Joaquin Farm Bureau Federation	Eastern San Joaquin Groundwater Basin GWMP	9/2004	9/22/2004
Eastern San Joaquin Subbasin	South San Joaquin ID	South San Joaquin Irrigation District GWMP	12/1994	2/1995
Eastern San Joaquin Subbasin	Stockton East WD	Stockton East Water District GWMP	10/1995	
Tracy Subbasin	City of Tracy, Banta Carbona ID, Del Puerto WD, Patterson WD, Plain View WD, West Stanislaus ID, Westside ID, SJCFWCWD	Tracy Regional GWMP	5/21/1996	5/21/1996
Tracy and Delta-Mendota Subbasins	San Luis & Delta Mendota Water Authority-North. Other agencies involved: Banta Carbona ID, Del Puerto WD, Patterson WD, Plain View WD, West Stanislaus ID, Westside ID, SJCFWCWD	GWMP for the Northern Agencies in the Delta-Mendota Canal Service Area and a portion of San Joaquin County	10/1995	12/5/1997
Suisun-Fairfield Basin				
Suisun-Fairfield Basin	Solano ID	Assembly Bill 3030 GWMP	2/15/1995	

Source: California Department of Water Resources 2009b.

GWMP = groundwater management plan; ID = irrigation district; SJCFWCWD = San Joaquin County Flood Control and Water Conservation District; WCD = water conservation district; WD = water district.

2

1 7.2.2.4 Basin Adjudications

2 Basin adjudications occur through a court decision at the end of a lawsuit. The final court decision
 3 determines the groundwater rights of all the groundwater users overlying the basin. In addition, the
 4 court decides who the extractors are and how much groundwater those well owners are allowed to
 5 extract, and appoints a Watermaster whose role is to ensure that the basin is managed in accordance
 6 with the court's decree. The Watermaster must report periodically to the court. There are currently
 7 21 adjudicated groundwater basins located within the project area, most of which are located in
 8 Southern California (Table 7-5).

9 An adjudication process is currently underway for the Antelope Valley groundwater basin located in
 10 Kern and Los Angeles Counties.

11 **Table 7-5. Adjudicated Groundwater Basins in Southern California**

Basin Name	Date of Final Court Decision	County	Hydrologic Region
Beaumont Basin	2004	Riverside	South Coast/ Colorado River
Brite Basin	1970	Kern	Tulare Lake
Central Basin	1965	Los Angeles	South Coast
Chino Basin	1978	San Bernardino	South Coast
Cucamonga Basin	1978	San Bernardino	South Coast
Cummings Basin	1972	Kern	Tulare Lake
Goleta Basin	1989	Santa Barbara	Central Coast
Main San Gabriel Basin: Puente Narrows	1973	Los Angeles	South Coast
Mojave Basin Area	1996	San Bernardino	South Lahontan
Puente Basin	1985	Los Angeles	South Coast
Raymond Basin	1944	Los Angeles	South Coast
Rialto-Colton	1961	San Bernardino	South Coast
Santa Margarita River Watershed	1966	San Diego	South Coast
Santa Maria Valley Basin	2008	Santa Barbara, San Luis Obispo	Central Coast
Santa Paula Basin	1996	Ventura	South Coast
Six Basins	1998	Los Angeles	South Coast
Tehachapi Basin	1973	Kern	Tulare Lake
Upper Los Angeles River Area (including San Fernando Basin)	1979	Los Angeles	South Coast
Warren Valley Basin	1977	San Bernardino	Colorado River
West Coast Basin	1961	Los Angeles	South Coast
Western San Bernardino	1969	San Bernardino	South Coast

Sources: California Department of Water Resources 2003, 2014.

12

1 **7.2.2.5 California Statewide Groundwater Elevation Monitoring** 2 **Program (CASGEM) (SBX7-6)**

3 SBX7-6, enacted in November 2009, mandates a statewide groundwater elevation monitoring
4 program to track seasonal and long-term trends in groundwater elevations in California's
5 groundwater basins. This amendment to the Water Code requires the collaboration between local
6 monitoring entities and DWR to collect groundwater elevation data. To achieve this goal, DWR
7 developed the California Statewide Groundwater Elevation Monitoring (CASGEM) Program to
8 establish a permanent, locally managed program of regular and systematic monitoring in all of the
9 state's alluvial groundwater basins.

10 SBX7-6 adds to and amends parts of Division 6 of the California Water Code, specifically Part 2.11
11 Groundwater Monitoring. The law requires that local agencies monitor and report the elevation of
12 their groundwater basins. DWR is required by the law to establish a priority schedule for monitoring
13 groundwater basins, and to report to the Legislature on the findings from these investigations
14 (California Water Code Section 10920 et. seq).

15 SBX7-6 provides the following.

- 16 • Local parties may assume responsibility for monitoring and reporting groundwater elevations.
- 17 • DWR works cooperatively with local monitoring entities to achieve monitoring programs that
18 demonstrate seasonal and long-term trends in groundwater elevations.
- 19 • DWR reviews prospective monitoring entity submittals, then designates the monitoring entity,
20 notifies the monitoring entity, and makes that information available to the public.
- 21 • DWR performs groundwater elevation monitoring in basins where no local party has agreed to
22 perform the monitoring functions.
- 23 • If local parties (for example, counties) do not volunteer to perform the groundwater monitoring
24 functions and DWR assumes those functions, then those parties become ineligible for water
25 grants or loans from the state.

26 The law required local entities to notify DWR in writing by January 1, 2011 if the local agency or
27 party seeks to assume groundwater monitoring functions in accordance with the law. Monitoring
28 Entities were to begin reporting seasonal groundwater elevation measurements on or before
29 January 1, 2012. As part of the CASGEM program, DWR's role is to work cooperatively with local
30 entities, and to maintain the collected elevation data in a readily and widely available public
31 database. The 2012 CASGEM Status Report to the Legislature describes the progress made in the
32 first 2 years of this program. In summary, more than 400 monitoring entities have been identified
33 and water level data from the fall 2011 sampling round have been submitted to DWR. DWR is
34 currently developing an online system for a monitoring entity to submit groundwater elevation data,
35 which will be compatible with DWR's Water Data Library.

36 **7.2.2.6 Sustainable Groundwater Management Act**

37 Legislation was passed in 2014 that provides a statewide framework for sustainable groundwater
38 management in California (SB 1168, AB 1739, and SB 1319). This legislation, referred to as the
39 Sustainable Groundwater Management Act (SGMA), is intended to support local groundwater
40 management through technical assistance and oversight of Groundwater Sustainability Agencies
41 (GSAs) and the implementation of their groundwater sustainability plans (GSPs). SGMA requires

1 GSAs to develop monitoring, management, and reporting of those data necessary to support
 2 sustainable groundwater management including: 1) sufficient land and water resource data to
 3 establish an accounting of the short- and long-term trends of the basin's water balance; 2) measures
 4 of basin sustainability, such as minimum groundwater elevations at key stations or maximum long-
 5 term average groundwater pumping volumes; and 3) those data necessary to resolve disputes
 6 regarding sustainable yield (maximum average groundwater pumping), beneficial uses, and water
 7 rights.

8 Implementation of SGMA provides for state agency oversight if GSAs do not implement their GSPs.
 9 To avoid intervention by the State Water Resources Control Board, SGMA requires GSAs to establish
 10 sustainability goals, accurately track the effectiveness of management actions to achieve the
 11 sustainability goals, and manage the basin within its sustainable yield without causing undesirable
 12 results. DWR is required to develop regulations for developing and evaluating GSPs, the
 13 implementation of GSPs, and necessary coordination agreements to achieve sustainable yields in
 14 each basin within 20 years (2035). The GSP regulations will identify the necessary GSP components
 15 related to the collection, analysis, and reporting of water budget information that will assist local
 16 agencies in developing and implementing GSPs, establishing the maximum sustainable yield
 17 (groundwater pumping limits) and coordination agreements. Establishing consistency in the
 18 collection, analysis, and reporting of data components related to water budget accounting will be
 19 critical for effective statewide evaluation of GSP development and implementation. However,
 20 because every groundwater basin is different, the regulations will consider groundwater basin
 21 variability and will provide flexibility in the water budget data and methods that will be required
 22 based the specific aquifer conditions and sustainability goals of each basin. SGMA is expected to
 23 greatly increase the collection and use of groundwater information and will likely improve the
 24 sustainable conjunctive (joint) use of surface water and groundwater in California.

25 **7.2.3 Regional and Local Plans, Policies, and Regulations**

26 Several counties have adopted or are considering groundwater ordinances applicable to
 27 groundwater basins in the Delta Region, the Upstream of the Delta Region, and other portions of the
 28 Export Service Areas. The ordinances primarily address well installation, groundwater extraction,
 29 and exportation. The counties that incorporate groundwater-related ordinances in the Delta Region,
 30 Upstream of the Delta Region, and other portions of the Export Service Areas consist of Shasta,
 31 Tehama, Glenn, Colusa, Yolo, Sacramento, San Joaquin, Calaveras, Tuolumne, Madera, Fresno, Kern,
 32 Napa, Ventura, San Diego, and San Bernardino. Local county ordinances vary by authority, agency, or
 33 region but typically involve provisions to limit or prevent groundwater overdraft, to regulate
 34 transfers, and to protect groundwater quality. For example, San Joaquin County's groundwater
 35 management ordinance was promulgated in 1996. It requires a permit for any groundwater exports
 36 from the Eastern San Joaquin County groundwater basin. Before a permit will be issued, an applicant
 37 is required to demonstrate that the proposed export will not exacerbate the existing groundwater
 38 overdraft condition.

39 Special Act Districts are created through a special act of the Legislature and are granted greater
 40 authority to manage groundwater resources. Currently thirteen such local agencies exist in
 41 California. For example, the Orange County Water District has been granted Special Act District
 42 authorities. In general, the specific authority of this district includes two general categories.

- 43 ● Limiting export and extraction of groundwater in their jurisdictions (upon evidence of overdraft
 44 or threat of overdraft).

- Requiring the users in the basin to report extractions to the agency, who can levy a fee from groundwater management or water supply replenishment.

The SCVWD District Act provides broad authority to manage water resources; however, there is no specific language limiting groundwater extraction.

7.3 Environmental Consequences

This section describes the potential groundwater-related effects that could result from project construction, operation, and maintenance. In general, impacts attributable to construction, dewatering activities, and long-term operation are addressed in the Delta Region. Project implementation also would potentially result in changes in SWP/CVP water supply availability in the Delta Region, Upstream of the Delta Region, and other portions of the Export Service Areas. Changes in SWP/CVP water supply availability could result in changes in groundwater production in areas that use SWP/CVP water supplies.

In the Delta Region, the water table is approximately 5 feet below land surface except in areas adjacent to surface water bodies, where groundwater levels are maintained by island drainage systems to within 1 to 2 feet of the land surface (California Department of Water Resources 2009a). Groundwater levels are influenced throughout the Delta by precipitation, irrigation, interaction with surface water features, subsurface inflow from adjacent areas, evapotranspiration, groundwater pumping, sea level, and agricultural drainage systems. Such drainage systems are operated to keep groundwater below the rooting depths of crops.

The potential for interaction between the canal alignments and the underlying aquifer system in the Delta Region was evaluated using a numerical model, Central Valley Hydrologic Model-Delta (CVHM-D), described in Section 7.3.1.2, *Analysis of Groundwater Conditions Associated with Construction and Operations of Facilities in the Delta*. The estimates of groundwater recharge (i.e., seepage) from the canals are described herein on a qualitative basis. This is because future canal seepage rates would be significantly influenced by the built-out design of the canal system. The design approaches being considered to control seepage along various reaches of the canal range from low permeability slurry walls, to passive drain systems, to groundwater interception wells. Each of these approaches would have different levels of effectiveness, and would therefore result in different rates of canal seepage.

In the Sacramento Valley, groundwater levels are generally in balance valley-wide, with pumping matched by recharge from the various sources annually, as described in Section 7.1.1.3, *Delta Watershed Groundwater Setting*. There are some areas with persistent drawdown, including the northern Sacramento County area, areas near Chico, and on the far west side of the Sacramento Valley in Glenn County. Surface water is provided to several areas within the Sacramento Valley that do not have adequate groundwater supplies, such as the Tehama Colusa Canal Authority service area that uses CVP water supplies.

In the San Joaquin Valley, groundwater levels have been in various rates of decline prior to the 1920s, as described in Section 7.1.1.3, *Delta Watershed Groundwater Setting*. Land subsidence due to groundwater extraction began in the mid-1920s and accelerated as higher groundwater production rates persisted into the 1970s; groundwater quality degradation, and higher pumping costs have resulted. Historically, the western and southern portions of the San Joaquin Valley are most affected by groundwater-level declines (State Water Resources Control Board and California Environmental Protection Agency 2006).

1 In portions of the Export Service Areas outside of the Central Valley, basin adjudications and
 2 groundwater management programs such as artificial basin recharge have been implemented to
 3 help reduce the groundwater overdraft in some basins and reverse the groundwater level decline
 4 trend in the San Francisco Bay Area, the Central Coast, and Southern California. Implementation of
 5 these types of groundwater management programs are described in Section 7.1.1.4, *Groundwater*
 6 *Setting in the Export Service Areas outside the Delta Watershed.*

7 **7.3.1 Methods for Analysis**

8 The groundwater analysis addresses three different aspects of the project. First, the analysis
 9 addresses adverse and beneficial changes in groundwater conditions in the areas that use SWP/CVP
 10 water in the Delta Region, Upstream of the Delta Region, and other areas of the Export Service Areas
 11 due to changes in SWP/CVP water supply availability. Second, the analysis addresses changes in
 12 groundwater conditions in the vicinity of the water conveyance facilities within the Delta due to
 13 construction and operations and maintenance activities. Third, the analysis addresses changes in
 14 groundwater conditions due to the construction and implementation of restoration actions in areas
 15 within the Delta where conservation measures or Environmental Commitments could be
 16 implemented.

17 **7.3.1.1 Analysis of Groundwater Conditions in Areas that Use SWP/CVP** 18 **Water Supplies**

19 Changes in SWP/CVP water supply availability, as described in Chapter 5, *Water Supply*, could result
 20 in changes in groundwater conditions in those areas, as observed from historical trends described in
 21 Section 7.1.1.3, *Delta Watershed Groundwater Setting*. It is assumed that in areas that experience
 22 increased SWP/CVP water supplies, groundwater withdrawals would decline, and depending upon
 23 the local groundwater characteristics, groundwater elevations may rise. It is further assumed that if
 24 SWP/CVP water supplies decrease in areas that have historically relied upon groundwater for major
 25 portions of the water supply, groundwater withdrawals would increase to replace the reduction in
 26 SWP/CVP surface water supplies.

27 There could be minor decreases in water supply availability to CVP water users in the Sacramento
 28 Valley service area due to the implementation of the alternatives. These minor changes have been
 29 estimated at approximately 50,000 acre-feet per year, which is approximately 2% of the current
 30 annual average groundwater production quantity in the Sacramento Valley. The Sacramento Valley
 31 groundwater basin is “full” in most areas, except during droughts and in a few locales where
 32 drawdown has been observed over the years. In most areas groundwater levels recover to pre-
 33 irrigation season levels each spring. A 2% increase in groundwater use in the Sacramento Valley to
 34 make up for any shortfalls in surface water supply is not anticipated to substantially affect the
 35 groundwater resources as long as the additional pumping is not concentrated in a particular area of
 36 the valley. Therefore, the Sacramento Valley groundwater basin is not included in the groundwater
 37 analysis presented in this chapter.

38 To capture the correlation between surface water deliveries and groundwater withdrawals, and the
 39 associated impacts on groundwater in the San Joaquin Valley and Tulare Lake basins, the impact
 40 analysis was conducted using CVHM. CVHM is a three-dimensional numerical groundwater flow
 41 model developed by the USGS and documented in *Groundwater Availability of the Central Valley*
 42 *Aquifer, California* (U.S. Geological Survey 2009). CVHM simulates primarily subsurface and limited

1 surface hydrologic processes over the entire Central Valley at a uniform grid-cell spacing of 1 mile.
 2 Figure 7-4 shows the CVHM domain and a description of CVHM is provided below.

3 The analysis evaluates groundwater conditions using the following comparisons:

- 4 • Existing Conditions (without sea level rise or climate change [i.e., effects on precipitation and
 5 snowpack]) and the No Action Alternative (with sea level rise and climate change that would
 6 occur in the late long-term [LLT] timeframe, or around Year 2060).
- 7 • Existing Conditions (without sea level rise or climate change) and the No Action Alternative
 8 (with sea level rise and climate change that would occur at Year 2025 [early long-term (ELT)
 9 timeframe]).

10 **CEQA Comparison:** Existing Conditions (without sea level rise or climate change) and BDCP
 11 alternatives (with sea level rise and climate change that would occur in the LLT timeframe, or
 12 around Year 2060). Alternatives 4A, 2D, and 5A (with sea level rise and climate change that would
 13 occur at 2025 [ELT timeframe] compared to Existing Conditions [without sea level rise or climate
 14 change]).

15 **NEPA Comparison:** The No Action Alternative and BDCP alternatives (both with sea level rise and
 16 climate change that would occur in the LLT timeframe, or around Year 2060). The No Action
 17 Alternative and Alternatives 4A, 2D, and 5A (with sea level rise and climate change that would occur
 18 at 2025 [ELT timeframe]). The results of the comparison of Existing Conditions to the alternatives
 19 reflect differences in groundwater conditions resulting from the difference in SWP/CVP surface
 20 water supply availability due to changes in SWP/CVP operations under the alternatives and due to
 21 sea level rise and climate change.

22 The results of the comparison of the No Action Alternative to the alternatives reflect differences in
 23 groundwater conditions resulting from the difference in SWP/CVP surface water supply availability
 24 due to changes in SWP/CVP operations under the alternatives only.

25 In noting effects under different SWP/CVP operational scenarios under LLT around Year 2060
 26 conditions and under ELT around Year 2025 conditions, readers should be aware that some of the
 27 differences between those anticipated future conditions and Existing Conditions (for CEQA) are
 28 attributable to sea level rise and climate change, and not to the operational scenarios themselves.
 29 Many of the figures in this chapter depicting differences between alternatives under LLT or ELT
 30 conditions and the CEQA Existing Conditions baseline may therefore seem to exaggerate the effects
 31 of proposed operational changes. In some of these figures, the environmental changes depicted are
 32 largely attributable to sea level rise and climate change (i.e., anticipated reductions in snowfall and
 33 effects on precipitation generally).

34 **Describing Changes due to Sea Level Rise and Climate Change as Compared to** 35 **Changes due to New Facilities and Operations**

36 As is the case throughout this document, effects are analyzed in this chapter under both NEPA and
 37 CEQA, with the NEPA analysis being based on a comparison of the effects of action alternatives
 38 against a future No Action condition and the CEQA analysis being based on a comparison of these
 39 effects against Existing Conditions. One consequence of the different approaches is the manner in
 40 which sea level rise and climate change are reflected in the respective impact conclusions under the
 41 two sets of laws. Under NEPA, the effects of sea level rise and climate change are evident both in the
 42 future condition and in the effects of the action alternatives. Under CEQA, in contrast, the absence of

1 sea level rise and climate change in Existing Conditions results in model-generated impact
 2 conclusions that include the impacts of sea level rise and climate change with the effects of the
 3 action alternatives. As a consequence, the CEQA conclusions in many instances either overstate the
 4 effects of the action alternatives or suggest significant effects that are largely attributable to sea level
 5 rise and climate change, and not to the action alternatives.

6 In both sets of analyses, the lead agencies have relied on computer models that represent best
 7 available science; however, any predictions of conditions 50 years from the present are inherently
 8 limited and reflect a large degree of speculation. In the interest of informing the public of what DWR
 9 believes to be the reasonably foreseeable impacts of the action alternatives, DWR has focused
 10 primarily on the contribution of the action alternatives, as opposed to the impacts of sea level rise
 11 and climate change, in assessing the significance of the impacts of these action alternatives. The
 12 opposite approach, which would treat the impacts of sea level rise and climate change as though
 13 they were impacts of the action alternatives, would overestimate the effects of the action
 14 alternatives. The approach taken here by DWR also has the effect of highlighting the substantial
 15 nature of the consequences of sea level rise and climate change on California's water system.

16 As described in Chapter 5, *Water Supply*, the differences in SWP/CVP surface water supply
 17 availability under a BDCP alternative or Alternatives 4A, 2D, or 5A, as compared to Existing
 18 Conditions were frequently more related to changes in sea level rise and climate change than to
 19 SWP/CVP operations under the alternative. More details on these effects are described in Chapter 5,
 20 *Water Supply*.

21 For each alternative, the following impact assessment comparisons are presented for the
 22 quantitative analyses of groundwater level changes and associated impacts in the Delta and in the
 23 Export Service Areas.

- 24 • Comparison of each alternative (at LLT or ELT) to Existing Conditions (the CEQA baseline),
 25 which will result in changes in SWP/CVP water supply conditions that are caused by three
 26 factors: sea level rise, climate change, and implementation of the alternative. It is not possible to
 27 specifically define the exact extent of the changes due to implementation of the alternative using
 28 the model simulation results presented in this chapter. Thus, the precise contributions of sea
 29 level rise and climate change to the total differences between Existing Conditions and LLT or
 30 ELT conditions under each alternative cannot be isolated.
- 31 • Comparison of alternatives (at LLT) to the No Action Alternative (at LLT) or alternatives (at
 32 ELT) to the No Action Alternative (at ELT) to indicate the general extent of changes in SWP/CVP
 33 water supply conditions due to implementation of the alternative. Because sea level rise and
 34 climate change are reflected in each action alternative and in the No Action alternative, this
 35 comparison reflects the extent of changes in SWP/CVP water supplies attributable to the
 36 differences in operational scenarios amongst the different action alternatives.

37 For the other Export Service Areas in the San Francisco Bay Area, the Central Coast, and Southern
 38 California, no regional models are available, and the discussion of impacts is qualitative.

39 **Central Valley Hydrologic Model Methodology**

40 CVHM simulates surface water flows, groundwater flows, and land subsidence in response to
 41 stresses from water use and climate variability throughout the entire Central Valley. It uses the
 42 MODFLOW-2000 (U.S. Geological Survey 2000b) groundwater flow model code combined with a
 43 module called the Farm Process (FMP) (U.S. Geological Survey 2006c) to simulate groundwater and

1 surface water flow, irrigated agriculture, and other key processes in the Central Valley on a monthly
 2 basis from April 1961 through September 2003. The CVHM domain is subdivided laterally into 1-
 3 square-mile grid-blocks over a 20,000-square-mile area, and vertically into 10 layers ranging in
 4 thickness from 50 feet near the land surface to 750 feet at depth. The thinner layers near the land
 5 surface provide for more detailed estimates of groundwater impacts near the project facilities.

6 FMP allocates water, simulates processes, and computes mass balances for 21 defined subregions of
 7 the model domain. These subregions are referred to as Water Budget Subareas and “farms” in
 8 CVHM. FMP was developed for MODFLOW-2000 to estimate irrigation water allocations from
 9 conjunctively used surface water and groundwater. It is designed to simulate the demand
 10 components representing crop irrigation requirements and on-farm inefficiency losses, and the
 11 supply components representing surface water deliveries and supplemental groundwater pumping.
 12 FMP also simulates additional head-dependent inflows and outflows such as canal losses and gains,
 13 surface runoff, surface water return flows, evaporation, transpiration, and deep percolation of
 14 applied water. Unmetered pumping and surface water deliveries for the 21 water budget subareas
 15 (WBSs) are also included within FMP.

16 CVHM, which uses results from CALSIM II (see Chapter 5, *Water Supply*, Section 5.3.1, and Chapter 6,
 17 *Surface Water*, Section 6.3.1, for further description of the assumptions associated with CALSIM II
 18 modeling for Existing Conditions, the No Action Alternative, and the action alternatives), was
 19 calibrated using a combination of trial-and-error and automated methods. An autocalibration code,
 20 UCODE-2005 (U.S. Geological Survey 2005), was used to help assess the ability of CVHM to estimate
 21 the effects of changing stresses on the hydrologic system. Simulated changes in water levels, stream
 22 flows, stream flow losses, and land subsidence through time were compared with those measured at
 23 wells, stream flow gages, and extensometers. For model calibration, groundwater levels and surface
 24 water stages were assimilated to establish calibration-target locations distributed spatially
 25 (geographically and vertically) throughout the Central Valley, distributed temporally throughout the
 26 simulation period (1961–2003), and with available data during wet and dry climatic regimes. From
 27 the available well records, a subset of 170 comparison wells was selected on the basis of perforation
 28 depths, completeness of record, and locations throughout the Central Valley (U.S. Geological Survey
 29 2009). For additional information, see Appendix 7A, *Groundwater Model Documentation*.

30 Effects associated with changing groundwater use in the Export Service Areas in the San Joaquin
 31 Valley were evaluated using CVHM. The Delta exports simulated by CALSIM II were used as inputs
 32 into CVHM to assess impacts on groundwater levels due to changes in surface water deliveries.
 33 Because CALSIM II assumes the same deliveries for the different types of conveyance per
 34 alternative, CVHM also used only one delivery time series per alternative (not distinguishing any
 35 “sub-alternative;” e.g., 1A, 1B, 1C). Therefore, the impacts for Alternatives 1A, 1B, and 1C are
 36 assumed to be the same within the Export Service Areas. Similarly, impacts for Alternatives 6A, 6B,
 37 and 6C are also assumed to be the same within the Export Service Areas. The same holds true for
 38 Alternatives 2A, 2B, and 2C.

39 **7.3.1.2 Analysis of Groundwater Conditions Associated with** 40 **Construction and Operations of Facilities in the Delta**

41 The analysis describes the potential for temporary construction and long-term operations activities
 42 associated with the following conveyance concepts to directly or indirectly affect groundwater
 43 resources.

- 1 • Pipeline/Tunnel (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8).
- 2 • East Alignment (unlined and lined canal) (Alternatives 1B, 2B, and 6B).
- 3 • West Alignment (unlined and lined canal) (Alternatives 1C, 2C, and 6C).
- 4 • Modified Pipeline/Tunnel (Alternatives 4, 4A, 2D, and 5A).
- 5 • Through Delta/Separate Corridors (Alternative 9).

6 The analysis relies upon geospatial information identifying temporary ground-disturbing activities
 7 necessary for project construction in the Delta Region. Longer-term effects resulting from the
 8 physical footprints of water conveyance facilities and conservation areas, as well as operational
 9 effects on groundwater resources are described separately. Areas south of the Delta that receive
 10 Delta water would not be affected during construction activities in the Delta because the changes in
 11 groundwater levels due to construction dewatering occur locally around the site of dewatering and
 12 are not propagated into other groundwater basins. During construction activities, the Delta exports
 13 are assumed to remain identical to what they would be without construction activities associated
 14 with the new conveyance facility.

15 CVHM-D was used to evaluate the effects of the construction and long-term operation of the water
 16 conveyance facilities associated with the project on groundwater resources in the Delta Region.
 17 CVHM-D is essentially a higher resolution version of CVHM with a smaller model domain footprint
 18 centered on the Delta Region that simulates hydrologic processes in the Delta Region at a more
 19 refined grid-cell spacing of 0.25 mile (compared with the grid-cell spacing of 1 mile with CVHM).
 20 Other enhancements were incorporated in CVHM-D, as described below. Figure 7-5 shows the
 21 CVHM-D domain in relation to the CVHM domain. The main activity evaluated for the construction
 22 phase was the dewatering associated with the construction of pump stations, canal crossings, and
 23 other project facilities. The parameters used to simulate the dewatering projects were obtained
 24 from two DWR technical memoranda: *Definition of Existing Groundwater Regime for Conveyance*
 25 *Canal Dewatering and Groundwater Evaluation* (California Department of Water Resources 2010a)
 26 and *Analysis of Dewatering Requirements for Potential Excavations* (California Department of Water
 27 Resources 2010b). Each dewatering project was simulated using CVHM-D. The effects of each
 28 dewatering simulation were compared to the simulation of the No Action Alternative baseline
 29 conditions to obtain an estimate of the incremental impacts of dewatering activities. CVHM-D results
 30 were used to support the analysis in the Environmental Consequences assessment. The conveyance
 31 facilities could include various structures including low-permeability cut-off walls, toe drains, or
 32 other structures that could affect groundwater resources during long-term operation. The
 33 conveyance features for each alternative were incorporated into CVHM-D as boundary conditions
 34 using various MODFLOW packages as described in Appendix 7A, *Groundwater Model Documentation*.
 35 In addition, surface water inflows for streams affected by operational changes were estimated from
 36 CALSIM II simulations for each alternative and incorporated into CVHM-D.

37 For the portion of the impacts analysis described herein using CVHM-D, the Existing Conditions
 38 baseline was considered comparable to the No Action Alternative without sea level rise and climate
 39 change, as Delta flows do not change substantially between the two scenarios, and no new
 40 conveyance is built in the Delta under either scenario that could result in differential impacts.
 41 Therefore, results for CEQA conclusions are presented via a comparison of each alternative with the
 42 No Action Alternative without sea level rise and climate change.

1 **Central Valley Hydrologic Model–Delta Methodology**

2 The objectives of Central Valley Hydrologic Model–Delta (CVHM-D) were to develop a model capable
 3 of being accurate at scales relevant to water-management decisions and to develop a better
 4 understanding of the flow system at a regional scale (correlating to the original water budget
 5 subareas defined by USGS, 2009). The more generalized Central Valley Hydrologic Model (CVHM),
 6 contains sufficient fundamental information to facilitate the addition of more detailed features that
 7 may be relevant at a subregional scale (U.S. Geological Survey 2009). However, evaluating the
 8 potential impacts of the action alternatives on groundwater resources in the Delta Region required
 9 modification of CVHM. Five fundamental modifications were made to CVHM for application to this
 10 project.

- 11 • Model domain extent of CVHM was reduced to include only the Delta Region.
- 12 • Model grid-cell spacing was reduced from 1-mile to 0.25-mile centers.
- 13 • The original Water Budget Subarea 9 for CVHM was split into smaller water budgets subareas.
- 14 • Additional streams, sloughs, and canals were incorporated.
- 15 • Boundary conditions in the Delta Region were refined to allow for more precise simulation of
 16 water routing in the Delta Region, as compared to CVHM.

17 The CVHM domain was reduced by eliminating most of the Sacramento Valley and San Joaquin
 18 Valley from the domain when developing CVHM-D. This modification allowed for greater precision
 19 in model output in the Delta Region. Modifying the extent of the model domain required the
 20 assignment of boundary conditions on the northern and southern edges of CVHM-D. These
 21 boundary conditions were specified as General Head Boundaries (GHBs) with associated
 22 groundwater heads that reflect groundwater levels consistent with monthly groundwater level
 23 output from CVHM. Thus, CVHM was run initially to assign transient groundwater levels to the GHBs
 24 on the northern and southern boundaries of CVHM-D. This methodology ensured that the
 25 information contained in the overall CVHM was transferred to the refined scale CVHM-D. In addition,
 26 some streams flow from the original CVHM domain into the CVHM-D domain. The CVHM flows were
 27 used as boundary inflows into the CVHM-D domain. Figure 7-5 shows the CVHM-D domain.

28 The resolution of the CVHM-D grid was increased to improve the depiction of the physical
 29 configuration of the surface water features that exist within the Delta Region and to improve the
 30 precision of estimates of impacts on groundwater resources from project construction and
 31 operation. Further, CVHM includes explicit representation of only the primary rivers that enter the
 32 Delta Region and represents the remainder of the Delta as a large groundwater discharge area,
 33 which is simulated using a GHB boundary condition. To more accurately evaluate the effects of the
 34 alternatives on stream flows and surface water/groundwater interaction, a more detailed
 35 representation of the stream, slough, and canal networks in the Delta was required. These water
 36 courses were digitized from USGS maps and included in CVHM-D. For additional information, see
 37 Appendix 7A, *Groundwater Model Documentation*.

38 **7.3.1.3 Analysis of Conservation Measures 2–21 in the Delta**

39 Because conservation activities planned within the Delta for CM2–CM21 are conceptual at this point,
 40 this analysis took a programmatic approach to addressing effects on groundwater resources using
 41 similar analytical approaches and tools for the placement of structural facilities. These effects are
 42 included in Section 7.3.3, *Effects and Mitigation Approaches*; however, they will also be discussed in

1 greater detail and specificity in subsequent project-level environmental documentation after the
 2 specific locations of CM2–CM21 are determined. Therefore, impacts related to the implementation of
 3 the restoration areas in the Delta Region are described in qualitative terms.

4 **7.3.2 Determination of Effects**

5 Potential impacts associated with groundwater resources were evaluated based on the four criteria
 6 listed below. Each of these criteria was in turn used to capture potential effects during construction,
 7 operation, and maintenance of the water conveyance facilities (CM1), and implementation of the
 8 CM2–CM21, as applicable. Effects on groundwater resources were considered adverse under NEPA
 9 and significant under CEQA if implementation of an alternative would result in any of the following
 10 conditions.

- 11 • Deplete groundwater supplies or interfere with groundwater recharge such that there would be
 12 a net deficit in aquifer volume or a lowering of the local groundwater table level that would
 13 reduce well yields to a level that would not support existing land uses or planned uses for which
 14 permits have been granted (referred to as Impact GW-1 and GW-2 from construction and
 15 operation, respectively, in the Delta Region and as Impact GW-6 from operation in the Export
 16 Service Areas). For the purposes of this analysis, “a lowering of the local groundwater table level
 17 that would reduce well yields to a level that would not support existing or planned land uses” is
 18 defined as circumstances in which temporary construction dewatering activities lowers local
 19 groundwater levels in shallow wells and reduces the well yield significantly such that existing
 20 land uses cannot be sustained. During operations of conveyance, this impact is defined as
 21 circumstances in which local groundwater levels are lowered in nearby wells such that existing
 22 and planned land uses cannot be sustained. In this case, shallow domestic wells might be
 23 affected, while deep agricultural or municipal wells might not be affected. The distinction in well
 24 depth is provided in the impacts analysis. The pumping of a well depresses the water table in the
 25 immediate vicinity, which in turn decreases the saturated thickness available to near-by wells.
 26 This reduction in saturated thickness results in a diminished well yield from those affected
 27 wells.
- 28 • Degrade groundwater quality (referred to as Impact GW-3 and GW-7 in the Delta Region and
 29 Export Service Areas, respectively, during both construction and operation). For the purposes of
 30 this analysis, “degrade groundwater quality” is defined as circumstances in which changes in
 31 groundwater flow directions would result in poor groundwater quality migration into areas of
 32 better quality groundwater.
- 33 • Interfere with agricultural drainage in the Delta Region due to the construction and operation of
 34 conveyance facilities and restoration areas (referred to as Impact GW-4 and GW-5 from
 35 construction and operation, respectively, in the Delta Region). For the purposes of this analysis,
 36 “interfere with agricultural drainage” is defined as circumstances in which 1) shallow
 37 groundwater levels rise near the land surface (or plant root zone) and interfere with existing
 38 drainage systems or require the installation of such systems to allow for optimal crop growth, or
 39 2) shallow groundwater flow directions are altered such that existing drainage systems would
 40 no longer be functional.
- 41 • Result in groundwater level-induced land subsidence in the Export Service Areas (referred to as
 42 Impact GW-8 from operation in the Export Service Areas). For purposes of this analysis,
 43 “groundwater level-induced land subsidence” is defined as circumstances in which confined

1 groundwater levels decrease such that unconsolidated materials undergo compaction resulting
2 in inelastic subsidence of the land surface.

3 As discussed in greater detail in Chapter 5, *Water Supply*, Section 5.3.2, the NEPA No Action
4 Alternative, which reflects an anticipated future condition in 2060, includes both sea level rise and
5 climate change (changed precipitation patterns), and also assumes, among many other programs,
6 projects, and policies, implementation of most of the required actions under both the December
7 2008 USFWS BiOp and the June 2009 NFMS BiOp. The NEPA effects analyses in this chapter reflect
8 these No Action assumptions.

9 **7.3.3 Effects and Mitigation Approaches**

10 The assessment of effects resulting from implementation of the action alternatives is complicated by
11 the fact that locations and construction details for existing production wells in the vicinity of the
12 project are unknown at this time. Most wells in the project area are private domestic or agricultural
13 wells and their locations and production rates are not publicly available. Therefore the model
14 predictions of changes in groundwater levels or flow directions cannot be correlated to a particular
15 well that may potentially be affected. The approach used herein is to make general inferences
16 regarding well construction and land use, and then evaluate whether the forecasted impacts have
17 the potential to significantly affect existing wells. For instance, if forecasted impacts indicate a
18 reduction in saturated thickness would occur, and well yields are inferred to be reduced enough to
19 no longer sustain current and planned land uses for which permits have been granted, then that
20 particular alternative was deemed to have the potential to result in significant impacts.

21 The distribution of groundwater quality across the project areas is not available in the Delta as
22 water quality monitoring of wells in the Delta is not routinely performed. In the Export Service
23 Areas, available information on groundwater quality issues is described Section 7.1, *Environmental*
24 *Setting/Affected Environment*. The approach used herein to identify areas of potential groundwater
25 quality degradation is to infer how groundwater flow directions would change upon project
26 implementation. This was done by comparing simulated groundwater flow patterns before and after
27 project implementation.

28 If no significant regional changes in groundwater flow directions are forecasted, then it is inferred
29 that the potential for inducement of poor quality groundwater into areas of better quality is unlikely.
30 This approach may not account for the groundwater degradation that could result from the
31 presence of existing localized areas of poor quality groundwater (such as that resulting from a leaky
32 fuel tank or other point release).

33 As described in Section 7.3.1, *Methods for Analysis*, CVHM simulations output describes monthly
34 results over a total of 510 simulation intervals, referred to as stress periods (the entire simulation
35 runs for 42.5 years between April 1961 and September 2003), that are each compared to baseline
36 conditions. The resulting water level changes for all 510 monthly stress periods were plotted on a
37 map and for each alternative, a typical groundwater level change in the Service Areas was chosen.
38 The maximum groundwater level changes are typically reached in August, when the irrigation
39 season is at its peak. Therefore, this was the month of choice for the evaluation of impacts in the
40 Service Areas. Maps comparing the groundwater conditions under each alternative to the baseline
41 condition are provided for each alternative and groundwater level changes are discussed.

1 7.3.3.1 No Action Alternative Late Long-Term

2 The No Action Alternative includes continued implementation of SWP/CVP operations,
 3 maintenance, enforcement, and protection programs by federal, state, and local agencies, as well as
 4 projects that are permitted or under construction. A complete list and description of programs and
 5 plans considered under the No Action Alternative is provided in Appendix 3D, *Defining Existing*
 6 *Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact Conditions*.
 7 Operations of the SWP and CVP facilities would change under the No Action Alternative due to
 8 increased water rights demands and implementation of a provision in U.S. Fish and Wildlife Service
 9 2008 BiOp (see Chapter 5, *Water Supply* and Chapter 6, *Surface Water*, for more details).

10 For discussion purposes, groundwater conditions analyzed under the No Action Alternative and
 11 compared to Existing Conditions are described on a subarea basis summarized below.

- 12 ● Delta Region
 - 13 ○ **North Delta.** This subregion comprises CVHM-D WBS 22, shown in Figure 7-5.
 - 14 ○ **Central Delta.** This subregion comprises CVHM-D WBSs 23–33, 40–42, and 44, shown in
 15 Figure 7-5.
 - 16 ○ **South Delta.** This subregion comprises CVHM-D WBSs 34–39 and 43, shown in Figure 7-5.
- 17 ● Export Service Areas
 - 18 ○ **San Joaquin Basin.** This subregion includes CVHM WBSs 10, 11, 12, and 13, shown in
 19 Figure 7-4.
 - 20 ○ **Tulare Basin.** This subregion includes CVHM WBSs 14–21, shown in Figure 7-4.
 - 21 ○ **Other Portions of the Export Service Areas.** The San Francisco Bay Area, Central Coast,
 22 and Southern California were analyzed qualitatively.

23 Delta Region

24 The following is a brief discussion on how groundwater levels are expected to vary under the No
 25 Action Alternative. Water level descriptions are based on CVHM-D simulation results. Groundwater
 26 resources are not anticipated to be substantially affected in the Delta Region under the No Action
 27 Alternative because surface water inflows to this area are sufficient to satisfy most of the
 28 agricultural, industrial, and municipal water supply needs. Groundwater use in the Delta Region is
 29 limited primarily because of high salinity, particularly for municipal and industrial uses. In the North
 30 Delta, groundwater is assumed to be used only as a supplemental source of supply for agriculture.

31 North Delta

32 Forecasted groundwater flow in the north Delta under Existing Conditions is generally to the south
 33 and toward the Sacramento River and Deep Water Ship Channel, which are oriented in a north-south
 34 direction. The average of the monthly forecasted groundwater levels for irrigated areas within the
 35 north Delta typically range from -10 to -5 feet above the National Geodetic Vertical Datum of 1929
 36 (NGVD29) over the 42-year simulation period. No long-term increasing or decreasing groundwater-
 37 level trends are forecasted in the North Delta.

1 **Central Delta**

2 Forecasted groundwater flow in the central Delta under Existing Conditions is complex because of
 3 the spatially variable water use (e.g., drainage pumping, irrigation, etc.) and island, slough, stream,
 4 canal, and levee configurations therein. However, regionally groundwater is forecasted to flow from
 5 east to west toward the confluence of the Sacramento and San Joaquin Rivers in the western Delta.
 6 The average of the monthly forecasted groundwater levels for irrigated areas within the central
 7 Delta typically range from -20 feet to -1 foot NGVD29 over the 42-year simulation period. No long-
 8 term increasing or decreasing groundwater-level trends are forecasted in the Central Delta.

9 **South Delta**

10 Forecasted groundwater flow in the south Delta under Existing Conditions is complex because of the
 11 spatially variable water use (e.g., drainage pumping, irrigation, etc.) and island, slough, stream,
 12 canal, and levee configurations therein. However, regionally forecasted groundwater flow in the
 13 south Delta is generally north-northwest toward the confluence of the Sacramento and San Joaquin
 14 Rivers in the western Delta. The average of the monthly forecasted groundwater levels for irrigated
 15 areas within the South Delta typically range from -18 to -3 feet NGVD29 over the 42-year simulation
 16 period, except in WBS 38 and WBS 39 in the south and southeast portions of the South Delta. The
 17 average of the monthly forecasted groundwater levels for irrigated areas within WBS 38 and WBS
 18 39 typically range from 1 to 25 feet NGVD29 over the 42-year simulation period. No long-term
 19 increasing or decreasing groundwater-level trends are forecasted in the South Delta.

20 Groundwater conditions under the No Action Alternative (with future projected sea level rise and
 21 climate change at approximately year 2060) compared to Existing Conditions are provided in the
 22 descriptions that follow. The comparison is made through a review of simulated groundwater
 23 resources conditions in the Delta.

24 **Changes in Delta Groundwater Levels**

25 Groundwater levels in the Delta for the No Action Alternative would be strongly influenced by
 26 surface water flows in the Sacramento River that fluctuate due to sea level rise, climate change and
 27 due to surface water operations.

28 Compared with Existing Conditions, forecasted groundwater levels would increase by up to 5 feet in
 29 the Suisun Marsh area in the No Action Alternative; the increase is due to sea level rise in San
 30 Francisco Bay. This incremental increase in groundwater level in the No Action Alternative is not
 31 expected to cause significant effects on nearby well yields and might result in an increase in shallow
 32 well yields. In other areas of the Delta, groundwater levels would be similar under Existing
 33 Conditions as compared to the No Action Alternative.

34 **Changes in Delta Groundwater Quality**

35 As described above, groundwater levels would be similar under Existing Conditions and the No
 36 Action Alternative except for a localized area around Suisun Marsh. Therefore, changes in
 37 groundwater conditions under the No Action Alternative are not anticipated to alter regional
 38 patterns of groundwater flow or quality, compared with Existing Conditions. Minor groundwater
 39 quality effects due to seawater intrusion might occur; however, no groundwater salinity simulations
 40 are available to verify this hypothesis.

1 **Changes in Delta Agricultural Drainage**

2 Due to fluctuations in groundwater levels that occur with sea level rise and climate change, some
3 areas of the Delta might experience rises in groundwater levels in the vicinity of rivers and in the
4 Suisun Marsh area under the No Action Alternative compared to Existing Conditions. This could
5 affect agricultural drainage. However, changes are anticipated to be minor and these areas would be
6 surrounded by larger regional flow patterns that would remain largely unchanged under the No
7 Action Alternative.

8 **CEQA Conclusion:** Groundwater resources are not anticipated to be substantially affected in the
9 Delta Region under the No Action Alternative because surface water inflows to this area are
10 sufficient to satisfy most of the agricultural, industrial, and municipal water supply needs. Therefore,
11 the No Action Alternative would have less-than-significant impacts on Delta groundwater levels,
12 groundwater quality, and agricultural drainage because changes in groundwater flows and
13 groundwater use are not anticipated to occur due to the abundant surface water in the Delta.

14 **SWP/CVP Export Service Areas**

15 Under the No Action Alternative, surface water supplies to the Export Service Areas would continue
16 to decline based on water modeling and operational assumptions described in Chapter 5, *Water*
17 *Supply*, and Chapter 6, *Surface Water*, which project reductions in SWP/CVP water supply
18 availability, compared to Existing Conditions. In addition, decreases in SWP/CVP surface water
19 deliveries in the Export Service Areas for the No Action Alternative compared to Existing Conditions
20 also occur due to sea level rise and climate change, as described in Chapter 5, *Water Supply*.

21 Under the No Action Alternative, it is assumed that land use remains constant at Year 2000
22 conditions over the 42-year simulation period; however, numerous political, economic, and
23 environmental factors could result in land use changes. The 2000 land use input files were the latest
24 available from the CVHM (U.S. Geological Survey 2009).

25 Groundwater conditions under the No Action Alternative (with future projected sea level rise and
26 climate change at approximately year 2060) compared to Existing Conditions are provided in the
27 descriptions that follow. The comparison is made through a review of simulated groundwater
28 resources conditions in the San Joaquin and Tulare Basins.

29 **CEQA Conclusion:**

30 **San Joaquin Basin**

31 Forecasted groundwater flow in the San Joaquin Basin under the No Action Alternative is generally
32 toward the San Joaquin River from the margins of the basin and to the northwest toward the Delta.
33 As compared to Existing Conditions, groundwater levels would decline by up to 25 feet beneath the
34 Corcoran Clay in portions of the San Joaquin Basin (see Figure 7-6) under the No Action Alternative.
35 This reduction in groundwater levels could substantially affect groundwater resources in the San
36 Joaquin Basin by reducing well yields of nearby agricultural and municipal wells. Therefore, the No
37 Action Alternative would result in a significant impact on groundwater resources.

38 **Tulare Basin**

39 Forecasted groundwater flow in the Tulare Basin under the No Action Alternative is complex
40 because of the spatially variable water use over such a large area. Forecasted groundwater flow in

1 the Tulare Basin is generally away from the margins of the basin toward areas of substantial
2 groundwater production. As compared to Existing Conditions, groundwater levels would decline as
3 much as 250 feet beneath the Corcoran Clay in dry years in portions of the Tulare Basin irrigated
4 areas, notably the Westside and Northern Pleasant Valley basins (WBS 14) in the western portion
5 (see Figure 7-6) under the No Action Alternative. The forecasted maximum groundwater level
6 changes occur in August because agricultural groundwater pumping is typically highest during this
7 month.

8 The anticipated reduction in groundwater levels could substantially affect groundwater resources in
9 the Tulare Basin in terms of affecting well yields of nearby agricultural and municipal wells,
10 groundwater supplies, and groundwater recharge and therefore, the No Action Alternative would
11 result in a significant impact on groundwater resources.

12 The increase in groundwater pumping that could occur under the No Action Alternative compared
13 to Existing Conditions in portions of the Export Service Areas in response to reduced SWP/CVP
14 water supply availability could induce the local migration of poor-quality groundwater into areas of
15 good-quality groundwater. However, it is not anticipated to alter regional groundwater flow
16 patterns and would not be considered a significant impact on groundwater quality.

17 Forecasted land subsidence estimates indicate that most of the Export Service Areas under the No
18 Action Alternative compared to Existing Conditions would see land subsidence of no more than a
19 hundredth of an inch on average. Therefore, the potential for substantial land subsidence from
20 groundwater pumping from implementation of the No Action Alternative is low, and would not be
21 considered an a significant impact.

22 **Other Portions of the Export Service Areas**

23 The total long-term average annual water deliveries to the Export Service Areas in portions outside
24 of the Central Valley under the No Action Alternative would be less than under Existing Conditions.
25 If less surface water is available for municipal, industrial, and agricultural users, utilization of
26 groundwater resources would be increased (see Chapter 5, *Water Supply*). Therefore, significant
27 impacts on groundwater supplies, groundwater recharge, and local groundwater table levels are
28 expected to result under the No Action Alternative in these Export Service Areas. This would also
29 reduce the amount of groundwater resources availability.

30 However, in the Central Coast and Southern California, overdrafted basins have, for the most part,
31 been adjudicated to control the amount of pumping, thus reducing the amount of groundwater
32 resource availability. In addition, many groundwater basins in the San Francisco Bay Area, Central
33 Coast, and Southern California rely on SWP/CVP surface water to recharge groundwater basins.

34 **Ongoing Plans, Policies, and Programs**

35 The programs, plans, and projects included under the No Action Alternative are summarized in
36 Table 7-6, along with their anticipated effects on groundwater resources. In summary, these projects
37 are not anticipated to have any adverse effects on groundwater resources.

38 **CEQA Conclusion:** Due to the decrease in availability of SWP and CVP deliveries to the Export
39 Service Areas under the No Action Alternative as compared to existing conditions, groundwater
40 pumping would increase in some areas. This would result in a corresponding decrease in
41 groundwater levels which could significantly affect the yield of domestic, municipal and agricultural
42 wells. Migration of poor quality groundwater into areas of better quality groundwater might also

1 occur. Impacts on groundwater levels and groundwater quality in the Export Service Areas are
2 considered significant under the No Action Alternative.

3 In total, the ongoing programs and plans under the No Action Alternative would not result in
4 significant impacts on groundwater resources based upon information presented in related
5 environmental documentation.

6 **Table 7-6. Effects on Groundwater Resources from the Plans, Policies, and Programs for the No Action**
7 **Alternative as Compared to Existing Conditions**

Agency	Program/Project	Status	Description of Program/Project	Effects on Groundwater Resources
California Department of Water Resources	Mayberry Farms Subsidence Reversal and Carbon Sequestration Project	Completed October 2010.	Permanently flood 308-acre parcel of DWR-owned land (Hunting Club leased) and restore 274 acres of palustrine emergent wetlands within Sherman Island to create permanent wetlands and to monitor waterfowl, water quality, and greenhouse gases.	No adverse effects on groundwater resources are anticipated (Bureau of Reclamation District 341 2009).
Contra Costa Water District	Contra Costa Canal Fish Screen Project (Rock Slough)	Under construction as of July 2011.	Installation of a fish screen at Rock Slough Intake.	No adverse effects on groundwater resources are anticipated due to implementation of mitigation measures.
Contra Costa Water District, Bureau of Reclamation, and California Department of Water Resources	Middle River Intake and Pump Station (previously known as the Alternative Intake Pump Station)	Project completed and formally dedicated July 20, 2010.	This project includes a potable water intake and pump station to improve drinking water quality for Contra Costa Water District customers.	No adverse effects on groundwater resources are anticipated (Contra Costa Water District 2006).
California Department of Water Resources	Federal Energy Regulatory Commission License Renewal for Oroville Project	Draft Water Quality Certification issued December 6, 2010 and comments on Draft received December 10, 2010.	The renewed federal license will allow the Oroville Facilities to continue providing hydroelectric power and regulatory compliance with water supply and flood control.	No adverse effects on groundwater resources are anticipated (California Department of Water Resources 2008).
Freeport Regional Water Authority and Bureau of Reclamation	Freeport Regional Water Project	Project was completed late 2010.	Project includes an intake/pumping plant near Freeport on the Sacramento River and a conveyance structure to transport water through Sacramento County to the Folsom South Canal.	No adverse effects on groundwater resources are anticipated (Freeport Regional Water Authority 2003).
California Department of Water Resources and Solano County Water Agency	North Bay Aqueduct Alternative Intake Project		This project will construct an alternative intake on the Sacramento River and a new segment of pipeline to connect it to the North Bay Aqueduct system.	No adverse effects on groundwater are anticipated.

Agency	Program/Project	Status	Description of Program/Project	Effects on Groundwater Resources
Reclamation District 2093	Liberty Island Conservation Bank		This project includes the restoration of inaccessible, flood-prone land, zoned as agriculture but not actively farmed, to area enhancement of wildlife resources.	No adverse effects on groundwater resources are anticipated (Bureau of Reclamation District 2093 2009).
City of Stockton	Delta Water Supply Project (Phase 1)	The project is currently under construction.	This project consists of a new intake structure and pumping station adjacent to the San Joaquin River; a water treatment plant along Lower Sacramento Road; and water pipelines along Eight Mile, Davis, and Lower Sacramento Roads.	No adverse effects on groundwater are anticipated due to implementation of mitigation measures (City of Stockton 2005).
Bureau of Reclamation and State Water Resources Control Board	Battle Creek Salmon and Steelhead Restoration Project	Project is ongoing.	This project includes restoration of approximately 48 miles of habitat in Battle Creek and its tributaries to improve passage, growth, and recovery for anadromous fish populations.	No adverse effects on groundwater resources are anticipated (Bureau of Reclamation 2005).
Tehama Colusa Canal Authority and Bureau of Reclamation	Red Bluff Diversion Dam Fish Passage Project	Completed	Proposed improvements include modifications made to upstream and downstream anadromous fish passage and water delivery to agricultural lands within CVP.	No adverse effects on groundwater are anticipated (Bureau of Reclamation 2002).
Bureau of Reclamation, California Department of Fish and Wildlife, and Natomas Central Mutual Water Company	American Basin Fish Screen and Habitat Improvement Project		This three-phase project includes consolidation of diversion facilities; removal of decommissioned facilities; aquatic and riparian habitat restoration; and installation of fish screens in the Sacramento River. Total project footprint encompasses approximately 124 acres east of the Yolo Bypass.	No adverse effects on groundwater resources are anticipated (Bureau of Reclamation 2008a).
Bureau of Reclamation, U.S. Army Corps of Engineers, Sacramento Area Flood Control Agency, and Central Valley Flood Protection Board	Folsom Dam Safety and Flood Damage Reduction Project	Anticipated completion by 2016.	This project includes implementation of an auxiliary spillway, dam safety modifications, security and reduction improvements, and flood damage prevention.	No adverse effects on groundwater resources are anticipated due to implementation of mitigation measures (Bureau of Reclamation 2008b).
Bureau of Reclamation	Delta-Mendota Canal/California Aqueduct Intertie	Completed in 2012.	The purpose of the intertie is to better coordinate water delivery operations between the California Aqueduct (state) and the Delta-Mendota Canal (federal) and to provide better pumping capacity for the Jones Pumping Plant. New project facilities include a pipeline and pumping plant.	No adverse effects on groundwater are anticipated (Bureau of Reclamation 2009).

Agency	Program/Project	Status	Description of Program/Project	Effects on Groundwater Resources
Yolo County	General Plan Update	General plan was adopted November 10, 2009.	Anticipated implementation of policies and programs such as the Farmland Conversion Mitigation Program would minimize conversion of agricultural land to nonagricultural uses through mitigation.	No adverse effects on groundwater resources are anticipated due to implementation of mitigation measures (Yolo County 2009).
Zone 7 Water Agency and California Department of Water Resources	South Bay Aqueduct Improvement and Enlargement Project	Project is ongoing.	The project includes construction of a new reservoir and pipelines and canals to increase the capacity of the South Bay Aqueduct.	No adverse effects on groundwater resources are anticipated due to implementation of mitigation measures (California Department of Water Resources 2004e).
Bureau of Reclamation, San Luis & Delta Mendota Water Authority	Grassland Bypass Project, 2010–2019, and Agricultural Drainage Selenium Management Program	Program under development. Final EIS/EIR in 2009	Reduce effects from agricultural drainage on wildlife refuges and wetlands. Will convey subsurface agricultural drainage to Mud Slough (tributary of San Joaquin River) (Bureau of Reclamation and San Luis & Delta-Mendota Water Authority 2008)	Beneficial, neutral, or less-than-significant effects on subsurface agricultural drainage and shallow groundwater levels; beneficial effects on groundwater salinity

1

2 **7.3.3.2 Alternative 1A—Dual Conveyance with Pipeline/Tunnel and** 3 **Intakes 1–5 (15,000 cfs; Operational Scenario A)**

4 Alternative 1A would result in temporary effects on lands and communities associated with
5 construction of five intakes and intake pumping plants, and other associated facilities; two forebays;
6 conveyance pipelines; and tunnels. Nearby areas would be altered as work or staging areas, concrete
7 batch plants, fuel stations, or be used for spoils storage areas. Sites used temporarily for borrow and
8 then for spoils would also be anticipated to have a temporary effect on lands and communities.
9 Transmission lines, access roads, and other incidental facilities would also be needed for operation
10 of the project and construction of these structures would have temporary effects on lands and
11 communities.

12 The following impact analysis is divided into two subsections: 1) effects of construction and
13 operation of facilities under CM1 and other conservation measures in the Delta Region, and 2)
14 effects of operations of facilities under CM1 in the Export Service Areas.

15 **Delta Region**

16 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with** 17 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity** 18 **of Preexisting Nearby Wells**

19 Construction of the conveyance facilities would require dewatering operations. The dewatering
20 wells would be generally 75–300 feet deep, placed every 50–75 feet apart along the construction
21 perimeter as needed, and each would pump 30–100 gpm. Dewatering for the tunnel shaft

1 constitutes the deeper dewatering (300 feet deep) while the shallow (75 feet deep) dewatering is
2 reserved for open trench construction; no dewatering is required along the tunnel alignment; and
3 the 50–75 feet dewatering wells frequency distance applies to the pipelines, intakes, widened levees,
4 the perimeter of the forebay embankments, the perimeter of excavation for the pumping plants, and
5 the perimeter of tunnel shafts.

6 Tunnel shaft construction is assumed to use slurry diaphragm walls, and, therefore, require only
7 minimal dewatering. Construction of the tunnel shafts is not anticipated to result in significant
8 impacts on surrounding groundwater because the dewatered zone would be hydraulically isolated
9 from the surrounding aquifer system.

10 Dewatering would occur 24 hours per day and 7 days per week and would be initiated 1 to 4 weeks
11 prior to excavation. Dewatering would continue until excavation is completed and the construction
12 site is protected from higher groundwater levels. Dewatering requirements of the intake
13 construction and construction of other major features along this alignment are estimated to range
14 from approximately 34 to 1,360 gpm. (California Department of Water Resources 2010b).

15 Groundwater removed with the dewatering system would be treated as necessary and discharged to
16 surface waters under an NPDES permit. Velocity dissipation features, such as rock or grouted riprap,
17 would be used to reduce velocity and energy and prevent scour. Dewatering facilities would be
18 removed following construction activities.

19 **NEPA Effects:** Dewatering would temporarily lower groundwater levels in the vicinity of the
20 dewatering sites. Two areas could be subject to substantial lowering of groundwater levels: 1) in the
21 vicinity of the intake pump stations along the Sacramento River; and 2) in the vicinity of the Byron
22 Tract Forebay. Groundwater-level lowering from construction dewatering activities is forecasted to
23 be less than 10 feet in the vicinity of the intakes and less than 20 feet in the vicinity of the forebay.
24 The horizontal distance from the boundary of the excavation to locations where forecasted
25 groundwater levels are 5 feet below the static groundwater level is defined as the “radius of
26 influence”. The radius of influence is forecasted to extend approximately 2,600 feet from the Byron
27 Tract Forebay excavation and from the intake excavations (Figure 7-7). Groundwater would return
28 to pre-pumping levels over the course of several months. Simulation results suggest that 2 months
29 after pumping ceases, water levels would recover to within 5 feet of pre-pumping water levels. The
30 sustainable yield of some wells might temporarily be affected by the lowering of water levels such
31 that they are not able to support existing land uses. The construction of conveyance features could
32 result in an adverse effect on groundwater levels and associated well yields that would be
33 temporary. It should be noted that the forecasted effects described above reflect a worst-case
34 scenario as the option of installing seepage cutoff walls during dewatering was not considered in the
35 analysis.

36 **CEQA Conclusion:** Construction activities associated with conveyance facilities under CM1, including
37 temporary dewatering and associated reduced groundwater levels, have the potential to
38 temporarily affect the productivity of existing nearby water supply wells. Groundwater levels within
39 2,600 feet of the areas to be dewatered are anticipated to experience groundwater level reductions
40 of up to 20 feet for the duration of the dewatering activities and up to 2 months after dewatering
41 activities are completed. Nearby domestic and municipal wells could experience significant
42 reductions in well yield, if they are shallow wells, and may not be able to support existing land uses.
43 The temporary localized impact on groundwater levels and associated well yields is considered
44 significant because construction-related dewatering might affect the amount of water supplied by

1 shallow wells located near the CM1 construction sites. Mitigation Measure GW-1 identifies a
 2 monitoring procedure and options for maintaining an adequate water supply for landowners that
 3 experience a reduction in groundwater production from wells within 2,600 feet of construction-
 4 related dewatering activities. It should be noted that the forecasted impacts described above reflect
 5 a worst-case scenario as the option of installing seepage cutoff walls during dewatering was not
 6 considered in the analysis. Implementing Mitigation Measure GW-1 would help address these
 7 effects; however, the impact may remain significant because replacement water supplies may not
 8 meet the preexisting demands or planned land use demands of the affected party. In some cases this
 9 impact might temporarily be significant and unavoidable until groundwater elevations recover to
 10 preconstruction conditions, which could require several months after dewatering operations cease.

11 **Mitigation Measure GW-1: Maintain Water Supplies in Areas Affected by Construction** 12 **Dewatering**

13 Prior to construction, project proponents will determine the location of wells within the
 14 anticipated area of influence of construction sites at which dewatering would occur. Based on
 15 available information, thorough site investigations, and desk studies; the location of wells,
 16 depths of the wells and the depth to groundwater within these wells will be determined. During
 17 construction dewatering, monitoring wells should be installed sufficiently close to the
 18 groundwater dewatering sites, or if possible, water levels in existing wells will be monitored, in
 19 order to be able to detect changes in water levels attributable to dewatering activities. If
 20 monitoring data or other substantial evidence indicates that groundwater levels have declined
 21 in a manner that could adversely affect adjacent wells, temporarily rendering the wells unable to
 22 provide adequate supply to meet preexisting demands or planned land use demands, the project
 23 proponents will implement one or more of the following measures.

- 24 • Offset domestic water supply losses attributable to construction dewatering activities. The
 25 project proponents will ensure domestic water supplies provided by wells are maintained
 26 during construction. Potential actions to offset these losses include installing cutoff walls in
 27 the form of sheet piles or slurry walls to depths below groundwater elevations, deepening
 28 or modifying wells used for domestic purposes to maintain water supplies at
 29 preconstruction levels, or securing potable water supplies from offsite sources. Offsite
 30 sources could include potable water transported from a permitted source or providing a
 31 temporary connection to nearby wells not adversely affected by dewatering.
- 32 • Offset agricultural water supply losses attributable to construction dewatering activities.
 33 The project proponents will ensure agricultural water supplies are maintained during
 34 construction or provide compensation to offset for crop production losses. If feasible, the
 35 project proponents will install sheet piles to depths below groundwater elevations, or
 36 deepen or modify the wells to ensure agricultural production supported by water supplied
 37 by these wells is maintained. If deepening or modifying existing wells is not feasible, the
 38 project proponents will secure a temporary alternative water supply or compensate farmers
 39 for production losses attributable to a reduction in available groundwater supplies.

40 Implementation of Mitigation Measure GW-1 will follow the steps below.

- 41 • Project proponents will be responsible for determining the area of influence of dewatering
 42 operations and the location of potentially affected existing wells, in addition to the
 43 installation of potential new monitoring wells and the monitoring of existing wells.

- 1 • Prior to commencement of construction activities the project proponents will determine the
2 locations of existing wells which will require monitoring. In addition, shallow monitoring
3 wells may be installed prior to construction dewatering operations. Monitoring of water
4 levels in these wells will occur during construction. Implementation of measures necessary
5 to offset domestic and agricultural water supply losses will occur during construction as
6 necessary.
- 7 • Monitoring wells will be installed; or, if feasible, water levels in existing wells will be
8 monitored, in order to detect changes in water levels attributable to dewatering activities.
9 Water levels in the installed monitoring wells and existing wells will be measured by the
10 project proponents and/or construction contractors prior to construction dewatering and
11 on a weekly or daily basis, as needed, during the entire construction dewatering period.
12 Upon completion of construction, the water levels in the monitoring wells will be measured
13 and monitoring will continue for up to 6 months following termination of construction
14 dewatering activities or less if groundwater levels reach preconstruction levels.
- 15 • All monitoring data will be reported on a monthly basis, and in an annual summary report
16 prepared by the project proponents that will evaluate the impacts of the construction
17 dewatering for that year. The monthly reports will contain tabular water level data as well
18 as changes in water levels from the previous months. The annual report will summarize
19 monthly data and show the most recent water level contour map as well as the
20 preconstruction contour map. The final report will include water level contour maps for the
21 area of the groundwater aquifer that is affected by dewatering showing initial,
22 preconstruction water levels and final, postconstruction water levels.
- 23 • If water level data indicate that dewatering operations are responsible for reductions in well
24 productivity such that water supplies are inadequate to meet existing or planned land use
25 demands, mitigation will be required and implemented.
- 26 • If monitoring data or other substantial evidence indicates that groundwater levels have
27 declined in a manner that could adversely affect adjacent wells, temporarily rendering the
28 wells unable to provide adequate supply to meet preexisting demands or planned land use
29 demands, the project proponents will contact the affected landowners in a timely manner
30 and implement one or more of the measures described above.

31 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with**
32 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
33 **of Preexisting Nearby Wells**

34 *NEPA Effects:* The operation of Alternative 1A conveyance features is anticipated to affect
35 groundwater levels in the vicinity of the two new forebays: the Intermediate Forebay and the Byron
36 Tract Forebay adjacent to the east side of Clifton Court. In the absence of design features intended to
37 minimize seepage, groundwater levels are projected to rise by up to 10 feet in the vicinity of the
38 Intermediate and Byron Tract Forebays due to groundwater recharge from these surface water
39 impoundments (Figure 7-8). Were they to occur, these groundwater-level increases could
40 potentially result in groundwater levels encroaching on the ground surface in the vicinity of the new
41 forebays, and potentially result in effects on agricultural operations in the vicinity. Effects, design
42 measures, and mitigation measures related to seepage are addressed in the discussions of Impacts
43 GW-4 and GW-5 and related mitigation measures.

1 Groundwater level rises of 10 feet or more could occur in the vicinity of the Intermediate and Byron
 2 Tract Forebays, which would not reduce yields of nearby wells. Operation of the tunnel would have
 3 no effect on existing wells or yields given these facilities would be located more than 100 feet
 4 underground and would not substantially alter groundwater levels in the vicinity. There would be
 5 no adverse effect under Alternative 1A.

6 Model simulations also indicate up to 5-foot episodic lowering of groundwater levels beneath the
 7 Sacramento River due to lower flows in the river as a result of diversions at the north Delta intakes
 8 that result in a reduction in river flows and elevations, as described in Chapter 6, *Surface Water*. The
 9 groundwater level changes would be 5-feet or less on nearby shallow domestic well yields. Due to
 10 the implementation of Mitigation Measure GW-1, no additional mitigation measures are required.

11 **CEQA Conclusion:** Groundwater level rises of 10 feet or more could occur in the vicinity of the
 12 Intermediate and Byron Tract forebays, which would not reduce yields of nearby wells. Operation of
 13 the tunnel would have no impact on existing wells or yields given these facilities would be located
 14 over 100 feet underground and would not substantially alter groundwater levels in the vicinity.
 15 Groundwater levels in the Suisun Marsh area under Alternative 1A are forecasted to rise by 1 to 5
 16 feet compared with Existing Conditions (Figure 7-9). This groundwater level rise is primarily
 17 attributable to sea level rise and climate change conditions in the Alternative 1A CVHM-D
 18 simulation. However, the anticipated effects of climate change and sea level rise are provided for
 19 information purposes only and do not lead to mitigation measures. Therefore, this impact would be
 20 less than significant. No mitigation is required.

21 Model simulations indicate up to 5-foot episodic lowering of groundwater levels beneath the
 22 Sacramento River on either side of the river due to lower flows in the river as a result of diversions
 23 at the north Delta intakes that result in a reduction in river flows and elevations. Shallow wells in the
 24 vicinity of this corridor might see an episodic decrease in yields which might affect the existing or
 25 planned land-uses for which permits have been granted in this area. Due to the implementation of
 26 Mitigation Measure GW-1, no additional mitigation measures are required.

27 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of** 28 **Conveyance Facilities**

29 **NEPA Effects:** Dewatering would temporarily lower groundwater levels and cause small changes in
 30 groundwater flow patterns near the intake pump stations along the Sacramento River, Intermediate
 31 Forebay, and Byron Tract Forebay. Groundwater would return to levels within 5 feet of the static
 32 condition about 2 months after dewatering activities cease. Since no significant regional changes in
 33 groundwater flow directions are forecasted, and the inducement of poor-quality groundwater into
 34 areas of better quality is unlikely, it is anticipated that there would be no change in groundwater
 35 quality for Alternative 1A (see the introduction to Section 7.3.3, *Effects and Mitigation Approaches*).

36 Groundwater removed with the dewatering system would be treated as necessary and discharged to
 37 surface waters under an NPDES permit (see Chapter 8, *Water Quality*). Construction best
 38 management practices would also be implemented to minimize dewatering impacts to the extent
 39 practicable, as described in Appendix 3B, *Environmental Commitments, AMMs, and CMs*. There would
 40 be no adverse effect.

41 **CEQA Conclusion:** No significant groundwater quality impacts are anticipated during construction
 42 activities. Because of the temporary and localized nature of construction dewatering, the potential
 43 for the inducement of the migration of poor-quality groundwater into areas of higher quality

1 groundwater would be low. Further, the planned treatment of extracted groundwater prior to
2 discharge into adjacent surface waters would prevent significant impacts on groundwater quality.

3 No significant groundwater quality impacts are anticipated in most areas of the Delta during the
4 implementation of Alternative 1A, because changes to regional patterns of groundwater flow are not
5 anticipated. However, degradation of groundwater quality near the Suisun Marsh area are likely,
6 due to the effects of saline water intrusion caused by rising sea levels (see discussion under Impact
7 GW-2). Effects due to climate change are provided for informational purposes only and do not lead
8 to mitigation. This impact would be less than significant. No mitigation is required.

9 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural** 10 **Drainage in the Delta**

11 **NEPA Effects:** In the absence of seepage cutoff walls intended to minimize local changes to
12 groundwater flow, the lowering of groundwater levels due to construction dewatering would
13 temporarily affect localized shallow groundwater flow patterns during and immediately after the
14 construction dewatering period. In particular, nearby shallow groundwater would temporarily flow
15 toward the construction dewatering sites. The radius of influence, as described above, provides a
16 sense of the potential areal extent of the temporary change in shallow groundwater flow patterns.
17 For the Byron Tract Forebay site, only a portion of the shallow groundwater flow would be directed
18 inward toward the dewatering operations. Forecasted temporary changes in shallow groundwater
19 flow directions and areas of impacts are minor near the intakes, as discussed in Impact GW-1.
20 Therefore, agricultural drainage during construction of conveyance features is not forecasted to
21 result in adverse effects under Alternative 1A. In some instances, the lowering of groundwater levels
22 in areas that experience near-surface water level conditions (or near-saturated root zones) would
23 be beneficial. There would be no adverse effect.

24 **CEQA Conclusion:** The forecasted changes in shallow groundwater flow patterns due to
25 construction dewatering activities in the Delta are localized and temporary and are not anticipated
26 to cause significant impacts on agricultural drainage. This impact would be less than significant. No
27 mitigation is required.

28 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the** 29 **Delta**

30 **NEPA Effects:** The Intermediate and Byron Tract Forebays would be constructed to comply with the
31 requirements of the Division of Safety of Dams (DSD) which includes design provisions to minimize
32 seepage under the embankments, such as cutoff walls. These design provisions would minimize
33 seepage under the embankments and onto adjacent properties. Once constructed, the operation of
34 the forebays would be monitored to ensure seepage does not exceed performance requirements. In
35 the event seepage were to exceed these performance requirements, the project proponents would
36 modify the embankments or construct seepage collection systems that would ensure any seepage
37 from the forebays would be collected and conveyed back to the forebay or other suitable disposal
38 site.

39 However, operation of Alternative 1A would result in local changes in groundwater flow patterns
40 adjacent to the Intermediate and Byron Tract Forebays, where groundwater recharge from surface
41 water would result in groundwater level increases. If agricultural drainage systems adjacent to these
42 forebays are not adequate to accommodate the additional drainage requirements, operation of the
43 forebays could interfere with agricultural drainage in the Delta.

1 **CEQA Conclusion:** The Intermediate and Byron Tract Forebay embankments would be constructed
2 to DSD standards and the BDCP proponents would monitor the performance of the embankments to
3 ensure seepage does not exceed performance requirements. In the event seepage would exceed DSD
4 requirements, the BDCP proponents would modify the embankments or construct and operate
5 seepage collection systems to ensure the performance of existing agricultural drainage systems
6 would be maintained.

7 However, operation of Alternative 1A would result in local changes in shallow groundwater flow
8 patterns in the vicinity of the Intermediate and Byron Tract forebays caused by recharge from
9 surface water, and could cause significant impacts on agricultural drainage where existing systems
10 are not adequate to accommodate the additional drainage requirements. Implementation of
11 Mitigation Measure GW-5 is anticipated to reduce this impact to a less-than-significant level in most
12 instances, though in some instances mitigation may be infeasible due to factors such as costs that
13 would be imprudent to bear in light of the fair market value of the affected land. The impact is
14 therefore significant and unavoidable as applied to such latter properties.

15 In addition, as described for Impact GW-2, groundwater levels are projected to increase in Suisun
16 Marsh under Alternative 1A compared to Existing Conditions, primarily due to sea level rise and
17 climate change conditions as simulated with the Alternative 1A CVHM-D run. These increases in
18 groundwater levels could affect agricultural drainage in the Suisun Marsh area, but do not in and of
19 themselves require mitigation.

20 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

21 Areas potentially subject to seepage caused by implementation of habitat restoration and
22 enhancement actions or operation of water conveyance facilities shall be monitored and
23 evaluated on a site-specific basis by project proponents prior to the commencement of
24 construction activities to identify baseline groundwater conditions. Restoration sites, along with
25 the sites of water conveyance features that could result in seepage, shall be subsequently
26 monitored once construction is completed. Monitoring shall include placement of piezometers
27 and/or periodic field checks to assess local groundwater levels and salinity and associated
28 impacts on agricultural field conditions. In areas where operation of water conveyance facilities
29 or habitat restoration is determined to result in seepage impacts on adjacent parcels, potentially
30 feasible additional mitigation measures will be developed in consultation with affected
31 landowners. These measures may include installation or improvement of subsurface
32 agricultural drainage or an equivalent drainage measure, as well as pumping to provide for
33 suitable field conditions (groundwater levels near pre-project levels). Such measures shall
34 ensure that the drainage characteristics of affected areas would be maintained to the level
35 existing prior to project construction.

36 The implementation of this mitigation measure will follow the steps below:

- 37 • Project proponents will be responsible for monitoring and evaluation to identify baseline
38 groundwater conditions as well as monitoring after construction is complete.
- 39 • Monitoring will occur at areas adjacent to the expanded Clifton Court Forebay portion at
40 Byron Tract, where groundwater recharge from surface water would result in groundwater
41 level increases, and other areas potentially affected by operation of the water conveyance
42 facilities.

- 1 • Monitoring and evaluation shall occur prior to commencement of construction activities to
2 identify baseline conditions and with sufficient time allotted to develop additional
3 mitigation measures if needed. Monitoring of restoration sites, along with the sites of water
4 conveyance features that could result in seepage will occur after construction is completed.
- 5 • Monitoring shall include placement of piezometers and/or periodic field checks to assess
6 local shallow groundwater levels and salinity and associated impacts on agricultural field
7 conditions.
- 8 • Monitoring will collect information on two thresholds:
- 9 1. Water surface elevation (recorded as depth to water)
- 10 2. Shallow groundwater salinity (measured as specific conductance)
- 11 • Monitoring of groundwater levels will occur on a daily basis to check real-time measured
12 groundwater levels. This can be performed by equipping the piezometers with electronic
13 water level probes which automatically record levels on a daily basis. Periodic field checks,
14 including measurements of specific conductance will occur on a monthly basis and in the
15 event groundwater levels are above identified thresholds.
- 16 • Baseline conditions of shallow groundwater levels and salinity will be determined prior to
17 construction through water level measurements and water testing at the installed
18 piezometers in proximity to restoration areas and conveyance features that might affect
19 drainage on adjacent lands.
- 20 • Salinity will be determined by measuring specific conductance at the piezometers with a
21 calibrated field probe before construction begins, and monthly during operation.
- 22 • Visual observations will also be used to monitor associated impacts on agricultural field
23 conditions. Visual surveys will be conducted during periodic field checks as well as by local
24 landowners on a continual basis.
- 25 • A seepage hotline will be established for landowners to report any visual observations of
26 seepage or deteriorating crop health as a result of an excessive rise in the water table
27 and/or increasing root-zone salinity due to deteriorating shallow groundwater quality.
- 28 • All monitoring data will be reported on a monthly basis, and in an annual summary report
29 prepared by the Project proponents that will evaluate the potential impacts of the operation
30 of CMs for that year. The monthly reports will contain tabular water level and salinity data
31 as well as compute changes in water levels and salinity from the previous months. The
32 annual report will summarize monthly data and evaluate if impacts have occurred.
- 33 • Groundwater levels at the affected areas will be maintained to the level existing prior to
34 project construction.
- 35 • Shallow groundwater salinity will be monitored prior to construction and a threshold will
36 be determined in coordination with the local landowners, based on existing crop salinity
37 tolerance (considerations will include both if shallow groundwater is used for irrigation or if
38 shallow groundwater levels rise and encroach upon the root-zone area).

1 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter**
 2 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or**
 3 **Interfere with Agricultural Drainage as a Result of Implementing CM2–CM21**

4 **NEPA Effects:** Increased frequency of inundation of areas associated with the proposed tidal habitat,
 5 channel margin habitat, and seasonally inundated floodplain restoration actions would result in
 6 increased groundwater recharge. Such increased recharge could result in groundwater level rises in
 7 some areas. Depending on the local geology, flooding of one area could also increase seepage to
 8 adjacent islands. Seasonally inundated floodplain restoration actions proposed in the north, east,
 9 and south Delta areas would be expected to result in a substantially increased rate of recharge and
 10 related groundwater-level increases. The magnitude of these effects depends on existing
 11 groundwater levels and land uses. For example, in the central Delta and portions of the north and
 12 south Delta, areas that are below sea level would experience saturated soils. More frequent
 13 inundation would increase seepage, which is already difficult and expensive to control in most
 14 agricultural lands in the Delta (see Chapter 14, *Agricultural Resources*). Effects on agricultural
 15 drainage and potential effects would need to be addressed on a site-specific basis.

16 **CEQA Conclusion:** Increased frequency of inundation of areas associated with the proposed tidal
 17 habitat, channel margin habitat, and seasonally inundated floodplain restoration actions would
 18 result in increased groundwater recharge. Such increased recharge could result in groundwater
 19 level rises in some areas and would increase seepage, which is already difficult and expensive to
 20 control in most agricultural lands in the Delta (see Chapter 14, *Agricultural Resources*). This impact
 21 would be reduced to a less-than-significant level with the implementation of Mitigation Measure
 22 GW-5 by identifying areas where seepage conditions have worsened and installing additional
 23 subsurface drainage measures, as needed.

24 Implementation of Mitigation Measure GW-5 is anticipated to reduce this impact to a less-than-
 25 significant level in most instances, though in some instances mitigation may be infeasible due to
 26 factors such as costs. The impact is therefore significant and unavoidable as applied to such latter
 27 properties.

28 As described for Impact GW-2, groundwater levels are projected to increase in Suisun Marsh under
 29 Alternative 1A compared to Existing Conditions, primarily due to sea level rise and climate change
 30 conditions as simulated with the Alternative 1A CVHM-D run. These increases in groundwater levels
 31 could affect agricultural drainage in the Suisun Marsh area, but do not in and of themselves require
 32 mitigation.

33 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

34 See Mitigation Measure GW-5 under Impact GW-5.

35 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2–CM21**

36 **NEPA Effects:** Implementation of other conservation measures under Alternative 1A is generally not
 37 anticipated to alter regional patterns of groundwater flow or quality. However, increased inundation
 38 frequency in restoration areas would increase the localized areas exposed to saline and brackish
 39 surface water, which could result in increased groundwater salinity beneath such areas. Potential
 40 effects would need to be addressed on a site-specific basis.

41 The flooding of large areas with saline or brackish water would result in an adverse effect on
 42 groundwater quality beneath or adjacent to flooded areas. It would not be possible to

1 completely avoid this effect. However, if water supply wells in the vicinity of these areas are not
2 useable because of water quality issues, Mitigation Measure GW-7 is available to address this effect.

3 **CEQA Conclusion:** At this point, a definitive conclusion regarding the potential for groundwater
4 quality degradation beneath restoration areas cannot be reached. Potential impacts would need to
5 be addressed on a site-specific basis, but are anticipated to be significant. Implementation of
6 Mitigation Measure GW-7 would reduce this impact, but the impact would remain significant and
7 unavoidable.

8 **Mitigation Measure GW-7: Provide an Alternate Source of Water**

9 For areas that will be on or adjacent to implemented restoration components, groundwater
10 quality will be monitored by project proponents prior to implementation to establish baseline
11 groundwater quality conditions. Unacceptable degradation of groundwater quality will be
12 determined by comparing post-implementation groundwater quality to relevant regulatory
13 standards and with consideration of previously established beneficial uses. For wells affected by
14 degradation in groundwater quality, water of a quality comparable to pre-project conditions
15 would be provided. Options for replacing the water supply could include drilling an additional
16 well or a deeper well to an aquifer zone with water quality comparable to or better than
17 preconstruction conditions or replacement of potable water supply. Construction activities are
18 anticipated to be localized and would not result in change in land uses. The well drilling
19 activities would result in short-term noise impacts for several days. (Chapter 31, *Other*
20 *CEQA/NEPA Required Sections, including Mitigation and Environmental Commitment Impacts,*
21 *Environmentally Superior Alternative, and Public Trust Considerations, provides an assessment of*
22 *the impacts of implementing proposed mitigation measures.*)

23 **SWP/CVP Export Service Areas**

24 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with** 25 **Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of** 26 **Preexisting Nearby Wells**

27 Total long-term average annual water deliveries to the CVP and SWP Service Areas under
28 Alternative 1A would be higher than under the No Action Alternative, as described in Chapter 5,
29 *Water Supply*, and Table 7-7.

30 **NEPA Effects:** Increases in surface water deliveries attributable to project operations from the
31 implementation of Alternative 1A are anticipated to result in a corresponding decrease in
32 groundwater use in the Export Service Areas as compared to the No Action Alternative.

33 Historically, groundwater resources were the only source of water supply in the Central Valley. The
34 heavy use of groundwater has caused groundwater quality issues, drainage issues, groundwater
35 overdraft, and land subsidence (as discussed in Section 7.1, *Environmental Setting/Affected*
36 *Environment*). Throughout many areas of the San Joaquin River and Tulare Lake watersheds,
37 shallow groundwater is characterized by high salinity. Use of this groundwater for irrigation
38 deposited salts along with agricultural chemicals (nutrients and fertilizers) in the upper soil layer.
39 These constituents leached into the underlying shallow groundwater aquifers and caused them to be
40 unsuitable for irrigation.

Table 7-7. Long-Term State Water Project and Central Valley Project Deliveries to Hydrologic Regions Located South of the Delta

Alternative	Long-Term Average State Water Project and Central Valley Project Deliveries (TAF/year)		
	San Joaquin River and Tulare Lake Hydrologic Regions	Central Coast Hydrologic Region	Southern California Hydrologic Region
Existing Conditions	2,964	47	1,647
No Action Alternative	2,519	40	1,484
Alternative 1	3,070	51	1,853
Alternative 2	2,846	49	1,711
Alternative 3	3,023	50	1,821
Alternative 4 Scenario H1	2,949	49	1,784
Alternative 4 Scenario H2	2,767	40	1,491
Alternative 4 Scenario H3	2,781	48	1,668
Alternative 4 Scenario H4	2,610	39	1,370
Alternative 5	2,709	45	1,613
Alternative 6	2,285	34	1,136
Alternative 7	2,272	36	1,162
Alternative 8	2,069	27	803
Alternative 9	2,529	43	1,410

TAF/year = thousand acre-feet per year.

Surface water was provided through the CVP and SWP to provide irrigation water of higher quality than was available in local groundwater. The expanded use of surface water for irrigation has resulted in a reduction in the degree of groundwater overdraft of local groundwater basins. County ordinances and groundwater management plans also aim at reducing impacts on groundwater by various users (see Section 7.2, *Regulatory Setting*). None of the groundwater basins in the Central Valley have been adjudicated.

Generally, when available, agricultural water users in the San Joaquin River and Tulare Lake areas prefer to use surface water for irrigation because the water quality is better than for groundwater. When adequate surface water is not available, they will use groundwater (U.S. Geological Survey 2009:60). The CVHM uses the FMP process (see Section 7.3.1.1, *Analysis of Groundwater Conditions in Areas that Use SWP/CVP Water Supplies*) to estimate agricultural water supply needs and assumes that when surface water deliveries are available, they are used first, before groundwater is pumped for additional water supplies.

CVHM modeling results show that groundwater levels would rise beneath the Corcoran Clay by up to 10 feet in most areas in the western portions of the San Joaquin and Tulare Basins, but could exceed 250 feet under WBS 14 (i.e., Westside and Northern Pleasant Valley basins) as compared to the No Action Alternative. The forecasted maximum groundwater level changes occur in August because agricultural groundwater pumping is typically highest during this month.

The forecasted groundwater level rises across the Export Service Areas during a typical peak groundwater level change condition in August, as compared to the No Action Alternative are shown in Figure 7-10. These forecasted changes in groundwater levels result from decreased agricultural

1 pumping during the irrigation season due to an increase in surface water deliveries from the Delta
2 under Alternative 1A in the western portion of the San Joaquin and Tulare Lake Basins. Higher
3 groundwater levels associated with reduced overall groundwater use would result in a beneficial
4 effect.

5 Alternative 1A also is forecasted to increase the surface water supplies from the Delta to the Export
6 Service Areas outside of the Central Valley. If more surface water is available for municipal,
7 industrial, and agricultural users, utilization of groundwater resources would be reduced (see
8 Chapter 5, *Water Supply*). Therefore, adverse effects on groundwater levels are not expected to
9 occur due to the implementation of Alternative 1A in these areas.

10 Alternative 1A would result in a beneficial effect on groundwater levels in the Export Service Areas
11 as compared with the No Action Alternative.

12 **CEQA Conclusion:** Groundwater levels would rise by up to 100 feet under WBS 14 (i.e., Westside and
13 Northern Pleasant Valley basins) as compared to Existing Conditions. The forecasted maximum
14 groundwater level changes occur in August because agricultural groundwater pumping is typically
15 highest during this month.

16 The forecasted groundwater level rises across the Export Service Areas during a typical peak
17 groundwater level change condition in August, as compared to Existing Conditions are shown in
18 Figure 7-11.

19 On the eastern side of the San Joaquin and Tulare Lake basins, climate change impacts on stream
20 flows could result in a decline in groundwater levels of up to 25 feet. In addition, if reduced stream
21 flows are not adequate to meet the surface water diversion requirements, groundwater pumping
22 could increase, resulting in a further decline in groundwater levels. However, impacts due to climate
23 change would occur independently of the BDCP. The anticipated effects of climate change are
24 provided for informational purposes only, but do not lead to mitigation measures.

25 Groundwater level rises associated with reduced overall groundwater use for Alternative 1A would
26 be considered a beneficial impact for most of the Export Service Areas and thus would not adversely
27 affect the yield of domestic, municipal and agricultural wells. No mitigation is required.

28 **Impact GW-9: Degrade Groundwater Quality**

29 **NEPA Effects:** Increases in surface water deliveries attributable to Alternative 1A operations are
30 anticipated to result in a corresponding decrease in groundwater use in the Export Service Areas.
31 The decreased groundwater use is not anticipated to alter regional patterns of groundwater flow or
32 groundwater quality in the Export Service Areas. Therefore, there would be no adverse effect on
33 groundwater quality in the Export Service Areas.

34 No change in groundwater quality is anticipated during construction activities because such
35 activities would occur in the Delta Region outside of the Export Service Areas. There would be no
36 adverse effect.

37 **CEQA Conclusion:** No significant groundwater quality impacts are anticipated during the
38 implementation of Alternative 1A because it is not anticipated to alter regional groundwater flow
39 patterns in the Export Service Areas. Therefore, this impact is considered less than significant. No
40 mitigation is required.

1 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

2 **NEPA Effects:** Forecasted land subsidence estimates indicate that most of the Export Service Areas
3 would see land subsidence of no more than a hundredth of an inch on average under Alternative 1A
4 as compared with the No Action Alternative. Therefore, the potential for substantial land subsidence
5 from groundwater pumping from implementation of Alternative 1A is low, and there would be no
6 change in subsidence levels. There would be no adverse effects.

7 **CEQA Conclusion:** Forecasted land subsidence estimates indicate that most of the Export Service
8 Areas would see land subsidence of no more than a hundredth of an inch on average under
9 Alternative 1A as compared with Existing Conditions. Because the potential for land subsidence in
10 the Export Service Areas is low, this impact is considered less than significant.

11 **7.3.3.3 Alternative 1B—Dual Conveyance with East Alignment and** 12 **Intakes 1–5 (15,000 cfs; Operational Scenario A)**

13 Alternative 1B would result in potential effects on groundwater in the study area associated with
14 construction of five intakes and intake pumping plants, one forebay, pipelines, canals, tunnels,
15 siphons, an intermediate pumping plant, and other conservation measures. This alternative would
16 differ from Alternative 1A primarily in that it would use a series of canals generally along the east
17 section of the Delta to convey water from north to south, rather than long segments of deep tunnel
18 through the central part of the Delta.

19 **Delta Region**

20 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with** 21 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity** 22 **of Preexisting Nearby Wells**

23 Construction of the conveyance facilities would require dewatering operations. The dewatering
24 wells would be generally 75–300 feet deep, placed every 50–75 feet apart along the construction
25 perimeter as needed, and each would pump 30–100 gpm. Dewatering for the tunnel shaft
26 constitutes the deeper dewatering (300 feet deep) while the shallow (75 feet deep) dewatering is
27 reserved for open trench construction; no dewatering is required along the tunnel alignment; and
28 the 50–75 feet dewatering wells frequency distance applies to the pipelines, intakes, widened levees,
29 the perimeter of the forebay embankments, the perimeter of excavation for the pumping plants, and
30 the perimeter of tunnel shafts. Construction of tunnel shafts is assumed to use slurry diaphragm
31 walls, and, therefore, require only minimal dewatering. Construction of the tunnel shafts is not
32 anticipated to result in significant impacts on surrounding groundwater because the dewatered
33 zone would be hydraulically isolated from the surrounding aquifer system.

34 Dewatering would occur 24 hours per day and 7 days per week and would be initiated 1 to 4 weeks
35 prior to excavation. Dewatering would continue until excavation is completed and the construction
36 site is protected from higher groundwater levels. Dewatering requirements of the intake
37 construction and construction of other major features along this alignment are estimated to range
38 from approximately 34 to 1,360 gpm (California Department of Water Resources 2010b).

39 Groundwater removed with the dewatering system would be treated as necessary and discharged to
40 surface waters under an NPDES permit. Velocity dissipation features, such as rock or grouted riprap,

1 would be used to reduce velocity and energy and prevent scour. Dewatering facilities would be
2 removed following construction activities.

3 **NEPA Effects:** Dewatering would temporarily lower groundwater levels in the vicinity of the
4 dewatering sites. Groundwater levels would decline in response to dewatering operations along the
5 entire Eastern Canal alignment. Groundwater level impacts forecasted to occur along the canal
6 during the middle stage construction period are shown in Figure 7-12a. Impacts along the central
7 and southern portions of the canal alignment are anticipated to occur toward the end of the
8 construction period and are shown in Figure 7-12b. Groundwater levels in the vicinity of the forebay
9 would decline by up to 20 feet. Groundwater levels in the vicinity of the siphons and along the canal
10 alignment are predicted to decline by up to approximately 10–15 feet. The horizontal distance from
11 the boundary of the excavation to locations where drawdown is 5 feet below the static groundwater
12 level, is defined as the radius of influence. The radius of influence is forecasted to extend up to
13 approximately 5,000 feet from the forebay, intake, siphon, and canal excavations. Impacts on
14 groundwater levels would cease after approximately 3 months following the termination of
15 dewatering activities at each excavation site. The sustainable yield of some wells might temporarily
16 be affected by the lower water levels such that they are not able to support existing land uses. The
17 construction of conveyance features would result in an adverse effect on groundwater levels and
18 associated well yields that would be temporary. It should be noted that the forecasted effects
19 described above reflect a worst-case scenario as the option of installing seepage cutoff walls during
20 dewatering was not considered in the analysis.

21 **CEQA Conclusion:** Construction activities under Alternative 1B including temporary dewatering and
22 associated reduced groundwater levels have the potential to temporarily affect the productivity of
23 existing nearby water supply wells. Groundwater levels within 5,000 feet of the areas to be
24 dewatered are anticipated to experience groundwater level declines up to 20 feet for the duration of
25 dewatering activities and up to 3 months after dewatering is completed. Nearby domestic and
26 municipal wells located within this area could experience reductions in well yield, if they are
27 shallow wells. The sustainable yield of some wells might temporarily be affected by the lower water
28 levels such that they are not able to support the existing land uses. The temporary localized impact
29 on groundwater levels and associated well yields would be significant because construction-related
30 dewatering might affect the amount of water supplied by shallow wells located near the CM1
31 construction sites. Mitigation Measure GW-1 identifies a monitoring procedure and options for
32 maintaining an adequate water supply for landowners that experience a reduction in groundwater
33 production from wells within 5,000 feet of construction-related dewatering activities. It should be
34 noted that the forecasted impacts described above reflect a worst-case scenario as the option of
35 installing seepage cutoff walls during dewatering was not considered in the analysis. Implementing
36 Mitigation Measure GW-1 would help address these effects; however, the impact may remain
37 significant because replacement water supplies may not meet the preexisting demands or planned
38 land use demands of the affected party. In some cases this impact might temporarily be significant
39 and unavoidable until groundwater elevations recover to preconstruction conditions, which could
40 require several months after dewatering operations cease.

41 **Mitigation Measure GW-1: Maintain Water Supplies in Areas Affected by Construction** 42 **Dewatering**

43 See Mitigation Measure GW-1 under Impact GW-1 in the discussion of Alternative 1A.

1 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with**
2 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
3 **of Preexisting Nearby Wells**

4 When water levels in the canal are maintained below the elevation of the adjacent water table,
5 groundwater will discharge from the aquifer into the canal system, and vice versa. However, the rate
6 of groundwater and surface water interaction during operations would be different for the unlined
7 and lined canal options due to differences in the permeability of the canal lining.

8 ***NEPA Effects:***

9 **Unlined Canal**

10 For the unlined canal option, some groundwater recharge would occur episodically beneath the
11 northern portion of the canal between the intakes and the Mokelumne River, resulting in a
12 groundwater level rise of less than 5 feet, which would not adversely affect the yield of nearby
13 supply wells. Groundwater discharge into the canal would occur along the middle portion of the
14 canal between the Mokelumne River and the San Joaquin River. Forecasted groundwater level
15 declines of approximately 10 feet would occur in this area, which could result in reduced yields of
16 shallow supply wells located within 2 miles of the canal. Groundwater level declines of up to 10 feet
17 are unlikely to affect the yields of deeper wells that may exist nearby. In the southern portion of the
18 canal, between San Joaquin River and the Byron Tract Forebay, groundwater recharge from the
19 canal would occur, thereby causing groundwater levels to rise up to 10 feet, which would not
20 adversely affect the yield of nearby supply wells. In the absence of design features intended to
21 minimize seepage, groundwater levels are also forecasted to rise up to 10 feet in the vicinity of the
22 Byron Tract Forebay due to groundwater recharge from this surface water impoundment. Figure 7-
23 13 presents the magnitude of groundwater elevation change during a typical peak groundwater
24 level change condition. Simulations indicate that groundwater recharge from the southern portion
25 of the canal could result in near-surface groundwater levels in localized areas. Effects, design
26 measures, and mitigation measures related to seepage are discussed in Impacts GW-4 and GW-5 and
27 related mitigation measures.

28 **Lined Canal**

29 For the lined canal option, minimal changes of less than 1 foot would occur to groundwater levels in
30 most areas in the vicinity of the canal due to the limited exchange of groundwater and surface water
31 between the lined canal and the underlying groundwater aquifer. In the absence of design features
32 intended to minimize seepage, modest groundwater level rises would occur in the vicinity of the
33 Byron Tract Forebay (up to 10 feet), similar to the changes discussed under Alternative 1A, as
34 shown in Figure 7-14. Groundwater discharge to the canal would occur along the middle portion of
35 the canal between the Mokelumne River and the San Joaquin River. Forecasted groundwater level
36 declines of less than 5 feet would occur in this area, and indicates potential reduction of shallow well
37 yields within approximately 2 miles of the canal.

38 **Unlined and Lined Canals**

39 For both unlined and lined canal options, model simulations indicate up to 5-foot episodic lowering
40 of groundwater levels beneath the Sacramento River within an approximately 4-mile wide corridor
41 (about 2 miles on either side of the river) due to lower flows in the river as a result of diversions at
42 the north Delta intakes that result in a reduction in river flows and elevations, as described in

1 Chapter 6, *Surface Water*. For both the unlined and the lined canal option, the groundwater level
2 changes would cause an adverse effect on nearby shallow domestic well yields.

3 **CEQA Conclusion:** For the unlined canal option, some groundwater recharge would occur
4 episodically beneath the northern portion of the canal, between the intakes and the Mokelumne
5 River. This results in a simulated groundwater level increase of less than 5 feet, which would not
6 adversely affect the yield of nearby supply wells. Simulations further indicate that groundwater
7 discharge would occur to the middle portion of the canal between the Mokelumne River and San
8 Joaquin River. Forecasted groundwater level declines of approximately 10 feet could occur in this
9 area, which could reduce the yields of shallow supply wells located within 2 miles of the canal
10 (Figure 7-15). This impact would be significant for shallow wells near the canal where significant
11 groundwater level declines occur. The sustainable yield of some wells might be affected by the lower
12 water levels such that they are not able to support the existing or planned land uses for which
13 permits have been granted. Implementation of Mitigation Measure GW-2 would help address these
14 effects; however, the impact may continue to be significant because replacement water supplies may
15 not meet the preexisting demands or planned land use demands of the affected party, as discussed
16 for Impact GW-1 under Alternative 1A. Groundwater level declines of up to 10 feet are unlikely to
17 affect the yields of nearby deeper wells. In the southern portion of the canal, between the San
18 Joaquin River and the Byron Tract Forebay, groundwater recharge from the canal would occur and
19 increase groundwater levels by up to 5 feet, which would not adversely affect the yield of nearby
20 supply wells.

21 For the lined canal option, groundwater levels in the northern and southern portions of the canal
22 would increase by less than 1 foot, which would not adversely affect the yield of nearby wells.
23 Groundwater discharge to the canal would occur along the middle portion of the canal between the
24 Mokelumne River and the San Joaquin River. Forecasted groundwater level declines of less than 5
25 feet would occur in this area, and indicates potential reduction of shallow well yields within
26 approximately 2 miles of the canal (Figure 7-16). The sustainable yield of some wells might be
27 affected by the lower water levels such that they are not able to support the existing or planned land
28 uses for which permits have been granted. Implementation of Mitigation Measure GW-2 would help
29 address these effects; however, the impact may continue to be significant because replacement
30 water supplies may not meet the preexisting demands or planned land use demands of the affected
31 party, as discussed for Impact GW-1 under Alternative 1A.

32 For both unlined and lined canal options, model simulations indicate up to 5-foot episodic lowering
33 of groundwater levels beneath the Sacramento River on either side of the river due to lower flows in
34 the river as a result of diversions at the north Delta intakes that result in a reduction in river flows
35 and elevations. Shallow wells in the vicinity of this corridor might see an episodic decrease in yields
36 which might affect the existing or planned land-uses for which permits have been granted in this
37 area. In the absence of design features intended to minimize seepage, modest groundwater level
38 rises would occur in the vicinity of the Byron Tract Forebay (up to 10 feet), similar to the changes
39 discussed under Alternative 1A.

40 Groundwater levels in the Suisun Marsh area under Alternative 1B are forecasted to rise by 1 to 5
41 feet compared with Existing Conditions. This groundwater level rise is primarily attributable to sea
42 level rise and climate change conditions in the Alternative 1B CVHM-D simulation. However, the
43 anticipated effects of climate change and sea level rise are provided for information purposes only
44 and do not lead to mitigation measures.

1 **Mitigation Measure GW-2: Maintain Water Supplies in Areas Affected by Changes in**
2 **Groundwater Levels during Operation of Canals**

3 See Mitigation Measure GW-1 for Impact GW-1 under Alternative 1A for applicable mitigations
4 for this impact.

5 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of**
6 **Conveyance Facilities**

7 **NEPA Effects:** Changes in groundwater flow patterns under Alternative 1B would be similar to those
8 described for Alternative 1A. Groundwater dewatering activities along the canal alignment under
9 Alternative 1B would occur on a wider area than dewatering activities along the tunnel alignment
10 under Alternative 1A and might result in more extensive groundwater flow and quality disturbances
11 than for Alternative 1A. However, regional groundwater flow patterns would remain unchanged by
12 localized construction dewatering operations. Implementation of Alternative 1B is not anticipated to
13 alter regional patterns of groundwater flow or quality. Therefore, there would be no change in
14 groundwater quality and no adverse effect.

15 **CEQA Conclusion:** See the CEQA conclusion for Impact GW-3 under Alternative 1A. The impact
16 would be less than significant.

17 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural**
18 **Drainage in the Delta**

19 **NEPA Effects:** In the absence of seepage cutoff walls intended to minimize local changes to
20 groundwater flow, the lowering of groundwater levels from construction dewatering under
21 Alternative 1B would temporarily affect shallow groundwater flow patterns during and immediately
22 after the construction dewatering period. In particular, nearby shallow groundwater would
23 temporarily flow toward the construction dewatering sites. The radius of influence, as described
24 above, provides a sense of the potential areal extent of the temporary change in shallow
25 groundwater flow patterns. Shallow groundwater flow patterns would be temporarily inward
26 toward dewatering sites with minor changes in groundwater flow directions near the intakes.
27 Substantial localized changes in groundwater flow directions could occur in the vicinity of the canal
28 alignment. These forecasted changes in shallow groundwater flow patterns are localized and
29 temporary and are not anticipated to cause adverse effects on agricultural drainage.

30 **CEQA Conclusion:** Under Alternative 1B, the temporary lowering of groundwater levels from
31 construction dewatering activities would temporarily affect shallow groundwater flow patterns
32 during and immediately after the construction dewatering period. In particular, nearby shallow
33 groundwater would temporarily flow toward the construction dewatering sites. Shallow
34 groundwater flow patterns would be temporarily inward toward dewatering sites with minor
35 changes in groundwater flow directions near the intakes. Substantial localized changes in
36 groundwater flow directions could occur in the vicinity of the canal alignment. These forecasted
37 changes in shallow groundwater flow patterns are localized and temporary and are not anticipated
38 to cause significant impacts on agricultural drainage. Therefore, this impact is considered less than
39 significant.

1 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the**
2 **Delta**

3 **NEPA Effects:** Byron Tract Forebay would be constructed to comply with the requirements of the
4 DSD which includes design provisions to minimize seepage under the embankments, such as cutoff
5 walls. These design provisions would minimize seepage under the embankments and onto adjacent
6 properties. Once constructed, the operation of the forebay would be monitored to ensure seepage
7 does not exceed performance requirements. In the event seepage were to exceed these performance
8 requirements, the project proponents would modify the embankments or construct seepage
9 collection systems that would ensure any seepage from the forebay would be collected and
10 conveyed back to the forebay or other suitable disposal site. However, local changes in groundwater
11 flow patterns adjacent to the Byron Tract Forebay might occur due to groundwater recharge from
12 surface water impoundment and would result in groundwater level increases. If agricultural
13 drainage systems adjacent to this forebay are not adequate to accommodate the additional drainage
14 requirements, operation of the forebay could interfere with agricultural drainage in the Delta under
15 Alternative 1B.

16 Implementation of Alternative 1B with an unlined canal would result in local changes in
17 groundwater flow patterns in the vicinity of the unlined canal alignment, where recharge to and
18 discharge from the groundwater system would occur, resulting in groundwater level increases. The
19 middle portion of the unlined canal is forecasted to gain groundwater from the east and west sides.
20 This suggests that groundwater flow directions on the west side of the middle portion of the unlined
21 canal would be altered from their prior east-west direction. Because groundwater would flow into
22 the unlined canal, the potential exists to improve agricultural drainage in this area.

23 The lower portion of the unlined canal is situated in an area of the Delta that lies at or below sea
24 level and existing land uses rely on drainage systems. Groundwater levels in this area are forecasted
25 to increase due to leakage from the unlined canal, which would affect agricultural drainage.
26 Operation of the unlined canal would cause an adverse effect on agricultural drainage that would be
27 addressed by Mitigation Measure GW-5.

28 For the lined canal option, minimal changes to groundwater levels would occur in relation to canal
29 operation due to the limited quantity of groundwater recharge from the lined canal or discharge
30 from groundwater to the lined canal, as described under Impact GW-2 for Alternative 1B. However,
31 implementation of Alternative 1B would result in local changes in groundwater flow patterns
32 adjacent to the Byron Tract Forebay (as discussed above).

33 **CEQA Conclusion:** The forebay embankment would be constructed to DSD standards and the BDCP
34 proponents would monitor the performance of the embankments to ensure seepage does not exceed
35 performance requirements. In the event seepage would exceed DSD requirements, the BDCP
36 proponents would modify the embankments or construct and operate seepage collection systems to
37 ensure the performance of existing agricultural drainage systems would be maintained. However,
38 local changes in groundwater flow patterns adjacent to the Byron Tract Forebay might occur due to
39 groundwater recharge from surface water impoundment and would result in groundwater level
40 increases. If agricultural drainage systems adjacent to this forebay are not adequate to
41 accommodate the additional drainage requirements, operation of the forebay could cause significant
42 impacts on agricultural drainage. Implementation of Mitigation Measure GW-5 is anticipated to
43 reduce this impact to a less-than-significant level in most instances, though in some instances
44 mitigation may be infeasible due to factors such as costs that would be imprudent to bear in light of

1 the fair market value of the affected land. The impact is therefore significant and unavoidable as
 2 applied to such latter properties.

3 Implementation of Alternative 1B with the unlined canal would result in local changes in shallow
 4 groundwater flow patterns in the vicinity of the unlined canal alignment, and could cause significant
 5 impacts on agricultural drainage where systems are not adequate to accommodate the additional
 6 drainage requirements. Implementation of Mitigation Measure GW-5 is anticipated to reduce this
 7 impact in most instances. Occasionally, however, mitigation may be determined infeasible and the
 8 impact is therefore considered significant and unavoidable.

9 For the lined canal option, implementation of Alternative 1B would result in minimal changes to
 10 groundwater levels due to the limited quantity of groundwater recharge from the lined canal or
 11 discharge from groundwater to the lined canal. This impact is considered less than significant in the
 12 vicinity of the lined canal.

13 Groundwater levels in the Suisun Marsh area under Alternative 1B are forecasted to rise by 1 to 5
 14 feet compared with Existing Conditions, which could lead to impacts on agricultural drainage. This
 15 groundwater level rise is primarily attributable to sea level rise and climate change conditions in the
 16 Alternative 1B CVHM-D simulation. However, the anticipated effects of climate change and sea level
 17 rise are provided for information purposes only and do not lead to mitigation measures.

18 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

19 Please see Mitigation Measure GW-5 under Impact GW-5 in the discussion of Alternative 1A.

20 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter 21 Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or 22 Interfere with Agricultural Drainage as a Result of Implementing CM2–CM21**

23 See Impact GW-6 under Alternative 1A; CM2–CM21 under Alternative 1B would be identical to those
 24 under Alternative 1A.

25 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2–CM21**

26 See Impact GW-7 under Alternative 1A; CM2–CM21 under Alternative 1B would be identical to those
 27 under Alternative 1A.

28 **SWP/CVP Export Service Areas**

29 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with 30 Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of 31 Preexisting Nearby Wells**

32 See Impact GW-8 under Alternative 1A; project operations under Alternative 1B would be identical
 33 to those under Alternative 1A.

34 **Impact GW-9: Degrade Groundwater Quality**

35 See Impact GW-9 under Alternative 1A; project operations under Alternative 1B would be identical
 36 to those under Alternative 1A.

1 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

2 See Impact GW-10 under Alternative 1A; project operations of under Alternative 1B would be
3 identical to those under Alternative 1A.

4 **7.3.3.4 Alternative 1C—Dual Conveyance with West Alignment and** 5 **Intakes W1–W5 (15,000 cfs; Operational Scenario A)**

6 Alternative 1C would result in effects on groundwater in the study area associated with construction
7 of five intakes and intake pumping plants, one forebay, conveyance pipelines, canals, a tunnel,
8 culvert siphons, an intermediate pumping plant, and other conservation measures. This alternative
9 would differ from Alternative 1A primarily in its use of a series of canals generally along the west
10 section of the Delta to convey water from north to south, with a tunnel under a portion of the
11 western Delta and the San Joaquin River rather than long segments of deep tunnel through the
12 central part of the Delta.

13 **Delta Region**

14 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with** 15 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity** 16 **of Preexisting Nearby Wells**

17 Construction of the conveyance facilities would require dewatering operations. The dewatering
18 wells would be generally 75 to 300 feet deep, placed every 50 to 75 feet apart, and would each pump
19 30–100 gpm. Dewatering for the tunnel shaft constitutes the deeper dewatering (300 feet deep)
20 while the shallow (75 feet deep) dewatering is reserved for open trench construction; no
21 dewatering is required along the tunnel alignment; and the 50–75 feet dewatering wells frequency
22 distance applies to the pipelines, intakes, widened levees, the perimeter of the forebay
23 embankments, the perimeter of excavation for the pumping plants, and the perimeter of tunnel
24 shafts. Tunnel shaft construction is assumed to use slurry diaphragm walls, and, therefore, require
25 only minimal dewatering. Construction of the tunnel shafts is not anticipated to result in significant
26 impacts on surrounding groundwater because the dewatered zone would be hydraulically isolated
27 from the surrounding aquifer system.

28 Dewatering would occur 24 hours per day and 7 days per week and would be initiated 1 to 4 weeks
29 prior to excavation and continue until excavation is completed and the construction site is protected
30 from higher groundwater. Dewatering requirements of the intake construction and construction of
31 other major features along this alignment are estimated to range from approximately 34 gpm to
32 1,360 gpm (California Department of Water Resources 2010b).

33 Groundwater removed with the dewatering system would be treated as necessary and discharged to
34 surface waters under an NPDES permit. Velocity dissipation features, such as rock or grouted riprap,
35 would be used to reduce velocity and energy and prevent scour. Dewatering facilities would be
36 removed following construction.

37 **NEPA Effects:** Dewatering would temporarily lower groundwater levels in the vicinity of the
38 dewatering sites. Groundwater levels would decline in response to dewatering operations along the
39 entire Western Canal alignment. The construction of the tunnel portion of this alignment would not
40 require dewatering.

1 Groundwater level effects predicted to occur along the northern and southern portions of the
2 alignment during construction activities are shown in Figure 7-17. Groundwater levels in the
3 vicinity of the intakes and the forebay would decline by up to 20 feet. Groundwater levels in the
4 vicinity of the siphons and along the canal alignment are predicted to decline by approximately 10–
5 15 feet. The horizontal distance from the boundary of the excavation to locations where forecasted
6 groundwater levels are 5 feet below the static groundwater level is defined as the radius of
7 influence. The radius of influence would extend approximately up to 5,000 feet from the forebay,
8 intake, siphon, and canal excavations. Effects on groundwater levels would cease after
9 approximately 3 months following the termination of dewatering activities at each excavation site.
10 The sustainable yield of some wells might temporarily be affected by the lower water levels such
11 that they are not able to support existing land uses. The construction of conveyance features would
12 result in an adverse effect on groundwater levels and associated well yields that would be
13 temporary. It should be noted that the forecasted effects described above reflect a worst-case
14 scenario as the option of installing seepage cutoff walls during dewatering was not considered in the
15 analysis.

16 **CEQA Conclusion:** Construction activities under Alternative 1C including temporary dewatering and
17 associated reduced groundwater levels have the potential to temporarily affect the productivity of
18 existing nearby water supply wells. Groundwater levels within 5,000 feet of the areas to be
19 dewatered are anticipated to experience groundwater level reductions of up to 20 feet for the
20 dewatering activities and up to 3 months after dewatering is completed. Shallow domestic and
21 municipal wells located within this area could experience reductions in well yield. The sustainable
22 yield of some wells might temporarily be affected by the lower water levels such that they are not
23 able to support existing land uses. The temporary localized impact on groundwater levels and
24 associated well yields would be significant because construction-related dewatering might affect the
25 amount of water supplied by shallow wells located near the CM1 construction sites. Mitigation
26 Measure GW-1 identifies a monitoring procedure and options for maintaining an adequate water
27 supply for landowners that experience a reduction in groundwater production from wells within
28 5,000 feet of construction-related dewatering activities. It should be noted that the forecasted
29 impacts described above reflect a worst-case scenario as the option of installing seepage cutoff walls
30 during dewatering was not considered in the analysis. Implementing Mitigation Measure GW-1
31 would help address these effects; however, the impact may remain significant because replacement
32 water supplies may not meet the preexisting demands or planned land use demands of the affected
33 party. In some cases this impact might temporarily be significant and unavoidable until
34 groundwater elevations recover to preconstruction conditions, which could require several months
35 after dewatering operations cease.

36 **Mitigation Measure GW-1: Maintain Water Supplies in Areas Affected by Construction**
37 **Dewatering**

38 See Mitigation Measure GW-1 under Impact GW-1 in the discussion of Alternative 1A.

1 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with**
2 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
3 **of Preexisting Nearby Wells**

4 **NEPA Effects:**

5 **Unlined Canal**

6 For the unlined canal option, most canal leakage would occur in the northern portion of the canal,
7 between the intakes and the inflow to the tunnel. Thus, rises in groundwater levels are forecasted to
8 occur in these areas of the north Delta (up to 10 feet), which would not reduce the yields of nearby
9 wells. This water level rise is not anticipated to adversely affect groundwater recharge.

10 No substantial effect on groundwater levels would be anticipated in the vicinity of the tunnel.

11 In the canal segment south of the tunnel, an area of groundwater recharge from the unlined canal
12 would occur in an area that transitions to a zone of groundwater discharge to the canal in the
13 vicinity of Byron Tract. This pattern of groundwater recharge and discharge results from the
14 hydraulic grade line of the canal being above the groundwater table just south of the tunnel and
15 transitioning to a condition where the hydraulic grade line falls below the groundwater table further
16 south. The effects on groundwater levels would be less than 5 feet throughout this area. In the
17 absence of design features intended to minimize seepage, modest groundwater level rises would
18 occur in the vicinity of the Byron Tract Forebay (up to 10 feet). The magnitude of groundwater
19 elevation change during a typical peak water level change condition is shown in Figure 7-18.
20 No substantial effect on groundwater levels are indicated in the vicinity of the tunnel. In the
21 southern portion of the canal near Byron Tract, yields of nearby shallow wells could be reduced.

22 **Lined Canal**

23 For the lined canal option, minimal changes to groundwater levels would occur due to the limited
24 quantity of groundwater recharge from the lined canal reaches or discharge from groundwater to
25 the lined canal, as shown in Figure 7-19. In the absence of design features intended to minimize
26 seepage, modest groundwater level rises in the vicinity of the Byron Tract Forebay (up to 10 feet),
27 similar to the changes discussed under Alternative 1A. No substantial effect on groundwater levels is
28 indicated in the vicinity of the tunnel. In the southern portion of the canal, simulation results
29 indicate that groundwater levels would occasionally decline less than 5 feet throughout the
30 alignment, which could reduce yields of nearby shallow wells.

31 **Unlined and Lined Canals**

32 For both unlined and lined canal options, groundwater levels would decline along the Sacramento
33 River, as described under Alternative 1B.

34 For both canal options, the groundwater level changes could cause an adverse effect on nearby
35 shallow domestic well yields. The sustainable yield of some wells might be affected by the lower
36 water levels such that they are not able to support the existing or planned land uses for which
37 permits have been granted.

38 **CEQA Conclusion:** For the unlined canal option under Alternative 1C, groundwater levels in the
39 northern portion of the canal would increase by less than 10 feet, which would not reduce the yields
40 of nearby wells. No substantial impact on groundwater levels is indicated in the vicinity of the

1 tunnel. Along the unlined canal located south of the tunnel section, an area of groundwater recharge
 2 from the unlined canal would occur and would transition to a zone of groundwater discharge to the
 3 unlined canal in the vicinity of Byron Tract (Figure 7-20). The forecasted impacts on groundwater
 4 levels are less than 5 feet throughout the southern alignment of the unlined canal. In the southern
 5 portion of the unlined canal near Byron Tract, yields of nearby shallow wells could be reduced,
 6 which might affect the sustainability of existing or planned land uses for which permits have been
 7 granted and that use water from these wells.

8 For the lined canal option, minimal changes to groundwater levels would occur due to the limited
 9 quantity of groundwater recharge from the lined canal reaches or discharge from groundwater to
 10 the lined canal, as shown in Figure 7-21. In the absence of design features intended to minimize
 11 seepage, modest groundwater level rises in the vicinity of the Byron Tract Forebay (up to 10 feet),
 12 similar to the changes discussed under Alternative 1A. No substantial effect on groundwater levels is
 13 indicated in the vicinity of the tunnel. In the southern portion of the canal, simulation results
 14 indicate that groundwater levels would occasionally decline less than 5 feet throughout the
 15 alignment, which could reduce yields of nearby shallow wells.

16 For both the lined and the unlined canal option, the impact on well yields could be significant in
 17 areas near the southern portion of the canal. Implementation of Mitigation Measure GW-2 would
 18 help address these effects; however, the impact may continue to be significant and unavoidable
 19 because replacement water supplies may not meet the preexisting demands or planned land use
 20 demands of the affected party, as discussed for Impact GW-1 under Alternative 1A. In the absence of
 21 design features intended to minimize seepage, modest groundwater level rises in the vicinity of the
 22 Byron Tract Forebay (up to 10 feet), similar to the changes discussed under Alternative 1A.

23 Groundwater levels in the Suisun Marsh area under Alternative 1C are forecasted to rise by 1 to 5
 24 feet compared with Existing Conditions. This groundwater level rise is primarily attributable to sea
 25 level rise and climate change conditions in the Alternative 1C CVHM-D simulation. However, the
 26 anticipated effects of climate change and sea level rise are provided for information purposes only
 27 and do not lead to mitigation measures.

28 **Mitigation Measure GW-2: Maintain Water Supplies in Areas Affected by Changes in** 29 **Groundwater Levels during Operation of Canals**

30 Please see Mitigation Measure GW-1 under Impact GW-1 in the discussion of Alternative 1A.

31 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of** 32 **Conveyance Facilities**

33 See Impact GW-3 for Alternative 1B.

34 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural** 35 **Drainage in the Delta**

36 **NEPA Effects:** In the absence of seepage cutoff walls intended to minimize local changes to
 37 groundwater flow, the lowering of groundwater levels from construction dewatering under
 38 Alternative 1C would temporarily affect shallow groundwater flow patterns during and immediately
 39 after the construction dewatering period. In particular, nearby shallow groundwater would
 40 temporarily flow toward the construction dewatering sites. The radius of influence, as described
 41 above, provides a sense of the potential areal extent of the temporary change in shallow

1 groundwater flow patterns. Shallow groundwater flow patterns would be temporarily inward
 2 toward dewatering sites, compared with the No Action Alternative. Therefore, this effect would not
 3 be adverse.

4 **CEQA Conclusion:** Under Alternative 1C, the temporary lowering of groundwater levels from
 5 dewatering activities would temporarily affect localized and shallow groundwater flow patterns
 6 during and immediately after the construction dewatering period. In particular, nearby and shallow
 7 groundwater would flow toward the construction dewatering sites. The radius of influence provides
 8 a sense of the potential areal extent of the temporary change in shallow groundwater flow patterns.
 9 Groundwater flow patterns would not change substantially at the Byron Tract Forebay site and only
 10 small changes in flow direction at the intakes would occur. These forecasted changes in shallow
 11 groundwater flow patterns are localized and temporary. Therefore, this impact is considered less
 12 than significant.

13 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the** 14 **Delta**

15 **NEPA Effects:** Implementation of Alternative 1C with an unlined canal would result in local changes
 16 in groundwater flow patterns adjacent to the unlined canal, where groundwater recharge from
 17 surface water would result in groundwater level increases. The upper portion of the unlined canal,
 18 between the Sacramento River intakes and the transition to the tunnel, would lose water to the
 19 surrounding groundwater, which would affect agricultural drainage in the area. Operations of the
 20 unlined canal would cause an adverse effect on agricultural drainage. Mitigation Measure GW-5 is
 21 available to address this effect.

22 For the lined canal option, minimal changes to groundwater levels would occur due to the limited
 23 quantity of groundwater recharge from the lined canal or discharge from groundwater to the lined
 24 canal, as described under Impact GW-2 for Alternative 1C. However, implementation of Alternative
 25 1C would result in local changes in groundwater flow patterns adjacent to the Byron Tract Forebay.

26 The Byron Tract Forebay would be constructed to comply with the requirements of the DSD which
 27 includes design provisions to minimize seepage under the embankments, such as cutoff walls. These
 28 design provisions would minimize seepage under the embankments and onto adjacent properties.
 29 Once constructed, the operation of the forebay would be monitored to ensure seepage does not
 30 exceed performance requirements. In the event seepage were to exceed these performance
 31 requirements, the project proponents would modify the embankments or construct seepage
 32 collection systems that would ensure any seepage from the forebay would be collected and
 33 conveyed back to the forebay or other suitable disposal site.

34 However, local changes in groundwater flow patterns adjacent to the Byron Tract Forebay might
 35 occur due to groundwater recharge from surface water impoundment and would result in
 36 groundwater level increases. If agricultural drainage systems adjacent to this forebay are not
 37 adequate to accommodate the additional drainage requirements, operation of the forebay could
 38 interfere with agricultural drainage in the Delta.

39 **CEQA Conclusion:** The Byron Tract Forebay embankments would be constructed to DSD standards
 40 and the BDCP proponents would monitor the performance of the embankments to ensure seepage
 41 does not exceed performance requirements. In the event seepage would exceed DSD requirements,
 42 the BDCP proponents would modify the embankments or construct and operate seepage collection
 43 systems to ensure the performance of existing agricultural drainage systems would be maintained.

1 However, local changes in groundwater flow patterns adjacent to the Byron Tract Forebay might
2 occur due to groundwater recharge from surface water impoundment and would result in
3 groundwater level increases. If agricultural drainage systems adjacent to this forebay are not
4 adequate to accommodate the additional drainage requirements, operation of the forebay could
5 cause significant impacts on agricultural drainage. Implementation of Mitigation Measure GW-5 is
6 anticipated to reduce this impact to a less-than-significant level in most instances, though in some
7 instances mitigation may be infeasible due to factors such as costs that would be imprudent to bear
8 in light of the fair market value of the affected land. The impact is therefore significant and
9 unavoidable as applied to such latter properties.

10 The implementation of Alternative 1C would result in local changes in shallow groundwater flow
11 patterns in the vicinity of the unlined canal alignment, and could cause significant impacts on
12 agricultural drainage where systems are not adequate to accommodate the additional drainage
13 requirements. This impact is considered significant. Implementation of Mitigation Measure GW-5 is
14 anticipated to reduce this impact in most instances. Occasionally, however, mitigation may be
15 determined infeasible and the impact is therefore considered significant and unavoidable.

16 For the lined canal option, minimal changes to groundwater levels would occur in the proximity of
17 the canal due to the limited quantity of groundwater recharge from the lined canal or discharge
18 from groundwater to the lined canal. Impact GW-5 would be considered less than significant in the
19 vicinity of the lined canal.

20 Groundwater levels in the Suisun Marsh area under Alternative 1C are forecasted to rise by 1 to 5
21 feet compared with Existing Conditions, which could lead to impacts on agricultural drainage. This
22 groundwater level rise is primarily attributable to sea level rise and climate change conditions in the
23 Alternative 1C CVHM-D simulation. However, the anticipated effects of climate change and sea level
24 rise are provided for information purposes only and do not lead to mitigation measures.

25 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

26 Please see Mitigation Measure GW-5 under Impact GW-5 in the discussion of Alternative 1A.

27 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter** 28 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or** 29 **Interfere with Agricultural Drainage as a Result of Implementing CM2-CM21**

30 See Impact GW-6 under Alternative 1A; CM2-CM21 under Alternative 1C would be identical to those
31 under Alternative 1A.

32 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2-CM21**

33 See Impact GW-7 under Alternative 1A; CM2-CM21 under Alternative 1C would be identical to those
34 under Alternative 1A.

1 SWP/CVP Export Service Areas

2 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with** 3 **Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of** 4 **Preexisting Nearby Wells**

5 See Impact GW-8 under Alternative 1A; project operations under Alternative 1C would be identical
6 to those under Alternative 1A.

7 **Impact GW-9: Degrade Groundwater Quality**

8 See Impact GW-9 under Alternative 1A; project operations under Alternative 1C would be identical
9 to those under Alternative 1A.

10 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

11 See Impact GW-10 under Alternative 1A; project operations under Alternative 1C would be identical
12 to those under Alternative 1A.

13 **7.3.3.5 Alternative 2A—Dual Conveyance with Pipeline/Tunnel and Five** 14 **Intakes (15,000 cfs; Operational Scenario B)**

15 Facilities construction under Alternative 2A would be identical to those described for Alternative
16 1A. Alternative 2A would involve relocation of two of the intakes to a location south of the
17 confluence of Sutter and Steamboat sloughs and the Sacramento River.

18 **Delta Region**

19 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with** 20 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity** 21 **of Preexisting Nearby Wells**

22 See Impact GW-1 under Alternative 1A; construction activities under Alternative 2A would result in
23 impacts similar to those under Alternative 1A. The only difference between Alternative 1A and
24 Alternative 2A would be associated with the location of the intakes. Both alternatives use Intakes 1,
25 2, and 3. However, Alternative 2A uses Intakes 6 and 7 as opposed to Intakes 4 and 5 for Alternative
26 1A.

27 **NEPA Effects:** Dewatering would temporarily lower groundwater levels in the vicinity of the
28 dewatering sites. Three areas could be subject to substantial lowering of groundwater levels: (1) in
29 the vicinity of intake pump stations 1, 2, and 3; (2) in the vicinity of intake pump stations 6 and 7;
30 and (3) in the vicinity of Byron Tract Forebay. Groundwater-level lowering from construction
31 dewatering activities is forecasted to be less than 10 feet in the vicinity of the intakes and less than
32 20 feet in the vicinity of the forebay. The horizontal distance from the boundary of the excavation to
33 locations where forecasted groundwater levels are 5 feet below the static groundwater level is
34 defined as the radius of influence herein. The radius of influence is forecasted to extend
35 approximately 2,600 feet from the Byron Tract Forebay excavation and from the Intakes 1, 2, and 3
36 excavations and approximately 1,300 feet from the Intake 6 and 7 excavations (Figure 7-22).
37 Groundwater levels in the area of Intakes 6 and 7 are deeper than in the area for Intakes 1, 2, and 3;
38 therefore less groundwater needs to be pumped for construction dewatering purposes.

1 Groundwater would return to pre-pumping levels over the course of several months. Simulation
 2 results suggest that 2 months after pumping ceases, water levels would be within 5 feet of pre-
 3 pumping water levels. The sustainable yield of some wells might temporarily be affected by the
 4 lower water levels such that they are not able to support existing land uses. The construction of
 5 conveyance features would result in an adverse effect on groundwater levels and associated well
 6 yields that would be temporary. It should be noted that the forecasted effects described above
 7 reflect a worst-case scenario as the option of installing seepage cutoff walls during dewatering was
 8 not considered in the analysis.

9 **CEQA Conclusion:** Construction activities associated with conveyance facilities under CM1 for
 10 Alternative 2A including temporary dewatering and associated reduced groundwater levels have the
 11 potential to temporarily affect the productivity of existing nearby water supply wells. Groundwater
 12 levels within 1,300–2,600 feet of the areas to be dewatered are anticipated to experience
 13 groundwater level reductions of less than 20 feet for the duration of the dewatering activities and up
 14 to 2 months after dewatering is completed. Nearby domestic and municipal wells could experience
 15 significant reductions in well yield, if they are shallow wells and may not be able to support existing
 16 land uses. The temporary localized impact on groundwater levels and associated well yields could
 17 be significant because construction-related dewatering might affect the amount of water supplied by
 18 shallow wells located near the CM1 construction sites. Mitigation Measure GW-1 identifies a
 19 monitoring procedure and options for maintaining an adequate water supply for landowners that
 20 experience a reduction in groundwater production from wells within the anticipated area of
 21 influence of construction-related dewatering activities. It should be noted that the forecasted
 22 impacts described above reflect a worst-case scenario as the option of installing seepage cutoff walls
 23 during dewatering was not considered in the analysis. Implementing Mitigation Measure GW-1
 24 would help address these effects; however, the impact may remain significant because replacement
 25 water supplies may not meet the preexisting demands or planned land use demands of the affected
 26 party. In some cases this impact might temporarily be significant and unavoidable until
 27 groundwater elevations recover to preconstruction conditions, which could require several months
 28 after dewatering operations cease.

29 **Mitigation Measure GW-1: Maintain Water Supplies in Areas Affected by Construction**
 30 **Dewatering**

31 See Mitigation Measure GW-1 under Impact GW-1 in the discussion of Alternative 1A.

32 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with**
 33 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 34 **of Preexisting Nearby Wells**

35 See Impact GW-2 under Alternative 1A; operations activities under Alternative 2A would result in
 36 impacts similar to those under Alternative 1A. Both alternatives use the same forebay locations,
 37 which, in the absence of design features intended to minimize seepage, would be the main locations
 38 of potential effects on groundwater levels and associated well yields.

39 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of**
 40 **Conveyance Facilities**

41 See Impact GW-3 under Alternative 1A; construction and operations activities under Alternative 2A
 42 would result in effects similar to those under Alternative 1A.

1 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural**
 2 **Drainage in the Delta**

3 **NEPA Effects:** See Impact GW-4 under Alternative 1A; construction activities under Alternative 2A
 4 would result in effects similar to those under Alternative 1A. The only difference between
 5 Alternative 1A and Alternative 2A would be associated with the location of the intakes. Alternative
 6 2A uses Intakes 6 and 7 as opposed to Intakes 4 and 5 for Alternative 1A.

7 The lowering of groundwater levels due to construction dewatering would temporarily affect
 8 localized shallow groundwater flow patterns during and immediately after the construction
 9 dewatering period. In particular, nearby shallow groundwater would temporarily flow toward the
 10 construction dewatering sites. The radius of influence, as described above, provides a sense of the
 11 potential areal extent of the temporary change in shallow groundwater flow patterns. For the Byron
 12 Tract Forebay site, only a portion of the shallow groundwater flow would be directed inward toward
 13 the dewatering operations. Forecasted temporary changes in shallow groundwater flow directions
 14 and areas of impacts are minor near the intakes, as discussed in Impact GW-1. Therefore,
 15 agricultural drainage during construction of conveyance features is forecasted to result in no change
 16 under Alternative 2A. In some instances, the lowering of groundwater levels in areas that experience
 17 near-surface water level conditions (or near-saturated root zones) would be beneficial. There would
 18 be no adverse effect.

19 **CEQA Conclusion:** The forecasted changes in shallow groundwater flow patterns due to
 20 construction dewatering activities in the Delta are localized and temporary and are not anticipated
 21 to cause significant impacts on agricultural drainage. This impact would be less than significant. No
 22 mitigation is required.

23 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the**
 24 **Delta**

25 See Impact GW-5 under Alternative 1A; operations activities under Alternative 2A would result in
 26 effects similar to those under Alternative 1A.

27 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter**
 28 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or**
 29 **Interfere with Agricultural Drainage as a Result of Implementing CM2-CM21**

30 See Impact GW-6 under Alternative 1A; CM2-CM21 under Alternative 2A would result in effects
 31 similar to those under Alternative 1A.

32 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2-CM21**

33 See Impact GW-7 under Alternative 1A; CM2-CM21 under Alternative 2A would result in effects
 34 similar to those under Alternative 1A.

1 SWP/CVP Export Service Areas

2 Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with 3 Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of 4 Preexisting Nearby Wells

5 **NEPA Effects:** Total long-term average annual water deliveries to the CVP and SWP Service Areas
6 under Alternative 2A would be higher than under the No Action Alternative, as described in Chapter
7 5, *Water Supply*, and Table 7-7. Increases in surface water deliveries attributable to project
8 operations from the implementation of Alternative 2A are anticipated to result in a corresponding
9 decrease in groundwater use in the Export Service Areas compared to the No Action Alternative, as
10 discussed in subsection 7.3.3.2, *Alternative 1A—Dual Conveyance with Pipeline/Tunnel and Intakes*
11 *1–5*.

12 CVHM modeling results show that groundwater levels would rise beneath the Corcoran Clay of up to
13 10 feet in most areas in the western and southern portions of the Valley, but could exceed 250 feet
14 under WBS 14 (i.e., Westside and Northern Pleasant Valley basins of the western Tulare Basin) as
15 compared with the No Action Alternative. The forecasted maximum groundwater level changes
16 occur in August because agricultural groundwater pumping is typically highest during this month.
17 These forecast changes in groundwater levels, as shown in Figure 7-23, result from decreased
18 agricultural pumping during the irrigation season due to an increase in surface water deliveries
19 from the Delta under Alternative 2A in the western portion of the San Joaquin and Tulare Lake
20 Basins. Higher groundwater levels associated with reduced overall groundwater use would result in
21 a beneficial effect.

22 The SWP deliveries to areas outside of the Central Valley under this alternative would be greater
23 than those under the No Action Alternative. If more SWP/CVP surface water is available, utilization
24 of groundwater resources could be reduced. Implementation of Alternative 2A would result in an
25 overall decrease in groundwater pumping and a corresponding increase in groundwater levels.
26 Therefore, adverse effects on groundwater levels are not expected to occur due to the
27 implementation of Alternative 2A in these areas.

28 **CEQA Conclusion:** Total long-term average annual surface water deliveries to the CVP and SWP
29 Service Areas under Alternative 2A would be less than under Existing Conditions in the Export
30 Service Areas within the San Joaquin and Tulare groundwater basins, largely because of effects due
31 to climate change, sea level rise, and increased water demand north of the Delta. As a result,
32 modeling predicts that groundwater pumping under Alternative 2A would be greater than under
33 Existing Conditions, and that groundwater levels in some areas would be lower than under Existing
34 Conditions.

35 CVHM modeling results show that groundwater levels would decrease by up to 250 feet beneath the
36 Corcoran Clay under WBS14 (i.e., Westside and Northern Pleasant Valley basins) as compared with
37 Existing Conditions. The forecasted groundwater level changes across the Export Service Areas
38 during a typical peak groundwater level change condition in August as compared to Existing
39 Conditions are shown in Figure 7-24. These forecasted changes in groundwater levels result from
40 increased agricultural pumping during the irrigation season due to a decrease in surface water
41 deliveries from the Delta under Alternative 2A in the western portion of the San Joaquin and Tulare
42 Lake basins. On the eastern side of the San Joaquin and Tulare Lake basins, climate change impacts
43 on stream flows could result in a decline in groundwater levels of up to 50 feet. In addition, if

1 reduced stream flows are not adequate to meet the surface water diversion requirements,
2 groundwater pumping could increase, resulting in a further decline in groundwater levels.

3 As shown above in the NEPA analysis, SWP and CVP deliveries would either not change or would
4 increase under Alternative 2A as compared to deliveries under conditions in 2060 without
5 Alternative 2A if sea level rise and climate change conditions are considered the same under both
6 scenarios. For reasons discussed in Section 7.3.1, *Methods for Analysis*, DWR has identified effects of
7 action alternatives under CEQA separately from the effects of increased water demands, sea level
8 rise, and climate change, which would occur without and independent of the BDCP. Absent these
9 factors, the impacts of Alternative 2A with respect to groundwater levels are considered to be less
10 than significant.

11 The SWP deliveries to Southern California areas under Alternative 2A would be greater than those
12 under Existing Conditions, even considering the effects of increased water demands north of the
13 Delta, sea level rise, and climate change. As a result, groundwater withdrawals would not need to be
14 increased under Alternative 2A as compared to Existing Conditions, and the impact associated with
15 groundwater levels and recharge in Southern California areas would be less than significant.
16 Therefore, Alternative 2A would not in itself result in a significant impact on groundwater levels and
17 associated well yields in the Export Service Areas within the San Joaquin and Tulare groundwater
18 basins and within Southern California.

19 **Impact GW-9: Degrade Groundwater Quality**

20 **NEPA Effects:** As discussed under impact GW-8 above, surface water deliveries to the CVP and SWP
21 Export Service Areas are expected to increase under this alternative as compared to the No Action
22 Alternative, which is anticipated to result in a decrease in groundwater use. The decreased
23 groundwater use is not anticipated to alter regional patterns of groundwater flow in the Export
24 Service Areas. Therefore, it is not anticipated this would result in an adverse effect on groundwater
25 quality in the Export Service Areas.

26 **CEQA Conclusion:** As discussed under impact GW-8 above, the impacts of Alternative 2A with
27 respect to groundwater levels are considered to be less than significant. Therefore, no significant
28 groundwater quality impacts are anticipated during the implementation of Alternative 2A because it
29 is not anticipated to alter regional groundwater flow patterns in the Export Service Areas. Therefore,
30 this impact is considered less than significant. No mitigation is required.

31 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

32 The potential for groundwater level-induced land subsidence under this alternative would be
33 similar to that under Alternatives 1A and 6A. See Impact GW-10 under Alternative 1A.

34 **7.3.3.6 Alternative 2B—Dual Conveyance with East Alignment and Five** 35 **Intakes (15,000 cfs; Operational Scenario B)**

36 Facilities construction under Alternative 2B would be identical to those described for Alternative 1B.
37 Alternative 2B would involve relocation of two of the intakes to a location south of the confluence of
38 Sutter and Steamboat sloughs and the Sacramento River.

39 Operations of the facilities and implementation of the conservation measures under Alternative 2B
40 would be identical to actions described under Alternative 2A.

1 **Delta Region**

2 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with** 3 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity** 4 **of Preexisting Nearby Wells**

5 See Impact GW-1 under Alternative 1B; construction activities under Alternative 2B would be
 6 similar to those under Alternative 1B. The impacts on groundwater levels resulting from dewatering
 7 activities are dependent on the local hydrogeology and the depth and duration of dewatering
 8 required. Because all of the pump stations associated with the intakes are located in areas of similar
 9 geology and hydrogeology, and the dewatering configurations are identical for each of the facilities,
 10 it would be expected that the impacts of construction activities on local groundwater levels and
 11 associated well yields would be similar. The only differences would be associated with the location
 12 of the intakes. Both alternatives use Intakes 1, 2, and 3. However, Alternative 2B uses Intakes 6 and
 13 7 as opposed to Intakes 4 and 5 for Alternative 1B. The different intake locations would also add two
 14 different conveyance pipelines between the intakes and the canal. This intake location difference
 15 does not change the type of dewatering impact and the magnitude of the effect is expected to be
 16 similar. Therefore, the effects and mitigation measures described for Alternative 1B are valid for this
 17 alternative as well.

18 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with** 19 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity** 20 **of Preexisting Nearby Wells**

21 See Impact GW-2 under Alternative 1B; operations activities under Alternative 2B would be similar
 22 to those under Alternative 1B.

23 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of** 24 **Conveyance Facilities**

25 See Impact GW-3 under Alternative 1B; construction and operations activities under Alternative 2B
 26 would be similar to those under Alternative 1B.

27 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural** 28 **Drainage in the Delta**

29 See Impact GW-4 under Alternative 1B; construction activities under Alternative 2B would be
 30 similar to those under Alternative 1B. The impacts on groundwater levels resulting from dewatering
 31 activities are dependent on the local hydrogeology and the depth and duration of dewatering
 32 required. Because all of the pump stations associated with the intakes are located in areas of similar
 33 geology and hydrogeology, and the dewatering configurations are identical for each of the facilities,
 34 it would be expected that the impacts of construction activities on local agricultural drainage would
 35 be similar. The only differences would be associated with the location of the intakes. However,
 36 Alternative 2B uses Intakes 6 and 7 as opposed to Intakes 4 and 5 for Alternative 1B. The different
 37 intake locations would also add two different conveyance pipelines between the intakes and the
 38 canal. This intake location difference does not change the type of dewatering impact and the
 39 magnitude of the effect is expected to be similar. Therefore, the effects described for Alternative 1B
 40 are valid for this alternative as well.

1 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the**
2 **Delta**

3 See Impact GW-5 under Alternative 1B; operations activities under Alternative 2B would be similar
4 to those under Alternative 1B.

5 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter**
6 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or**
7 **Interfere with Agricultural Drainage as a Result of Implementing CM2–CM21**

8 See Impact GW-6 under Alternative 1B; CM2–CM21 under Alternative 2B would result in effects
9 similar to those under Alternative 1B.

10 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2–CM21**

11 See Impact GW-7 under Alternative 1B; CM2–CM21 under Alternative 2B would result in effects
12 similar to those under Alternative 1B.

13 **SWP/CVP Export Service Areas**

14 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with**
15 **Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of**
16 **Preexisting Nearby Wells**

17 See Impact GW-8 under Alternative 2A; project operations under Alternative 2B would be identical
18 to those under Alternative 2A.

19 **Impact GW-9: Degrade Groundwater Quality**

20 See Impact GW-9 under Alternative 2A; project operations under Alternative 2B would be identical
21 to those under Alternative 2A.

22 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

23 See Impact GW-10 under Alternative 2A; project operations under Alternative 2B would be identical
24 to those under Alternative 2A.

25 **7.3.3.7 Alternative 2C—Dual Conveyance with West Alignment and**
26 **Intakes W1–W5 (15,000 cfs; Operational Scenario B)**

27 Facilities construction under Alternative 2C would be identical to those described for Alternative 1C.

28 Operations of the facilities and implementation of the conservation measures under Alternative 2C
29 would be identical to actions described under Alternative 2A.

1 **Delta Region**

2 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with**
 3 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 4 **of Preexisting Nearby Wells**

5 See Impact GW-1 under Alternative 1C; construction activities under Alternative 2C would be the
 6 same as those under Alternative 1C. Both alternatives use the same intakes and conveyance
 7 footprint.

8 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with**
 9 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 10 **of Preexisting Nearby Wells**

11 See Impact GW-2 under Alternative 1C; operations activities under Alternative 2C would be the
 12 same as those under Alternative 1C.

13 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of**
 14 **Conveyance Facilities**

15 See Impact GW-3 under Alternative 1C; construction and operations activities under Alternative 2C
 16 would be the same as those under Alternative 1C.

17 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural**
 18 **Drainage in the Delta**

19 See Impact GW-4 under Alternative 1C; construction activities under Alternative 2C would be the
 20 same as those under Alternative 1C. Both alternatives use the same intakes and conveyance
 21 footprint.

22 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the**
 23 **Delta**

24 See Impact GW-5 under Alternative 1C; operations activities under Alternative 2C would be the
 25 same as under Alternative 1C.

26 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter**
 27 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or**
 28 **Interfere with Agricultural Drainage as a Result of Implementing CM2–CM21**

29 See Impact GW-6 under Alternative 1C; CM2–CM21 under Alternative 2C would result in effects
 30 similar to those under Alternative 1C.

31 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2–CM21**

32 See Impact GW-7 under Alternative 1C; CM2–CM21 under Alternative 2C would result in effects
 33 similar to those under Alternative 1C.

1 **SWP/CVP Export Service Areas**

2 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with**
 3 **Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of**
 4 **Preexisting Nearby Wells**

5 See Impact GW-8 under Alternative 2A; project operations under Alternative 2C would be identical
 6 to those under Alternative 2A.

7 **Impact GW-9: Degrade Groundwater Quality**

8 See Impact GW-9 under Alternative 2A; project operations under Alternative 2C would be identical
 9 to those under Alternative 2A.

10 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

11 See Impact GW-10 under Alternative 2A; project operations under Alternative 2C would be identical
 12 to those under Alternative 2A.

13 **7.3.3.8 Alternative 3—Dual Conveyance with Pipeline/Tunnel and**
 14 **Intakes 1 and 2 (6,000 cfs; Operational Scenario A)**

15 Facilities construction under Alternative 3 would be similar to those described for Alternative 1A,
 16 but with only two intakes.

17 Operations under Alternative 3 would be identical as under Alternative 1A except that there would
 18 be more reliance on the south Delta intakes due to less capacity provided by the north Delta intakes.
 19 Under Alternative 1A, the total north Delta intake capacity would be 15,000 cfs as compared with
 20 6,000 cfs under Alternative 3.

21 **Delta Region**

22 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with**
 23 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 24 **of Preexisting Nearby Wells**

25 See Impact GW-1 under Alternative 1A; construction activities under Alternative 3 would be similar
 26 to those under Alternative 1A. The impacts on groundwater levels resulting from dewatering
 27 activities are dependent on the local hydrogeology and the depth and duration of dewatering
 28 required. Because all of the pump stations associated with the intakes are located in areas of similar
 29 geology and hydrogeology, and the dewatering configurations are identical for each of the facilities,
 30 it would be expected that the impacts of construction activities on local groundwater levels and
 31 associated well yields would be similar. The only difference would be associated with the number of
 32 intakes used. This alternative would use two intakes instead of the five intakes used in Alternative 1.
 33 This would result in decreased dewatering impacts and fewer wells being affected.

1 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with**
 2 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 3 **of Preexisting Nearby Wells**

4 See Impact GW-2 under Alternative 1A; operations activities under Alternative 3 would be the same
 5 as those under Alternative 1A. Both alternatives use the same forebay locations, which, in the
 6 absence of design features intended to minimize seepage, would be the main locations of potential
 7 impacts on groundwater levels.

8 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of**
 9 **Conveyance Facilities**

10 See Impact GW-3 under Alternative 1A; construction and operations activities under Alternative 3
 11 would be similar to those under Alternative 1A, but to a lesser magnitude, because only two intakes
 12 would be constructed.

13 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural**
 14 **Drainage in the Delta**

15 See Impact GW-4 under Alternative 1A; construction activities under Alternative 3 would be similar
 16 to those under Alternative 1A, but to a lesser magnitude, because only two intakes would be
 17 constructed.

18 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the**
 19 **Delta**

20 See Impact GW-5 under Alternative 1A; operations activities under Alternative 3 would be similar to
 21 those under Alternative 1A.

22 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter**
 23 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or**
 24 **Interfere with Agricultural Drainage as a Result of Implementing CM2–CM21**

25 See Impact GW-6 under Alternative 1A; CM2–CM21 under Alternative 3 would result in effects
 26 similar to those under Alternative 1A.

27 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2–CM21**

28 See Impact GW-7 under Alternative 1A; CM2–CM21 under Alternative 3 would result in effects
 29 similar to those under Alternative 1A.

30 **SWP/CVP Export Service Areas**

31 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with**
 32 **Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of**
 33 **Preexisting Nearby Wells**

34 **NEPA Effects:** Total long-term average annual water deliveries to the CVP and SWP Service Areas
 35 under Alternative 3 would be higher than under the No Action Alternative, as described in Chapter
 36 5, *Water Supply*, and Table 7-7. Alternative 3 operations and deliveries would be very similar to the
 37 ones described for Alternative 1A.

1 Increases in surface water deliveries attributable to project operations from the implementation of
2 Alternative 3 are anticipated to result in a corresponding decrease in groundwater use in the Export
3 Service Areas, as discussed in subsection 7.3.3.2, *Alternative 1A–Dual Conveyance with*
4 *Pipeline/Tunnel and Intakes 1–5*.

5 CVHM modeling results show that groundwater levels would rise beneath the Corcoran Clay by up
6 to 10 feet in most areas in the western portions of the San Joaquin and Tulare Basins, but could rise
7 up to 250 feet under WBS 14 (i.e., Westside and Northern Pleasant Valley Basins) as compared with
8 the No Action Alternative. The forecasted maximum groundwater level changes occur in August
9 because agricultural groundwater pumping is typically highest during this month.

10 The forecasted groundwater level rises across the Export Service Areas during a typical peak
11 groundwater level change condition in August as compared to the No Action Alternative, are shown
12 in Figure 7-25. These forecasted changes in groundwater levels result from decreased agricultural
13 pumping during the irrigation season due to an increase in surface water deliveries from the Delta
14 under Alternative 3 in the western portion of the San Joaquin and Tulare Lake Basins. Effects on
15 groundwater levels due to the implementation of Alternative 3 are similar to the ones described for
16 Alternative 1A. However, the geographical extent of the impacts under Alternative 3 is slightly
17 different.

18 Overall, the CVP and SWP deliveries to agricultural areas in the Export Service Areas within the San
19 Joaquin and Tulare groundwater basins under this alternative would be greater than for the No
20 Action Alternative. This would result in an overall decrease in groundwater pumping and a
21 corresponding increase in groundwater levels.

22 The SWP deliveries to Southern California areas under Alternative 3 would be greater than those
23 under the No Action Alternative. Implementation of Alternative 3 would result in an overall
24 decrease in groundwater pumping and a corresponding increase in groundwater levels.

25 **CEQA Conclusion:** Total long-term average annual surface water deliveries to the CVP and SWP
26 Service Areas under Alternative 3 would be greater than those under Existing Conditions in the
27 Export Service Areas within the San Joaquin and Tulare groundwater basins, which would cause a
28 decrease in groundwater pumping and a resulting increase in groundwater levels in some areas.

29 CVHM modeling results show that groundwater levels would rise beneath the Corcoran Clay by up
30 to 100 feet under WBS 14 (i.e., Westside and Northern Pleasant Valley basins) as compared with
31 Existing Conditions (Figure 7-26). The forecasted maximum groundwater level changes occur in
32 August because agricultural groundwater pumping is typically highest during this month. On the
33 eastern side of the San Joaquin and Tulare Lake basins, climate change impacts on stream flows
34 could result in a decline in groundwater levels of up to 25 feet. In addition, if reduced stream flows
35 are not adequate to meet the surface water diversion requirements, groundwater pumping could
36 increase, resulting in a further decline in groundwater levels.

37 For reasons discussed in Section 7.3.1, *Methods for Analysis*, DWR has identified effects of action
38 alternatives under CEQA separately from the effects of increased water demands, sea level rise, and
39 climate change, which would occur without and independent of the BDCP. Absent these factors, the
40 impacts of Alternative 3 with respect to groundwater levels are considered to be less than
41 significant.

42 The SWP deliveries to areas outside of the Central Valley under Alternative 3 would be greater than
43 those under Existing Conditions. The impact associated with groundwater levels and recharge in

1 those areas would be less than significant. Therefore, Alternative 3 would not result in a significant
 2 impact on groundwater levels and associated well yields in the Export Service Areas within the San
 3 Joaquin and Tulare groundwater basins and in Southern California.

4 **Impact GW-9: Degrade Groundwater Quality**

5 **NEPA Effects:** The decrease in groundwater pumping that would occur in the Export Service Areas
 6 (as described in Impact GW-8) in response to greater CVP and SWP water supply availability would
 7 not alter regional patterns of groundwater flow and therefore would not degrade groundwater
 8 quality in the area. No adverse effect on groundwater quality is anticipated as a result of
 9 implementing Alternative 3.

10 **CEQA Conclusion:** Implementation of Alternative 3 is not anticipated to degrade groundwater
 11 quality in the Export Service Areas. This impact is considered less than significant. No mitigation is
 12 required.

13 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

14 The potential for groundwater level-induced land subsidence under Alternative 3 would be similar
 15 to that under Alternatives 1A and 6A. See Impact GW-10 under Alternative 1A.

16 **7.3.3.9 Alternative 4—Dual Conveyance with Modified Pipeline/Tunnel** 17 **and Intakes 2, 3, and 5 (9,000 cfs; Operational Scenario H)**

18 Facilities construction under Alternative 4 would be similar to those described for Alternative 1A;
 19 however, only three intakes would be constructed, which would include the use of slurry cutoff
 20 walls at the intake sites, as described in Chapter 3 *Description of Alternatives*, Section 3.6.1.1, and in
 21 the Modified Pipeline/Tunnel Option (MPTO) Conceptual Engineering Report (CER) (California
 22 Department of Water Resources 2015). The Intermediate Forebay for Alternative 4 differs
 23 significantly from the one that would be constructed under Alternative 1A. The Alternative 4
 24 Intermediate Forebay would be smaller (from 720 acres to 40 acres in water surface area) and
 25 would be located farther away from the Sacramento River and farther south from the intakes as
 26 compared to Alternative 1A. Alternative 4 would result in the modification and expansion of Clifton
 27 Court Forebay to include the Byron Tract area. Construction at both of these forebays and the tunnel
 28 shafts would include installation of slurry cutoff walls, as described in Chapter 3 *Description of*
 29 *Alternatives*, Section 3.6.1 and in the MPTO CER.

30 The discussion below presents a combination of simulated quantitative results and a qualitative
 31 approach, since the only scenario that was simulated with CVHM and CVHM-D is Scenario H3 due to
 32 the fact that it falls within the range of delivery resulting from the other Alternative 4 scenarios and
 33 provides a realistic average.

34 **Delta Region**

35 Construction and operation of Alternative 4 facilities would be similar under each of the operational
 36 scenarios for the purposes of this analysis, since the footprint is the same. Therefore, the description
 37 of impacts that were simulated with CVHM-D for Scenario H3 below is applicable to each Alternative
 38 4 scenario.

1 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with**
 2 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 3 **of Preexisting Nearby Wells**

4 See Impact GW-1 under Alternative 1A; construction activities that would affect groundwater
 5 conditions under Alternative 4 would generally be similar to those under Alternative 1A, except for
 6 the installation of slurry cutoff walls at the intake locations, tunnel shafts and forebays. The impacts
 7 on groundwater levels resulting from dewatering activities are dependent on the local hydrogeology
 8 and the depth and duration of dewatering required. Because all of the intakes are located in areas of
 9 similar geology and hydrogeology, and the dewatering configurations are identical for each of the
 10 facilities, it would be expected that the impacts of construction activities on local groundwater levels
 11 and associated well yields would be similar with respect to intake construction. This alternative uses
 12 three intakes instead of five used in Alternative 1A. The reduction in the number of intakes in
 13 addition to the use of slurry cutoff walls would result in decreased dewatering effects and fewer
 14 wells being affected.

15 Geotechnical explorations including geophysical surveys, seismic profiling, pressure meter and
 16 aquifer tests would be performed to collect data related to subsoil properties and the construction
 17 dewatering requirements in areas where deep excavation is anticipated (California Department of
 18 Water Resources 2014).

19 Specific considerations for the construction of elements of Alternative 4 are as follows and are
 20 described in the MPTO CER (California Department of Water Resources 2015).

21 **Intakes**

22 According to the MPTO CER, “a deep slurry cutoff wall will be installed to enhance future public
 23 protection from levee under seepage in accordance with USACE requirements and to reduce the
 24 groundwater inflow into deep excavations within the intake facility site pad” (California Department
 25 of Water Resources 2015).

26 Slurry cutoff walls would also be installed around the entire intake construction site to reduce
 27 dewatering effects on surrounding wells during construction.

28 **Intake Pipelines**

29 Pipeline dewatering with two dewatering schemes are being considered, pending more detailed
 30 geotechnical and groundwater quality investigations to assess the best methodology to be used.
 31 Where high groundwater is encountered along portions of the alignment, a groundwater collection
 32 and disposal system would be installed and operated continuously during the construction period
 33 while the excavation trench is open. Temporary localized impacts would be mitigated.

34 **Clifton Court Pumping Plant Shafts**

35 The pumping plant shafts are assumed to be constructed using slurry diaphragm walls. Dewatering
 36 inside the slurry wall enclosure would be conducted as necessary to support shaft excavation, but
 37 likely would be intermittent. No significant impacts due to shaft construction dewatering are
 38 anticipated as the dewatered zone would be hydraulically isolated from the surrounding aquifer
 39 system.

1 **Tunnel Shafts**

2 Tunnel shafts are assumed to be constructed using slurry diaphragm walls, and therefore require
3 only minimal dewatering, as necessary. Construction of the tunnel shafts is not anticipated to result
4 in significant impacts on surrounding groundwater as the dewatered zone would be hydraulically
5 isolated from the surrounding aquifer system.

6 **Intermediate Forebay**

7 Dewatering is required for excavation operations at the Intermediate Forebay, notably to build the
8 embankments. Slurry cutoff walls would also be installed along the embankments of the forebay
9 site to reduce dewatering effects on surrounding wells during construction.

10 **Clifton Court Forebays**

11 The new embankments at Clifton Court Forebay would be constructed by installing a sheet pile
12 cofferdam, dewatering, excavating the embankment foundations down to suitable material. Slurry
13 cutoff walls would also be installed along the embankments of the forebay site to reduce dewatering
14 effects on surrounding wells during construction.

15 **NEPA Effects:** Due to the measures described above and in Appendix 3B, *Environmental*
16 *Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, construction activities
17 associated with Alternative 4 conveyance facilities are not anticipated to result in adverse effects on
18 surrounding groundwater levels and well yields. If site-specific geotechnical conditions result in
19 localized groundwater elevation reductions, mitigation measure GW-1 is available to help reduce
20 this effect.

21 **CEQA Conclusion:** Due to the measures described above and in Appendix 3B, *Environmental*
22 *Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, construction activities
23 associated with conveyance facilities under CM1 for Alternative 4 including temporary dewatering
24 are not anticipated to result in significant impacts on surrounding groundwater levels and well
25 yields. If site-specific geotechnical conditions result in localized groundwater elevation reductions,
26 mitigation measure GW-1 is available to help reduce this effect. This impact is therefore less-than-
27 significant.

28 **Mitigation Measure GW-1: Maintain Water Supplies in Areas Affected by Construction** 29 **Dewatering**

30 See Mitigation Measure GW-1 under Impact GW-1 in the discussion of Alternative 1A.

31 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with** 32 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity** 33 **of Preexisting Nearby Wells**

34 **NEPA Effects:** Due to the measures described above for Impact GW-1 and in Appendix 3B,
35 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, operations
36 of Alternative 4 conveyance facilities are not anticipated to result in adverse effects on surrounding
37 groundwater levels and well yields. The new Intermediate Forebay and the expanded Clifton Court
38 Forebay would be constructed to comply with the requirements of the DSD which include design
39 features intended to minimize seepage under the embankments. In addition, the forebays would

1 include a seepage cutoff wall installed to the impervious layer and a toe drain around the forebay
2 embankment, to capture water and pump it back into the forebay.

3 Operation of the tunnel would have no effect on existing wells or yields given the facilities would be
4 located more than 100 feet underground and would not substantially alter groundwater levels in the
5 vicinity.

6 Model simulations also indicate up to 5-foot episodic lowering of groundwater levels beneath the
7 Sacramento River due to lower flows in the river as a result of diversions at the north Delta intakes
8 that result in a reduction in river flows and elevations, as described in Chapter 6, *Surface Water*. The
9 groundwater level changes would be 5-feet or less on nearby shallow domestic well yields. Due to
10 the implementation of Mitigation Measure GW-1, no additional mitigation measures are required.

11 Therefore, during operations there would be no adverse effects on groundwater resources.

12 **CEQA Conclusion:** Due to the measures described above for Impact GW-1 and in Appendix 3B,
13 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, operations
14 of Alternative 4 conveyance facilities are not anticipated to result in adverse effects on surrounding
15 groundwater levels and well yields. The new Intermediate Forebay and the expanded Clifton Court
16 Forebay would include design features intended to minimize seepage under the embankments and a
17 toe drain around the forebay embankment, to capture water and pump it back into the forebay.

18 Operation of the tunnel would have no impact on existing wells or yields given these facilities would
19 be located over 100 feet underground and would not substantially alter groundwater levels in the
20 vicinity.

21 Groundwater levels in the Suisun Marsh area under Alternative 4 are forecasted to rise by 1–5 feet
22 compared with Existing Conditions, as described for Alternative 1A. This groundwater level rise is
23 primarily attributable to sea level rise and climate change conditions in the Alternative 1A CVHM-D
24 simulation. However, the anticipated effects of climate change and sea level rise are provided for
25 information purposes only and do not lead to mitigation measures.

26 Model simulations also indicate up to 5-foot episodic lowering of groundwater levels beneath the
27 Sacramento River due to lower flows in the river as a result of diversions at the north Delta intakes
28 that result in a reduction in river flows and elevations, as described in Chapter 6, *Surface Water*. The
29 groundwater level changes would be 5-feet or less on nearby shallow domestic well yields. Due to
30 the implementation of Mitigation Measure GW-1, no additional mitigation measures are required.

31 Therefore, this impact would be less than significant. No mitigation is required.

32 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of** 33 **Conveyance Facilities**

34 **NEPA Effects:** Due to the measures described above under Impact GW-1 and in Appendix 3B,
35 *Environmental Commitments, AMMs, and CMs* related to installation of slurry cutoff walls,
36 construction and operations activities associated with Alternative 4 conveyance facilities are not
37 anticipated to result in adverse effects on surrounding groundwater levels or changes in direction of
38 groundwater flow patterns near the intake pump stations along the Sacramento River, Intermediate
39 Forebay, and the expanded Clifton Court Forebay that includes the Byron Tract area. Since no
40 significant regional changes in groundwater flow directions are forecasted, and the inducement of
41 poor-quality groundwater into areas of better quality is unlikely, it is anticipated that there would

1 be no change in groundwater quality for Alternative 4 (see Section 7.3.3, *Effects and Mitigation*
2 *Approaches*).

3 Groundwater removed with the dewatering system would be treated as necessary and discharged to
4 surface waters under an NPDES permit (see Chapter 8, *Water Quality*). Construction best
5 management practices would also be implemented to minimize dewatering impacts to the extent
6 practicable, as described in Appendix 3B, *Environmental Commitments, AMMs, and CMs*. There would
7 be no adverse effect.

8 **CEQA Conclusion:** Due to the measures described above under Impact GW-1 and in Appendix 3B,
9 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
10 construction and operations activities associated with Alternative 4 conveyance facilities are not
11 anticipated to result in adverse effects on surrounding groundwater levels or changes in direction of
12 groundwater, no significant groundwater quality impacts are anticipated during construction and
13 operations activities of the conveyance facilities. Further, the planned treatment of extracted
14 groundwater prior to discharge into adjacent surface waters would prevent significant impacts on
15 groundwater quality.

16 No significant groundwater quality impacts are anticipated in most areas of the Delta during the
17 implementation of Alternative 4, because changes to regional patterns of groundwater flow are not
18 anticipated. However, degradation of groundwater quality near the Suisun Marsh area are likely,
19 due to the effects of saline water intrusion caused by rising sea levels (see discussion under Impact
20 GW-2). Effects due to climate change are provided for informational purposes only and do not lead
21 to mitigation. This impact would be less than significant. No mitigation is required.

22 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural** 23 **Drainage in the Delta**

24 **NEPA Effects:** Due to the measures described above under Impact GW-1 and in Appendix 3B,
25 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
26 construction activities associated with Alternative 4 conveyance facilities are not anticipated to
27 result in effects on surrounding groundwater levels that would affect agricultural drainage.
28 Therefore, construction of conveyance features is not forecasted to result in adverse effects to
29 agricultural drainage under Alternative 4.

30 **CEQA Conclusion:** Due to the measures described above under Impact GW-1 and in Appendix 3B,
31 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
32 construction activities associated with Alternative 4 conveyance facilities are not anticipated to
33 result in effects on surrounding groundwater levels that would affect agricultural drainage. This
34 impact would be less than significant. No mitigation is required.

35 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the** 36 **Delta**

37 **NEPA Effects:** As described in Chapter 3, *Description of Alternatives, Section 3.6.1.4*, under
38 Alternative 4, and in Appendix 3B, the Intermediate Forebay and the expanded Clifton Court
39 Forebay would include a seepage cutoff wall to the impervious layer and a toe drain around the
40 forebay embankment, to capture water and pump it back into the forebay. These design measures
41 would reduce potential for seepage onto adjacent lands and avoid interference with agricultural
42 drainage in the vicinity of the Intermediate Forebay and Clifton Court Forebay. Once constructed,

1 the operation of the forebay would be monitored to ensure seepage does not exceed performance
2 requirements, as described under Mitigation Measure GW-5.

3 **CEQA Conclusion:** As described in Chapter 3, *Description of Alternatives, Section 3.6.1.4*, under
4 Alternative 4, and in Appendix 3B, the Intermediate Forebay and the expanded Clifton Court
5 Forebay would include a seepage cutoff wall to the impervious layer and a toe drain around the
6 forebay embankment, to capture water and pump it back into the forebay. These design measures
7 would greatly reduce any potential for seepage onto adjacent lands and avoid interference with
8 agricultural drainage in the vicinity of the Intermediate Forebay and Clifton Court Forebay. Once
9 constructed, the operation of the forebay would be monitored to ensure seepage does not exceed
10 performance requirements, as described under Mitigation Measure GW-5.

11 .In addition, as described for Impact GW-2, groundwater levels are projected to increase in Suisun
12 Marsh under Alternative 1A compared to Existing Conditions, primarily due to sea level rise and
13 climate change conditions as simulated with the Alternative 1A CVHM-D run. These increases in
14 groundwater levels could affect agricultural drainage in the Suisun Marsh area, but do not in and of
15 themselves require mitigation.

16 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

17 Please see Mitigation Measure GW-5 under Impact GW-5 in the discussion of Alternative 1A.

18 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter** 19 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or** 20 **Interfere with Agricultural Drainage as a Result of Implementing CM2–CM21**

21 **NEPA Effects:** Increased frequency of inundation of areas associated with the proposed tidal habitat,
22 channel margin habitat, and seasonally inundated floodplain restoration actions would result in
23 increased groundwater recharge. Such increased recharge could result in groundwater level rises in
24 some areas. Depending on the local geology, flooding of one area could also increase seepage to
25 adjacent islands. Seasonally inundated floodplain restoration actions proposed in the north, east,
26 and south Delta areas would be expected to result in a substantially increased rate of recharge and
27 related groundwater-level increases. The magnitude of these effects depends on existing
28 groundwater levels and land uses. For example, in the central Delta and portions of the north and
29 south Delta, areas that are below sea level would experience saturated soils. More frequent
30 inundation would increase seepage, which is already difficult and expensive to control in most
31 agricultural lands in the Delta (see Chapter 14, *Agricultural Resources*). Effects on agricultural
32 drainage and potential effects would need to be addressed on a site-specific basis.

33 **CEQA Conclusion:** Increased frequency of inundation of areas associated with the proposed tidal
34 habitat, channel margin habitat, and seasonally inundated floodplain restoration actions would
35 result in increased groundwater recharge. Such increased recharge could result in groundwater
36 level rises in some areas and would increase seepage, which is already difficult and expensive to
37 control in most agricultural lands in the Delta (see Chapter 14, *Agricultural Resources*). This impact
38 would be reduced to a less-than-significant level with the implementation of Mitigation Measure
39 GW-5 by identifying areas where seepage conditions have worsened and installing additional
40 subsurface drainage measures, as needed.

41 Implementation of Mitigation Measure GW-5 is anticipated to reduce this impact to a less-than-
42 significant level in most instances, though in some instances mitigation may be infeasible due to

1 factors such as costs. The impact is therefore significant and unavoidable as applied to such latter
2 properties.

3 As described for Impact GW-2, groundwater levels are projected to increase in Suisun Marsh under
4 Alternative 4 compared to Existing Conditions, primarily due to sea level rise and climate change
5 conditions. These increases in groundwater levels could affect agricultural drainage in the Suisun
6 Marsh area, but do not in and of themselves require mitigation.

7 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

8 See Mitigation Measure GW-5 under Impact GW-5.

9 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2–CM21**

10 **NEPA Effects:** Implementation of other conservation measures under Alternative 4 is generally not
11 anticipated to alter regional patterns of groundwater flow or quality. However, increased inundation
12 frequency in restoration areas would increase the localized areas exposed to saline and brackish
13 surface water, which could result in increased groundwater salinity beneath such areas. Potential
14 effects would need to be addressed on a site-specific basis.

15 The flooding of large areas with saline or brackish water would result in an adverse effect on
16 groundwater quality beneath or adjacent to flooded areas. It would not be possible to
17 completely avoid this effect. However, if water supply wells in the vicinity of these areas are not
18 useable because of water quality issues, Mitigation Measure GW-7 is available to address this effect.

19 **CEQA Conclusion:** At this point, a definitive conclusion regarding the potential for groundwater
20 quality degradation beneath restoration areas cannot be reached. Potential impacts would need to
21 be addressed on a site-specific basis, but are anticipated to be significant. Implementation of
22 Mitigation Measure GW-7 would reduce this impact, but the impact would remain significant and
23 unavoidable.

24 **Mitigation Measure GW-7: Provide an Alternate Source of Water**

25 For areas that will be on or adjacent to implemented restoration components, groundwater
26 quality will be monitored by project proponents prior to implementation to establish baseline
27 groundwater quality conditions. Unacceptable degradation of groundwater quality will be
28 determined by comparing post-implementation groundwater quality to relevant regulatory
29 standards and with consideration of previously established beneficial uses. For wells affected by
30 degradation in groundwater quality, water of a quality comparable to pre-project conditions
31 would be provided. Options for replacing the water supply could include drilling an additional
32 well or a deeper well to an aquifer zone with water quality comparable to or better than
33 preconstruction conditions or replacement of potable water supply. Construction activities are
34 anticipated to be localized and would not result in change in land uses. The well drilling
35 activities would result in short-term noise impacts for several days. (Chapter 31, *Other*
36 *CEQA/NEPA Required Sections including Mitigation and Environmental Commitment Impacts,*
37 *Environmentally Superior Alternative, and Public Trust Considerations,* provides an assessment of
38 the impacts of implementing proposed mitigation measures.)

1 SWP/CVP Export Service Areas

2 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with** 3 **Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of** 4 **Preexisting Nearby Wells**

5 *NEPA Effects:* Total long-term average annual water deliveries to the CVP and SWP Service Areas
 6 under Alternative 4 vary for each of the scenarios, compared to the No Action Alternative.

7 The four operational scenarios represent a range of surface water exports to the CVP and SWP
 8 Service Areas. In general, Scenario H1 includes the highest total long-term average annual water
 9 deliveries to the CVP and SWP Service Areas, while Scenario H4 includes the lowest total long-term
 10 average annual water deliveries to the Export Service Areas. These two scenarios reflect the range of
 11 effects that would result from the four potential outcomes under Alternative 4, the effects associated
 12 with H2 and H3 fall within this range.

13 For the Export Service Areas within the San Joaquin and Tulare groundwater basins, each of the four
 14 potential outcomes provides higher surface water deliveries under Alternative 4, compared to the
 15 No Action Alternative. Alternative 4 Scenario H3 was simulated with CVHM, and was used to provide
 16 an example analysis for an outcome that is between the highest and the lowest deliveries. The
 17 discussion below provides an effect discussion based on CVHM simulation results for Alternative 4
 18 Scenario H3. The effects of Scenarios H1, H2, and H4 would be similar to those under Scenario H3,
 19 but with the magnitude of the effects proportional to the change in the quantity of CVP/SWP surface
 20 water supplies delivered to the Export Service Areas under each scenario.

21 Total long-term average annual water deliveries to the Export Service Areas under Alternative 4
 22 Scenario H3 would be higher than under the No Action Alternative, as described in Chapter 5, *Water*
 23 *Supply*, and Table 7-7. Increases in surface water deliveries attributable to project operations from
 24 the implementation of Alternative 4 are anticipated to result in a corresponding decrease in
 25 groundwater use in the Export Service Areas, as compared with the No Action Alternative, as
 26 discussed in subsection 7.3.3.2, *Alternative 1A–Dual Conveyance with Pipeline/Tunnel and Intakes 1–*
 27 *5*.

28 CVHM modeling results for groundwater under the Corcoran Clay layer show that levels would rise
 29 up to 10 feet in most areas in the western and southern portions of the Valley, but could increase by
 30 up to 250 feet under WBS 14 (i.e., Westside and Northern Pleasant Valley Basins) as compared with
 31 the No Action Alternative. The forecasted maximum groundwater level changes occur in August
 32 because agricultural groundwater pumping is typically highest during this month.

33 The forecasted groundwater level rises across the Export Service Areas during a typical peak
 34 groundwater level change condition in August, as compared to the No Action Alternative are shown
 35 in Figure 7-27. These forecasted changes in groundwater levels result from decreased agricultural
 36 pumping during the irrigation season due to an increase in surface water deliveries from the Delta
 37 under Alternative 4 Scenario H3 in the western portion of the San Joaquin and Tulare Lake Basins.
 38 Indirect effects of increased groundwater levels include a reduction in pumping costs due to
 39 reduced lift requirements, a reduced potential for the inducement of inelastic subsidence, and an
 40 increase in the available yields from pumping wells within the affected area. The SWP deliveries to
 41 Southern California areas under Alternative 4 Scenarios H1, H2, and H3 would be greater than those
 42 under the No Action Alternative. Implementation of Alternative 4 with these scenarios would result
 43 in an overall decrease in groundwater pumping and a corresponding increase in groundwater levels.

1 The SWP deliveries to Southern California areas under Alternative 4 Scenario H4 would be less than
2 those under the No Action Alternative. Implementation of Alternative 4 Scenario H4 may result in
3 additional groundwater pumping and a potential corresponding decrease in groundwater levels.
4 This could result in adverse effects associated with groundwater levels and recharge in Southern
5 California areas. However, opportunities for additional pumping might be limited by basin
6 adjudications and other groundwater management programs. Additionally, as discussed in
7 Appendix 5B, *Responses to Reduced South of Delta Water Supplies*, adverse effects might be avoided
8 due to the existence of various other water management options that could be undertaken in
9 response to reduced exports from the Delta. These options include wastewater recycling and reuse,
10 increased water conservation, water transfers, construction of new local reservoirs that could retain
11 Southern California rainfall during wet years, and desalination.

12 Even if the effect is adverse, feasible mitigation would not be available to diminish this effect due to
13 a number of factors. First, State Water Contractors currently and traditionally have received variable
14 water supplies under their contracts with DWR due to variations in hydrology and regulatory
15 constraints and are accustomed to responding accordingly. Any reductions associated with this
16 effect would be subject to these contractual limitations. Under standard state water contracts, the
17 risk of shortfalls in exports is borne by the contractors rather than DWR. As a result of this
18 variability, many Southern California water districts have complex water management strategies
19 that include numerous options, as described above, to supplement SWP surface water supplies.
20 These water districts are in the best position to determine the appropriate response to reduced
21 imports from the Delta. Second, as noted above, it may be legally impossible to extract additional
22 groundwater in adjudicated basins without gaining the permission of watermasters and accounting
23 for groundwater pumping entitlements and various parties under their adjudicated rights. Finally, in
24 many groundwater basins, additional groundwater pumping might exacerbate existing overdraft
25 and subsidence conditions, even if such pumping is legally permissible because the affected basin
26 has not been adjudicated or no other groundwater management program is in place.

27 **CEQA Conclusion:** For the Export Service Areas within the San Joaquin and Tulare groundwater
28 basins, each of the four potential outcomes provides lower surface water deliveries under
29 Alternative 4, compared to Existing Conditions, largely because of effects due to climate change, sea
30 level rise, and increased water demand north of the Delta. Alternative 4 Scenario H3 was simulated
31 with CVHM, and was used to provide an example impacts analysis for an outcome that is between
32 the highest and the lowest deliveries. Modeling predicts that groundwater pumping under
33 Alternative 4 Scenario H3 would be greater than under Existing Conditions, and that groundwater
34 levels in some areas would be lower than under Existing Conditions.

35 CVHM modeling results of groundwater under the Corcoran Clay layer show that levels would
36 decrease by up to 250 feet under WBS14 (i.e., Westside and Northern Pleasant Valley basins) as
37 compared with Existing Conditions. The forecasted groundwater level changes across the Export
38 Service Areas during a typical peak groundwater level change condition in August as compared to
39 Existing Conditions are shown in Figure 7-28. These forecasted changes in groundwater levels
40 under Alternative 4 result from increased agricultural pumping during the irrigation season due to a
41 decrease in surface water deliveries from the Delta to the western portion of the San Joaquin and
42 Tulare Lake basins. On the eastern side of the San Joaquin and Tulare Lake basins, climate change
43 impacts on stream flows could result in a decline in groundwater levels of up to 50 feet. In addition,
44 if reduced stream flows are not adequate to meet the surface water diversion requirements,
45 groundwater pumping could increase, resulting in a further decline in groundwater levels.

1 As shown above in the NEPA analysis, SWP and CVP deliveries would either not change or would
 2 increase under Alternative 4 for all scenarios as compared to deliveries under conditions in 2060
 3 without Alternative 4 if sea level rise and climate change conditions are considered the same under
 4 both scenarios. For reasons discussed in Section 7.3.1, *Methods for Analysis*, DWR has identified
 5 effects of action alternatives under CEQA separately from the effects of increased water demands,
 6 sea level rise, and climate change, which would occur without and independent of the BDCP. Absent
 7 these factors, the impacts of Alternative 4 for each of the four scenarios with respect to groundwater
 8 levels are considered to be less than significant.

9 Unlike the NEPA analysis where scenarios H1 and H4 bounded the range of anticipated impacts, the
 10 impacts relative to the Existing Conditions baseline are more variable. The SWP deliveries to
 11 Southern California areas under Alternative 4 Scenarios H1 and H3 would be greater than those
 12 under Existing Conditions. This would result in beneficial impacts associated with groundwater
 13 levels and recharge in Southern California areas. However, the SWP deliveries to Southern California
 14 areas under Alternative 4 Scenarios H2 and H4 would be less than those under Existing
 15 Conditions. For Scenario H2, the reduced surface water deliveries would be largely due to the effects
 16 of climate change, sea level rise, and increased water demand north of the Delta, and, as described
 17 above for the Tulare and San Joaquin areas, absent these factors, the impacts of Scenario H2 on
 18 groundwater levels would be less than significant. For Scenario H4, reduced surface water deliveries
 19 could result in significant impacts associated with groundwater levels and recharge in Southern
 20 California areas.

21 As discussed above in the NEPA conclusion, Southern California water districts may be able to avoid
 22 this impact due to various water management options. For reasons also discussed above, no feasible
 23 mitigation would be available to mitigate this impact if it is significant. Due to these uncertainties,
 24 the overall impact for Alternative 4 (Scenarios H1–H4) is considered significant and unavoidable.

25 **Impact GW-9: Degrade Groundwater Quality**

26 **NEPA Effects:** As discussed under Impact GW-8, surface water deliveries to the CVP and SWP Export
 27 Service Areas in the San Joaquin Valley and Tulare Basin under all Alternative 4 scenarios (H1–H4)
 28 outcomes are expected to increase as compared to the No Action Alternative. Increased surface
 29 water deliveries could result in a decrease in groundwater use. The decreased groundwater use is
 30 not anticipated to alter regional patterns of groundwater flow in these service areas. Therefore, it is
 31 not anticipated this would result in an adverse effect on groundwater quality in these areas.

32 In contrast, under Scenario H4 there would be reduced SWP supplies in Southern California. It is
 33 unclear, however, whether such reductions would lead to increased groundwater pumping for
 34 reasons discussed in connection to Impact GW-8. If groundwater pumping is increased, there could
 35 be resulting changes in regional patterns of groundwater flow and a change in groundwater quality.
 36 Due to the uncertainty associated with these effects, this effect is considered adverse. For the same
 37 reasons discussed earlier in connection with the possibility of increased groundwater pumping in
 38 Southern California, there is no feasible mitigation available to mitigate any changes in regional
 39 groundwater quality.

40 **CEQA Conclusion:** As discussed under Impact GW-8 above, the impacts of Alternative 4 under all
 41 scenarios with respect to groundwater levels are considered to be less than significant in the CVP
 42 and SWP Export Service Areas in the San Joaquin Valley and Tulare Basin. Therefore, no significant
 43 groundwater quality impacts are anticipated in these areas during the implementation of
 44 Alternative 4 because it is not anticipated to alter regional groundwater flow patterns. Therefore,

1 this impact is considered less than significant with respect to these areas. The same is true for
2 Scenarios H1-H3 for the Southern California SWP Export Service Areas.

3 However, implementation of Alternative 4 Scenarios H4 could degrade groundwater quality in
4 portions of the Southern California SWP Export Service Areas; this impact is considered significant
5 due to the possibility of increased groundwater pumping and the resulting effects on regional
6 groundwater flow patterns. As discussed above, there is no feasible mitigation available to address
7 this significant impact. The impact would be considered significant and unavoidable in these areas.

8 Due to the uncertainties identified in connection with the potential response to Impact GW-8 under
9 Scenario H4 in Southern California, the overall impact for Impact GW-9 Alternative 4 (Scenarios H1-
10 H4) is considered significant and unavoidable.

11 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

12 Groundwater level-induced land subsidence has the highest potential to occur in the San Joaquin
13 Valley and Tulare Basin portions of the Export Service Areas, based on historical data, if
14 groundwater pumping substantially increases due to implementation of the alternative.

15 **NEPA Effects:** As discussed under Impact GW-8, surface water deliveries to the Export Service Areas
16 in the San Joaquin Valley and Tulare Basin under all Alternative 4 scenarios (H1-H4) outcomes are
17 expected to increase as compared to the No Action Alternative. Increased surface water deliveries
18 could result in a decrease in groundwater pumping. The decreased groundwater pumping would
19 result in higher groundwater levels, and therefore, the potential for groundwater level-induced land
20 subsidence is reduced under Alternative 4. Operations under Alternative 4 would not result in an
21 adverse effect on the potential for groundwater level-induced land subsidence in these areas
22 because groundwater levels would not decline such that compaction of unconsolidated materials in
23 the unconfined aquifer would occur.

24 **CEQA Conclusion:** As discussed under Impact GW-8, the impacts of Alternative 4 under all scenarios
25 with respect to groundwater levels are considered to be less than significant in the CVP and SWP
26 Export Service Areas in the San Joaquin Valley and Tulare Basin. Therefore, the potential for
27 groundwater level-induced land subsidence is anticipated to be less than significant in these areas
28 during the implementation of Alternative 4 because it is not anticipated to result in a decline in
29 groundwater levels such that compaction of unconsolidated materials in the unconfined aquifer
30 would occur.

31 **7.3.3.10 Alternative 5—Dual Conveyance with Pipeline/Tunnel and** 32 **Intake 1 (3,000 cfs; Operational Scenario C)**

33 Facilities construction under Alternative 5 would be similar to those described for Alternative 1A
34 with only one intake.

35 Operations under Alternative 5 would be similar to those under Alternative 1A except for a few
36 actions, as described in Chapter 6, *Surface Water*.

1 **Delta Region**

2 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with** 3 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity** 4 **of Preexisting Nearby Wells**

5 See Impact GW-1 under Alternative 1A; construction activities under Alternative 5 would be similar
 6 to those under Alternative 1A. The impacts on groundwater levels resulting from dewatering
 7 activities are dependent on the local hydrogeology and the depth and duration of dewatering
 8 required. Because all of the pump stations associated with the intakes are located in areas of similar
 9 geology and hydrogeology, and the dewatering configurations are identical for each of the facilities,
 10 it would be expected that the impacts of construction activities on local groundwater levels and
 11 associated well yields would be similar. The only difference would be associated with the number of
 12 intakes used. This alternative uses one intake instead of five used in Alternative 1A. This would
 13 result in decreased dewatering effects and fewer wells being affected.

14 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with** 15 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity** 16 **of Preexisting Nearby Wells**

17 See Impact GW-2 under Alternative 1A; operations activities under Alternative 5 would be similar to
 18 those under Alternative 1A. Both alternatives use the same forebay locations, which, in the absence
 19 of design features intended to minimize seepage, would be the main locations of potential impacts
 20 on groundwater levels.

21 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of** 22 **Conveyance Facilities**

23 See Impact GW-3 under Alternative 1A; construction and operations activities under Alternative 5
 24 would be similar to those under Alternative 1A, but to a lesser magnitude, because only one intake
 25 would be constructed.

26 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural** 27 **Drainage in the Delta**

28 See Impact GW-4 under Alternative 1A; construction activities under Alternative 5 would be similar
 29 to those under Alternative 1A, but to a lesser magnitude, because only one intake would be
 30 constructed.

31 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the** 32 **Delta**

33 See Impact GW-5 under Alternative 1A; operations activities under Alternative 5 would be similar to
 34 those under Alternative 1A.

35 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter** 36 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or** 37 **Interfere with Agricultural Drainage as a Result of Implementing CM2–CM21**

38 See Impact GW-6 under Alternative 1A; CM2–CM21 under Alternative 5 would result in effects
 39 similar to those under Alternative 1A.

1 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2–CM21**

2 See Impact GW-7 under Alternative 1A; CM2–CM21 under Alternative 5 would result in effects
3 similar to those under Alternative 1A.

4 **SWP/CVP Export Service Areas**

5 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with**
6 **Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of**
7 **Preexisting Nearby Wells**

8 **NEPA Effects:** Total long-term average annual water deliveries to the CVP and SWP Service Areas
9 under Alternative 5 would be higher than under the No Action Alternative, as described in Chapter
10 5, *Water Supply*, and Table 7-7. Increases in surface water deliveries attributable to project
11 operations from the implementation of Alternative 5 are anticipated to result in a corresponding
12 decrease in groundwater use in the Export Service Areas, as compared with the No Action
13 Alternative as discussed in subsection 7.3.3.2, *Alternative 1A–Dual Conveyance with Pipeline/Tunnel*
14 *and Intakes 1–5*.

15 CVHM modeling results show that groundwater levels would rise beneath the Corcoran Clay of up to
16 10 feet in most areas in the western and southern portions of the valley, but could increase by up to
17 250 feet under WBS 14 (i.e., Westside and Northern Pleasant Valley Basins of the western Tulare
18 Basin).

19 The forecasted maximum groundwater level declines across the Export Service Areas during a
20 typical peak groundwater level change condition in August, as compared with the No Action
21 Alternative, are shown in Figure 7-29.

22 The SWP deliveries to Southern California areas under Alternative 5 would be higher than those
23 under the No Action Alternative. Therefore, implementation of Alternative 5 would result in an
24 overall decrease in groundwater pumping and a corresponding increase in groundwater levels.
25 Therefore, adverse effects on groundwater levels are not expected to occur due to the
26 implementation of Alternative 5 in these areas.

27 **CEQA Conclusion:** Total long-term average annual surface water deliveries to the CVP and SWP
28 Service Areas under Alternative 5 would be less than under Existing Conditions in the Export
29 Service Areas within the San Joaquin and Tulare groundwater basins, largely because of effects due
30 to climate change, sea level rise, and increased water demand north of the Delta. As a result,
31 modeling predicts that groundwater pumping under Alternative 5 would be greater than under
32 Existing Conditions, and that groundwater levels in some areas would be lower than under Existing
33 Conditions.

34 CVHM modeling results show that groundwater levels would decrease by up to 250 feet beneath the
35 Corcoran Clay under WBS14 (i.e., Westside and Northern Pleasant Valley basins) as compared with
36 Existing Conditions. The forecasted groundwater level changes across the Export Service Areas
37 during a typical peak groundwater level change condition in August as compared to Existing
38 Conditions are shown in Figure 7-30. These forecasted changes in groundwater levels result from
39 increased agricultural pumping during the irrigation season due to a decrease in surface water
40 deliveries from the Delta under Alternative 5 in the western portion of the San Joaquin and Tulare
41 Lake basins. On the eastern side of the San Joaquin and Tulare Lake basins, climate change impacts

1 on stream flows could result in a decline in groundwater levels of up to 50 feet. In addition, if
 2 reduced stream flows are not adequate to meet the surface water diversion requirements,
 3 groundwater pumping could increase, resulting in a further decline in groundwater levels.

4 The SWP deliveries to Southern California areas under Alternative 5 would be less than those under
 5 Existing Conditions, which could result in additional groundwater pumping and a corresponding
 6 decrease in groundwater levels in some areas.

7 As shown above in the NEPA analysis, SWP and CVP deliveries would either not change or would
 8 increase under Alternative 5 as compared to deliveries under conditions in 2060 without
 9 Alternative 5 if sea level rise and climate change conditions are considered the same for both
 10 scenarios. For reasons discussed in Section 7.3.1, *Methods for Analysis*, DWR has identified effects of
 11 action alternatives under CEQA separately from the effects of increased water demands, sea level
 12 rise, and climate change, which would occur without and independent of the BDCP. Absent these
 13 factors, the impacts of Alternative 5 with respect to groundwater levels are considered to be less
 14 than significant.

15 **Impact GW-9: Degrade Groundwater Quality**

16 **NEPA Effects:** As discussed under impact GW-8 above, surface water deliveries to the CVP and SWP
 17 Export Service Areas are expected to increase under this alternative as compared to the No Action
 18 Alternative, which is anticipated to result in a decrease in groundwater use. The decreased
 19 groundwater use is not anticipated to alter regional patterns of groundwater flow or groundwater
 20 quality in the Export Service Areas. Therefore, it is not anticipated this would result in an adverse
 21 effect on groundwater quality in the Export Service Areas.

22 **CEQA Conclusion:** As discussed under impact GW-8 above, the impacts of Alternative 5 with respect
 23 to groundwater levels are considered to be less than significant. Therefore, no significant
 24 groundwater quality impacts are anticipated during the implementation of Alternative 5 because it
 25 is not anticipated to alter regional patterns of groundwater flow in the Export Service Areas.
 26 Therefore, this impact is considered less than significant. No mitigation is required.

27 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

28 The potential for groundwater level-induced land subsidence under Alternative 5 would be similar
 29 to that under Alternatives 1A and 6A. See Impact GW-10 under Alternative 1A.

30 **7.3.3.11 Alternative 6A—Isolated Conveyance with Pipeline/Tunnel and** 31 **Intakes 1–5 (15,000 cfs; Operational Scenario D)**

32 Facilities construction under Alternative 6A would be similar to those described for Alternative 1A.
 33 The different operational scenario under Alternative 6A would be reflected in changes in
 34 groundwater conditions in the Export Service Areas.

1 **Delta Region**

2 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with**
 3 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 4 **of Preexisting Nearby Wells**

5 See Impact GW-1 under Alternative 1A; construction activities under Alternative 6A would be
 6 identical to those under Alternative 1A.

7 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with**
 8 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 9 **of Preexisting Nearby Wells**

10 See Impact GW-2 under Alternative 1A; construction activities under Alternative 6A would be
 11 identical to those under Alternative 1A.

12 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of**
 13 **Conveyance Facilities**

14 See Impact GW-3 under Alternative 1A; the construction activities would be identical to those under
 15 Alternative 1A.

16 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural**
 17 **Drainage in the Delta**

18 See Impact GW-4 under Alternative 1A; construction activities under Alternative 6A would be
 19 identical to those under Alternative 1A.

20 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the**
 21 **Delta**

22 See Impact GW-5 under Alternative 1A; construction activities under Alternative 6A would be
 23 identical to those under Alternative 1A.

24 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter**
 25 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or**
 26 **Interfere with Agricultural Drainage as a Result of Implementing CM2–CM21**

27 See Impact GW-6 under Alternative 1A; CM2–CM21 under Alternative 6A would result in effects
 28 similar to those under Alternative 1A.

29 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2–CM21**

30 See Impact GW-7 under Alternative 1A; CM2–CM21 under Alternative 6A would result in effects
 31 similar to those under Alternative 1A.

1 SWP/CVP Export Service Areas

2 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with** 3 **Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of** 4 **Preexisting Nearby Wells**

5 *NEPA Effects:* Total long-term average annual water deliveries to the CVP and SWP Service Areas
 6 under Alternative 6A would be less than under the No Action Alternative, as described in Chapter 5,
 7 *Water Supply*, and Table 7-7.

8 Decreases in surface water deliveries attributable to project operations from the implementation of
 9 Alternative 6A are anticipated to result in a corresponding increase in groundwater use in the
 10 Export Service Areas, as compared with the No Action Alternative as discussed in subsection 7.3.3.2,
 11 *Alternative 1A–Dual Conveyance with Pipeline/Tunnel and Intakes 1–5*.

12 CVHM modeling results show that Alternative 6A is forecasted to result in groundwater level
 13 declines beneath the Corcoran Clay of up to 25 feet in most areas but could exceed 200 feet under
 14 WBS 14 (i.e., Westside and Northern Pleasant Valley Basins of the western Tulare Basin). The
 15 maximum groundwater level changes are forecasted to typically occur in August because
 16 agricultural groundwater pumping is typically highest in this month.

17 The forecasted groundwater level decreases across the San Joaquin Valley and Tulare Basins during
 18 a typical peak groundwater level change condition in August, as compared with the No Action
 19 Alternative, are shown in Figure 7-31. These forecasted changes in groundwater levels result from
 20 increased agricultural pumping during the irrigation season because of a decrease in surface water
 21 deliveries from the Delta under Alternative 6A.

22 Overall, the CVP and SWP deliveries to agricultural areas in the San Joaquin Valley and Tulare
 23 Service Areas under this alternative would be less than for the No Action Alternative. The
 24 sustainable yield of some wells might be affected by the lower water levels such that they are not
 25 able to support the existing or planned land uses for which permits have been granted. The increase
 26 in groundwater pumping would cause an adverse effect on groundwater levels and associated well
 27 yields.

28 Alternative 6A is also forecasted to decrease the surface water supplies from the Delta to Export
 29 Service Areas outside of the Central Valley. If less surface water is available for municipal, industrial,
 30 and agricultural users, utilization of groundwater resources could be increased (see Chapter 5,
 31 *Water Supply*). However, in the Central Coast and Southern California, overdrafted basins have, for
 32 the most part, been adjudicated to control the amount of pumping, thus reducing the amount of
 33 groundwater resource availability.

34 Many groundwater basins in the San Francisco Bay Area, Central Coast, and Southern California rely
 35 on SWP/CVP surface water to recharge groundwater basins (as described in subsection 7.1.1.4,
 36 *Groundwater Setting in the Export Service Areas outside the Delta Watershed*). Therefore, adverse
 37 effects on groundwater supplies, groundwater recharge, and local groundwater table levels are
 38 expected to result from the implementation of Alternative 6A in these Export Service Areas.

39 Feasible mitigation would not be available to diminish this effect due to a number of factors. First,
 40 State and federal Water Contractors currently and traditionally have received variable water
 41 supplies under their contracts with DWR and Reclamation due to variations in hydrology and
 42 regulatory constraints and are accustomed to responding accordingly. Any reductions associated

1 with this impact would be subject to these contractual limitations. Under standard state and federal
 2 water contracts, the risk of shortfalls in exports is borne by the contractors rather than DWR or
 3 Reclamation. As a result of this variability, many of the water contractors in water districts have
 4 complex water management strategies that include numerous options to supplement CVP and SWP
 5 surface water supplies. As discussed in Appendix 5B, *Responses to Reduced South of Delta Water*
 6 *Supplies*, adverse effects might be avoided due to the existence of various other water management
 7 options that could be undertaken in response to reduced exports from the Delta. In urban areas,
 8 these options include wastewater recycling and reuse, increased water conservation, water
 9 transfers, construction of new local reservoirs that could retain rainfall during wet years, and
 10 desalination in coastal areas. In agricultural areas, options for responding to reduced exports
 11 include changes in cropping patterns, improvements in irrigation efficiency, water transfers, and
 12 development of new local supplies. In both rural and urban areas, the affected water districts or
 13 individual water users are in the best position to determine the appropriate response to reduced
 14 deliveries from the Delta. Second, in adjudicated groundwater basins, it may be legally impossible to
 15 extract additional groundwater without gaining the permission of watermasters and accounting for
 16 groundwater pumping entitlements and various parties under their adjudicated rights. Finally, in
 17 many groundwater basins in the Central Coast and Central Valley, additional groundwater pumping
 18 might exacerbate existing overdraft and subsidence conditions, even if such pumping is legally
 19 permissible because the affected basin has not been adjudicated or no other groundwater
 20 management program is in place.

21 **CEQA Conclusion:** Total long-term average annual surface water deliveries to the CVP and SWP
 22 Service Areas under Alternative 6A would be less than under Existing Conditions in the Export
 23 Service Areas within the San Joaquin and Tulare groundwater basins. As a result, modeling predicts
 24 that groundwater pumping under Alternative 5 would be greater than under Existing Conditions,
 25 and that groundwater levels in some areas would be lower than under Existing Conditions.

26 CVHM modeling results show that Alternative 6A would result in groundwater level declines
 27 beneath the Corcoran Clay (Central Valley) of up to 25 feet in most areas; declines could exceed 200
 28 feet in the Westside and Northern Pleasant Valley basins of the western Tulare Lake Basin (Figure 7-
 29 32). On the eastern side of the San Joaquin and Tulare Lake basins, climate change effects on stream
 30 flows could result in a decline in groundwater levels by as much as 25 feet. In addition, if reduced
 31 stream flows are not adequate to meet the surface water diversion requirements, groundwater
 32 pumping might increase, resulting in a further decline in groundwater level. However, effects due to
 33 climate change would occur independently of the BDCP. The anticipated effects of climate change
 34 are provided for informational purposes only, but do not lead to mitigation measures.

35 Decreased groundwater levels associated with increased overall groundwater use for Alternative 6A
 36 could result in significant impacts in most of the Export Service Areas and significantly affect the
 37 yield of domestic and municipal wells, such that they are not able to support the existing or planned
 38 land uses for which permits have been granted. As discussed above in the NEPA conclusion there is
 39 no feasible mitigation available to address this impact. Therefore, the impact would be considered
 40 significant and unavoidable.

41 **Impact GW-9: Degrade Groundwater Quality**

42 **NEPA Effects:** As discussed under Impact GW-8, the increase in groundwater pumping that could
 43 occur in portions of the Export Service Areas in response to reduced SWP/CVP water supply
 44 availability could alter regional patterns of groundwater flow and induce the migration of poor-

1 quality groundwater into areas of good-quality groundwater, especially in the coastal areas of the
 2 Central Coast and Southern California, where seawater intrusion has occurred in the past. For the
 3 same reasons discussed earlier, there is no feasible mitigation available to mitigate any changes in
 4 regional groundwater quality. This effect is considered adverse.

5 **CEQA Conclusion:** Alternative 6A could induce the degradation of groundwater quality in some
 6 areas due to the possibility of increased groundwater pumping and the resulting effects on regional
 7 groundwater flow patterns. As discussed above, there is no feasible mitigation available to address
 8 this significant impact. The impact would be considered significant and unavoidable in these areas.

9 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

10 See Impact GW-10 under Alternative 1A.

11 **7.3.3.12 Alternative 6B—Isolated Conveyance with East Alignment and** 12 **Intakes 1–5 (15,000 cfs; Operational Scenario D)**

13 Facilities construction under Alternative 6B would be similar to that described for Alternative 1B.
 14 The different operational scenario under Alternative 6B would be reflected in changes in
 15 groundwater conditions in the Export Service Areas.

16 **Delta Region**

17 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with** 18 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity** 19 **of Preexisting Nearby Wells**

20 See Impact GW-1 under Alternative 1B; construction activities under Alternative 6B would be
 21 identical to those under Alternative 1B.

22 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with** 23 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity** 24 **of Preexisting Nearby Wells**

25 See Impact GW-2 under Alternative 1B; construction activities under Alternative 6B would be
 26 identical to those under Alternative 1B.

27 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of** 28 **Conveyance Facilities**

29 See Impact GW-3 under Alternative 1B; construction activities under Alternative 6B would be
 30 identical to those under Alternative 1B.

31 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural** 32 **Drainage in the Delta**

33 See Impact GW-4 under Alternative 1B; construction activities under Alternative 6B would be
 34 identical to those under Alternative 1B.

1 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the**
2 **Delta**

3 See Impact GW-5 under Alternative 1B; construction activities under Alternative 6B would be
4 identical to those under Alternative 1B.

5 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter**
6 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or**
7 **Interfere with Agricultural Drainage as a Result of Implementing CM2–CM21**

8 See Impact GW-6 under Alternative 1A; CM2–CM21 under Alternative 6B would result in effects
9 similar to those under Alternative 1A.

10 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2–CM21**

11 See Impact GW-7 under Alternative 1A; CM2–CM21 under Alternative 6B would result in effects
12 similar to those under Alternative 1A.

13 **SWP/CVP Export Service Areas**

14 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with**
15 **Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of**
16 **Preexisting Nearby Wells**

17 See Impact GW-8 under Alternative 6A; project operations under Alternative 6B would be identical
18 to those under Alternative 6A.

19 **Impact GW-9: Degrade Groundwater Quality**

20 See Impact GW-9 under Alternative 6A; project operations under Alternative 6B would be identical
21 to those under Alternative 6A.

22 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

23 See Impact GW-10 under Alternative 6A; project operations under Alternative 6B would be identical
24 to those under Alternative 6A.

25 **7.3.3.13 Alternative 6C—Isolated Conveyance with West Alignment and**
26 **Intakes W1–W5 (15,000 cfs; Operational Scenario D)**

27 Facilities construction under Alternative 6C would be similar to that described for Alternative 1C.
28 The different operational scenario under Alternative 6C would be reflected in changes in
29 groundwater conditions in the Export Service Areas.

1 **Delta Region**

2 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with**
 3 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 4 **of Preexisting Nearby Wells**

5 See Impact GW-1 under Alternative 1C; construction activities under Alternative 6C would be
 6 identical to those under Alternative 1C.

7 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with**
 8 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 9 **of Preexisting Nearby Wells**

10 See Impact GW-2 under Alternative 1C; construction activities under Alternative 6C would be
 11 identical to those under Alternative 1C.

12 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of**
 13 **Conveyance Facilities**

14 See Impact GW-3 under Alternative 1C; construction activities under Alternative 6C would be
 15 identical to those under Alternative 1C.

16 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural**
 17 **Drainage in the Delta**

18 See Impact GW-4 under Alternative 1C; construction activities under Alternative 6C would be
 19 identical to those under Alternative 1C.

20 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the**
 21 **Delta**

22 See Impact GW-5 under Alternative 1C; construction activities under Alternative 6C would be
 23 identical to those under Alternative 1C.

24 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter**
 25 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or**
 26 **Interfere with Agricultural Drainage as a Result of Implementing CM2–CM21**

27 See Impact GW-6 under Alternative 1A; CM2–CM21 under Alternative 6C would result in effects
 28 similar to those under Alternative 1A.

29 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2–CM21**

30 See Impact GW-7 under Alternative 1A; CM2–CM21 under Alternative 6C would result in effects
 31 similar to those under Alternative 1A.

1 **SWP/CVP Export Service Areas**

2 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with**
 3 **Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of**
 4 **Preexisting Nearby Wells**

5 See Impact GW-8 under Alternative 6A; project operations under Alternative 6C would be identical
 6 to those under Alternative 6A.

7 **Impact GW-9: Degrade Groundwater Quality**

8 See Impact GW-9 under Alternative 6A; project operations under Alternative 6C would be identical
 9 to those under Alternative 6A.

10 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

11 See Impact GW-10 under Alternative 6A; project operations under Alternative 6C would be identical
 12 to those under Alternative 6A.

13 **7.3.3.14 Alternative 7—Dual Conveyance with Pipeline/Tunnel, Intakes 2,**
 14 **3, and 5, and Enhanced Aquatic Conservation (9,000 cfs;**
 15 **Operational Scenario E)**

16 Facilities construction under Alternative 7 would be similar to those described for Alternative 1A
 17 with only three intakes.

18 Operations under Alternative 7 would be similar to those under Alternative 1A except for the
 19 actions described in Chapter 6, *Surface Water*.

20 **Delta Region**

21 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with**
 22 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 23 **of Preexisting Nearby Wells**

24 See Impact GW-1 under Alternative 1A; construction activities under Alternative 7 would be similar
 25 to those under Alternative 1A. The impacts on groundwater levels resulting from dewatering
 26 activities are dependent on the local hydrogeology and the depth and duration of dewatering
 27 required. Because all of the pump stations associated with the intakes are located in areas of similar
 28 geology and hydrogeology, and the dewatering configurations are identical for each of the facilities,
 29 it would be expected that the impacts of construction activities on local groundwater levels and
 30 associated well yields would be similar. The only difference would be associated with the number of
 31 intakes used. This alternative would use intakes instead of five used in Alternative 1A. This would
 32 result in decreased dewatering impacts and fewer wells being affected.

33 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with**
 34 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 35 **of Preexisting Nearby Wells**

36 See Impact GW-2 under Alternative 1A; operations activities under Alternative 7 would be similar to
 37 those under Alternative 1A. Both alternatives use the same forebay locations, which, in the absence

1 of design features intended to minimize seepage, would be the main locations of potential effects on
2 groundwater levels.

3 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of**
4 **Conveyance Facilities**

5 See Impact GW-3 under Alternative 1A; construction and operations activities under Alternative 7
6 would be similar to those under Alternative 1A, but to a lesser magnitude, since only three intakes
7 would be constructed.

8 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural**
9 **Drainage in the Delta**

10 See Impact GW-4 under Alternative 1A; construction activities under Alternative 7 would be similar
11 to those under Alternative 1A, but to a lesser magnitude, because only three intakes would be
12 constructed.

13 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the**
14 **Delta**

15 See Impact GW-5 under Alternative 1A; operations activities under Alternative 7 would be similar to
16 those under Alternative 1A.

17 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter**
18 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or**
19 **Interfere with Agricultural Drainage as a Result of Implementing CM2–CM21**

20 See Impact GW-6 under Alternative 1A; CM2–CM21 under Alternative 7 would result in effects
21 similar to those under Alternative 1A.

22 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2–CM21**

23 See Impact GW-7 under Alternative 1A; CM2–CM21 under Alternative 7 would result in effects
24 similar to those under Alternative 1A.

25 **SWP/CVP Export Service Areas**

26 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with**
27 **Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of**
28 **Preexisting Nearby Wells**

29 SWP/CVP deliveries to the Export Service Areas under Alternative 7 would be almost identical to
30 those under Alternative 6A (see Chapter 5, *Water Supply*, and Table 7-7). Therefore, effects on
31 groundwater levels under Alternative 7 are anticipated to be in the same range as those under
32 Alternative 6A.

33 See Impact GW-8 under Alternative 6A.

34 **Impact GW-9: Degrade Groundwater Quality**

35 See Impact GW-9 under Alternative 6A.

1 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

2 See Impact GW-10 under Alternative 1A.

3 **7.3.3.15 Alternative 8—Dual Conveyance with Pipeline/Tunnel, Intakes 2,**
 4 **3, and 5, and Increased Delta Outflow (9,000 cfs; Operational**
 5 **Scenario F)**

6 Facilities construction under Alternative 8 would be similar to that described for Alternative 1A
 7 with only three intakes.

8 Operations under Alternative 8 would be similar to those under Alternative 1A except for the
 9 actions described in Chapter 6, *Surface Water*.

10 **Delta Region**

11 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with**
 12 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 13 **of Preexisting Nearby Wells**

14 See Impact GW-1 under Alternative 1A; construction activities under Alternative 8 would be similar
 15 to those under Alternative 1A. The impacts on groundwater levels resulting from dewatering
 16 activities are dependent on the local hydrogeology and the depth and duration of dewatering
 17 required. Because all of the pump stations associated with the intakes are located in areas of similar
 18 geology and hydrogeology, and the dewatering configurations are identical for each of the facilities,
 19 it would be expected that the impacts of construction activities on local groundwater levels and
 20 associated well yields would be similar. The only difference would be associated with the number of
 21 intakes used. This alternative would use three intakes instead of five used in Alternative 1A. This
 22 would result in decreased dewatering effects and fewer wells being affected.

23 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with**
 24 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity**
 25 **of Preexisting Nearby Wells**

26 See Impact GW-2 under Alternative 1A; operations activities under Alternative 8 would be similar to
 27 those under Alternative 1A. Both alternatives would use the same forebay locations, which, in the
 28 absence of design features intended to minimize seepage, would be the main locations of potential
 29 effects on groundwater levels.

30 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of**
 31 **Conveyance Facilities**

32 See Impact GW-3 under Alternative 1A; construction and operations activities under Alternative 8
 33 would be similar to those under Alternative 1A, but to a lesser magnitude, because only three
 34 intakes would be constructed.

1 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural**
 2 **Drainage in the Delta**

3 See Impact GW-4 under Alternative 1A; construction activities under Alternative 8 would be similar
 4 to those under Alternative 1A, but to a lesser magnitude, because only three intakes would be
 5 constructed.

6 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the**
 7 **Delta**

8 See Impact GW-5 under Alternative 1A; operations activities under Alternative 8 would be similar to
 9 those under Alternative 1A.

10 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter**
 11 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or**
 12 **Interfere with Agricultural Drainage as a Result of Implementing CM2–CM21**

13 See Impact GW-6 under Alternative 1A; CM2–CM21 under Alternative 8 would result in effects
 14 similar to those under Alternative 1A.

15 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2–CM21**

16 See Impact GW-7 under Alternative 1A; CM2–CM21 under Alternative 8 would result in effects
 17 similar to those under Alternative 1A.

18 **SWP/CVP Export Service Areas**

19 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with**
 20 **Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of**
 21 **Preexisting Nearby Wells**

22 **NEPA Effects:** Total long-term average annual water deliveries to the CVP and SWP Service Areas
 23 under Alternative 8 would be less than under the No Action Alternative, as described in Chapter 5,
 24 *Water Supply*, and Table 7-7. Decreases in surface water deliveries attributable to project operations
 25 from the implementation of Alternative 8 are anticipated to result in a corresponding increase in
 26 groundwater use in the Export Service Areas, as compared with the No Action Alternative as
 27 discussed in Section 7.3.3.2, *Alternative 1A–Dual Conveyance with Pipeline/Tunnel and Intakes 1–5*.

28 CVHM modeling results show that Alternative 8 is forecasted to result in groundwater level declines
 29 beneath the Corcoran Clay of up to 25 feet in most areas but could exceed 250 feet under WBS 14
 30 (i.e., Westside and Northern Pleasant Valley basins of the western Tulare Basin). The maximum
 31 groundwater level changes are forecasted to occur in August because agricultural groundwater
 32 pumping is typically highest in this month.

33 The forecasted groundwater level decreases across the San Joaquin and Tulare Basins during a
 34 typical peak groundwater level change condition in August, as compared with the No Action
 35 Alternative, are shown in Figure 733. These forecasted changes in groundwater levels result from
 36 increased agricultural pumping during the irrigation season because of a decrease in surface water
 37 deliveries from the Delta under Alternative 8.

1 Overall, the CVP and SWP deliveries to agricultural areas in the Export Service Areas within the San
2 Joaquin and Tulare groundwater basins under this alternative would be less than for the No Action
3 Alternative. The sustainable yield of some wells might be affected by the lower water levels such
4 that they are not able to support the existing or planned land uses for which permits have been
5 granted. The increase in groundwater pumping would cause an adverse effect on groundwater
6 levels and associated well yields.

7 Alternative 8 is also forecasted to decrease the surface water supplies from the Delta to Export
8 Service Areas outside of the Central Valley. If less surface water is available for municipal, industrial,
9 and agricultural users, utilization of groundwater resources could increase (see Chapter 5, *Water*
10 *Supply*). However, in the Central Coast and Southern California, overdrafted basins have, for the
11 most part, been adjudicated to control the amount of pumping, thus reducing the amount of
12 groundwater resource availability.

13 Many groundwater basins in the San Francisco Bay Area, Central Coast, and Southern California rely
14 on SWP/CVP surface water to recharge groundwater basins (as described in subsection 7.1.1.4,
15 *Groundwater Setting in the Export Service Areas outside the Delta Watershed*). Therefore, adverse
16 effects on groundwater supplies, groundwater recharge, and local groundwater table levels are
17 expected to result from the implementation of Alternative 8 in these Export Service Areas.

18 Feasible mitigation would not be available to diminish this effect due to a number of factors. First,
19 State and federal Water Contractors currently and traditionally have received variable water
20 supplies under their contracts with DWR and Reclamation due to variations in hydrology and
21 regulatory constraints and are accustomed to responding accordingly. Any reductions associated
22 with this effect would be subject to these contractual limitations. Under standard state and federal
23 water contracts, the risk of shortfalls in exports is borne by the contractors rather than DWR or
24 Reclamation. As a result of this variability, many of the water contractors in water districts have
25 complex water management strategies that include numerous options to supplement CVP and SWP
26 surface water supplies. As discussed in Appendix 5B, *Responses to Reduced South of Delta Water*
27 *Supplies*, adverse effects might be avoided due to the existence of various other water management
28 options that could be undertaken in response to reduced exports from the Delta. In urban areas,
29 these options include wastewater recycling and reuse, increased water conservation, water
30 transfers, construction of new local reservoirs that could retain rainfall during wet years, and
31 desalination in coastal areas. In agricultural areas, options for responding to reduced exports
32 include changes in cropping patterns, improvements in irrigation efficiency, water transfers, and
33 development of new local supplies. In both rural and urban areas, the affected water districts or
34 individual water users are in the best position to determine the appropriate response to reduced
35 deliveries from the Delta. Second, in adjudicated groundwater basins, it may be legally impossible to
36 extract additional groundwater without gaining the permission of watermasters and accounting for
37 groundwater pumping entitlements and various parties under their adjudicated rights. Finally, in
38 many groundwater basins in the Central Coast and Central Valley, additional groundwater pumping
39 might exacerbate existing overdraft and subsidence conditions, even if such pumping is legally
40 permissible because the affected basin has not been adjudicated or no other groundwater
41 management program is in place.

42 **CEQA Conclusion:** Total long-term average annual surface water deliveries to the CVP and SWP
43 Service Areas under Alternative 8 would be less than under Existing Conditions in the Export
44 Service Areas within the San Joaquin and Tulare groundwater basins. As a result, modeling predicts

1 that groundwater pumping under Alternative 8 would be greater than under Existing Conditions,
2 and that groundwater levels in some areas would be lower than under Existing Conditions.

3 CVHM modeling results show that Alternative 8 would result in groundwater level declines beneath
4 the Corcoran Clay (Central Valley) of up to 25 feet in most areas; declines could exceed 250 feet in
5 the Westside and Northern Pleasant Valley basins of the western Tulare Lake Basin (Figure 7-34).
6 On the eastern side of the San Joaquin and Tulare Lake basins, climate change effects on stream
7 flows could result in a decline in groundwater levels by as much as 50 feet. In addition, if reduced
8 stream flows are not adequate to meet the surface water diversion requirements, groundwater
9 pumping might increase, resulting in a further decline in groundwater level. However, effects due to
10 climate change would occur independently of the BDCP. The anticipated effects of climate change
11 are provided for informational purposes only, but do not lead to mitigation measures.

12 Decreased groundwater levels associated with increased overall groundwater use under Alternative
13 8 could result in significant impacts in most of the Export Service Areas and significantly affect the
14 yield of domestic, municipal and agricultural wells, such that they are not able to support the
15 existing or planned land uses for which permits have been granted. As discussed above in the NEPA
16 conclusion there is no feasible mitigation available to address this impact. Therefore, the impact
17 would be considered significant and unavoidable.

18 **Impact GW-9: Degrade Groundwater Quality**

19 **NEPA Effects:** As discussed under Impact GW-8, the increase in groundwater pumping that could
20 occur in portions of the Export Service Areas in response to reduced SWP/CVP water supply
21 availability could alter regional patterns of groundwater flow and induce the migration of poor-
22 quality groundwater into areas of good-quality groundwater, especially in the coastal areas of the
23 Central Coast and Southern California, where seawater intrusion has occurred in the past. For the
24 same reasons discussed earlier, there is no feasible mitigation available to mitigate any changes in
25 regional groundwater quality. This effect is considered adverse.

26 **CEQA Conclusion:** Alternative 8 could induce the degradation of groundwater quality in some areas
27 due to the possibility of increased groundwater pumping and the resulting effects on regional
28 groundwater flow patterns. As discussed above, there is no feasible mitigation available to address
29 this significant impact. The impact would be considered significant and unavoidable in these areas.

30 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

31 See Impact GW-10 under Alternative 1A.

32 **7.3.3.16 Alternative 9—Through Delta/Separate Corridors (15,000 cfs; 33 Operational Scenario G)**

34 Facilities constructed under Alternative 9 would include two fish-screened intakes along the
35 Sacramento River near Walnut Grove, 14 operable barriers, two pumping plants and other
36 associated facilities, two culvert siphons, three alignment segments, new levees, and new channel
37 connections. Some existing channels would also be enlarged under this alternative. Nearby areas
38 would be altered as work or staging areas or used for the deposition of spoils.

39 Alternative 9 does not include north Delta intakes. Instead, water would continue to flow by gravity
40 from the Sacramento River into two existing channels, Delta Cross Channel and Georgiana Slough.

1 Alternative 9 would operate in a manner more similar to the No Action Alternative with operational
 2 criteria related to minimizing reverse flows in Old and Middle Rivers applying only to Middle River
 3 and not including San Joaquin River export/inflow ratio criteria.

4 **Delta Region**

5 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with** 6 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity** 7 **of Preexisting Nearby Wells**

8 **NEPA Effects:** Construction activities would take place primarily within the stream channels and in
 9 the shallow subsurface. The construction of on-bank diversions on Georgiana Slough and the Delta
 10 Cross-Channel, and the addition of channel sections, would likely require groundwater dewatering
 11 and would temporarily and locally affect groundwater levels as a result. The construction of a
 12 pumping plant on the San Joaquin River at the Head of Old River and a pumping plant on Middle
 13 River upstream of Victoria Canal would also require potentially substantial dewatering activities.
 14 During the dewatering period and for a short time thereafter, localized groundwater level
 15 drawdown is anticipated. While detailed dewatering activities and effects are not available, the
 16 effect on local shallow groundwater levels and nearby shallow well yields would be considered
 17 adverse. Mitigation Measure GW-1 is available to address this effect.

18 **CEQA Conclusion:** Construction activities related to temporary dewatering and associated reduced
 19 groundwater levels have the potential to temporarily affect the productivity of existing nearby
 20 water supply wells. This impact is considered significant. Implementation of Mitigation Measure
 21 GW-1 would reduce this impact to a less-than-significant level.

22 **Mitigation Measure GW-1: Maintain Water Supplies in Areas Affected by Construction** 23 **Dewatering**

24 Please see Mitigation Measure GW-1 under Impact GW-1 in the discussion of Alternative 1A.

25 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with** 26 **Groundwater Recharge, Alter Local Groundwater Levels, or Reduce the Production Capacity** 27 **of Preexisting Nearby Wells**

28 **NEPA Effects:** Alternative 9 is not anticipated to cause substantial effects on groundwater levels and
 29 recharge in the Delta Region because the primary changes to the existing system would consist of re-
 30 routing surface water through various existing canals and streams through operable gates. New,
 31 small canal sections and channel connections would be operated with this alternative, but
 32 groundwater effects would not be substantial. It is not anticipated that Alternative 9 would create
 33 adverse effects on domestic and municipal well yields. The operation of the additional
 34 infrastructure, such as small canal sections and operable barriers in streams is not anticipated to
 35 cause adverse effects on groundwater well yields.

36 **CEQA Conclusion:** Under Alternative 9, operation of the additional infrastructure, such as small
 37 canal sections and operable barriers in streams, is not anticipated to deplete groundwater supplies
 38 or interfere with groundwater recharge, alter local groundwater levels, or reduce the production
 39 capacity of preexisting nearby wells. This impact is considered less than significant. No mitigation is
 40 required.

1 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of**
 2 **Conveyance Facilities**

3 *NEPA Effects:* Groundwater flow patterns are not expected to change under Alternative 9
 4 construction and implementation. Therefore, there is no potential for poor-quality groundwater to
 5 migrate under this alternative. There would be no change to groundwater quality due to the
 6 construction and operation of Alternative 9, and no adverse effect.

7 *CEQA Conclusion:* Under Alternative 9, construction and operation of the additional infrastructure,
 8 such as small canal sections and operable barriers in streams, is not anticipated to degrade
 9 groundwater quality. This impact is considered less than significant. No mitigation is required.

10 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural**
 11 **Drainage in the Delta**

12 *NEPA Effects:* Construction activities would take place primarily within the stream channels and in
 13 the shallow subsurface, so no substantial dewatering activities are anticipated and there should be
 14 no substantial effects on groundwater flow and agricultural drainage in the main Delta areas. The
 15 construction of on-bank diversions on Georgiana Slough and the Delta Cross Channel, and the
 16 addition of channel sections, would likely require groundwater dewatering and thus would
 17 temporarily and locally affect groundwater levels. The construction of a pumping plant on the San
 18 Joaquin River at the Head of Old River and a pumping plant on Middle River upstream of Victoria
 19 Canal would also require potentially substantial dewatering activities. During the dewatering period
 20 and for a short time thereafter, localized groundwater flow and agricultural drainage disturbances
 21 are anticipated. The effect on agricultural drainage during construction is considered to be adverse.
 22 Mitigation Measure GW-5 is available to address this effect.

23 *CEQA Conclusion:* Under Alternative 9, construction activities related to temporary dewatering and
 24 associated changes in groundwater flow patterns have the potential to affect agricultural drainage
 25 nearby. This impact is considered significant. Implementation of Mitigation Measure GW-5 would
 26 reduce this impact to a less-than-significant level.

27 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

28 Please see Mitigation Measure GW-5 under Impact GW-5 in the discussion of Alternative 1A.

29 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the**
 30 **Delta**

31 *NEPA Effects:* Operation of facilities under Alternative 9 is not anticipated to cause adverse effects
 32 on groundwater flow and agricultural drainage in the Delta Region. The new, small canal sections
 33 and channel connections could result in localized effects on groundwater flow and agricultural
 34 drainage. However, no regional effects are anticipated to occur. No interference with agricultural
 35 drainage is anticipated.

36 *CEQA Conclusion:* Alternative 9 is not anticipated to cause significant impacts on groundwater flow
 37 and agricultural drainage in the Delta Region. The new, small canal sections and channel
 38 connections could result in localized impacts on groundwater flow and agricultural drainage.
 39 However, no regional impacts are anticipated to occur. This impact is considered less than
 40 significant. No mitigation is required.

1 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge, Alter**
 2 **Local Groundwater Levels, Reduce the Production Capacity of Preexisting Nearby Wells, or**
 3 **Interfere with Agricultural Drainage as a Result of Implementing CM2–CM21**

4 See Impact GW-6 under Alternative 1A; CM2–CM21 under Alternative 9 would result in effects
 5 similar to those under Alternative 1A.

6 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing CM2–CM21**

7 See Impact GW-7 under Alternative 1A; CM2–CM21 under Alternative 9 would result in effects
 8 similar to those under Alternative 1A.

9 **SWP/CVP Export Service Areas**

10 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with**
 11 **Groundwater Recharge, Alter Groundwater Levels, or Reduce the Production Capacity of**
 12 **Preexisting Nearby Wells**

13 *NEPA Effects:* Total long-term average annual water deliveries to the CVP and SWP Service Areas
 14 under Alternative 9 would be similar to those under the No Action Alternative, as described in
 15 Chapter 5, *Water Supply*, and Table 7-7. Periodic decreases in surface water deliveries attributable
 16 to project operations from the implementation of Alternative 9 are anticipated to result in a
 17 corresponding increase in groundwater use in the Export Service Areas, as compared with the No
 18 Action Alternative as discussed in Section 7.3.3.2, *Alternative 1A–Dual Conveyance with*
 19 *Pipeline/Tunnel and Intakes 1–5.*

20 CVHM modeling results show that groundwater levels would decrease by up to 100 feet beneath the
 21 Corcoran Clay under WBS 14 (i.e., Westside and Northern Pleasant Valley basins). The forecasted
 22 maximum groundwater level changes occur in dry years in August because agricultural
 23 groundwater pumping is typically highest during this month.

24 The forecasted groundwater level declines across the Export Service Areas during a typical peak
 25 groundwater level change condition in August, as compared with the No Action Alternative, are
 26 shown in Figure 7-35.

27 Overall, the CVP and SWP deliveries to agricultural areas in the Export Service Areas within the San
 28 Joaquin and Tulare groundwater basins under this alternative would be less than for the No Action
 29 Alternative. The sustainable yield of some wells might be affected by the lower water levels such
 30 that they are not able to support the existing or planned land uses for which permits have been
 31 granted. The increase in groundwater pumping would cause an adverse effect on groundwater
 32 levels and associated well yields. Under Alternative 9, SWP deliveries to Southern California areas
 33 would be less than those under the No Action Alternative. Implementation of Alternative 9 could
 34 result in an overall increase in groundwater pumping and a corresponding decrease in groundwater
 35 levels; therefore creating an adverse impact on groundwater resources. However, in the Central
 36 Coast and Southern California, overdrafted basins have, for the most part, been adjudicated to
 37 control the amount of pumping, thus reducing the amount of groundwater resource availability.

38 Feasible mitigation would not be available to diminish this effect due to a number of factors. First,
 39 State and federal Water Contractors currently and traditionally have received variable water
 40 supplies under their contracts with DWR and Reclamation due to variations in hydrology and
 41 regulatory constraints and are accustomed to responding accordingly. Any reductions associated

1 with this impact would be subject to these contractual limitations. Under standard state and federal
 2 water contracts, the risk of shortfalls in exports is borne by the contractors rather than DWR or
 3 Reclamation. As a result of this variability, many of the water contractors in water districts have
 4 complex water management strategies that include numerous options to supplement CVP and SWP
 5 surface water supplies. As discussed in Appendix 5B, *Responses to Reduced South of Delta Water*
 6 *Supplies*, adverse effects might be avoided due to the existence of various other water management
 7 options that could be undertaken in response to reduced exports from the Delta. In urban areas,
 8 these options include wastewater recycling and reuse, increased water conservation, water
 9 transfers, construction of new local reservoirs that could retain rainfall during wet years, and
 10 desalination in coastal areas. In agricultural areas, options for responding to reduced exports
 11 include changes in cropping patterns, improvements in irrigation efficiency, water transfers, and
 12 development of new local supplies. In both rural and urban areas, the affected water districts or
 13 individual water users are in the best position to determine the appropriate response to reduced
 14 deliveries from the Delta. Second, in adjudicated groundwater basins, it may be legally impossible to
 15 extract additional groundwater without gaining the permission of watermasters and accounting for
 16 groundwater pumping entitlements and various parties under their adjudicated rights. Finally, in
 17 many groundwater basins in the Central Coast and Central Valley, additional groundwater pumping
 18 might exacerbate existing overdraft and subsidence conditions, even if such pumping is legally
 19 permissible because the affected basin has not been adjudicated or no other groundwater
 20 management program is in place.

21 **CEQA Conclusion:** Total long-term average annual surface water deliveries to the CVP and SWP
 22 Service Areas under Alternative 9 would be less than under Existing Conditions in the Export
 23 Service Areas within the San Joaquin and Tulare groundwater basins. As a result, modeling predicts
 24 that groundwater pumping under Alternative 9 would be greater than under Existing Conditions,
 25 and that groundwater levels in some areas would be lower than under Existing Conditions. CVHM
 26 modeling results show that Alternative 9 would result in groundwater level declines beneath the
 27 Corcoran Clay (Central Valley) of up to 25 feet in most areas; declines could exceed 250 feet in the
 28 Westside and Northern Pleasant Valley basins of the western Tulare Lake Basin (Figure 7-36). On
 29 the eastern side of the San Joaquin and Tulare Lake basins, climate change effects on stream flows
 30 could result in a decline in groundwater levels by as much as 50 feet. In addition, if reduced stream
 31 flows are not adequate to meet the surface water diversion requirements, groundwater pumping
 32 might increase, resulting in a further decline in groundwater level. However, effects due to climate
 33 change would occur independently of the BDCP. The anticipated effects of climate change are
 34 provided for informational purposes only, but do not lead to mitigation measures.

35 Decreased groundwater levels associated with increased overall groundwater use under Alternative
 36 9 could result in significant impacts in most of the Export Service Areas and significantly affect the
 37 yield of domestic, municipal and agricultural wells, such that they are not able to support the
 38 existing or planned land uses for which permits have been granted. As discussed above in the NEPA
 39 conclusion there is no feasible mitigation available to address this impact. Therefore, the impact
 40 would be considered significant and unavoidable.

41 **Impact GW-9: Degrade Groundwater Quality**

42 **NEPA Effects:** As discussed under Impact GW-8, the increase in groundwater pumping that could
 43 occur in portions of the Export Service Areas in response to reduced CVP water supply availability
 44 could alter regional patterns of groundwater flow and induce the migration of poor-quality
 45 groundwater into areas of good-quality groundwater, especially in the coastal areas of central Coast

1 and Southern California, where seawater intrusion has occurred in the past. For the same reasons
 2 discussed earlier, there is no feasible mitigation available to mitigate any changes in regional
 3 groundwater quality. This effect is considered adverse.

4 **CEQA Conclusion:** Implementation of Alternative 9 could induce the degradation of groundwater
 5 quality in portions of the Export Service Areas due to the possibility of increased groundwater
 6 pumping and the resulting effects on regional groundwater flow patterns. As discussed above, there
 7 is no feasible mitigation available to address this significant impact. The impact would be considered
 8 significant and unavoidable in these areas.

9 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

10 The potential for groundwater level-induced land subsidence under Alternative 9 would be similar
 11 to that under Alternatives 1A and 6A. See Impact GW-10 under Alternative 1A.

12 **7.3.4 Effects and Mitigation Approaches—Alternatives 4A, 13 2D, and 5A**

14 The assessment of effects that would result from implementation of Alternatives 4A, 2D, and 5A uses
 15 the same methodologies as the ones described in Section 7.3.3, *Effects and Mitigation Approaches*.

16 **7.3.4.1 No Action Alternative Early Long-Term**

17 **Delta Region**

18 The effects of the No Action Alternative (ELT) as considered for the purposes of Alternatives 4A, 2D,
 19 and 5A (ELT) would be expected to be similar to those effects described for the No Action
 20 Alternative (LLT) in Section 7.3.3.1, *No Action Alternative Late Long-Term*.

21 Groundwater resources are not anticipated to be substantially affected in the Delta Region under the
 22 No Action Alternative (ELT) because surface water inflows to this area are sufficient to satisfy most
 23 of the agricultural, industrial, and municipal water supply needs.

24 **Changes in Delta Groundwater Levels.** Groundwater levels in the Delta for the No Action
 25 Alternative (ELT) would be strongly influenced by surface water flows in the Sacramento River that
 26 fluctuate due to moderate sea level rise, climate change and due to surface water operations. Sea
 27 level rise under the No Action Alternative (ELT) would be less than that described under the No
 28 Action Alternative (LLT), therefore, impacts on the Suisun Marsh area groundwater levels would be
 29 less than under the No Action Alternative (LLT). In most other areas of the Delta, groundwater levels
 30 under the No Action Alternative (ELT) would be similar to Existing Conditions.

31 **Changes in Delta Groundwater Quality.** As described above, groundwater levels would be similar
 32 under Existing Conditions and the No Action Alternative (ELT) except for a localized area around
 33 Suisun Marsh. Therefore, changes in groundwater conditions under the No Action Alternative (ELT)
 34 are not anticipated to alter regional patterns of groundwater flow or quality, compared with Existing
 35 Conditions.

36 **Changes in Delta Agricultural Drainage.** Changes in agricultural drainage are anticipated to be
 37 similar or less under the No Action Alternative (ELT) as compared to the No Action Alternative
 38 (LLT). As described in subsection 7.3.3.1, *No Action Alternative Late Long-Term*, due to fluctuations

1 in groundwater levels that occur with moderate sea level rise and climate change, some areas of the
 2 Delta might experience rises in groundwater levels in the vicinity of rivers and in the Suisun Marsh
 3 area under the No Action Alternative (ELT) compared to Existing Conditions. This could affect
 4 agricultural drainage. However, changes are anticipated to be minor and these areas would be
 5 surrounded by larger regional flow patterns that would remain largely unchanged under the No
 6 Action Alternative (ELT).

7 **CEQA Conclusion:** Groundwater resources are not anticipated to be substantially affected in the
 8 Delta Region under the No Action Alternative (ELT) because surface water inflows to this area are
 9 sufficient to satisfy most of the agricultural, industrial, and municipal water supply needs. Therefore
 10 the No Action Alternative (ELT) would have less-than-significant impacts on Delta groundwater
 11 levels, groundwater quality, and agricultural drainage because changes in groundwater flows and
 12 groundwater use are not anticipated to occur due to the abundant surface water in the Delta.

13 **SWP/CVP Export Service Areas**

14 Under the No Action Alternative (ELT), surface water supplies to the Export Service Areas would
 15 continue to decline based on water modeling and operational assumptions described in Chapter 5,
 16 *Water Supply*, and Chapter 6, *Surface Water*, which project reductions in SWP/CVP water supply
 17 availability, compared to Existing Conditions. In addition, decreases in SWP/CVP surface water
 18 deliveries in the Export Service Areas for the No Action Alternative (ELT) compared to Existing
 19 Conditions also occur due to sea level rise and climate change, as described in Chapter 5, *Water*
 20 *Supply*.

21 CVHM simulation assumptions for the No Action Alternative (ELT) are similar to those for the No
 22 Action Alternative (LLT).

23 Groundwater conditions under the No Action Alternative (ELT) (with future projected sea level rise
 24 and climate change at approximately year 2025) compared to Existing Conditions are provided in
 25 the descriptions that follow. The comparison is made through a review of simulated groundwater
 26 resources conditions in the San Joaquin and Tulare Basins.

27 **CEQA Conclusion:**

28 **San Joaquin Basin**

29 Forecasted groundwater flow in the San Joaquin Basin under the No Action Alternative (ELT) is
 30 generally toward the San Joaquin River from the margins of the basin and to the northwest toward
 31 the Delta. As compared to Existing Conditions, groundwater levels would decline by up to 10 feet
 32 beneath the Corcoran Clay in portions of the San Joaquin Basin (see Figure 7-37¹) under the No
 33 Action Alternative (ELT). This reduction in groundwater levels could substantially affect
 34 groundwater resources in the San Joaquin Basin by reducing well yields of nearby agricultural and
 35 municipal wells. Therefore, the No Action Alternative (ELT) would result in a significant impact on
 36 groundwater resources.

¹ Results based on CVHM groundwater model simulations using inputs processed from the CALSIM II outputs for the No Action Alternative (ELT) in the Draft EIR/EIS.

1 **Tulare Basin**

2 Forecasted groundwater flow in the Tulare Basin under the No Action Alternative (ELT) is complex
 3 because of the spatially variable water use over such a large area. Forecasted groundwater flow in
 4 the Tulare Basin is generally away from the margins of the basin toward areas of substantial
 5 groundwater production. As compared to Existing Conditions, groundwater levels would decline up
 6 to 100 feet with a small area that could see water level declines of as much as 250 feet beneath the
 7 Corcoran Clay in dry years in portions of the Tulare Basin irrigated areas, notably the Westside and
 8 Northern Pleasant Valley basins (WBS 14) in the western portion (see Figure 7-37) under the No
 9 Action Alternative (ELT). The forecasted maximum groundwater level changes occur in August
 10 because agricultural groundwater pumping is typically highest during this month.

11 The anticipated reduction in groundwater levels could substantially affect groundwater resources in
 12 the Tulare Basin in terms of affecting well yields of nearby agricultural and municipal wells,
 13 groundwater supplies, and groundwater recharge and therefore, the No Action Alternative (ELT)
 14 would result in a significant impact on groundwater resources.

15 The increase in groundwater pumping that could occur under the No Action Alternative (ELT)
 16 compared to Existing Conditions in portions of the Export Service Areas in response to reduced
 17 SWP/CVP water supply availability could induce the local migration of poor-quality groundwater
 18 into areas of good-quality groundwater. However, it is not anticipated to alter regional groundwater
 19 flow patterns and would not be considered a significant impact on groundwater quality.

20 **Other Portions of the Export Service Areas**

21 The total long-term average annual water deliveries to the Export Service Areas in portions outside
 22 of the Central Valley under the No Action Alternative (ELT) would be slightly less than under
 23 Existing Conditions, but more than under No Action Alternative (LLT). The reduction in surface
 24 water deliveries could result in an increase in groundwater pumping and the associated decrease in
 25 groundwater levels. The anticipated reduction in groundwater levels could substantially affect
 26 groundwater resources in terms of affecting well yields of nearby agricultural and municipal wells,
 27 groundwater supplies, and groundwater recharge. Therefore, the No Action Alternative (ELT) would
 28 have a significant impact on groundwater resources.

29 However, in the Central Coast and Southern California, overdrafted basins have, for the most part,
 30 been adjudicated to control the amount of pumping, thus reducing the amount of groundwater
 31 resource availability. In addition, many groundwater basins in the San Francisco Bay Area, Central
 32 Coast, and Southern California rely on SWP/CVP surface water to recharge groundwater basins.

33 **7.3.4.2 Alternative 4A—Dual Conveyance with Modified** 34 **Pipeline/Tunnel and Intakes 2, 3, and 5 (9,000 cfs; Operational** 35 **Scenario H)**

36 **Delta Region**

37 The conveyance facilities for Alternative 4A are identical to those for Alternative 4 and the footprint
 38 of the Alternative 4A conveyance facilities in the Delta is identical to the Alternative 4 footprint, as
 39 described in Section 7.3.3.9, *Alternative 4—Dual Conveyance with Modified Pipeline/Tunnel and*
 40 *Intakes 2, 3, and 5*. Therefore, impacts due to construction of the water conveyance facilities in the

1 Delta would be identical to those described for Alternative 4, as they would occur in the same
2 timeframe.

3 The effects of the operations under Alternative 4A compared to the No Action Alternative (ELT) are
4 similar to the effects of operations under Alternative 4 as compared to the No Action Alternative
5 (LLT). Therefore, the effects on the Delta groundwater resources based on the comparison to each of
6 the No Action Alternatives are similar.

7 Modeling for Alternative 4A was conducted for Operational Scenario H3+, a point that generally falls
8 between Scenario H3 and H4 operations, as the initial conveyance facilities operational scenario. As
9 specified in Chapter 3, *Description of Alternatives*, Section 3.6.4 the Delta outflow criteria under
10 Scenario H for Alternative 4A would be determined by the Endangered Species Act and California
11 Endangered Species Act Section 2081 permits, and operations to obtain such outflow would likely
12 be between Scenarios H3 and H4. Modeling results for Scenarios H3 and H4 using the 2015 CALSIM
13 II model are shown in Appendix 5E, *Supplemental Modeling Requested by the State Water Resources*
14 *Control Board Related to Increased Delta Outflows*, Attachment 1. In addition, following the initial
15 operations, the adaptive management and monitoring program could be used to make long-term
16 changes in initial operations criteria to address uncertainties about spring outflow for longfin smelt
17 and fall outflow for delta smelt, among other species.

18 Future conveyance facilities operational changes may also be made as a result of adaptive
19 management to respond to advances in science and understanding of how operations affect species.
20 Conveyance facilities would be operated under an adaptive management range represented by
21 Boundary 1 and Boundary 2 (see Section 5E.2 of Appendix 5E for additional information on
22 Boundary 1 and Boundary 2). Impacts as a result of operations within this range would be
23 consistent with the impacts discussed for the alternatives considered in this EIR/EIS. As shown in
24 Appendix 5F, water supply modeling results for H3+ are within the range of results for Scenarios H3
25 and H4, and is consistent with the impacts discussed in the Recirculated Draft Environmental Impact
26 Report/Supplement Draft Environmental Impact Statement. The following analysis of Alternative 4A
27 impacts reflects modeling results of Operational Scenario H3+.

28 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with**
29 **Groundwater Recharge, Alter Local Groundwater Levels or Reduce the Production Capacity of**
30 **Preexisting Nearby Wells**

31 See Impact GW-1 under Alternative 4; construction activities and potential impacts under
32 Alternative 4A would be identical to those under Alternative 4 because both alternatives have the
33 same footprint in the Delta.

34 **NEPA Effects:** Due to the measures described above for Alternative 4 and in Appendix 3B,
35 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
36 construction activities associated with Alternative 4A conveyance facilities are not anticipated to
37 result in adverse effects on surrounding groundwater levels and well yields. If site-specific
38 geotechnical conditions result in localized groundwater elevation reductions, mitigation measure
39 GW-1 is available to help reduce this effect.

40 **CEQA Conclusion:** Due to the measures described above for Alternative 4 and in Appendix 3B,
41 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
42 construction activities associated with conveyance facilities for Alternative 4A including temporary
43 dewatering are not anticipated to result in significant impacts on surrounding groundwater levels

1 and well yields. If site-specific geotechnical conditions result in localized groundwater elevation
 2 reductions, mitigation measure GW-1 is available to help reduce this effect. This impact is therefore
 3 less-than-significant.

4 **Mitigation Measure GW-1: Maintain Water Supplies in Areas Affected by Construction**
 5 **Dewatering**

6 Please see Mitigation Measure GW-1 under Impact GW-1 in the discussion of Alternative 1A.

7 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with**
 8 **Groundwater Recharge, Alter Local Groundwater Levels or Reduce the Production Capacity of**
 9 **Preexisting Nearby Wells**

10 See Impact GW-2 under Alternative 4; operations under Alternative 4A fall within the range of
 11 operations scenarios analyzed for Alternative 4.

12 **NEPA Effects:** Due to the measures described above for Alternative 4 and in Appendix 3B,
 13 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, operations
 14 of Alternative 4A conveyance facilities are not anticipated to result in adverse effects on surrounding
 15 groundwater levels and well yields. The new Intermediate Forebay and the expanded Clifton Court
 16 Forebay would be constructed to comply with the requirements of the DSD which include design
 17 features intended to minimize seepage under the embankments. In addition, the forebays would
 18 include a seepage cutoff wall installed to the impervious layer and a toe drain around the forebay
 19 embankment, to capture water and pump it back into the forebay.

20 Operation of the tunnel would have no impact on existing wells or yields given the facilities would
 21 be located more than 100 feet underground and would not substantially alter groundwater levels in
 22 the vicinity.

23 Model simulations also indicate up to 5-foot episodic lowering of groundwater levels beneath the
 24 Sacramento River due to lower flows in the river as a result of diversions at the north Delta intakes
 25 that result in a reduction in river flows and elevations, as described in Chapter 6, *Surface Water*. The
 26 groundwater level changes would be 5-feet or less on nearby shallow domestic well yields. Due to
 27 the implementation of Mitigation Measure GW-1, no additional mitigation measures are required.

28 Therefore, during operations there would be no adverse effects on groundwater resources.

29 **CEQA Conclusion:** Due to the measures described above for Alternative 4 and in Appendix 3B,
 30 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, operations
 31 of Alternative 4A conveyance facilities are not anticipated to result in adverse effects on surrounding
 32 groundwater levels and well yields. The new Intermediate Forebay and the expanded Clifton Court
 33 Forebay would include design features intended to minimize seepage under the embankments and a
 34 toe drain around the forebay embankment, to capture water and pump it back into the forebay.

35 Operation of the tunnel would have no impact on existing wells or yields given these facilities would
 36 be located over 100 feet underground and would not substantially alter groundwater levels in the
 37 vicinity.

38 Model simulations also indicate up to 5-foot episodic lowering of groundwater levels beneath the
 39 Sacramento River due to lower flows in the river as a result of diversions at the north Delta intakes
 40 that result in a reduction in river flows and elevations, as described in Chapter 6, *Surface Water*. The

1 groundwater level changes would be 5-feet or less on nearby shallow domestic well yields. Due to
2 the implementation of Mitigation Measure GW-1, no additional mitigation measures are required.

3 Therefore, this impact would be less than significant. No mitigation is required.

4 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of** 5 **Conveyance Facilities**

6 See Impact GW-3 under Alternative 4; the construction activities under Alternative 4A would be
7 identical to those under Alternative 4. The operations under Alternative 4A fall within the range of
8 operations scenarios analyzed for Alternative 4.

9 **NEPA Effects:** Due to the measures described above under Alternative 4 and in Appendix 3B,
10 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
11 construction and operations activities associated with Alternative 4 conveyance facilities are not
12 anticipated to result in adverse effects on surrounding groundwater levels or changes in direction of
13 groundwater flow patterns near the intake pump stations along the Sacramento River, Intermediate
14 Forebay, and Byron Tract Forebay. Since no significant regional changes in groundwater flow
15 directions are forecasted, and the inducement of poor-quality groundwater into areas of better
16 quality is unlikely, it is anticipated that there would be no change in groundwater quality for
17 Alternative 4A. Further, the planned treatment of extracted groundwater prior to discharge into
18 adjacent surface waters would prevent significant impacts on groundwater quality. There would be
19 no adverse effect.

20 **CEQA Conclusion:** Due to the measures described above under Alternative 4 and in Appendix 3B,
21 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
22 construction and operations activities associated with Alternative 4 conveyance facilities are not
23 anticipated to result in adverse effects on surrounding groundwater levels or changes in direction of
24 groundwater, no significant groundwater quality impacts are anticipated during construction and
25 operations activities of the conveyance facilities. Further, the planned treatment of extracted
26 groundwater prior to discharge into adjacent surface waters would prevent significant impacts on
27 groundwater quality.

28 No significant groundwater quality impacts are anticipated in most areas of the Delta during the
29 implementation of Alternative 4A, because changes to regional patterns of groundwater flow are not
30 anticipated. However, degradation of groundwater quality near the Suisun Marsh area is likely, due
31 to the effects of saline water intrusion caused by slightly rising sea levels. Effects due to climate
32 change are provided for informational purposes only and do not lead to mitigation. This impact
33 would be less than significant. No mitigation is required.

34 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural** 35 **Drainage in the Delta**

36 See Impact GW-4 under Alternative 4; construction activities under Alternative 4A would be
37 identical to those under Alternative 4.

38 **NEPA Effects:** Due to the measures described above under Impact GW-1 and in Appendix 3B,
39 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
40 construction activities associated with Alternative 4 conveyance facilities are not anticipated to
41 result in effects on surrounding groundwater levels that would affect agricultural drainage.

1 Therefore, construction of conveyance features is not forecasted to result in adverse effects to
2 agricultural drainage under Alternative 4A.

3 **CEQA Conclusion:** Due to the measures described above under Alternative 4 and in Appendix 3B,
4 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
5 construction activities associated with Alternative 4 conveyance facilities are not anticipated to
6 result in effects on surrounding groundwater levels that would affect agricultural drainage. This
7 impact would be less than significant. No mitigation is required.

8 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the** 9 **Delta**

10 See Impact GW-5 under Alternative 4; operations under Alternative 4A would be similar to those
11 under Alternative 4 from a footprint perspective in the Delta Region.

12 **NEPA Effects:** Due to the measures described above under Alternative 4 and in Appendix 3B,
13 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, the
14 Intermediate Forebay and the expanded Clifton Court Forebay would include a seepage cutoff wall
15 to the impervious layer and a toe drain around the forebay embankment, to capture water and
16 pump it back into the forebay. These design measures would greatly reduce any potential for
17 seepage onto adjacent lands and avoid interference with agricultural drainage in the vicinity of the
18 Intermediate Forebay and Clifton Court Forebay. Once constructed, the operation of the forebay
19 would be monitored to ensure seepage does not exceed performance requirements, as described
20 under Mitigation Measure GW-5.

21 **CEQA Conclusion:** Due to the measures described above under Alternative 4 and in Appendix 3B,
22 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, the
23 Intermediate Forebay and the expanded Clifton Court Forebay would include a seepage cutoff wall
24 to the impervious layer and a toe drain around the forebay embankment, to capture water and
25 pump it back into the forebay. These design measures would greatly reduce any potential for
26 seepage onto adjacent lands and avoid interference with agricultural drainage in the vicinity of the
27 Intermediate Forebay and Clifton Court Forebay. Once constructed, the operation of the forebay
28 would be monitored to ensure seepage does not exceed performance requirements, as described
29 under Mitigation Measure GW-5.

30 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

31 Please see Mitigation Measure GW-5 under Impact GW-5 in the discussion of Alternative 1A.

32 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge Alter** 33 **Local Groundwater Levels Reduce the Production Capacity of Preexisting Nearby Wells, or** 34 **Interfere with Agricultural Drainage as a Result of Implementing Environmental** 35 **Commitments 3, 4, 6-12, 15, and 16**

36 **NEPA Effects:** Implementation of the Environmental Commitments under Alternative 4A could
37 result in additional increased frequency of inundation of areas associated with the proposed tidal
38 habitat, channel margin habitat, and seasonally inundated floodplain restoration actions, which
39 would result in increased groundwater recharge. Such increased recharge could result in
40 groundwater level rises in some areas. More frequent inundation would also increase seepage,
41 which is already difficult and expensive to control in most agricultural lands in the Delta (see

1 Chapter 14, *Agricultural Resources*). Effects associated with the implementation of those
2 Environmental Commitments would be adverse. The implementation of Mitigation Measure GW-5
3 would help address these effects by identifying areas where seepage conditions have worsened and
4 installing additional subsurface drainage measures, as needed.

5 **CEQA Conclusion:** Implementation of the Environmental Commitments under Alternative 4A could
6 result in additional increased frequency of inundation of areas associated with the proposed tidal
7 habitat, channel margin habitat, and seasonally inundated floodplain restoration actions, which
8 would result in increased groundwater recharge. Such increased recharge could result in
9 groundwater level rises in some areas. More frequent inundation would also increase seepage,
10 which is already difficult and expensive to control in most agricultural lands in the Delta (see
11 Chapter 14, *Agricultural Resources*). Impacts associated with the implementation of those
12 Environmental Commitments would result in significant impacts. Mitigation Measure GW-5 would
13 reduce this impact to a less-than-significant level in most instances by identifying areas where
14 seepage conditions have worsened and installing additional subsurface drainage measures, as
15 needed. However, this impact would still be significant and unavoidable.

16 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

17 Please see Mitigation Measure GW-5 under Impact GW-5 in the discussion of Alternative 1A.

18 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing Environmental** 19 **Commitments 3, 4, 6-12, 15, and 16**

20 **NEPA Effects:** The increased inundation frequency in restoration areas from the Environmental
21 Commitments under Alternative 4A would increase the localized areas exposed to saline and
22 brackish surface water, which would result in increased groundwater salinity beneath such areas.
23 The flooding of large areas with saline or brackish water would result in an adverse effect on
24 groundwater quality beneath or adjacent to flooded areas. It would not be possible to
25 completely avoid this effect. However, if water supply wells in the vicinity of these areas are not
26 useable because of water quality issues, Mitigation Measure GW-7 would help reduce the severity of
27 this effect, but it would remain adverse.

28 **CEQA Conclusion:** The increased inundation frequency in restoration areas from the Environmental
29 Commitments under Alternative 4A would increase the localized areas exposed to saline and
30 brackish surface water, which would result in increased groundwater salinity beneath such areas.
31 The flooding of large areas with saline or brackish water would result in significant impacts on
32 groundwater quality beneath or adjacent to flooded areas. It would not be possible to
33 completely avoid this effect. However, if water supply wells in the vicinity of these areas are not
34 useable because of water quality issues, Mitigation Measure GW-7 is available to address this effect,
35 but the impact would remain significant and unavoidable.

36 **Mitigation Measure GW-7: Provide an Alternate Source of Water**

37 Please see Mitigation Measure GW-7 under Impact GW-7 in the discussion of Alternative 1A.

1 SWP/CVP Export Service Areas

2 Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with 3 Groundwater Recharge, Alter Groundwater Levels or Reduce the Production Capacity of 4 Preexisting Nearby Wells

5 Table 7-8 below shows the long-term average SWP and CVP deliveries for Alternative 4A compared
6 to Existing Conditions and the No Action Alternative at early long-term.

7 **Table 7-8. Long-Term State Water Project and Central Valley Project Deliveries to Hydrologic**
8 **Regions Located South of the Delta at Early Long-Term**

Alternative	Long-Term Average State Water Project and Central Valley Project Deliveries at Early Long-Term (TAF/year)		
	San Joaquin River and Tulare Lake Hydrologic Region	Central Coast Hydrologic Region	Southern California Hydrologic Region
Existing Conditions	2,964	47	1,647
No Action Alternative (ELT)	2,683	43	1,580
Alternative 4A ELT	2,761	45	1,662

TAF/year = thousand acre-feet per year.

9
10 The groundwater resource impacts of Alternative 4A would be similar to those under Alternative 4
11 compared to the No Action Alternative (LLT); however, the magnitude of the impacts would be
12 proportional to the change in the quantity of CVP and SWP surface water supplies delivered to the
13 Export Service Areas compared to the No Action Alternative (ELT). See Table 7-7 for long-term
14 average SWP and CVP surface water deliveries at LLT.

15 **NEPA Effects:** In the San Joaquin River and Tulare Lake Hydrologic Regions, total long-term average
16 annual water deliveries to the CVP and SWP Service Areas under Alternative 4A ELT would be
17 generally higher than the exports under the No Action Alternative (ELT). Increases in surface water
18 deliveries attributable to project operations from the implementation of Alternative 4A are
19 anticipated to result in a corresponding decrease in groundwater use in the Export Service Areas
20 within the San Joaquin and Tulare groundwater basins as compared to the No Action Alternative
21 (ELT. Higher or similar groundwater levels associated with reduced overall groundwater use would
22 not result in an adverse effect on groundwater levels. As discussed in Chapter 5, *Water Supply*,
23 annual water deliveries to the CVP and SWP Service Areas under Alternative 4A could decrease in
24 some isolated years as compared to No Action Alternative (ELT) and could temporarily affect
25 groundwater levels. However, water levels would rebound in subsequent years once surface water
26 deliveries are back to or above No Action Alternative levels. Therefore, sustained effects on
27 groundwater levels are not anticipated.

28 The only change that would occur between ELT and LLT is the expected climate change and sea level
29 rise, and these changes would occur under both the No Action Alternative and Alternative 4A. The
30 incremental differences between No Action Alternative and Alternative 4A would be similar at ELT
31 and at LLT conditions. Therefore, the total long-term average annual water deliveries to the CVP and
32 SWP Service Areas under Alternative 4A at LLT are expected to be higher than the exports under the
33 No Action Alternative (LLT).

1 The total long-term average annual SWP deliveries to Southern California areas under Alternative
2 4A at ELT would increase by approximately 82 thousand acre-feet per year (TAF/year) as compared
3 to the No Action Alternative (ELT). An increase in surface water deliveries could result in a decrease
4 in groundwater pumping and an associated increase in groundwater levels. Therefore, increases in
5 surface water deliveries would not result in adverse effects on groundwater levels.

6 When comparing the total long-term average annual SWP deliveries to Southern California areas
7 under Alternative 4A at LLT with the No Action Alternative (LLT), deliveries are expected to
8 increase and would not adversely affect groundwater levels. Therefore, the effects on groundwater
9 resources would be similar at ELT and at LLT, as noted above for the San Joaquin and Tulare Basins.

10 **CEQA Conclusion:** For the Export Service Areas within the San Joaquin and Tulare groundwater
11 basins, total long-term average surface water deliveries under Alternative 4A at ELT and at LLT
12 would be lower compared to Existing Conditions, largely because of effects due to climate change,
13 sea level rise, and increased water demand north of the Delta. Groundwater pumping under
14 Alternative 4A at ELT is anticipated to be greater than under Existing Conditions, and that
15 groundwater levels in some areas would be lower than under Existing Conditions.

16 As shown above in the NEPA analysis, SWP and CVP deliveries would increase under Alternative 4A
17 as compared to deliveries under conditions in 2025 without Alternative 4A if sea level rise and
18 climate change conditions are considered the same. For reasons discussed in Section 7.3.1, *Methods*
19 *for Analysis*, DWR has identified effects of action alternatives under CEQA separately from the effects
20 of increased water demands, sea level rise, and climate change, which would occur without and
21 independent of the Alternative 4A. Absent these factors, the impacts of Alternative 4A with respect
22 to groundwater levels are anticipated to be less than significant because in most years groundwater
23 pumping is not anticipated to increase due to Alternative 4A.

24 Similarly to the NEPA analysis, in Southern California, long-term average surface water supplies
25 under Alternative 4A at ELT would increase by approximately 15 TAF/year compared to Existing
26 Conditions. An increase in surface water deliveries could result in a decrease in groundwater
27 pumping and an increase in groundwater levels, depending on the total water portfolio of the site
28 specific areas. Therefore, increases in surface water deliveries would not result in significant
29 impacts on groundwater resources under Alternative 4A (ELT) and are considered less than
30 significant.

31 However, total long-term average surface water deliveries under Alternative 4A at LLT may be less
32 than under Existing Conditions, largely because of effects due to climate change, sea level rise, and
33 increased water demand north of the Delta. Therefore, groundwater pumping under Alternative 4A
34 at LLT may be greater than under Existing Conditions, which could result in groundwater level
35 decline in some areas. Southern California water districts may be able to avoid this impact due to
36 various water management options. These options include wastewater recycling and reuse,
37 increased water conservation, water transfers, construction of new local reservoirs that could retain
38 Southern California rainfall during wet years, and desalination. No feasible mitigation would be
39 available to mitigate this impact if it is significant because of a number of factors. First, State Water
40 Contractors currently and traditionally have received variable water supplies under their contracts
41 with DWR due to variations in hydrology and regulatory constraints and are accustomed to
42 responding accordingly. Any reductions associated with this impact would be subject to these
43 contractual limitations. Under standard state water contracts, the risk of shortfalls in exports is
44 borne by the contractors rather than DWR. As a result of this variability, many Southern California

1 water districts have complex water management strategies that include numerous options, as
2 described above, to supplement SWP surface water supplies. These water districts are in the best
3 position to determine the appropriate response to reduced imports from the Delta. Second it may be
4 legally impossible to extract additional groundwater in adjudicated basins without gaining the
5 permission of watermasters and accounting for groundwater pumping entitlements and various
6 parties under their adjudicated rights. Therefore, they would use alternative water supplies, as
7 described, for example, in Urban Water Management Plans.

8 **Impact GW-9: Degrade Groundwater Quality**

9 **NEPA Effects:** As discussed under Impact GW-8, surface water deliveries to the Export Service Areas
10 in the San Joaquin Valley and Tulare Basin under Alternative 4A are expected to increase as
11 compared to the No Action Alternative (ELT) as well as at LLT. Increased surface water deliveries
12 could result in a decrease in groundwater use. The decreased groundwater use is not anticipated to
13 alter regional patterns of groundwater flow in these service areas. Therefore, it is not anticipated
14 this would result in an adverse effect on groundwater quality in these areas because similar
15 groundwater flow patterns would not cause poor quality groundwater migration into areas of better
16 quality groundwater as might occur with increased pumping.

17 Long-term average annual SWP surface water supplies to Southern California would also increase
18 compared to the No Action Alternative (ELT and LLT). Therefore, no adverse effects on groundwater
19 quality are anticipated in those areas.

20 **CEQA Conclusion:** As discussed under Impact GW-8 above, the impacts of Alternative 4A with
21 respect to groundwater levels are considered to be less than significant in the CVP and SWP Export
22 Service Areas in the San Joaquin Valley and Tulare Basin. Therefore, no significant groundwater
23 quality impacts are anticipated in these areas during the implementation of Alternative 4A because
24 it is not anticipated to alter regional groundwater flow patterns. Therefore, this impact is considered
25 less than significant because groundwater levels and flow patterns would not change compared to
26 Existing Conditions, and similar groundwater flow patterns would not cause poor quality
27 groundwater migration into areas of better quality groundwater.

28 Long-term average annual SWP surface water supplies to Southern California would also increase
29 compared to the No Action Alternative (ELT). Therefore, as described above, this impact is
30 considered less than significant in those areas.

31 However, as described in the NEPA conclusion, total long-term average surface water deliveries
32 under Alternative 4A at LLT may be less than under Existing Conditions, and implementation of
33 Alternative 4A at LLT could degrade groundwater quality in portions of the Southern California SWP
34 Export Service Areas; this impact is considered significant due to the possibility of increased
35 groundwater pumping and the resulting effects on regional groundwater flow patterns. There is no
36 feasible mitigation available to address this significant impact. The impact would be considered
37 significant and unavoidable in these areas.

38 Due to the uncertainties identified in connection with the potential response to Impact GW-8 under
39 Alternative 4A in Southern California, the overall impact for Impact GW-9 Alternative 4A is
40 considered significant and unavoidable.

1 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

2 Groundwater level-induced land subsidence has the highest potential to occur in the Export Service
3 Areas within the San Joaquin and Tulare groundwater basins, based on historical data, if
4 groundwater pumping substantially increases due to the alternative.

5 **NEPA Effects:** As discussed under Impact GW-8, surface water deliveries to the Export Service Areas
6 in the San Joaquin Valley and Tulare Basin under Alternative 4A are expected to increase as
7 compared to the No Action Alternative (ELT and LLT). Increased surface water deliveries could
8 result in a decrease in groundwater pumping. The decreased groundwater pumping would result in
9 higher groundwater levels, and therefore, the potential for groundwater level-induced land
10 subsidence is reduced under Alternative 4A. Operations under Alternative 4A would not result in an
11 adverse effect on the potential for groundwater level-induced land subsidence in these areas
12 because groundwater levels would not decline such that compaction of unconsolidated materials in
13 the unconfined aquifer would occur.

14 **CEQA Conclusion:** As discussed under Impact GW-8 above, the impacts of Alternative 4A with
15 respect to groundwater levels are considered to be less than significant in the CVP and SWP Export
16 Service Areas in the San Joaquin Valley and Tulare Basin. Therefore, the potential for groundwater
17 level-induced land subsidence is anticipated to be less than significant in these areas during the
18 implementation of Alternative 4A because it is not anticipated to result in a decline in groundwater
19 levels such that compaction of unconsolidated materials in the unconfined aquifer would occur.

20 **7.3.4.3 Alternative 2D—Dual Conveyance with Modified** 21 **Pipeline/Tunnel and Intakes 1, 2, 3, 4, and 5 (15,000 cfs;** 22 **Operational Scenario B)**

23 **Delta Region**

24 Alternative 2D would include the same physical/structural components as Alternative 4 but would
25 include two additional intakes. Facilities construction under Alternative 2D would be similar to
26 those described for Alternative 4, but with a larger footprint due to two additional intakes.

27 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with** 28 **Groundwater Recharge, Alter Local Groundwater Levels or Reduce the Production Capacity of** 29 **Preexisting Nearby Wells**

30 Construction activities under Alternative 2D would be similar to those under Alternative 4. The only
31 difference would be associated with the number of intakes used. This alternative would use five
32 intakes instead of only three intakes used in Alternative 4.

33 **NEPA Effects:** Similarly to the effects described under Alternative 4 and in Appendix 3B,
34 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
35 construction activities associated with Alternative 2D conveyance facilities are not anticipated to
36 result in adverse effects on surrounding groundwater levels and well yields for the same reasons
37 identified for Alternative 4. Please refer to Appendix 3B for a description of slurry wall
38 environmental commitments. If site-specific geotechnical conditions result in localized groundwater
39 elevation reductions, mitigation measure GW-1 is available to help reduce this effect.

1 **CEQA Conclusion:** Similarly to the impacts described under Alternative 4 and Appendix 3B,
 2 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
 3 construction activities associated with conveyance facilities for Alternative 2D including temporary
 4 dewatering are not anticipated to result in significant impacts on surrounding groundwater levels
 5 and well yields for the same reasons identified for Alternative 4. Please refer to Appendix 3B for a
 6 description of slurry wall environmental commitments. If site-specific geotechnical conditions result
 7 in localized groundwater elevation reductions, mitigation measure GW-1 is available to help reduce
 8 this effect. This impact is therefore less-than-significant.

9 Mitigation Measure GW-1 identifies a monitoring procedure and options for maintaining an
 10 adequate water supply for landowners that may experience a reduction in groundwater production
 11 from wells within the affected areas due to construction-related dewatering activities.

12 **Mitigation Measure GW-1: Maintain Water Supplies in Areas Affected by Construction**
 13 **Dewatering**

14 Please see Mitigation Measure GW-1 under Impact GW-1 in the discussion of Alternative 1A.

15 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with**
 16 **Groundwater Recharge, Alter Local Groundwater Levels or Reduce the Production Capacity of**
 17 **Preexisting Nearby Wells**

18 See Impact GW-2 under Alternative 4; operations under Alternative 2D would be similar to those
 19 under Alternative 4.

20 **NEPA Effects:** Due to the measures described above for Alternative 4 and in Appendix 3B,
 21 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, operations
 22 of Alternative 4A conveyance facilities are not anticipated to result in adverse effects on surrounding
 23 groundwater levels and well yields. The new Intermediate Forebay and the expanded Clifton Court
 24 Forebay would be constructed to comply with the requirements of the DSD which include design
 25 features intended to minimize seepage under the embankments. In addition, the forebays would
 26 include a seepage cutoff wall installed to the impervious layer and a toe drain around the forebay
 27 embankment, to capture water and pump it back into the forebay.

28 Operation of the tunnel would have no effect on existing wells or yields given the facilities would be
 29 located more than 100 feet underground and would not substantially alter groundwater levels in the
 30 vicinity.

31 Model simulations also indicate up to 5-foot episodic lowering of groundwater levels beneath the
 32 Sacramento River due to lower flows in the river as a result of diversions at the north Delta intakes
 33 that result in a reduction in river flows and elevations, as described in Chapter 6, *Surface Water*. The
 34 groundwater level changes would be 5-feet or less on nearby shallow domestic well yields. Due to
 35 the implementation of Mitigation Measure GW-1, no additional mitigation measures are required.

36 **CEQA Conclusion:** Due to the measures described above for Alternative 4 and in Appendix 3B,
 37 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, operations
 38 of Alternative 4A conveyance facilities are not anticipated to result in adverse effects on surrounding
 39 groundwater levels and well yields. The new Intermediate Forebay and the expanded Clifton Court
 40 Forebay would include design features intended to minimize seepage under the embankments and a
 41 toe drain around the forebay embankment, to capture water and pump it back into the forebay.

1 Operation of the tunnel would have no impact on existing wells or yields given these facilities would
2 be located over 100 feet underground and would not substantially alter groundwater levels in the
3 vicinity.

4 Model simulations also indicate up to 5-foot episodic lowering of groundwater levels beneath the
5 Sacramento River due to lower flows in the river as a result of diversions at the north Delta intakes
6 that result in a reduction in river flows and elevations, as described in Chapter 6, *Surface Water*. The
7 groundwater level changes would be 5-feet or less on nearby shallow domestic well yields. Due to
8 the implementation of Mitigation Measure GW-1, no additional mitigation measures are required.

9 Therefore, this impact would be less than significant. No mitigation is required.

10 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of** 11 **Conveyance Facilities**

12 See Impact GW-3 under Alternative 4; the construction and operations activities under Alternative
13 2D would be similar to those under Alternative 4, with potentially a higher magnitude, because five
14 intakes would be constructed (instead of three).

15 **NEPA Effects:** Due to the measures described above under Alternative 4 and in Appendix 3B,
16 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
17 construction and operations activities associated with Alternative 4 conveyance facilities are not
18 anticipated to result in adverse effects on surrounding groundwater levels or changes in direction of
19 groundwater flow patterns near the intake pump stations along the Sacramento River, Intermediate
20 Forebay, and Clifton Court Forebay. Because no significant regional changes in groundwater flow
21 directions are anticipated, and the inducement of poor-quality groundwater into areas of better
22 quality is unlikely, it is anticipated that there would be no change in groundwater quality for
23 Alternative 2D. Further, the planned treatment of extracted groundwater prior to discharge into
24 adjacent surface waters would prevent adverse effects on groundwater quality. There would be no
25 adverse effect.

26 **CEQA Conclusion:** Due to the measures described above under Alternative 4 and in Appendix 3B,
27 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
28 construction and operations activities associated with Alternative 4 conveyance facilities are not
29 anticipated to result in adverse effects on surrounding groundwater levels or changes in direction of
30 groundwater, no significant groundwater quality impacts are anticipated during construction and
31 operations activities of the conveyance facilities. Further, the planned treatment of extracted
32 groundwater prior to discharge into adjacent surface waters would prevent significant impacts on
33 groundwater quality.

34 No significant groundwater quality impacts are anticipated in most areas of the Delta during the
35 implementation of Alternative 2D, because changes to regional patterns of groundwater flow are not
36 anticipated. However, degradation of groundwater quality near the Suisun Marsh area are likely,
37 due to the effects of saline water intrusion caused by slightly rising sea levels. Effects due to climate
38 change are provided for informational purposes only and do not lead to mitigation. This impact
39 would be less than significant. No mitigation is required.

1 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural**
 2 **Drainage in the Delta**

3 See Impact GW-4 under Alternative 4; construction activities under Alternative 2D would be similar
 4 to those under Alternative 4, with a higher magnitude, because five intakes would be constructed
 5 (instead of three).

6 **NEPA Effects:** Due to the measures described above under Impact GW-1 and in Appendix 3B,
 7 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
 8 construction activities associated with Alternative 4 conveyance facilities are not anticipated to
 9 result in effects on surrounding groundwater levels that would affect agricultural drainage.
 10 Therefore, construction of conveyance features is not forecasted to result in adverse effects to
 11 agricultural drainage under Alternative 2D.

12 **CEQA Conclusion:** Due to the measures described above under Alternative 4 and in Appendix 3B,
 13 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
 14 construction activities associated with Alternative 4 conveyance facilities are not anticipated to
 15 result in effects on surrounding groundwater levels that would affect agricultural drainage. This
 16 impact would be less than significant. No mitigation is required.

17 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the**
 18 **Delta**

19 See Impact GW-5 under Alternative 4; operations under Alternative 2D would be similar to those
 20 under Alternative 4.

21 **NEPA Effects:** Due to the measures described above under Alternative 4 and in Appendix 3B,
 22 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, the
 23 Intermediate Forebay and the expanded Clifton Court Forebay would include a seepage cutoff wall
 24 to the impervious layer and a toe drain around the forebay embankment, to capture water and
 25 pump it back into the forebay. These design measures would greatly reduce any potential for
 26 seepage onto adjacent lands and avoid interference with agricultural drainage in the vicinity of the
 27 Intermediate Forebay and Clifton Court Forebay. Once constructed, the operation of the forebay
 28 would be monitored to ensure seepage does not exceed performance requirements, as described
 29 under Mitigation Measures GW-5.

30 **CEQA Conclusion:** Due to the measures described above under Alternative 4 and in Appendix 3B,
 31 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, the
 32 Intermediate Forebay and the expanded Clifton Court Forebay would include a seepage cutoff wall
 33 to the impervious layer and a toe drain around the forebay embankment, to capture water and
 34 pump it back into the forebay. These design measures would greatly reduce any potential for
 35 seepage onto adjacent lands and avoid interference with agricultural drainage in the vicinity of the
 36 Intermediate Forebay and Clifton Court Forebay. Once constructed, the operation of the forebay
 37 would be monitored to ensure seepage does not exceed performance requirements, as described
 38 under Mitigation Measure GW-5.

39 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

40 Please see Mitigation Measure GW-5 under Impact GW-5 in the discussion of Alternative 1A.

1 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge Alter**
 2 **Local Groundwater Levels Reduce the Production Capacity of Preexisting Nearby Wells, or**
 3 **Interfere with Agricultural Drainage as a Result of Implementing Environmental**
 4 **Commitments 3, 4, 6-12, 15, and 16**

5 **NEPA Effects:** Implementation of the Environmental Commitments under Alternative 2D could
 6 result in additional increased frequency of inundation of areas associated with the proposed tidal
 7 habitat, channel margin habitat, and seasonally inundated floodplain restoration actions, which
 8 would result in increased groundwater recharge. Such increased recharge could result in
 9 groundwater level rises in some areas. More frequent inundation would also increase seepage,
 10 which is already difficult and expensive to control in most agricultural lands in the Delta (see
 11 Chapter 14, *Agricultural Resources*). Effects associated with the implementation of those
 12 Environmental Commitments would be adverse. Implementation of Mitigation Measure GW-5 would
 13 help address these effects by identifying areas where seepage conditions have worsened and
 14 installing additional subsurface drainage measures, as needed.

15 **CEQA Conclusion:** Implementation of the Environmental Commitments under Alternative 2D could
 16 result in additional increased frequency of inundation of areas associated with the proposed tidal
 17 habitat, channel margin habitat, and seasonally inundated floodplain restoration actions, which
 18 would result in increased groundwater recharge. Such increased recharge could result in
 19 groundwater level rises in some areas. More frequent inundation would also increase seepage,
 20 which is already difficult and expensive to control in most agricultural lands in the Delta (see
 21 Chapter 14, *Agricultural Resources*). Impacts associated with the implementation of those
 22 Environmental Commitments would result in significant impacts. This impact would be reduced to a
 23 less-than-significant level in most instances, with the implementation of Mitigation Measure GW-5
 24 by identifying areas where seepage conditions have worsened and installing additional subsurface
 25 drainage measures, as needed.

26 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

27 Please see Mitigation Measure GW-5 under Impact GW-5 in the discussion of Alternative 1A.

28 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing Environmental**
 29 **Commitments 3, 4, 6-12, 15, and 16**

30 **NEPA Effects:** The increased inundation frequency in restoration areas from the Environmental
 31 Commitments under Alternative 2D would increase the localized areas exposed to saline and
 32 brackish surface water, which would result in increased groundwater salinity beneath such areas.
 33 The flooding of large areas with saline or brackish water would result in an adverse effect on
 34 groundwater quality beneath or adjacent to flooded areas. It would not be possible to
 35 completely avoid this effect. If water supply wells in the vicinity of these areas are not useable
 36 because of water quality issues, Mitigation Measure GW-7 would help reduce the severity of this
 37 effect, but it would remain adverse.

38 **CEQA Conclusion:** The increased inundation frequency in restoration areas from the Environmental
 39 Commitments under Alternative 2D would increase the localized areas exposed to saline and
 40 brackish surface water, which would result in increased groundwater salinity beneath such areas.
 41 The flooding of large areas with saline or brackish water would result in significant impacts on
 42 groundwater quality beneath or adjacent to flooded areas. It would not be possible to
 43 completely avoid this effect. However, if water supply wells in the vicinity of these areas are not

1 useable because of water quality issues, Mitigation Measure GW-7 is available to address this effect.
 2 Nonetheless, because it is not possible to completely avoid this impact, it is considered significant
 3 and unavoidable.

4 **Mitigation Measure GW-7: Provide an Alternate Source of Water**

5 Please see Mitigation Measure GW-7 under Impact GW-7 in the discussion of Alternative 1A.

6 **SWP/CVP Export Service Areas**

7 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with** 8 **Groundwater Recharge, Alter Groundwater Levels or Reduce the Production Capacity of** 9 **Preexisting Nearby Wells**

10 The groundwater resource impacts of Alternative 2D would be similar to those under Alternative
 11 2A, but with the magnitude of the impacts proportional to the change in the quantity of CVP and
 12 SWP surface water supplies delivered to the SWP/CVP Export Service Areas compared to the No
 13 Action Alternative (ELT).

14 Table 7-9 below shows the long-term average SWP and CVP deliveries for Alternative 2D compared
 15 to Existing Conditions and the No Action Alternative (ELT). See Table 7-7 for long-term average SWP
 16 and CVP surface water deliveries at LLT.

17 **Table 7-9. Long-Term State Water Project and Central Valley Project Deliveries to Hydrologic**
 18 **Regions Located South of the Delta at Early Long-Term**

Alternative	Long-Term Average State Water Project and Central Valley Project Deliveries at Early Long-Term (TAF/year)		
	San Joaquin River and Tulare Lake Hydrologic Region	Central Coast Hydrologic Region	Southern California Hydrologic Region
Existing Conditions	2,964	47	1,647
No Action Alternative (ELT)	2,683	43	1,580
Alternative 2D ELT	3,016	51	1,819

TAF/year = thousand acre-feet per year.

19
 20 **NEPA Effects:** In the San Joaquin River and Tulare Lake Hydrologic Regions, total long-term average
 21 annual water deliveries to the CVP and SWP Service Areas under Alternative 2D at ELT are expected
 22 to be higher than the exports under the No Action Alternative (ELT). Increases in surface water
 23 deliveries attributable to project operations from the implementation of Alternative 2D are
 24 anticipated to result in a corresponding decrease in groundwater use in the Export Service Areas
 25 within the San Joaquin and Tulare groundwater basins as compared to the No Action Alternative
 26 (ELT), as discussed in subsection 7.3.3.1, *No Action Alternative Late Long-Term*. Higher groundwater
 27 levels associated with reduced overall groundwater use would result in a beneficial effect on
 28 groundwater levels. Similarly, total long-term average annual water deliveries to the CVP and SWP
 29 Service Areas under Alternative 2D at LLT are expected to be higher than the exports under the No
 30 Action Alternative (LLT).

31 The total long-term average annual SWP deliveries to Southern California areas under Alternative
 32 2D would be greater than those under the No Action Alternative (ELT and LLT). Therefore,

1 implementation of Alternative 2D would result in a corresponding decrease in groundwater use.
2 There would be no adverse effects on groundwater levels because of the anticipated decreases in
3 groundwater pumping due to an increase in surface water deliveries.

4 **CEQA Conclusion:** For the Export Service Areas within the San Joaquin and Tulare groundwater
5 basins, total long-term average surface water deliveries under Alternative 2D at ELT would be
6 greater than under Existing Conditions. Increases in surface water deliveries attributable to project
7 operations from the implementation of Alternative 2D are anticipated to result in a corresponding
8 decrease in groundwater use in the Export Service Areas within the San Joaquin and Tulare
9 groundwater basins as compared to the Existing Conditions. Higher groundwater levels associated
10 with reduced overall groundwater use would result in less-than-significant impacts on groundwater
11 levels. Total long-term average surface water deliveries under Alternative 2D at LLT in the San
12 Joaquin Valley and Tulare Basin would be lower compared to Existing Conditions, largely because of
13 effects due to climate change, sea level rise, and increased water demand north of the Delta.

14 The total long-term average annual SWP deliveries to Southern California areas under Alternative
15 2D at ELT and at LLT would be greater than those under Existing Conditions. Therefore,
16 implementation of Alternative 2D would result in a corresponding decrease in groundwater use.
17 Impacts on groundwater levels would be less than significant because of the anticipated decreases
18 in groundwater pumping due to an increase in surface water deliveries.

19 **Impact GW-9: Degrade Groundwater Quality**

20 **NEPA Effects:** As discussed under Impact GW-8, surface water deliveries to the Export Service Areas
21 in the San Joaquin Valley and Tulare Basin under Alternative 2D are expected to increase as
22 compared to the No Action Alternative (ELT and LLT). Increased surface water deliveries could
23 result in a decrease in groundwater use. The decreased groundwater use is not anticipated to alter
24 regional patterns of groundwater flow in these service areas. Therefore, it is not anticipated this
25 would result in an adverse effect on groundwater quality in these areas because similar
26 groundwater flow patterns would not cause poor quality groundwater migration into areas of better
27 quality groundwater as might occur with increased pumping. Similarly, long-term average annual
28 SWP supplies to Southern California are anticipated to increase under Alternative 2D compared to
29 the No Action Alternative (ELT and LLT). Therefore, groundwater pumping is anticipated to
30 decrease, which would not alter regional groundwater flow patterns. As a result, adverse effects on
31 groundwater quality are not anticipated in this region because similar groundwater flow patterns
32 would not cause poor quality groundwater migration into areas of better quality groundwater.

33 **CEQA Conclusion:** As discussed under Impact GW-8 above, the impacts of Alternative 2D with
34 respect to groundwater levels are considered to be less than significant in the CVP and SWP Export
35 Service Areas in the San Joaquin Valley and Tulare Basin and in Southern California. Therefore, no
36 significant groundwater quality impacts are anticipated in these areas during the implementation of
37 Alternative 2D because it is not anticipated to alter regional groundwater flow patterns. Therefore,
38 this impact is considered less than significant because groundwater levels and flow patterns would
39 not change compared to Existing Conditions, and similar groundwater flow patterns would not
40 cause poor quality groundwater migration into areas of better quality groundwater.

1 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

2 Groundwater level-induced land subsidence has the highest potential to occur in the Export Service
3 Areas within the San Joaquin and Tulare groundwater basins, based on historical data, if
4 groundwater pumping substantially increases due to the alternative.

5 **NEPA Effects:** As discussed under Impact GW-8, surface water deliveries to the Export Service Areas
6 in the San Joaquin Valley and Tulare Basin under Alternative 2D are expected to increase as
7 compared to the No Action Alternative (ELT and LLT). Increased surface water deliveries could
8 result in a decrease in groundwater pumping. The decreased groundwater pumping would result in
9 higher groundwater levels, and therefore, the potential for groundwater level-induced land
10 subsidence is reduced under Alternative 2D. Operations under Alternative 2D would not result in an
11 adverse effect on the potential for groundwater level-induced land subsidence in these areas
12 because groundwater levels would not decline such that compaction of unconsolidated materials in
13 the unconfined aquifer would occur.

14 **CEQA Conclusion:** As discussed under Impact GW-8 above, the impacts of Alternative 2D with
15 respect to groundwater levels are considered to be less than significant in the CVP and SWP Export
16 Service Areas in the San Joaquin Valley and Tulare Basin. Therefore, the potential for groundwater
17 level-induced land subsidence is anticipated to be less than significant in these areas during the
18 implementation of Alternative 2D because it is not anticipated to result in a decline in groundwater
19 levels such that compaction of unconsolidated materials in the unconfined aquifer would occur.

20 **7.3.4.4 Alternative 5A—Dual Conveyance with Modified** 21 **Pipeline/Tunnel and Intake 2 (3,000 cfs; Operational Scenario C)**

22 **Delta Region**

23 Alternative 5A would include the same physical/structural components as Alternative 4 but would
24 include two fewer intakes. Facilities construction under Alternative 5A would be similar to those
25 described for Alternative 4, but with a smaller footprint due to two fewer intakes.

26 **Impact GW-1: During Construction, Deplete Groundwater Supplies or Interfere with** 27 **Groundwater Recharge, Alter Local Groundwater Levels or Reduce the Production Capacity of** 28 **Preexisting Nearby Wells**

29 Construction activities under Alternative 5A would be similar to those under Alternative 4. The only
30 difference would be associated with the number of intakes used. This alternative would use one
31 intake instead of three intakes used in Alternative 4.

32 **NEPA Effects:** Similarly to the effects described under Alternative 4 and in Appendix 3B,
33 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
34 construction activities associated with Alternative 5A conveyance facilities are not anticipated to
35 result in adverse effects on surrounding groundwater levels and well yields for the same reasons
36 identified for Alternative 4. Please refer to Appendix 3B for a description of slurry wall
37 environmental commitments. If site-specific geotechnical conditions result in localized groundwater
38 elevation reductions, mitigation measure GW-1 is available to help reduce this effect.

39 **CEQA Conclusion:** Similarly to the impacts described under Alternative 4 and Appendix 3B,
40 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,

1 construction activities associated with conveyance facilities for Alternative 5A including temporary
 2 dewatering are not anticipated to result in significant impacts on surrounding groundwater levels
 3 and well yields for the same reasons identified for Alternative 4. Please refer to Appendix 3B for a
 4 description of slurry wall environmental commitments. If site-specific geotechnical conditions result
 5 in localized groundwater elevation reductions, mitigation measure GW-1 is available to help reduce
 6 this effect. This impact is therefore less-than-significant.

7 Mitigation Measure GW-1 identifies a monitoring procedure and options for maintaining an
 8 adequate water supply for landowners that experience a reduction in groundwater production from
 9 wells within the affected areas due to construction-related dewatering activities.

10 **Mitigation Measure GW-1: Maintain Water Supplies in Areas Affected by Construction**
 11 **Dewatering**

12 Please see Mitigation Measure GW-1 under Impact GW-1 in the discussion of Alternative 1A.

13 **Impact GW-2: During Operations, Deplete Groundwater Supplies or Interfere with**
 14 **Groundwater Recharge, Alter Local Groundwater Levels or Reduce the Production Capacity of**
 15 **Preexisting Nearby Wells**

16 See Impact GW-2 under Alternative 4; operations under Alternative 5A would be similar to those
 17 under Alternative 4.

18 **NEPA Effects:** Due to the measures described above for Alternative 4 and in Appendix 3B,
 19 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, operations
 20 of Alternative 4A conveyance facilities are not anticipated to result in adverse effects on surrounding
 21 groundwater levels and well yields. The new Intermediate Forebay and the expanded Clifton Court
 22 Forebay would be constructed to comply with the requirements of the DSD which include design
 23 features intended to minimize seepage under the embankments. In addition, the forebays would
 24 include a seepage cutoff wall installed to the impervious layer and a toe drain around the forebay
 25 embankment, to capture water and pump it back into the forebay.

26 Operation of the tunnel would have no effect on existing wells or yields given the facilities would be
 27 located more than 100 feet underground and would not substantially alter groundwater levels in the
 28 vicinity.

29 Model simulations also indicate up to 5-foot episodic lowering of groundwater levels beneath the
 30 Sacramento River due to lower flows in the river as a result of diversions at the north Delta intakes
 31 that result in a reduction in river flows and elevations, as described in Chapter 6, *Surface Water*. The
 32 groundwater level changes would be 5-feet or less on nearby shallow domestic well yields. Due to
 33 the implementation of Mitigation Measure GW-1, no additional mitigation measures are required.

34 Therefore, during operations there would be no adverse effects on groundwater resources.

35 **CEQA Conclusion:** Due to the measures described above for Alternative 4 and in Appendix 3B,
 36 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, operations
 37 of Alternative 4A conveyance facilities are not anticipated to result in adverse effects on surrounding
 38 groundwater levels and well yields. The new Intermediate Forebay and the expanded Clifton Court
 39 Forebay would include design features intended to minimize seepage under the embankments and a
 40 toe drain around the forebay embankment, to capture water and pump it back into the forebay.

1 Operation of the tunnel would have no impact on existing wells or yields given these facilities would
 2 be located over 100 feet underground and would not substantially alter groundwater levels in the
 3 vicinity.

4 Model simulations also indicate up to 5-foot episodic lowering of groundwater levels beneath the
 5 Sacramento River due to lower flows in the river as a result of diversions at the north Delta intakes
 6 that result in a reduction in river flows and elevations, as described in Chapter 6, *Surface Water*. The
 7 groundwater level changes would be 5-feet or less on nearby shallow domestic well yields. Due to
 8 the implementation of Mitigation Measure GW-1, no additional mitigation measures are required.

9 Therefore, this impact would be less than significant. No mitigation is required.

10 **Impact GW-3: Degrade Groundwater Quality during Construction and Operation of** 11 **Conveyance Facilities**

12 See Impact GW-3 under Alternative 4; the construction and operations activities under Alternative
 13 5A would be similar to those under Alternative 4, with a lesser magnitude, because one intake would
 14 be constructed (instead of three).

15 **NEPA Effects:** Due to the measures described above under Alternative 4 and in Appendix 3B,
 16 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
 17 construction and operations activities associated with Alternative 4 conveyance facilities are not
 18 anticipated to result in adverse effects on surrounding groundwater levels or changes in direction of
 19 groundwater flow patterns near the intake pump stations along the Sacramento River, Intermediate
 20 Forebay, and Clifton Court Forebay. Because no significant regional changes in groundwater flow
 21 directions are anticipated, and the inducement of poor-quality groundwater into areas of better
 22 quality is unlikely, it is anticipated that there would be no change in groundwater quality for
 23 Alternative 5A. Further, the planned treatment of extracted groundwater prior to discharge into
 24 adjacent surface waters would prevent adverse effects on groundwater quality. There would be no
 25 adverse effect.

26 **CEQA Conclusion:** Due to the measures described above under Alternative 4 and in Appendix 3B,
 27 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
 28 construction and operations activities associated with Alternative 4 conveyance facilities are not
 29 anticipated to result in adverse effects on surrounding groundwater levels or changes in direction of
 30 groundwater, no significant groundwater quality impacts are anticipated during construction and
 31 operations activities of the conveyance facilities. Further, the planned treatment of extracted
 32 groundwater prior to discharge into adjacent surface waters would prevent significant impacts on
 33 groundwater quality.

34 No significant groundwater quality impacts are anticipated in most areas of the Delta during the
 35 implementation of Alternative 5A, because changes to regional patterns of groundwater flow are not
 36 anticipated. However, degradation of groundwater quality near the Suisun Marsh area are likely,
 37 due to the effects of saline water intrusion caused by slightly rising sea levels. Effects due to climate
 38 change are provided for informational purposes only and do not lead to mitigation. This impact
 39 would be less than significant. No mitigation is required.

1 **Impact GW-4: During Construction of Conveyance Facilities, Interfere with Agricultural**
 2 **Drainage in the Delta**

3 See Impact GW-4 under Alternative 4; construction activities under Alternative 5A would be similar
 4 to those under Alternative 4, with a lesser magnitude, because one intake would be constructed
 5 (instead of three).

6 **NEPA Effects:** Due to the measures described above under Impact GW-1 and in Appendix 3B,
 7 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
 8 construction activities associated with Alternative 4 conveyance facilities are not anticipated to
 9 result in effects on surrounding groundwater levels that would affect agricultural drainage.
 10 Therefore, construction of conveyance features is not forecasted to result in adverse effects to
 11 agricultural drainage under Alternative 5A.

12 **CEQA Conclusion:** Due to the measures described above under Alternative 4 and in Appendix 3B,
 13 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls,
 14 construction activities associated with Alternative 4 conveyance facilities are not anticipated to
 15 result in effects on surrounding groundwater levels that would affect agricultural drainage. This
 16 impact would be less than significant. No mitigation is required.

17 **Impact GW-5: During Operations of New Facilities, Interfere with Agricultural Drainage in the**
 18 **Delta**

19 See Impact GW-5 under Alternative 4; operations under Alternative 5A would be similar to those
 20 under Alternative 4.

21 **NEPA Effects:** Due to the measures described above under Alternative 4 and in Appendix 3B,
 22 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, the
 23 Intermediate Forebay and the expanded Clifton Court Forebay would include a seepage cutoff wall
 24 to the impervious layer and a toe drain around the forebay embankment, to capture water and
 25 pump it back into the forebay. These design measures would greatly reduce any potential for
 26 seepage onto adjacent lands and avoid interference with agricultural drainage in the vicinity of the
 27 Intermediate Forebay and Clifton Court Forebay. Once constructed, the operation of the forebay
 28 would be monitored to ensure seepage does not exceed performance requirements, as described in
 29 Mitigation Measures GW-5.

30 **CEQA Conclusion:** Due to the measures described above under Alternative 4 and in Appendix 3B,
 31 *Environmental Commitments, AMMs, and CMs*, related to installation of slurry cutoff walls, the
 32 Intermediate Forebay and the expanded Clifton Court Forebay would include a seepage cutoff wall
 33 to the impervious layer and a toe drain around the forebay embankment, to capture water and
 34 pump it back into the forebay. These design measures would greatly reduce any potential for
 35 seepage onto adjacent lands and avoid interference with agricultural drainage in the vicinity of the
 36 Intermediate Forebay and Clifton Court Forebay. Once constructed, the operation of the forebay
 37 would be monitored to ensure seepage does not exceed performance requirements, as described
 38 under Mitigation Measure GW-5.

39 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

40 Please see Mitigation Measure GW-5 under Impact GW-5 in the discussion of Alternative 1A.

1 **Impact GW-6: Deplete Groundwater Supplies or Interfere with Groundwater Recharge Alter**
 2 **Local Groundwater Levels Reduce the Production Capacity of Preexisting Nearby Wells, or**
 3 **Interfere with Agricultural Drainage as a Result of Implementing Environmental**
 4 **Commitments 3, 4, 6-12, 15, and 16**

5 **NEPA Effects:** Implementation of the Environmental Commitments under Alternative 5A could
 6 result in additional increased frequency of inundation of areas associated with the proposed tidal
 7 habitat, channel margin habitat, and seasonally inundated floodplain restoration actions, which
 8 would result in increased groundwater recharge. Such increased recharge could result in
 9 groundwater level rises in some areas. More frequent inundation would also increase seepage,
 10 which is already difficult and expensive to control in most agricultural lands in the Delta (see
 11 Chapter 14, *Agricultural Resources*). Effects associated with the implementation of those
 12 Environmental Commitments would be adverse. Implementation of Mitigation Measure GW-5 would
 13 help address these effects by identifying areas where seepage conditions have worsened and
 14 installing additional subsurface drainage measures, as needed.

15 **CEQA Conclusion:** Implementation of the Environmental Commitments under Alternative 5A could
 16 result in additional increased frequency of inundation of areas associated with the proposed tidal
 17 habitat, channel margin habitat, and seasonally inundated floodplain restoration actions, which
 18 would result in increased groundwater recharge. Such increased recharge could result in
 19 groundwater level rises in some areas. More frequent inundation would also increase seepage,
 20 which is already difficult and expensive to control in most agricultural lands in the Delta (see
 21 Chapter 14, *Agricultural Resources*). Impacts associated with the implementation of those
 22 Environmental Commitments would result in significant impacts. This impact would be reduced to a
 23 less-than-significant level in most instances, with the implementation of Mitigation Measure GW-5
 24 by identifying areas where seepage conditions have worsened and installing additional subsurface
 25 drainage measures, as needed. However, in some instances mitigation may be infeasible due to
 26 factors such as costs. The impact is therefore considered significant and unavoidable as applied to
 27 such latter properties.

28 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

29 Please see Mitigation Measure GW-5 under Impact GW-5 in the discussion of Alternative 1A.

30 **Impact GW-7: Degrade Groundwater Quality as a Result of Implementing Environmental**
 31 **Commitments 3, 4, 6-12, 15, and 16**

32 **NEPA Effects:** The increased inundation frequency in restoration areas from the Environmental
 33 Commitments under Alternative 5A would increase the localized areas exposed to saline and
 34 brackish surface water, which would result in increased groundwater salinity beneath such areas.
 35 The flooding of large areas with saline or brackish water would result in an adverse effect on
 36 groundwater quality beneath or adjacent to flooded areas. It would not be possible to
 37 completely avoid this effect. However, if water supply wells in the vicinity of these areas are not
 38 useable because of water quality issues, Mitigation Measure GW-7 is available to address this effect.

39 **CEQA Conclusion:** The increased inundation frequency in restoration areas from the Environmental
 40 Commitments under Alternative 5A would increase the localized areas exposed to saline and
 41 brackish surface water, which would result in increased groundwater salinity beneath such areas.
 42 The flooding of large areas with saline or brackish water would result in significant impacts on
 43 groundwater quality beneath or adjacent to flooded areas. It would not be possible to

1 completely avoid this effect. However, if water supply wells in the vicinity of these areas are not
 2 useable because of water quality issues, Mitigation Measure GW-7 would help reduce this impact,
 3 but the impact would remain significant and unavoidable.

4 **Mitigation Measure GW-7: Provide an Alternate Source of Water**

5 Please see Mitigation Measure GW-7 under Impact GW-7 in the discussion of Alternative 1A.

6 **SWP/CVP Export Service Areas**

7 **Impact GW-8: During Operations, Deplete Groundwater Supplies or Interfere with** 8 **Groundwater Recharge, Alter Groundwater Levels or Reduce the Production Capacity of** 9 **Preexisting Nearby Wells**

10 The groundwater resource impacts of Alternative 5A would be similar to those under Alternative 5,
 11 but with the magnitude of the impacts proportional to the change in the quantity of CVP and SWP
 12 surface water supplies delivered to the SWP/CVP Export Service Areas compared to the No Action
 13 Alternative (ELT).

14 Table 7-10 below shows the long-term average SWP and CVP deliveries for Alternative 5A compared
 15 to Existing Conditions and the No Action Alternative (ELT). See Table 7-7 for long-term average SWP
 16 and CVP surface water deliveries at LLT.

17 **Table 7-10. Long-Term State Water Project and Central Valley Project Deliveries to Hydrologic**
 18 **Regions Located South of the Delta at Early Long-Term**

Alternative	Long-Term Average State Water Project and Central Valley Project Deliveries at Early Long-Term (TAF/year)		
	San Joaquin River and Tulare Lake Hydrologic Region	Central Coast Hydrologic Region	Southern California Hydrologic Region
Existing Conditions	2,964	47	1,647
No Action Alternative (ELT)	2,683	43	1,580
Alternative 5A ELT	2,928	48	1,728

TAF/year = thousand acre-feet per year.

19
 20 **NEPA Effects:** In the San Joaquin River and Tulare Lake Hydrologic Regions, total long-term average
 21 annual water deliveries to the Export Service Areas under Alternative 5A at ELT are expected to be
 22 higher than the exports under the No Action Alternative (ELT). Increases in surface water deliveries
 23 attributable to project operations from the implementation of Alternative 5A are anticipated to
 24 result in a corresponding decrease in groundwater use in the Export Service Areas within the San
 25 Joaquin and Tulare groundwater basins as compared to the No Action Alternative (ELT), as
 26 discussed in Section 7.3.3.1, *No Action Alternative Late Long-Term*. Higher groundwater levels
 27 associated with reduced overall groundwater use would result in a beneficial effect on groundwater
 28 levels. Similarly, total long-term average annual water deliveries to the Export Service Areas under
 29 Alternative 5A at LLT are expected to be higher than the exports under the No Action Alternative
 30 (LLT).

31 The total long-term average annual SWP deliveries to Southern California areas under Alternative
 32 5A would be greater than those under the No Action Alternative (ELT and LLT). Therefore,

1 implementation of Alternative 5A would result in a corresponding decrease in groundwater use.
 2 There would be no adverse effects on groundwater levels because of the anticipated decreases in
 3 groundwater pumping due to an increase in surface water deliveries.

4 **CEQA Conclusion:** For the Export Service Areas within the San Joaquin and Tulare groundwater
 5 basins, total long-term average surface water deliveries under Alternative 5A at ELT would be
 6 slightly lower than under Existing Conditions, largely because of effects due to climate change, sea
 7 level rise, and increased water demand north of the Delta. Groundwater pumping under Alternative
 8 5A at ELT is anticipated to be greater than under Existing Conditions, and that groundwater levels in
 9 some areas would be lower than under Existing Conditions. Total long-term average surface water
 10 deliveries under Alternative 5A at LLT in the San Joaquin Valley and Tulare Basin would be lower
 11 compared to Existing Conditions, largely because of effects due to climate change, sea level rise, and
 12 increased water demand north of the Delta.

13 As shown above in the NEPA analysis, SWP and CVP deliveries would increase under Alternative 5A
 14 as compared to deliveries under conditions in 2025 without Alternative 5A if sea level rise and
 15 climate change conditions are considered the same. For reasons discussed in Section 7.3.1, *Methods*
 16 *for Analysis*, DWR has identified effects of action alternatives under CEQA separately from the effects
 17 of increased water demands, sea level rise, and climate change, which would occur without and
 18 independent of the Alternative 5A. Absent these factors, the impacts of Alternative 5A with respect
 19 to groundwater levels are anticipated to be less than significant because groundwater pumping is
 20 not anticipated to increase due to Alternative 5A.

21 The total long-term average annual SWP deliveries to Southern California areas under Alternative
 22 5A would be greater than those under Existing Conditions. Therefore, implementation of Alternative
 23 5A would result in a corresponding decrease in groundwater use. Impacts on groundwater levels
 24 would be less than significant because of the anticipated decreases in groundwater pumping due to
 25 an increase in surface water deliveries.

26 **Impact GW-9: Degrade Groundwater Quality**

27 **NEPA Effects:** As discussed under Impact GW-8, surface water deliveries to the Export Service Areas
 28 within the San Joaquin Valley and Tulare basins under Alternative 5A are expected to increase as
 29 compared to the No Action Alternative (ELT and LLT). Increased surface water deliveries could
 30 result in a decrease in groundwater use. The decreased groundwater use is not anticipated to alter
 31 regional patterns of groundwater flow in these service areas. Therefore, it is not anticipated this
 32 would result in an adverse effect on groundwater quality in these areas because similar
 33 groundwater flow patterns would not cause poor quality groundwater migration into areas of better
 34 quality groundwater as might occur with increased pumping.

35 Similarly, long-term average annual SWP supplies to Southern California are anticipated to increase
 36 under Alternative 5A compared to the No Action Alternative (ELT and LLT); therefore, groundwater
 37 pumping is anticipated to decrease, which would not alter regional groundwater flow patterns. As a
 38 result, adverse effects on groundwater quality are not anticipated in this region because similar
 39 groundwater flow patterns would not cause poor quality groundwater migration into areas of better
 40 quality groundwater.

41 **CEQA Conclusion:** As discussed under Impact GW-8 above, the impacts of Alternative 5A with
 42 respect to groundwater levels are considered to be less than significant in the CVP and SWP Export
 43 Service Areas in the San Joaquin Valley and Tulare basins and in Southern California. Therefore, no

1 significant groundwater quality impacts are anticipated in these areas during the implementation of
 2 Alternative 5A because it is not anticipated to alter regional groundwater flow patterns. Therefore,
 3 this impact is considered less than significant because groundwater levels and flow patterns would
 4 not change compared to Existing Conditions, and similar groundwater flow patterns would not
 5 cause poor quality groundwater migration into areas of better quality groundwater.

6 **Impact GW-10: Result in Groundwater Level-Induced Land Subsidence**

7 Groundwater level-induced land subsidence has the highest potential to occur in the Export Service
 8 Areas within the San Joaquin and Tulare groundwater basins, based on historical data, if
 9 groundwater pumping substantially increases due to the alternative.

10 **NEPA Effects:** As discussed under Impact GW-8, surface water deliveries to the Export Service Areas
 11 within the San Joaquin Valley and Tulare basins under Alternative 5A are expected to increase as
 12 compared to the No Action Alternative (ELT and LLT). Increased surface water deliveries could
 13 result in a decrease in groundwater pumping. The decreased groundwater pumping would result in
 14 higher groundwater levels, and therefore, the potential for groundwater level-induced land
 15 subsidence is reduced under Alternative 5A. Operations under Alternative 5A would not result in an
 16 adverse effect on the potential for groundwater level-induced land subsidence in these areas
 17 because groundwater levels would not decline such that compaction of unconsolidated materials in
 18 the unconfined aquifer would occur.

19 **CEQA Conclusion:** As discussed under Impact GW-8 above, the impacts of Alternative 5A with
 20 respect to groundwater levels are considered to be less than significant in the CVP and SWP Export
 21 Service Areas within the San Joaquin Valley and Tulare basin. Therefore, the potential for
 22 groundwater level-induced land subsidence is anticipated to be less than significant in these areas
 23 during the implementation of Alternative 5A because it is not anticipated to result in a decline in
 24 groundwater levels such that compaction of unconsolidated materials in the unconfined aquifer
 25 would occur.

26 **7.3.5 Cumulative Analysis**

27 Cumulative effects result from incremental impacts of a proposed action when added with other
 28 past, present, and reasonably foreseeable future actions. This section identifies the potential for
 29 past, present and reasonably foreseeable future programs, projects, and policies to cause adverse
 30 cumulative impacts on groundwater resources in the Delta Region and the Export Service Areas
 31 south of the Delta.

32 When the effects of any of the action alternatives are considered in combination with the effects of
 33 initiatives listed in Table 7-8, the cumulative effects on groundwater resources could be adverse.
 34 The specific programs, projects, and policies are identified below for each impact category based on
 35 the potential to contribute to an impact on groundwater identified under an action alternative that
 36 could be deemed cumulatively considerable. The potential for cumulative impacts on groundwater
 37 resources is described for effects related to the construction of water conveyance facilities and
 38 effects stemming from the long-term implementation of CM2-21 under BDCP alternatives or
 39 Environmental Commitments 3, 4, 6-12, 15, and 16 under non-HCP alternatives.

40 All of the action alternatives included the assumption that the following projects identified to occur
 41 under the No Project Alternative and No Action Alternative were implemented. These programs are:

- 1 • Grasslands Bypass Project.
- 2 • Lower American River Flow Management Standard (simulated in Existing Conditions, No Action
- 3 Alternative, and all action alternatives).
- 4 • Delta-Mendota Canal / California Aqueduct Intertie.
- 5 • Freeport Regional Water Project.

6 Therefore, the effects of those projects were included in the water supply operations presented in
 7 Chapter 5, *Water Supply*, and the associated groundwater resources effects analysis are presented in
 8 previous sections of this chapter through the comparison of the action alternatives to the No Action
 9 Alternative.

10 The Cumulative Analysis for groundwater resources includes a comparison of conditions that could
 11 occur without the action alternatives with conditions that could occur with implementation of the
 12 action alternatives to determine if the combined effect of implementation of all of these projects
 13 could be cumulatively significant, and if so, whether the incremental effect of the action alternatives
 14 could be considered cumulatively considerable.

15 The following list presented in Table 7-11 includes projects considered for this cumulative effects
 16 section; for a complete list of such projects, consult Appendix 3D, *Defining Existing Conditions, No*
 17 *Action Alternative, No Project Alternative, and Cumulative Impact Conditions*. Several projects that are
 18 included in Table 3D-5 for the Cumulative Impact Assessment might have had construction impacts
 19 on groundwater resources, but they have been completed, and therefore were not included in this
 20 analysis.

21 **Table 7-11. Effects on Groundwater Resources from the Plans, Policies, and Programs Considered for**
 22 **Cumulative Analysis**

Agency	Program/Project	Status	Description of Program/Project	Effects on Groundwater Resources
California Department of Water Resources	North Delta Flood Control and Ecosystem Restoration Project	Final EIR completed in 2010	Project implements flood control and ecosystem restoration benefits in the north Delta (California Department of Water Resources 2010c)	Potential increase in groundwater levels and groundwater recharge; potential groundwater seepage to adjacent islands/tracts; potential groundwater contamination
California Department of Water Resources	Dutch Slough Tidal Marsh Restoration Project	Program under development. Draft Plan and EIR in 2008. Final EIR in 2010.	Project includes breaching levees and restoring a tidal channel system on parcels between Dutch Slough and Contra Costa Canal (California Department of Water Resources 2010d)	Potential groundwater intrusion onto adjacent parcels
Contra Costa Water District, Bureau of Reclamation, and California Department of Water Resources	Los Vaqueros Reservoir Expansion Project	Program under development. Draft EIS/EIR in 2009. Final EIS/EIR in 2010. Estimated completion in 2012.	Project will increase the storage capacity of Los Vaqueros Reservoir and divert additional water from the Delta	First phase is being constructed. The second phase has been evaluated in an environmental impact report/environmental impact statement that indicates no adverse effects or less-than-significant effects on groundwater resources.

Agency	Program/Project	Status	Description of Program/Project	Effects on Groundwater Resources
Northeastern San Joaquin County Groundwater Banking Authority	Eastern San Joaquin Integrated Conjunctive Use Program	Program under development. Final Programmatic EIR in 2009	Program will improve the use and storage of groundwater by implementing conjunctive use projects such as water transfers and groundwater banking	Affect groundwater level fluctuations due to groundwater banking operations; potential groundwater quality impacts; mostly beneficial effects; the effects would be located outside of the action alternatives conveyance footprint area
Bureau of Reclamation, San Luis & Delta Mendota Water Authority	Grassland Bypass Project, 2010–2019, and Agricultural Drainage Selenium Management Program	Program under development. Final EIS/EIR in 2009	Reduce effects from agricultural drainage on wildlife refuges and wetlands. Will convey subsurface agricultural drainage to Mud Slough (tributary of San Joaquin River) (Bureau of Reclamation and San Luis & Delta-Mendota Water Authority 2008)	Beneficial, neutral, or less-than-significant effects on subsurface agricultural drainage and shallow groundwater levels; beneficial effects on groundwater salinity
Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Services, Department of Water Resources, and Department of Fish and Wildlife	San Joaquin River Restoration Program	Final EIS/EIR completed in 2012.	The San Joaquin River Restoration Program is a direct result of a September 2006 legal settlement by the U.S. Departments of the Interior and Commerce, the Natural Resources Defense Council, and the Friant Water Users Authority to restore spring and fall run Chinook salmon to the San Joaquin River below Friant Dam while supporting water management actions within the Friant Division. Public Law 111-11 authorized and directed federal agencies to implement the settlement. Interim flows began October 1, 2009, and full restoration flows are scheduled to begin no later than January 2014 (California Department of Water Resources 2009: SJ-12).	Temporary Construction-Related Effects on Groundwater Quality; changes in groundwater levels and groundwater quality along San Joaquin River; changes in groundwater levels and groundwater quality in CVP/SWP service areas
Department of Water Resources	California Water Action Plan	Initiated in January 2014	This plan lays out a roadmap for the next 5 years for actions that would fulfill 10 key themes. In addition, the plan describes certain specific actions and projects that call for improved water management throughout the state.	Most of the actions do not have a direct effect on groundwater, except for the improved groundwater management action, which would have a beneficial effect on groundwater resources.
Delta Conservancy	California EcoRestore	Initiated in 2015	This program will accelerate and implement a suite of Delta restoration actions for up to 30,000 acres of fish and wildlife habitat by 2020.	Potential for direct and indirect effects on groundwater conditions adjacent to tidal habitat restoration sites.

Agency	Program/Project	Status	Description of Program/Project	Effects on Groundwater Resources
California Department of Water Resources (in collaboration with State Water Resources Control Board)	Sustainable Groundwater Management Act (SGMA) Implementation	Signed into law September 2014	Defines rules and regulations that DWR needs to implement to help local agencies manage groundwater resources sustainably.	The SGMA requires the formation of locally controlled Groundwater Sustainability Agencies (GSAs), which must develop Groundwater Sustainability Plans (GSPs) in groundwater basins or subbasins that DWR designates as medium or high priority. This will have a beneficial effect on groundwater resources, as most areas will manage groundwater extractions to not exacerbate further groundwater level declines.
Bay Area Water Quality and Supply Reliability Program	San Francisco Bay Area Integrated Regional Water Management Plan	Final Released September 2013	The Bay Area Integrated Regional Management Plan is an evolving plan that will be used to prioritize projects and provide information for projects to be funded by state and federal agencies, such as the Proposition 50 projects.	Program identifies local water supply projects to increase water supply reliability in the Bay Area, including for SWP and CVP water users. One of the identified goals is for better conjunctive use and groundwater management. This would have a beneficial effect on groundwater resources.
Placer County Water Agency	Sacramento River Water Reliability Study	Notice of Preparation in 2003. Project is on hold during recent recession. Reclamation was preparing a joint NEPA document; however, the NEPA process was halted in 2009	Placer County Water Agency, Sacramento Suburban Water District, and the cities of Roseville and Sacramento, are investigating the viability of a joint water supply diversion from the Sacramento River, consistent with the Water Forum Agreement to meet planned future growth within the Placer-Sacramento region, maintain reliable water supply while reducing diversions of surface water from the American River in future dry years to preserve the river ecosystem, and enhance groundwater conjunctive management to help sustain the quality and availability of groundwater.	Outcomes of this study could help with improved groundwater and management in the region and reduced impacts on groundwater levels and quality.

Agency	Program/Project	Status	Description of Program/Project	Effects on Groundwater Resources
Semitropic Water Storage District	Delta Wetlands Projects	Semitropic Water Storage District issued a Draft EIR in 2010 and a Final EIR in 2012.	Under the current proposal, the project would: 1) provide water to Semitropic Water Storage District to augment its water supply, 2) bank water within the Semitropic Groundwater Storage Bank and Antelope Valley Water Bank, and 3) provide water to other places, including the service areas of the Golden State Water Company and Valley Mutual Water Company.	Project is inconsistent with Contra Costa County General Plan Policy for Agricultural Lands and Delta Protection Commission's Land Use Plan Principles for Agriculture and Recreation. Project will also result in conversion of existing agricultural land. Reservoir islands might affect shallow groundwater levels and agricultural drainage patterns.
Bureau of Reclamation	Shasta Lake Water Resources Investigation	Draft EIS published in June 2013	The project is a multiple purpose plan to modify Shasta Dam and Reservoir to increase survival of anadromous fish populations in the upper Sacramento River; increase water supplies and water supply reliability; and, to the extent possible through meeting these objectives, include features to benefit other identified ecosystem, flood damage reduction, and related water resources needs which could result in additional storage capacity of 256,000 to 634,000 acre-feet.	Program identifies water supply plans to maintain and possibly increase water supply reliability for CVP water users, which would indirectly benefit groundwater resources by helping reduce the amount of groundwater that needs to be pumped for agricultural irrigation.
California Department of Water Resources and Bureau of Reclamation	North-of-the-Delta Offstream Storage Investigation	Preliminary Administrative Draft EIS published in December 2013	The plan will provide offstream storage in the northern Sacramento Valley for improved water supply and water supply reliability, improved water quality, and enhanced survival of anadromous fish and other aquatic species. All alternatives include a new reservoir at the Sites location, with various facilities for water conveyance.	Program identifies water supply plans to maintain and possibly increase water supply reliability for CVP and non-CVP water users. This would help with decreasing the reliance on groundwater supply in dry years.
Bureau of Reclamation	Upper San Joaquin River Basin Storage Investigation	Draft EIS published in August 2014	The Upper San Joaquin Storage would contribute to restoration of the San Joaquin River, improve water quality of the San Joaquin River, and facilitate additional conjunctive management and water exchanges that improve the quality of water deliveries to urban communities.	Program identifies water supply plans to maintain and possibly increase water supply reliability for CVP and non-CVP water users. This would help with decreasing the reliance on groundwater supply in dry years in the Export Service Areas within the San Joaquin and Tulare groundwater basins.

Agency	Program/Project	Status	Description of Program/Project	Effects on Groundwater Resources
Western Municipal Water District and Bureau of Reclamation	Riverside-Corona Feeder Conjunctive Use Project	Final Supplemental EIS and EIR published in 2011	The project would allow WMWD to purchase water from SWP and store up to 40,000 acre-feet of water in the San Bernardino basin area and Chino basin and to extract the water from the groundwater basins. The facilities would convey local water supplies and deliver treated imported water.	Program would maintain and possibly increase water supply reliability for SWP water users, especially in drier years. This program would allow for better conjunctive use and management.
Metropolitan Water District of Orange County	Seawater Desalination Project at Huntington Beach	Final CEQA documents published in 2010. Awaiting permits	Water treatment plant would provide up to 50 million gallons per day of desalinated water.	Program would maintain and possibly increase water supply reliability for SWP water users. This would help with decreasing the reliance on groundwater supply.
San Diego County Water Authority and other water suppliers	Carlsbad Seawater Desalination Plant	Under construction.	Water treatment plant would provide up to 50 million gallons per day of desalinated water.	Program would maintain and possibly increase water supply reliability for SWP water users. This would help with decreasing the reliance on groundwater supply.
San Diego County Water Authority	Emergency Storage Project	Under construction	The project will increase the amount of water stored locally. New water storage and pipeline connections will distribute water throughout the region if imported water supplies are reduced. The Emergency Storage Project is expected to meet the county's emergency water needs through 2030.	Program would maintain and possibly increase water supply reliability for SWP water users. This would help with decreasing the reliance on groundwater supply.
Bureau of Reclamation	San Luis Reservoir Expansion	Draft Appraisal Report published in December 2013	The plan is to increase the storage capacity of San Luis Reservoir (behind B.F. Sisk Dam) to improve the reliability of CVP and SWP water supplies dependent upon San Luis Reservoir. Seismic risks under the dam and in the Delta, regulatory constraints to operating Delta export facilities, algae blooms at low water levels, and future climate change have and will reduce the reliability of CVP/SWP deliveries dependent upon the San Luis Reservoir.	Program identifies water supply plans to maintain and possibly increase water supply reliability for CVP and SWP water users. This would help with decreasing the reliance on groundwater supply.

Agency	Program/Project	Status	Description of Program/Project	Effects on Groundwater Resources
California Department of Water Resources	South Delta Temporary Barriers Project	Ongoing Program	The program was initiated in 1991, and includes four rock barriers across South Delta channels. The objectives of the project are to increase water levels, improve water circulation patterns and water quality in the southern Delta for local agricultural diversions, and improve operational flexibility of the SWP to help reduce fishery impacts and improve fishery conditions.	Program identifies water supply plans to maintain water supply reliability for CVP and SWP water users. This would help with decreasing the reliance on groundwater supply.
California Department of Water Resources	Implementation of Senate Bill X7 7	Legislation was adopted in 2009	This legislation requires the state to achieve a 20% reduction in urban per capita water use by December 31, 2020; require each urban retail water supplier to develop urban water use targets; agricultural water suppliers to implement efficient water management practices; and DWR in consultation with other state agencies, to develop a single standardized water use reporting form.	The legislation would reduce water demands for existing water users; and reduce projected demands for future growth.
State Water Resources Control Board	Bay-Delta Water Quality Control Plan Update	Ongoing development.	The State Water Resources Control Board is updating the 2006 Bay-Delta Water Quality Control Plan (WQCP) in four phases: Phase I: Modifying water quality objectives (i.e., establishing minimum flows) on the Lower San Joaquin River and Stanislaus, Tuolumne, and Merced Rivers to protect the beneficial use of fish and wildlife and (2) modifying the water quality objectives in the southern Delta to protect the beneficial use of agriculture; Phase II: Evaluating and potentially amending existing water quality objectives that protect beneficial uses and the program of implementation to achieve those objectives. Water quality objectives that could be amended include Delta outflow criteria; Phase III: Requires changes to water rights and other measures to implement changes to the WQCP from Phases I and II;	Water supplies of water rights users and SWP and CVP water users could be affected if increased instream flow and/or Delta outflow objectives are established in the regulatory process to protect beneficial uses. This could result in increased groundwater pumping and decreased groundwater levels in some areas.

Agency	Program/Project	Status	Description of Program/Project	Effects on Groundwater Resources
			Phase IV: Evaluating and potentially establishing water quality criteria and flow objectives that protect beneficial uses on tributaries to the Sacramento River.	
U.S. Army Corps of Engineers, San Joaquin Area Flood Control Agency, and Central Valley Flood Protection Board	San Joaquin River Basin Lower San Joaquin River, CA	Draft Integrated Interim Feasibility Report/EIS/EIR submitted February 2015	The purpose of the project is to improve flood risk management to North and Central Stockton by repairing and enhancing the levees that surround the city, and by constructing and operating closure structures on Fourteenmile Slough and Smith Canal.	The effects on groundwater are listed as "Potential construction related impacts if cutoff walls penetrate into groundwater. Contaminants that could reach groundwater include sediment, oil and grease, and hazardous materials." Although this impact could be significant, it would be reduced to a less-than-significant level with the implementation of a mitigation measure that implements a bentonite slurry spill contingency plan.
U.S. Army Corps of Engineers	Southport Sacramento River Early Implementation Project	Final EIS, May 2015	This project would implement flood risk-reduction measures along the Sacramento River South Levee in the city of West Sacramento, Yolo County, California. The area of flood risk-reduction measure implementation extends along the right (west) bank of the Sacramento River south of the Barge Canal downstream 5.6 miles to the South Cross Levee, adjacent to the Southport community of West Sacramento.	Significant impacts on groundwater could result from construction dewatering activities; these impacts would be reduced to a less-than-significant level with the implementation of groundwater well protection measures during construction.
City of Lathrop	River Islands at Lathrop Project	Final Subsequent EIR (2003) and Addenda (2005, 2007, 2012)	The proposed project is to develop a mixed-use residential/commercial development on 4,905 acres on Stewart Tract and Paradise Cut.	Impacts on groundwater could be potentially significant during construction but would be reduced to a less-than-significant level after mitigation. In addition, impacts on groundwater quality through the potential seepage of contaminants are considered less than significant.

1

2 All of these projects have completed draft or final environmental documents that analyzed their
3 potential impacts on groundwater resources. According to these documents, the impacts on
4 groundwater resources would be less than significant or less than significant after mitigation
5 measures are implemented.

1 The first four projects listed are located in or around the Delta Region. The last two projects listed
2 are located in the SWP/CVP Export Service Areas. The cumulative effects will be discussed
3 separately for the two regions.

4 **7.3.5.1 Cumulative Effects of the No Action Alternative**

5 **Changes in Delta Groundwater Levels**

6 Groundwater levels in the Delta for the No Action Alternative would be strongly influenced by
7 surface water flows in the Sacramento River that fluctuate due to sea level rise, climate change and
8 due to surface water operations. Similar effects related to these factors would also occur under the
9 action alternatives.

10 Compared with Existing Conditions, forecasted groundwater levels would increase by up to 5 feet in
11 the Suisun Marsh area in the No Action Alternative; the cumulative increase is due to sea level rise in
12 San Francisco Bay. This incremental increase in groundwater level in the No Action Alternative is
13 not expected to cause cumulative effects on nearby well yields. In other areas of the Delta,
14 groundwater levels would be similar under Existing Conditions as compared to the No Action
15 Alternative.

16 **Changes in Delta Groundwater Quality**

17 As described above, groundwater levels would be similar under Existing Conditions and the No
18 Action Alternative except for a localized area around Suisun Marsh. Therefore, cumulative changes
19 in groundwater conditions under the No Action Alternative are not anticipated to alter regional
20 patterns of groundwater flow or quality, compared with Existing Conditions. Minor cumulative
21 groundwater quality effects due to seawater intrusion might occur; however, no groundwater
22 salinity simulations are available to verify this hypothesis.

23 **Changes in Delta Agricultural Drainage**

24 Due to fluctuations in groundwater levels that occur with sea level rise and climate change, some
25 areas of the Delta might experience rises in groundwater levels in the vicinity of rivers and in the
26 Suisun Marsh area under the No Action Alternative compared to Existing Conditions. Similar effects
27 related to these factors would also occur under the action alternatives. This could affect agricultural
28 drainage. However, cumulative changes are anticipated to be minor and these areas would be
29 surrounded by larger regional flow patterns that would remain largely unchanged under the No
30 Action Alternative.

31 **SWP/CVP Export Service Areas**

32 Under the No Action Alternative, surface water supplies to the Export Service Areas would continue
33 to exhibit a cumulative decline based on water modeling and operational assumptions described in
34 Chapter 5, *Water Supply*, and Chapter 6, *Surface Water*, which project reductions in SWP/CVP water
35 supply availability, compared to Existing Conditions. In addition, cumulative decreases in SWP/CVP
36 surface water deliveries in the Export Service Areas for the No Action Alternative compared to
37 Existing Conditions also occur due to sea level rise and climate change, as described in Chapter 5,
38 *Water Supply*. Similar effects related to these factors would also occur under the action alternatives.

1 **7.3.5.2 Concurrent Project Effects**

2 The Alternatives 1A through 9 assessment evaluates the effects of the water conveyance facilities,
 3 plus the operational effects of CM2 and CM4, separately from the other effects of CM2–CM21. This
 4 section discusses the potential for the concurrent implementation of the water conveyance facilities
 5 and restoration activities under Alternatives 1A through 9 to result in more substantial effects on
 6 groundwater resources than identified in the separate impact assessments.

7 CM4 and CM5 are the only conservation measures identified with potential impacts on groundwater
 8 resources based on the locations and types of implementation measures involved. Additional
 9 impacts from the construction and operation of CM4 and CM5 are considered in Section 7.3.5,
 10 *Cumulative Analysis*.

11 No conservation measures beyond the water conveyance facilities would be implemented for the
 12 SWP/CVP Export Service Areas, so the discussion of concurrent groundwater effects of the water
 13 conveyance facilities in addition to restoration activities in this region are not applicable to
 14 groundwater resources in the SWP/CVP Export Service Areas.

15 **Delta Region**

16 ***Summary of Effects and Impacts due to Water Conveyance Facilities***

17 Construction of the water conveyance facilities under Alternatives 1A through 9 would result in
 18 temporary localized groundwater level declines of up to 20 feet in some areas due to construction
 19 dewatering activities in the vicinity of the facilities to be built. Groundwater level reductions are
 20 forecasted to last up to 2 months after dewatering activities are completed. Nearby domestic and
 21 municipal wells could experience significant reductions in well yield, if they are shallow wells, and
 22 may not be able to support existing land uses. Mitigation Measure GW-1 would be available to lessen
 23 the severity of the temporary groundwater level declines in the vicinity of construction dewatering
 24 sites. Construction activities are not anticipated to cause adverse effects on agricultural drainage in
 25 the Delta.

26 Operation of the new water conveyance facilities under Alternatives 1A, 2A, 2D, 3, 4, 4A, 5, 5A,6A, 7,
 27 and 8 would result in potential groundwater level rises near the Clifton Court and Bryon Tract
 28 Forebays, which would not adversely affect groundwater levels and nearby existing well yields.
 29 However, if agricultural drainage systems adjacent to these forebays are not adequate to
 30 accommodate the additional drainage requirements, operation of the forebays could interfere with
 31 agricultural drainage in some areas of the Delta. Mitigation Measure GW-5 would be available to
 32 lessen the severity of the impact on existing agricultural drainage systems. However, in some cases,
 33 the impact might not be mitigatable due to factors such as cost, and would be significant and
 34 unavoidable in those specific instances.

35 The Intermediate and Byron Tract Forebays, as well as the expanded Clifton Court Forebay under
 36 Alternatives 4, 4A, 2D, and 5A would be constructed to comply with the requirements of the DSD
 37 which includes design provisions to minimize seepage. These design provisions would minimize
 38 seepage under the embankments and onto adjacent properties. Once constructed and placed in
 39 operation, the operation of the forebays would be monitored to ensure seepage does not exceed
 40 performance requirements. In the event seepage were to exceed these performance requirements,
 41 the project proponents would modify the embankments or construct seepage collection systems
 42 that would ensure any seepage from the forebays would be collected and conveyed back to the

1 forebay or other suitable disposal site. Constructing the forebays to DSD standards, monitoring for
2 seepage, and making modifications to the forebays or constructing measures to attenuate seepage if
3 it were to occur would ensure that existing agricultural drainage systems would not be adversely
4 affected.

5 Operation of the new water conveyance facilities under Alternatives 1B, 2B, and 6B would result in
6 effects similar to the ones described for Alternatives 1A, 2A, 2D, 3, 4, 4A, 5, 5A, 6A, 7, and 8 above,
7 with additional effects due to the operation of the east canal alignment. For the unlined canal option,
8 some groundwater recharge could occur episodically beneath the northern portion of the canal
9 between the intakes and the Mokelumne River, resulting in a groundwater level rise of less than 5
10 feet, which would not adversely affect the yield of nearby supply wells. However, this groundwater
11 level rise from the unlined canal leakage could affect local agricultural drainage. Operation of the
12 unlined canal would cause an adverse effect on agricultural drainage that would be addressed by
13 Mitigation Measure GW-5.

14 Groundwater discharge into the canal would occur along the middle portion of the canal between
15 the Mokelumne River and the San Joaquin River, resulting in groundwater level declines of
16 approximately 10 feet, which could result in reduced yields of shallow supply wells located within 2
17 miles of the canal. Groundwater level declines of up to 10 feet are unlikely to affect the yields of
18 deeper wells that may exist nearby. For the lined canal option, minimal changes of less than 1 foot
19 would occur to groundwater levels in most areas in the vicinity of the canal due to the limited
20 exchange of groundwater and surface water between the lined canal and the underlying
21 groundwater aquifer. Groundwater discharge to the canal would occur along the middle portion of
22 the canal between the Mokelumne River and the San Joaquin River, resulting in groundwater level
23 declines of less than 5 feet. Potential reduction of shallow well yields within approximately 2 miles
24 of the canal would be possible. For both unlined and lined canal options, model simulations indicate
25 up to 5 foot episodic lowering of groundwater levels beneath the Sacramento River within an
26 approximately 4-mile wide corridor (about 2 miles on either side of the river) due to lower flows in
27 the river as a result of diversions at the north Delta intakes that result in a reduction in river flows
28 and elevations, as described in Chapter 6, *Surface Water*. For both the unlined and the lined canal
29 option, the groundwater level changes would cause an adverse effect on nearby shallow domestic
30 well yields. In some cases, the sustainable yield of some wells might be affected by the lower water
31 levels such that they are not able to support the existing or planned land uses for which permits
32 have been granted. Implementation of Mitigation Measure GW-2 would help address these effects;
33 however, the impact may continue to be significant because replacement water supplies may not
34 meet the preexisting demands or planned land use demands of the affected party.

35 Operation of the new water conveyance facilities under Alternatives 1C, 2C, and 6C would result in
36 effects similar to the ones described for Alternatives 1A, 2A, 2D, 3, 4, 4A, 5, 5A, 6A, 7, and 8 above,
37 with additional effects due to the operation of the west canal alignment. For the unlined canal
38 option, most canal leakage would occur in the northern portion of the canal, between the intakes
39 and the inflow to the tunnel. Thus, rises in groundwater levels are forecasted to occur in these areas
40 of the north Delta (up to 10 feet), which would not reduce the yields of nearby wells. This water
41 level rise is not anticipated to adversely affect groundwater recharge. However, these local changes
42 in groundwater flow patterns adjacent to the unlined canal, where groundwater recharge from
43 surface water occurs, would affect agricultural drainage in the area, due to groundwater level rises
44 from canal leakage. Operations of the unlined canal would cause an adverse effect on agricultural
45 drainage. Mitigation Measure GW-5 is available to address this effect. No substantial effect on
46 groundwater levels would be anticipated in the vicinity of the tunnel. In the canal segment south of

1 the tunnel, an area of groundwater recharge from the unlined canal would occur in an area that
 2 transitions to a zone of groundwater discharge to the canal in the vicinity of Byron Tract. For the
 3 lined canal option, minimal changes to groundwater levels would occur due to the limited quantity
 4 of groundwater recharge from the lined canal reaches or discharge from groundwater to the lined
 5 canal. For both canal options, the groundwater level changes could cause an adverse effect on
 6 nearby shallow domestic well yields. The sustainable yield of some wells might be affected by the
 7 lower water levels such that they are not able to support the existing or planned land uses for which
 8 permits have been granted. Implementation of Mitigation Measure GW-2 would help address these
 9 effects; however, the impact may continue to be significant because replacement water supplies may
 10 not meet the preexisting demands or planned land use demands of the affected party. For the lined
 11 canal option, minimal changes to groundwater levels would occur due to the limited quantity of
 12 groundwater recharge from the lined canal or discharge from groundwater to the lined canal.

13 Under Alternative 9, construction activities related to temporary dewatering and associated reduced
 14 groundwater levels have the potential to temporarily affect the productivity of existing nearby
 15 water supply wells. This impact is considered significant. Implementation of Mitigation Measure
 16 GW-1 would reduce this impact to a less-than-significant level. Operation of the additional
 17 infrastructure, such as small canal sections and operable barriers in streams, is not anticipated to
 18 deplete groundwater supplies or interfere with groundwater recharge, alter local groundwater
 19 levels, or reduce the production capacity of preexisting nearby wells. In addition, Alternative 9 is not
 20 anticipated to cause significant impacts on groundwater flow and agricultural drainage in the Delta
 21 Region. The new, small canal sections and channel connections could result in very localized impacts
 22 on groundwater flow and agricultural drainage. However, no regional impacts are anticipated to
 23 occur.

24 Construction and operation of the new water conveyance facilities under any of the alternatives are
 25 not anticipated to result in significant groundwater quality impacts in the Delta.

26 ***Combination of Effects and Impacts with CM4 and CM5***

27 Implementation of CM4 and CM5 under any of the alternatives could result in additional increased
 28 frequency of inundation of areas associated with the proposed tidal habitat, channel margin habitat,
 29 and seasonally inundated floodplain restoration actions, which would result in increased
 30 groundwater recharge. Such increased recharge could result in groundwater level rises in some
 31 areas. More frequent inundation would also increase seepage, which is already difficult and
 32 expensive to control in most agricultural lands in the Delta (see Chapter 14, *Agricultural Resources*).
 33 Impacts associated with the implementation of CM4 and CM5 would result in significant impacts and
 34 would have adverse effects on agricultural drainage due to additional seepage issues when
 35 considered concurrent to the effects from implementing conveyance facilities under Alternatives 1A
 36 through 9. This impact would be reduced to a less-than-significant level in most instances, with the
 37 implementation of Mitigation Measure GW-5 by identifying areas where seepage conditions have
 38 worsened and installing additional subsurface drainage measures, as needed.

39 The increased inundation frequency in restoration areas would also increase the localized areas
 40 exposed to saline and brackish surface water, which could result in increased groundwater salinity
 41 beneath such areas. The flooding of large areas with saline or brackish water would result in an
 42 adverse effect and would result in significant impacts on groundwater quality beneath or adjacent to
 43 flooded areas. Since adverse/significant groundwater quality impacts were not identified with the
 44 operation of the conveyance facilities, the implementation of CM4 and CM5 would result in new

1 significant impacts/adverse effects on groundwater quality in some areas of the Delta. It would not
 2 be possible to completely avoid this effect. However, if water supply wells in the vicinity of these
 3 areas are not useable because of water quality issues, Mitigation Measure GW-7 is available to
 4 address this effect. This discussion does not apply to Alternatives 4A, 2D, and 5A because those
 5 alternatives do not include an equivalent of CM5.

6 None of the action alternatives are anticipated to result in groundwater level-induced land
 7 subsidence.

8 **7.3.5.3 Cumulative Effects of the Action Alternatives**

9 This cumulative effects analysis considers the combined effects on groundwater as a result of the
 10 action alternatives and past, present, and reasonably foreseeable future projects. For this analysis,
 11 the projects considered are those listed in Table 7-8. For a complete list of such projects, consult
 12 Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and*
 13 *Cumulative Impact Conditions.*

14 **Delta Region**

15 **Impact GW-1: Cumulative Depletion of Groundwater Supplies or Interference with** 16 **Groundwater Recharge, Alteration of Local Groundwater Levels, or Reduction in the** 17 **Production Capacity of Preexisting Nearby Wells, as a Result of Construction and Operation of** 18 **the Proposed Conveyance Facilities**

19 **NEPA Effects:** Construction dewatering activities associated with each action alternative would
 20 result in temporary altered groundwater levels and associated potential decreases in well yields.
 21 The sustainable yield of some wells might temporarily be affected by the lower water levels such
 22 that they are not able to support the existing land uses. Alternatives 1B, 1C, 2B, 2C, 6B, and 6C, which
 23 include canals as conveyance options, have a larger construction footprint. In addition, the
 24 alternatives that include canal options might trigger groundwater discharge into some canal
 25 sections (mostly the unlined option), and locally lower groundwater levels by approximately up to
 26 10 feet, which could reduce the sustainable yield of shallow wells and affect associated land uses.

27 Other projects that would potentially affect groundwater levels and well yields through construction
 28 dewatering have been or are being completed. Implementing these projects in combination with any
 29 of the action alternatives would result in cumulative adverse effects. Mitigation Measure GW-1
 30 would be available to reduce those effects created by action alternatives.

31 **CEQA Conclusion:** Construction dewatering activities associated with each action alternative would
 32 result in temporary decreases in groundwater levels and associated well yields. Ongoing operations
 33 associated with the canal alignments would result in long-term discharge of groundwater to some
 34 canal sections. Other projects that would potentially affect groundwater levels and well yields
 35 through construction dewatering have been or are being completed. Implementing these projects in
 36 combination with any of the action alternatives would result in significant cumulative impacts
 37 because the number of wells in the region affected by construction dewatering from cumulative
 38 projects would increase. The action alternatives' contribution to this cumulative impact is
 39 cumulatively considerable because of the scale of the conveyance facility construction. Mitigation
 40 Measure GW-1 provides a monitoring procedure and options for maintaining an adequate water
 41 supply for landowners that experience a reduction in groundwater production from wells within
 42 2,600 feet of construction-related dewatering activities. Implementing Mitigation Measure GW-1

1 would help address these effects; however, the impact may remain significant because replacement
 2 water supplies may not meet the preexisting demands or planned land use demands of the affected
 3 party. In some cases the project-related impact might temporarily be cumulatively considerable and
 4 unavoidable until groundwater elevations recover to preconstruction conditions, which could
 5 require several months after dewatering operations cease.

6 **Mitigation Measure GW-1: Maintain Water Supplies in Areas Affected by Construction**
 7 **Dewatering**

8 Please see Mitigation Measure GW-1 under Impact GW-1 in the discussion of Alternative 1A.

9 **Impact GW-2: Cumulative Degradation of Groundwater Quality as a Result of Construction**
 10 **and Operation of the Proposed Conveyance Facilities**

11 **NEPA Effects:** Construction and ongoing operations associated with each action alternative would
 12 not substantially alter regional groundwater flow patterns and therefore would not change the
 13 quality of groundwater in the locally affected areas. Other projects that would potentially alter
 14 groundwater quality are listed in Table 7-8, based on information presented in project-specific
 15 environmental documents for each project. The North Delta Flood Control and Ecosystem
 16 Restoration Project would have a less-than-significant effect on groundwater quality. None of these
 17 projects are anticipated to alter groundwater flow and quality. Implementing these projects in
 18 combination with the action alternatives would not result in cumulative adverse effects because
 19 cumulative projects are not expected to combine to exacerbate localized groundwater quality
 20 conditions.

21 **CEQA Conclusion:** Construction and ongoing operations associated with each action alternative
 22 would not substantially alter regional groundwater flow patterns and therefore would not change
 23 the quality of groundwater in the locally affected areas. None of the projects listed in Table 7-8
 24 would affect groundwater flow and quality. Therefore, implementing these projects in combination
 25 with the action alternatives would not result in a significant cumulative impact because cumulative
 26 projects are not expected to combine to exacerbate localized groundwater quality conditions.

27 **Impact GW-3: Cumulative Interference with Agricultural Drainage in the Delta, as a Result of**
 28 **Construction and Operation of the Proposed Conveyance Facilities**

29 **NEPA Effects:** Construction dewatering activities associated with the action alternatives might
 30 temporarily and locally alter flow patterns near the dewatering centers; however, they are not
 31 anticipated to cause any significant effects on agricultural drainage. Ongoing operations of the action
 32 alternatives would alter groundwater flow patterns and groundwater levels in the vicinity of some
 33 canal segments. Operation of forebays is not expected to result in changes in groundwater flow
 34 patterns on adjacent lands, due to the DSD design provisions, which would minimize seepage under
 35 the embankments and onto adjacent properties. However, groundwater recharge from surface
 36 water could result in local groundwater level increases. If agricultural drainage systems adjacent to
 37 these forebays are not adequate to accommodate the additional drainage requirements, operation of
 38 the forebays could interfere with agricultural drainage in the Delta.

39 The Intermediate and Byron Tract Forebays, as well as the expanded Clifton Court Forebay under
 40 Alternatives 4, 4A, 2D, and 5A would be constructed to comply with the requirements of the DSD
 41 which includes design provisions to minimize seepage. These design provisions would minimize
 42 seepage under the embankments and onto adjacent properties. Once constructed and placed in

1 operation, the forebays would be monitored to ensure seepage does not exceed performance
2 requirements. In the event seepage were to exceed these performance requirements, the project
3 proponents would modify the embankments or construct seepage collection systems that would
4 ensure any seepage from the forebays would be collected and conveyed back to the forebay or other
5 suitable disposal site. Constructing the forebays to DSD standards, monitoring for seepage, and
6 making modifications to the forebays or constructing measures to attenuate seepage if it were to
7 occur would ensure that existing agricultural drainage systems would not be adversely affected.

8 For Alternatives 1B, 1C, 2B, 2C, 6B, and 6C, however, some canal segments might lose water to the
9 shallow aquifer, especially for the unlined canal option. The increase in groundwater levels might
10 affect agricultural drainage in those areas, if current agricultural drainage systems are not adequate
11 to accommodate the additional drainage requirements in the vicinity of these conveyance features.
12 For other locations, in which the canal segments are gaining water from the surrounding aquifer,
13 agricultural drainage might be improved.

14 Other projects that would potentially alter groundwater levels and agricultural drainage are listed in
15 Table 7-8. The North Delta Flood Control and Ecosystem Restoration Project and the Dutch Slough
16 Tidal Marsh Restoration Project as well as other California EcoRestore projects have potential for
17 groundwater seepage onto adjacent islands or tracts of the Delta, which could impair local
18 agricultural drainage. In addition, the Delta Wetlands Project includes the conversion of two Delta
19 islands into reservoir islands that would store water for future supplies. This additional water
20 storage might affect shallow groundwater levels and agricultural drainage patterns and present a
21 potential for groundwater seepage onto adjacent islands or tracts of the Delta. However, the EIRs
22 associated with these projects report less-than-significant impacts after mitigation. Implementing
23 these projects in combination with any of Alternatives 1B, 1C, 2B, 2C, 6B, or 6C would result in
24 cumulative adverse effects. Mitigation Measure GW-5 would be available to reduce those effects
25 created by the action alternatives.

26 **CEQA Conclusion:** Construction dewatering activities associated with each action alternative would
27 not substantially affect agricultural drainage. However, ongoing operations associated with
28 Alternatives 1B, 1C, 2B, 2C, 6B, or 6C would discharge water to the aquifer from some canal
29 segments for the unlined canal options. Other projects that would potentially alter groundwater
30 levels and agricultural drainage are listed in Table 7-8. None of these projects would have a
31 significant effect on agricultural drainage after mitigation. Implementing these projects in
32 combination with any of Alternatives 1B, 1C, 2B, 2C, 6B, or 6C would result in a significant
33 cumulative impact on agricultural drainage due to the potential water seepage from some canal
34 segments. These impacts would be due to the implementation of Alternatives 1B, 1C, 2B, 2C, 6B, or
35 6C. Mitigation Measure GW-5 would reduce the severity of impacts created by project-related
36 activities in most instances. Occasionally, however, mitigation may be determined infeasible and the
37 impact would be considered unavoidable.

38 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

39 Please see Mitigation Measure GW-5 under Impact GW-5 in the discussion of Alternative 1A.

1 **Impact GW-4: Cumulative Depletion of Groundwater Supplies or Interference with**
 2 **Groundwater Recharge, Alteration of Local Groundwater Levels, Reduction in the Production**
 3 **Capacity of Preexisting Nearby Wells, or Interference with Agricultural Drainage as a Result**
 4 **of Implementing CM2–CM21 or Environmental Commitments 3, 4, 6–12, 15, and 16**

5 *NEPA Effects:* Increased frequency of inundation of areas associated with the proposed tidal habitat,
 6 channel margin habitat, and seasonally inundated floodplain restoration actions would result in
 7 groundwater recharge which could in turn affect agricultural drainage in areas of shallow
 8 groundwater levels. Other projects that would potentially alter groundwater levels and agricultural
 9 drainage are listed in Table 7-8. These cumulative restoration projects combined with the action
 10 alternatives could create adverse effects on groundwater resources in the Delta.

11 For Alternatives 4A, 2D, and 5A, the only Environmental Commitments identified with potential
 12 effects on groundwater resources are Environmental Commitments 4 and 10, due to the locations
 13 and types of implementation measures described for these commitments. Combined with other
 14 cumulative projects, these action alternatives would result in adverse effects on groundwater
 15 resources because combined restoration actions could affect groundwater levels adjacent to project
 16 sites. Mitigation Measures GW-1 and GW-5 would be available to reduce those effects created by
 17 project-related activities.

18 *CEQA Conclusion:* Increased frequency of inundation of areas associated with the proposed
 19 restoration actions for CM2–CM21, or Environmental Commitments 3, 4, 6–12, 15, and 16 under the
 20 non-HCP alternatives, would result in groundwater recharge which could affect agricultural
 21 drainage in areas of shallow groundwater levels. Other projects that would potentially alter
 22 groundwater levels and agricultural drainage are listed in Table 7-8. Implementing these projects in
 23 combination with any of the action alternatives would result in a significant cumulative impact and
 24 the incremental contribution to this impact of any of the action alternatives would be cumulatively
 25 considerable. Mitigation Measures GW-1 and GW-5 would be available to reduce the severity of
 26 impacts created by the action alternatives.

27 **Mitigation Measure GW-1: Maintain Water Supplies in Areas Affected by Construction**
 28 **Dewatering**

29 Please see Mitigation Measure GW-1 under Impact GW-1 in the discussion of Alternative 1A.

30 **Mitigation Measure GW-5: Agricultural Lands Seepage Minimization**

31 Please see Mitigation Measure GW-5 under Impact GW-5 in the discussion of Alternative 1A.

32 **Impact GW-5: Cumulative Degradation of Groundwater Quality as a Result of Implementing**
 33 **CM2–CM21 or Environmental Commitments 3, 4, 6–12, 15, and 16**

34 *NEPA Effects:* Increased inundation frequency in restoration areas would increase the localized
 35 areas exposed to saline and brackish surface water, which could result in increased groundwater
 36 salinity beneath such areas. Other projects that would potentially affect groundwater quality are
 37 listed in Table 7-8. Implementing these projects in combination with any of the action alternatives
 38 would result in cumulative adverse effects on groundwater quality due to the implementation of the
 39 alternatives because groundwater quality adjacent to cumulative restoration actions could be
 40 affected.

1 For Alternatives 4A, 2D, and 5A, the only Environmental Commitments identified with potential
 2 effects on groundwater resources are Environmental Commitments 4 and 10, due to the locations
 3 and types of implementation measures. Combined with other cumulative restoration projects these
 4 Environmental Commitments could have a cumulative adverse effect on groundwater quality at
 5 locations adjacent to the restoration sites.

6 Mitigation Measure GW-7 would be available to reduce those effects created by the action
 7 alternatives.

8 **CEQA Conclusion:** Increased inundation frequency in restoration areas would increase the localized
 9 areas exposed to saline and brackish surface water, which could result in increased groundwater
 10 salinity beneath such areas. Other projects that would potentially alter groundwater levels and
 11 agricultural drainage are listed in Table 7-8. Implementing these projects in combination with any of
 12 the action alternatives would result in a significant cumulative impact because groundwater quality
 13 adjacent to cumulative restoration actions could be affected.

14 Mitigation Measure GW-7 would be available to reduce the severity of impacts created by project-
 15 related activities.

16 **Mitigation Measure GW-7: Provide an Alternate Source of Water**

17 Please see Mitigation Measure GW-7 under Impact GW-7 in the discussion of Alternative 1A.

18 **SWP/CVP Export Service Areas**

19 **Impact GW-6: Cumulative Depletion of Groundwater Supplies or Interference with** 20 **Groundwater Recharge, Alteration of Local Groundwater Levels, or Reduction in the** 21 **Production Capacity of Preexisting Nearby Wells, as a Result of Operation of the Proposed** 22 **Conveyance Facilities**

23 **NEPA Effects:** Ongoing operations associated with each action alternative could have effects on
 24 groundwater levels in the Export Service Areas. Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 2D, 3, 4, 4A, 5,
 25 and 5A could increase surface water deliveries to some of the service areas compared to the No
 26 Action Alternative, which could decrease groundwater pumping. The resulting increase in
 27 groundwater levels would be a beneficial effect.

28 Alternatives 4, 6A, 6B, 6C, 7, 8, and 9 could decrease surface water deliveries to some of the export
 29 service areas in most years compared to the No Action Alternative, which could result in an increase
 30 in groundwater pumping as an alternative water supply source. This increase in groundwater
 31 pumping would cause a decrease in groundwater levels and associated well yields, such that existing
 32 and future land uses for which permits have been granted might be affected. Other projects that
 33 would potentially affect groundwater levels are listed in Table 7-8. The San Joaquin River
 34 Restoration Program would result in a decrease in surface water deliveries to Friant Division long-
 35 term contractors which would result in an increase in groundwater pumping and subsequent
 36 decrease in groundwater levels. This program could result in potentially significant and unavoidable
 37 effects on groundwater levels (Bureau of Reclamation 2011:12-121). In addition, the
 38 implementation of the Bay-Delta Water Quality Control Plan Update might affect water supplies of
 39 water rights users and SWP and CVP water users if increased instream flow and/or Delta outflow
 40 objectives are established in the regulatory process to protect beneficial uses. This could result in
 41 increased groundwater pumping and decreased groundwater levels in some areas.

1 Implementing these projects in combination with any of the action alternatives could result in
2 cumulative adverse effects on groundwater levels and associated well yields.

3 However, opportunities for additional pumping might be limited by basin adjudications and other
4 groundwater management programs. Additionally, as discussed in Appendix 5B, *Responses to*
5 *Reduced South of Delta Water Supplies*, adverse effects might be avoided due to the existence of
6 various other water management options that could be undertaken in response to reduced exports
7 from the Delta. These options include wastewater recycling and reuse, increased water
8 conservation, water transfers, construction of new local reservoirs that could retain Southern
9 California rainfall during wet years, and desalination. Table 7-8 list some projects that could
10 enhance local water supply reliability and thus reduce reliance on groundwater pumping and help
11 manage the groundwater basins more sustainably. Other projects, such as projects that could be
12 implemented under the California Water Action Plan (CWAP) would also provide beneficial effects
13 on groundwater levels, storage, and conjunctive use. The implementation of the SGMA in high and
14 medium groundwater basins would further reduce the impacts on groundwater levels, storage and
15 groundwater supply by implementing sustainable groundwater management plans and actions at
16 the local level.

17 As part of the SGMA and CWAP actions and implementation, there would be several measures
18 available to SWP and CVP contractors, even with reduced surface water supply reliability. First,
19 State Water Contractors currently and traditionally have received variable water supplies under
20 their contracts with DWR due to variations in hydrology and regulatory constraints and are
21 accustomed to responding accordingly. Any reductions associated with this effect would be subject
22 to these contractual limitations. Under standard state water contracts, the risk of shortfalls in
23 exports is borne by the contractors rather than DWR. As a result of this variability, many Southern
24 California water districts have complex water management strategies that include numerous
25 options, as described above, to supplement SWP surface water supplies. These water districts are in
26 the best position to determine the appropriate response to reduced imports from the Delta. Second,
27 as noted above, it may be legally impossible to extract additional groundwater in adjudicated basins
28 without gaining the permission of watermasters and accounting for groundwater pumping
29 entitlements and various parties under their adjudicated rights.

30 **CEQA Conclusion:** Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 2D, 3, and 5A, could increase surface water
31 deliveries to the service areas compared to Existing Conditions, which could decrease groundwater
32 pumping. The resulting increase in groundwater levels would be a beneficial effect. Alternatives 2A,
33 2B, 2C, 4, 4A, 5, 5A, 6A, 6B, 6C, 7, 8, and 9 could decrease surface water deliveries to some of the export
34 areas (notably in the San Joaquin and Tulare basins) in most years compared to Existing Conditions,
35 which would result in an increase in groundwater pumping. This increase in groundwater pumping
36 could cause a decrease in groundwater levels and associated well yields, such that existing and future
37 land uses for which permits have been granted might be affected. Other projects that would
38 potentially affect groundwater levels are listed in Table 7-8. Implementing these projects in
39 combination with any of the action alternatives that would reduce surface water flows to export areas
40 would result in a significant cumulative impact and the incremental contribution to this impact of
41 these alternatives would be cumulatively considerable. However, opportunities for additional
42 pumping might be limited by basin adjudications and other groundwater management programs, and
43 adverse effects might be avoided due to the existence of various other water management options that
44 could be undertaken in response to reduced exports from the Delta. In particular, certain projects
45 listed in Table 7-8 could enhance local water supply reliability and thus reduce reliance on
46 groundwater pumping and help manage the groundwater basins more sustainably. Further, the

1 implementation of the SGMA in high and medium groundwater basins would further reduce the
 2 impacts on groundwater levels, storage and groundwater supply by implementing sustainable
 3 groundwater management plans and actions at the local level.

4 **Impact GW-7: Cumulative Degradation of Groundwater Quality as a Result of Operation of the** 5 **Proposed Conveyance Facilities**

6 **NEPA Effects:** Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 2D, 3, 4, 4A, 5, and 5A would not result in a
 7 degradation of groundwater quality compared to the No Action Alternative. Alternatives 4, 6A, 6B,
 8 6C, 7, 8, and 9 could induce additional groundwater pumping compared to the No Action Alternative
 9 and thus create the potential for migration of poor-quality groundwater into areas of good quality
 10 groundwater, degrading local groundwater supplies. Other projects that would potentially affect
 11 groundwater levels are listed in Table 7-8. The San Joaquin River Restoration Program would result
 12 in a decrease in surface water deliveries to Friant Division long-term contractors which would result
 13 in an increase in groundwater pumping and a potential for upwelling of poorer quality groundwater.
 14 This program could result in potentially significant and unavoidable effects on groundwater quality
 15 (Bureau of Reclamation 2011:12-122). Implementing these cumulative projects in combination with
 16 any of the action alternatives that would decrease surface water exports could result in cumulative
 17 adverse effects on groundwater quality. However, without the implementation of actions described
 18 in the CWAP and the SGMA, there is no feasible mitigation available to mitigate any changes in
 19 regional groundwater quality.

20 **CEQA Conclusion:** Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 2D, 3, and 5A, would increase surface water
 21 deliveries to the service areas compared to Existing Conditions, which would decrease groundwater
 22 pumping. The resulting increase in groundwater levels would be a beneficial effect. Alternatives 2A,
 23 2B, 2C, 4, 4A, 5, 5A, 6A, 6B, 6C, 7, 8, and 9 could decrease surface water deliveries to the export areas
 24 in most years compared to Existing Conditions, which would result in an increase in groundwater
 25 pumping. This increase in groundwater pumping could create the potential for a migration of poor-
 26 quality groundwater into areas of good quality groundwater, degrading local groundwater supplies.
 27 Other projects that would potentially affect groundwater levels are listed in Table 7-8. Implementing
 28 these projects in combination with action alternatives that would decrease surface water exports
 29 could result in a significant cumulative impact and the incremental contribution to this impact of
 30 these alternatives would be cumulatively considerable. However, without the implementation of
 31 actions described in the CWAP and the SGMA, there is no feasible mitigation available to mitigate
 32 any changes in regional groundwater quality.

33 **Impact GW-8: Cumulatively Result in Groundwater Level-Induced Land Subsidence**

34 **NEPA Effects:** None of the action alternatives would result in groundwater level-induced land
 35 subsidence. Other projects that would potentially affect groundwater level-induced land subsidence
 36 are listed in Table 7-8. None of these projects report a potential for inducing groundwater level-
 37 induced land subsidence as a significant effect. Implementing these projects in combination with any
 38 of the action alternatives would not result in cumulative adverse effects on groundwater level-
 39 induced land subsidence.

40 **CEQA Conclusion:** None of the action alternatives would result in groundwater level-induced land
 41 subsidence. Other projects that would potentially affect groundwater level-induced land subsidence
 42 are listed in Table 7-8. None of these projects report a potential for inducing groundwater level-
 43 induced land subsidence as a significant effect. Implementing these projects in combination with any

1 of the action alternatives would not result in cumulative significant effects on groundwater level-
 2 induced land subsidence because groundwater levels would not be substantially affected at
 3 cumulative project locations.

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