

## 10.0 Summary Comparison of Alternatives

A summary comparison of a number of important soil impacts is provided in Figure 10-0. This figure includes information on the magnitude of the most pertinent and quantifiable soil impacts that are expected to result from all alternatives. Important impacts to consider include loss of topsoil from excavation, overcovering, and inundation associated with construction of water conveyance facilities and loss of topsoil from excavation, overcovering, and inundation associated with restoration activities.

As depicted in Figure 10-0, topsoil loss would be significant and unavoidable for each alternative, with the exception of no action. During construction, Alternative 1B, 2B, and 6B would result in the greatest loss of topsoil, at 21,832 acres, whereas Alternative 4, and 4A would result in the a loss of 7,590 acres of topsoil Alternative 2D would result in slightly more than 7,590 acres due to construction of two additional intakes, while Alternative 5A would result in slightly less than 7,590 acres due to construction of only one intake. During restoration activities, Alternative 7 would result in the greatest loss of topsoil with a total of 87,600 acres lost, and Alternative 5 would result in the lowest amount of topsoil loss with slightly less than 77,600 acres.

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

## 10.1 Environmental Setting/Affected Environment

This section provides information on soils in the study area (the area in which impacts may occur) which is limited to the Plan Area (the area covered by the BDCP). This includes portions of the Sacramento–San Joaquin Delta (Delta), Suisun Marsh, and Yolo Bypass. See Chapter 1, *Introduction*, for a detailed description of the Plan Area. The Plan Area was selected for the geographic scope of the analysis because all soil-related effects and constraints are restricted to the immediate location of the potential effect. Land outside of the Plan Area were not considered because there are no structures being proposed and because changed operations at upstream and within the water user service areas do not increase potential adverse effects on soils in those areas. The information is based largely on Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service) soil surveys for the seven counties in the Plan Area and the online Soil Survey Geographic (SSURGO) database. Other sources include California Department of Water Resources (DWR) and U.S. Geological Survey publications, academic technical reports and publications, and county and city general plans.

This section describes soil characteristics in the study area (Plan Area) with respect to the following.

- Soil associations.
- Soil chemical and physical characteristics.
- Soil suitability/limitations for various uses.

- 1       • Land subsidence resulting from biological oxidation of organic carbon in peat soil and from  
2       other processes.

3       Other chapters that contain information related to soils are listed below.

- 4       • Soil resources, as they pertain to agricultural land use and important farmlands mapped by the  
5       Farmland Mapping and Monitoring Program (FMMP), are discussed in Chapter 13, *Land Use*.
- 6       • Soil resources, as they pertain to crop production (including potential salinization caused by  
7       irrigation), are discussed in Chapter 14, *Agricultural Resources*.
- 8       • Geotechnical properties of soils, as they pertain to soil stability, levee stability, and liquefaction,  
9       are described in Chapter 6, *Surface Water*, and Chapter 9, *Geology and Seismicity*.
- 10      • Carbon dioxide (CO<sub>2</sub>) flux to the atmosphere from oxidation of organic matter in peat soil is  
11      discussed in Chapter 29, *Climate Change*, and Chapter 22, *Air Quality and Greenhouse Gas*  
12      *Emissions*.
- 13      • Water quality concerns and regulatory implications associated with soil erosion and  
14      sedimentation are summarized in this chapter, but are more thoroughly discussed in Chapter 8,  
15      *Water Quality*.
- 16      • Land subsidence from groundwater extraction and geologic causes is described in Chapter 7,  
17      *Groundwater*, and Chapter 9, *Geology and Seismicity*.

18      This chapter does not describe the soil setting or potential project effects in the State Water Project  
19      (SWP) and Central Valley Project (CVP) Export Service Areas Region or in the areas upstream of the  
20      Delta. As appropriate, this topic is addressed in Chapter 30, *Growth Inducement and other Indirect*  
21      *Effects*.

22      The setting information for soils, except where otherwise noted, is derived from the soils appendix  
23      that was included in the conceptual engineering reports (CERs) prepared for the proposed project.

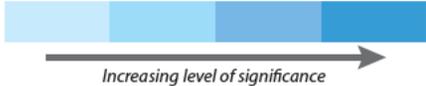
- 24      • *Conceptual Engineering Report—Isolated Conveyance Facility—All Tunnel Option* (California  
25      Department of Water Resources 2010a).
- 26      • *Conceptual Engineering Report—Isolated Conveyance Facility—Pipeline/Tunnel Option—*  
27      *Addendum* (California Department of Water Resources 2010b).
- 28      • *Conceptual Engineering Report—Isolated Conveyance Facility—East Option* (California  
29      Department of Water Resources 2009a).
- 30      • *Conceptual Engineering Report—Isolated Conveyance Facility—East Option—Addendum*  
31      (California Department of Water Resources 2010c).
- 32      • *Conceptual Engineering Report—Isolated Conveyance Facility—West Option* (California  
33      Department of Water Resources 2009b).
- 34      • *Conceptual Engineering Report—Isolated Conveyance Facility—West Option—Addendum*  
35      (California Department of Water Resources 2010d).
- 36      • *Option Description Report—Separate Corridors Option* (California Department of Water  
37      Resources 2010e).

| Chapter 10 – Soils  | Alternative        |           |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |       |        |        |
|---|--------------------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|-------|--------|--------|
|   | Existing Condition | No Action | 1A     | 1B     | 1C     | 2A     | 2B     | 2C     | 3      | 4      | 5       | 6A     | 6B     | 6C     | 7      | 8      | 9      | 4A    | 2D     | 5A     |
| <b>SOILS-2:</b> Loss of topsoil from excavation, overcovering, and inundation as a result of constructing the proposed water conveyance facilities (Acres)                                  | n/a                | 3,618     | 7,771  | 21,832 | 18,039 | 7,771  | 21,832 | 18,039 | <7,771 | 7,590  | >7,771  | 7,771  | 21,832 | 18,039 | <7,771 | <7,771 | <7,771 | 7,590 | >7,590 | <7,590 |
|   | n/a                | S/A       | SU/A    | SU/A   | SU/A   | SU/A   | SU/A   | SU/A   | SU/A   | SU/A  | SU/A   | SU/A   |
| <b>SOILS-7:</b> Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with Restoration Activities as a Result of Implementing the Proposed Conservation Measures (Acres) | n/a                | 1,352     | 77,600 | 77,600 | 77,600 | 77,600 | 77,600 | 77,600 | 77,600 | 77,600 | <77,600 | 77,600 | 77,600 | 77,600 | 87,600 | 77,600 | 77,600 | 1,176 | >1,000 | ≈1,000 |
|   | n/a                | S/A       | SU/A    | SU/A   | SU/A   | SU/A   | SU/A   | SU/A   | SU/A   | SU/A  | SU/A   | SU/A   |

**Key**

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



Increasing level of significance

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

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

|  |  |   |
|--|--|---|
| <p><b>CEQA Finding</b></p> <p>NI No Impact</p> <p>LTS Less than significant</p> <p>S Significant</p> <p>SU Significant and unavoidable</p> |  | <p><b>NEPA Finding</b></p> <p>B Beneficial</p> <p>NE No Effect</p> <p>NA Not Adverse</p> <p>A Adverse</p> |
|--|--|---|

**Figure 10-0  
Comparison of Impacts on Soils**

- 1 • *Conceptual Engineering Report—Dual Conveyance Facility Modified Pipeline/Tunnel Option —*  
2 *Clifton Court Forebay Pumping Plant (MPTO/CCO). Volume 1.* (California Department of Water  
3 Resources 2015)

#### 4 **10.1.1 Potential Environmental Effects Area**

5 The study area (the area in which impacts may occur) evaluated for potential effects on soil is the  
6 Plan Area (the area covered by the BDCP) and includes portions of Sacramento, Yolo, Solano, San  
7 Joaquin, Contra Costa, and Alameda Counties and the cities of Sacramento, Isleton, West Sacramento,  
8 Rio Vista, and Antioch, which lie within the Plan Area.

##### 9 **10.1.1.1 Soil Associations**

10 Soil is a natural body comprised of solids (minerals and organic matter), liquid, and gases that  
11 occurs on the land surface, occupies space, and is characterized by one or both of the following:  
12 horizons, or layers, that are distinguishable from the initial material as a result of additions, losses,  
13 transfers, and transformations of energy and matter or the ability to support rooted plants in a  
14 natural environment. Areas are not considered to have soil if the surface is permanently covered by  
15 water too deep (typically more than 8.2 feet) for the growth of rooted plants. The lower boundary  
16 that separates soil from the nonsoil underneath is most difficult to define. Soil consists of horizons  
17 near the Earth's surface that, in contrast to the underlying parent material, have been altered by the  
18 interactions of climate, relief, and living organisms over time. Commonly, soil grades at its lower  
19 boundary to hard rock or to earthy materials virtually devoid of animals, roots, or other marks of  
20 biological activity.

21 Soil formed in the Delta as the result of geologic processes over approximately the past 7,000 years.  
22 These processes produced landward accumulation of sediment behind the bedrock barrier at the  
23 Carquinez Strait, forming marshlands comprising approximately 100 islands that were surrounded  
24 by hundreds of miles of channels (Weir 1950). Generally, mineral soil formed near the channels  
25 during flood conditions and organic soil formed on marsh island interiors as plant residues  
26 accumulated faster than they could decompose. Prior to the mid-1800s, the Delta was a vast marsh  
27 and floodplain, under which peat soil developed to a thickness of up to 30 feet in many areas (Weir  
28 1950), with a thickness of approximately 55 feet in the vicinity of Sherman Island (Real and  
29 Knudsen 2009).

30 Management of Delta soil for agriculture and flood control over the past 100 years caused dramatic  
31 changes to soil and the overall landscape. The Delta today is a highly modified system of artificial  
32 levees and dredged waterways that were constructed to control flooding, to improve navigation, and  
33 to support farming and urban development on approximately 57 reclaimed islands (Ingebritsen et  
34 al. 2000). The peat soil have been largely drained, resulting in oxidation of organic matter and  
35 subsequent large-scale land subsidence on Delta islands.

36 Soils continue to be a key resource in the Delta (Delta Protection Commission 1993) and have  
37 physical and chemical characteristics that qualify many areas as prime farmland (see Chapter 14,  
38 *Agricultural Resources*). The growing season, drainage, and available moisture in many Delta soils  
39 provide an excellent medium for growing a wide variety of crops. The soils also continue to support  
40 important wetland ecosystems in the Delta and Suisun Marsh.

1 Because the study area is large, the soils are best described at a landscape scale, rather than at a  
 2 detailed scale. NRCS maps soils at a landscape scale by mapping soil associations. Soil associations  
 3 are groupings of individual soils that occur together in the landscape and are typically named after  
 4 the two or three dominant soil series. For example, the dominant soil components in the  
 5 Gazwell-Rindge soil association in Sacramento County are the Gazwell and Rindge soil series. Soil  
 6 associations cover broad areas that have a distinctive pattern of soils, relief, and drainage. Figure 10-  
 7 1 shows the soil associations in the Plan Area within each county (Soil Conservation Service 1966,  
 8 1972, 1977a, 1977b, 1988, 1992, 1993). This generalized soil map is useful for comparing the  
 9 suitability of large areas for general land use purposes. Larger scale maps showing the individual  
 10 soil map units that comprise each association are often used for evaluating soil suitability on a site-  
 11 specific scale (e.g., selecting a building site). Appendix 10A, *Soil Associations*, identifies the individual  
 12 map units that comprise each association.

13 Soils within the Plan Area can be generally grouped based on relationships with the following  
 14 physiographic settings. The geographic context of these relationships is described below.

- 15 • Basin, delta, and Suisun Marsh.
- 16 • Basin rims.
- 17 • Floodplains and stream terraces.
- 18 • Valley fill, alluvial fans, and low terraces.
- 19 • Uplands and high terraces.

## 20 **Basin, Delta, and Suisun Marsh Soils**

21 Basin and delta soils occupy the lowest elevations and are often protected by levees (Soil  
 22 Conservation Service 1992, 1993). Most of these low-lying soils contain substantial organic matter  
 23 and are classified as peats or mucks (Soil Conservation Service 1992, 1993); Figure 10-2 shows the  
 24 percent organic matter content of the upper 5 feet of soils in the Plan Area. Examples of organic soil  
 25 associations in the Delta include the Gazwell-Rindge association in Sacramento County, the Rindge-  
 26 Kingile-Ryde and Peltier-Egbert associations in San Joaquin County, and the Rindge-Kingile and  
 27 Joice-Reyes associations in Contra Costa County.

28 Peat soils contain large accumulations of partially decomposed plant material. In muck soils, plant  
 29 material is decomposed to a greater degree than in peat soils. In the Delta, unaltered peat soils are  
 30 characterized as having two layers: one relatively thin layer with plant material derived from tule,  
 31 and an underlying deeper layer of plant material derived from reed, primarily *Phragmites communis*  
 32 (Weir 1950). Peat soils are grouped in the soil order Histosols. By definition, Histosols contain more  
 33 than 18% organic carbon if the mineral fraction of the soil contains at least 60% clay, or more than  
 34 12% organic carbon if no clay is present (Buol et al. 1980:315-317). Histosols are further classified  
 35 into suborders according to level of decomposition in the subsurface. Fibrists (i.e., peat) exhibit  
 36 relatively minor decomposition, with fibric material dominant in the subsurface; Hemists are  
 37 moderately decomposed with hemic organic matter in the subsurface; and Saprists (i.e., muck) are  
 38 the most decomposed, with sapric material in the subsurface (Buol et al. 1980: 315-317). Soil series  
 39 representing organic soils from those closest to a natural state, to those most altered (and  
 40 possessing the highest to lowest organic matter content), are Venice, Staten, Egbert, and Roberts,  
 41 respectively (California Department of Water Resources 2007). Soils with less organic matter may  
 42 have been drained earlier than others (California Department of Water Resources 2007).

1 The thickness of the organic soils is greatest on islands of the central Delta. Figure 10-3 shows the  
 2 total thickness of the organic soils,<sup>1</sup> which extends well below the 5-foot depth typically described in  
 3 NRCS soil surveys. The areas with the thickest organic soils include southern Grand, southern Tyler,  
 4 southern Brannan, Twitchell, northern and southern Sherman, Venice, Medford, and western  
 5 Bouldin Islands in Sacramento and San Joaquin Counties (Delta Protection Commission 1993). The  
 6 Suisun Marsh has the largest contiguous area of highly organic soils, with poorly drained muck and  
 7 peat soils in salt marshes, such as the Joice-Suisun association. In addition to being very deep, peat  
 8 soils are also poorly drained and may have a high water table. They have a high water-holding  
 9 capacity. These soils have good fertility, with 2–3.5% nitrogen; therefore, they make excellent  
 10 agricultural soils when drained (Delta Protection Commission 1993).

11 Soils along the margin of the Delta contain more mineral material and less organic matter than those  
 12 in the central Delta. Mineral soils that occur in the Delta are typically fine textured with poor  
 13 drainage (e.g., the Clear Lake association in Sacramento County, the Sacramento association in Yolo  
 14 County, and the Sacramento-Omni association in Contra Costa County [Figure 10-1]). These soils  
 15 also may be calcareous with high salinity and a high sodium content (e.g., the Willows-Pescadero  
 16 association in Yolo and San Joaquin Counties [Figure 10-1]). Soils in the Yolo Bypass are primarily  
 17 those of the Capay-Sacramento association and are moderately well-drained to poorly drained silty  
 18 clay loams to clays, as shown in Figure 10-1 (Soil Conservation Service 1972).

19 The topsoil layer ranges between 20 and 60 inches thick.

## 20 Basin Rim Soils

21 Basin rim soils are found along the rims (edges) of basins. Soils in this physiographic setting are  
 22 mineral soils that are poorly drained to well-drained, and have fine textures in their surface  
 23 horizons. Some areas contain soils with a claypan layer in the subsurface. For example, the  
 24 Marcuse-Solano-Pescadero association in Contra Costa County contains very poorly drained to  
 25 somewhat poorly drained clays, loams, and clay loams (Figure 10-1). A cemented hardpan can occur  
 26 at depths of 40–60 inches in Hollenbeck soils in San Joaquin County (Figure 10-1). Dierssen soils in  
 27 western Sacramento County have a sandy clay loam texture at the surface, a calcareous clay subsoil,  
 28 and a hardpan at a depth of 20–45 inches (Figure 10-1) and also can have a perched water table at a  
 29 depth of 6–36 inches in winter and early spring (Soil Conservation Service 1993).

30 The topsoil layer of the soils in this physiographic setting generally ranges between 5 and 14 inches  
 31 thick.

## 32 Floodplain and Stream Terrace Soils

33 Floodplain and stream terrace soils are mineral soils located adjacent to major rivers and other  
 34 streams, and may be associated with landward sediment accumulations behind natural levees. Soils  
 35 are stratified, with relatively poor drainage and fine textures. Examples include Sailboat-Scribner-  
 36 Cosumnes and Egbert-Valpac associations adjacent to the Sacramento River, and the Columbia-  
 37 Cosumnes association adjacent to the Cosumnes River and other streams in Sacramento County  
 38 (Figure 10-1). The Merritt-Grangeville-Columbia and Columbia-Vina-Coyote Creek associations  
 39 in San Joaquin County (Figure 10-1) are additional examples.

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<sup>1</sup> The original source of this figure (California Department of Water Resources 2007) does not define “organic soils”, but is assumed to be those soil materials with a minimum of 15% organic matter content.

1 The topsoil layer of the soils in this physiographic setting generally ranges between 8 and 20 inches  
2 thick.

### 3 **Valley Fill, Alluvial Fan, and Low Terrace Soils**

4 Valley fill, alluvial fan, and low terrace soils are typically very deep with variable texture and ability  
5 to transmit water. Alluvial fan soils range from somewhat poorly drained fine sandy loams and silty  
6 clay loams (e.g., the Sycamore-Tyndall association in Yolo County) to well-drained silt loams and  
7 silty clay loams (e.g., the Yolo-Brentwood association in Yolo County). Soils on low terraces include  
8 the San Joaquin association in Sacramento County and San Joaquin-Bruella and Madera soils in San  
9 Joaquin County, which are moderately well-drained with a claypan subsoil and have a cemented  
10 hardpan at a depth of 20–40 inches (Soil Conservation Service 1992, 1993). A perched water table  
11 may be present (e.g., the Capay-Sycamore-Brentwood association in Contra Costa County [Soil  
12 Conservation Service 1977a]), or a high water table may sometimes be present as the result of  
13 irrigation (e.g., the Capay association on interfan basins of San Joaquin County [Soil Conservation  
14 Service 1992]). Delhi soils have sandy textures on dunes and are very deep and somewhat  
15 excessively drained (e.g., the Delhi-Veritas-Tinnin association on dunes, alluvial fans, and low fan  
16 terraces in San Joaquin County, and the Delhi association in Contra Costa County [Soil Conservation  
17 Service 1992, 1977a]).

18 The topsoil layer of the soils in this physiographic setting generally ranges between 6 and 26 inches  
19 thick.

### 20 **Upland and High Terrace Soils**

21 Upland and high terrace soils in general are well-drained and range in texture from loams to clays.  
22 These soils primarily formed in material weathered from sandstone, shale, and siltstone, and can  
23 occur on dissected terraces (e.g., Altamont-Diablo association in Solano and Alameda Counties)  
24 (Figure 10-1) or on mountainous uplands (Dibble-Los Osos and Millsholm associations in Solano  
25 County [Soil Conservation Service 1977b]). Erosion by surface water flows may be a hazard where  
26 slopes are steep. The subsoil may be slowly permeable (e.g., Corning-Hillgate association in Yolo  
27 County) (Figure 10-1), or a cemented hardpan may be present at depth (Redding-Yellowlark soils in  
28 San Joaquin County) (Figure 10-1).

29 The topsoil layer of the soils in this physiographic setting generally ranges between 7 and 30 inches  
30 thick, with the thicker horizons always occurring among the soils that are clay throughout the  
31 profile.

### 32 **10.1.1.2 Soil Physical and Chemical Properties**

33 Soil physical and chemical characteristics affect the way a soil “behaves” under specific land uses.  
34 These characteristics are especially important for engineering considerations. Suitability and  
35 limitation ratings for various engineering uses are identified in Appendix 10B, *Natural Resources*  
36 *Conservation Service Soil Suitability Ratings*. Relevant soil physical and chemical properties  
37 described in this section are expansiveness (i.e., shrink-swell potential) and erodibility by water and  
38 wind. Physical and chemical properties of soils in the Plan Area are detailed in Appendix 10C, *Soil*  
39 *Chemical and Physical Properties and Land Use Suitability*, and are described in the following  
40 sections. Other soil properties shown in Appendix 10C but not discussed below include those  
41 properties that are important for evaluation of soil suitability for agriculture, including Storie Index,  
42 Land Capability Classification, and Prime Farmland soils. A discussion of these characteristics, which

1 are relevant to agricultural use, is provided in Chapter 13, *Land Use*, and Chapter 14, *Agricultural*  
2 *Resources*.

### 3 **Expansive Soils (Shrink-Swell Potential)**

4 Expansive soils increase in volume when wet and shrink in volume when dry. The degree of  
5 expansiveness, or shrink-swell potential, depends on the type and amount of clay content in the soil.  
6 The highest shrink-swell potential exists in soils with high amounts of smectitic clays.  
7 Expansiveness can be characterized by measuring a soil's linear extensibility percentage (LEP),  
8 which is the change in length of an unconfined soil clod as moisture content is decreased from a  
9 moist to a dry state, reported as a percentage (Natural Resources Conservation Service 2010a). See  
10 Appendix 10C, *Soil Chemical and Physical Properties and Land Use Suitability*, for the LEP of the soil  
11 map units for the upper 5 feet of the soil profile. Table 10-1 shows the shrink-swell soil classes  
12 based on LEP.

13 **Table 10-1. Shrink-Swell Soil Classes Based on Linear Extensibility Percentage**

| Shrink-Swell Class | LEP |
|--------------------|-----|
| Low                | <3  |
| Moderate           | 3–6 |
| High               | 6–9 |
| Very High          | ≥9  |

Source: Natural Resources Conservation Service 2010b.

LEP = linear extensibility percentage.

14

15 Figure 10-4 shows the LEP classes for the upper 5 feet of soil material. The LEP of soil materials  
16 below approximately 5 feet is not rated. Where one soil layer in the soil profile has a different LEP  
17 than other layers, the layer with the highest LEP is shown on the figure. Areas of the Plan Area with  
18 the highest soil shrink-swell potential include large portions of the northern and southwestern parts  
19 of the Delta, the Yolo Bypass, and areas within Suisun Marsh (Figure 10-4). Soils with the lowest  
20 shrink-swell potential occur in the central and southeastern parts of the Delta.

### 21 **Water Erodibility**

22 Water erosion results when raindrop impact detaches soil particles and flowing water removes and  
23 transports soil material. Sheet erosion removes soil from an area in a fairly uniform manner without  
24 development of discrete channels. Rill erosion removes soil through the cutting of many small but  
25 discrete channels where runoff concentrates. Gully erosion occurs when water cuts down into the  
26 soil along the line of flow, and the cut channels are deep enough that they cannot be obliterated  
27 through tillage. Soil loss through sheet and rill erosion can be predicted through models, such as the  
28 Revised Universal Soil Loss Equation (RUSLE). RUSLE predicts soil loss based on numerous factors,  
29 including rainfall erosivity, soil erodibility (defined below), slope length and steepness, vegetative  
30 cover, and management practices (Natural Resources Conservation Service 2010b).

31 Appendix 10C, *Soil Chemical and Physical Properties and Land Use Suitability*, includes soil erodibility  
32 factors for each soil map unit in the Plan Area. The soil erodibility factor ( $K_w$ ) is a relative index of  
33 the susceptibility of a bare, cultivated soil to particle detachment and transport by raindrop impact  
34 and runoff, but does not reflect the influence of slope on potential erosion rates. Therefore, the

1 erosion hazard may be low in a level area with soils that have a high Kw value. Experimentally  
 2 measured Kw values vary from 0.02 to 0.69, with the higher end of the range representing soils with  
 3 greater susceptibility to particle detachment and transport. Clayey and sandy soils have low Kw  
 4 values because the soil particles are resistant to detachment from raindrop impact (clayey soils) or  
 5 because of their higher infiltration capacity (sandy soils). Loamy soils have moderate Kw values.  
 6 Silty soils are the most susceptible to water erosion, with high Kw values (Michigan State University  
 7 2002).

8 Figure 10-5 provides water erosion hazard ratings for the surface layer of soils in the Plan Area  
 9 (Natural Resources Conservation Service 2010a). *Erosion hazard* refers to the degree to which a soil  
 10 will be subject to accelerated erosion rates when the land surface is disturbed. Erosion hazard is  
 11 primarily controlled by the soil erodibility factor and the steepness of the slope. The soil survey  
 12 hazard ratings shown in Figure 10-5 are based on sheet or rill erosion in areas outside of roads and  
 13 trail areas, where 50–75% of the land surface has been exposed by ground-disturbing activities.<sup>2</sup>  
 14 Hazard ratings range from “slight,” which indicates that erosion is unlikely under ordinary climatic  
 15 conditions, to “very severe,” which indicates that significant erosion is expected, loss of soil  
 16 productivity, and offsite damage are likely, and erosion-control measures are costly and generally  
 17 impractical (Natural Resources Conservation Service 2010a). The ratings show the relative water  
 18 erosion hazard that would exist during construction or other ground-disturbing activities. The water  
 19 erosion hazard ratings are based on the dominant soil present, although other, minor soil  
 20 components also may be present within the map unit. Because of the level to nearly level slopes,  
 21 water erosion hazard is rated as slight throughout most of the Plan Area; in more sloping areas, the  
 22 water erosion hazard ranges from moderate to very severe.

### 23 **Soil Erodibility by Wind**

24 Soil erodibility by wind is related to soil texture, organic matter content, calcium carbonate content,  
 25 rock fragment content, mineralogy, and moisture content. NRCS assigns soil map units to one of  
 26 eight wind erodibility groups (WEGs) based on susceptibility to blowing (Natural Resources  
 27 Conservation Service 2010b): 1, 2, 3, 4, 4L, 5, 6, 7, and 8. The WEGs assume that the soil that has  
 28 been cultivated or is bare. The organic soils of the Suisun Marsh and the central Delta have a high  
 29 susceptibility to wind erosion, as indicated by their classification in WEGs 1 through 3. Figure 10-6  
 30 shows the WEG of the surface layer of the soils in the Plan Area.

#### 31 **10.1.1.3 Soil Suitability and Use Limitation Ratings**

32 Physical and chemical properties of soils are used by NRCS to determine suitability for various uses,  
 33 such as for agriculture, levee construction, urban development, or marsh wildlife habitat. Suitability  
 34 and limitation ratings for soil use in embankments, dikes, and levees; shallow excavations; and  
 35 corrosivity are identified in Appendix 10B, *Natural Resources Conservation Service Soil Suitability*  
 36 *Ratings* (Natural Resources Conservation Service 2010b).

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<sup>2</sup> For the purpose of this analysis, the erosion hazard rating for areas of Histosols and mucky mineral soils was modified from that provided in the SSURGO database to compensate for the influence of high organic matter content on the rating. The Histosols and mucky mineral soils in the Plan Area typically have a very low Kw value (i.e., 0.02). This low soil erodibility, combined with level to nearly level slopes, results in a slight erosion hazard in such areas; this characterization is consistent with the manuscript versions of the county soil survey reports.

## 1      **Use Limitations for Embankments, Dikes, and Levees**

2      Construction of embankments, dikes, and levees requires soil material that is resistant to seepage,  
3      piping, and erosion and that has favorable compaction characteristics. Soils with limited suitability  
4      for construction of embankments and levees include those with high organic matter content, high  
5      stone content, elevated sodium, high shrink-swell potential, and high gypsum (calcium sulfate)  
6      content (Natural Resources Conservation Service 2010b).

7      Soil use limitation ratings of slightly limited, somewhat limited, limited, and very limited, are  
8      provided in Appendix 10B, *Natural Resources Conservation Service Soil Suitability Ratings*, for each  
9      soil map unit. The rating is given for the whole soil, from the surface to a depth of about 5 feet, based  
10     on the assumption that soil horizons will be mixed in loading, dumping, and spreading. The ratings  
11     do not indicate the suitability of the undisturbed soil for supporting the embankment. Soil  
12     properties to a depth greater than the embankment height have an effect on the performance and  
13     safety of the embankment (e.g., low-density silts and clays in the supporting foundation generally  
14     have excessive settlement and low strength); therefore, geotechnical studies must generally be  
15     made to evaluate suitability as load-bearing surfaces. Nearly all soil units in the Plan Area have some  
16     restrictions associated with use for embankments, dikes, or levees, and the suitability of most soil  
17     types for these features is very limited (Appendix 10B).

## 18     **Use Limitations for Shallow Excavations**

19     Shallow excavations are trenches or holes dug in the soil to a maximum depth of 5 or 6 feet for  
20     construction of pipelines, sewer lines, telephone and power transmission lines, basements, and open  
21     ditches. These excavations are most commonly made by trenching machines or backhoes. Use  
22     limitation ratings are defined as slight, somewhat limited, limited, and very limited based on the soil  
23     properties that influence ease of excavation and resistance to sloughing. Restrictive properties  
24     adversely influence the ease of digging, filling, and compacting, and include shallow depth to  
25     bedrock or cemented pan and presence of large stones. Presence of a seasonally high water table  
26     and flooding may restrict the period when excavations can be made. Slope influences the ease of  
27     using machinery and accessibility. Soil texture and depth to water table influence the resistance of  
28     soil walls to sloughing (Natural Resources Conservation Service 2010b).

29     Use limitations for shallow excavations in the Plan Area are predominantly a result of caving  
30     potential of clay soils, slopes greater than 15%, soil saturation less than 2.5 feet in depth, and  
31     presence of high organic matter content to a depth of 20 inches below ground surface (Natural  
32     Resources Conservation Service 2010b). Nearly all soil map units in the Plan Area have some  
33     restrictions associated with shallow excavations, and many soil map units have a rating of very  
34     limited (Appendix 10B, *Natural Resources Conservation Service Soil Suitability Ratings*).

### 35     **10.1.1.4      Risk of Corrosion to Uncoated Steel**

36     Uncoated steel corrodes when soil-induced electrochemical or chemical actions convert iron from  
37     steel into its respective ions and cause the uncoated steel to dissolve or weaken (Natural Resources  
38     Conservation Service 2010b). The rate of deterioration of uncoated steel is controlled by soil  
39     moisture content, soil texture, acidity, and soluble salt content. The Soil Survey Handbook provides  
40     three classes of corrosion risk to uncoated steel (low, medium, and high), and the NRCS guidance for  
41     estimating corrosion risk is shown in Table 10-2.

1 **Table 10-2. Guidance for Estimating Corrosion Risk to Uncoated Steel<sup>a</sup>**

| Property  | Limits   |  |   |
|---|--|--|---|
|   | Low  | Moderate   | High  |
| Drainage Class and Texture  | Excessively drained coarse textured or well-drained, coarse to medium textured soils; or moderately well-drained coarse textured, soils; or somewhat poorly drained, coarse textured soils | Well-drained, moderately fine textured soils; or moderately well-drained, medium textured soils; or somewhat poorly drained, moderately coarse textured soils; or very poorly drained soils with stable high water table | Well-drained, fine textured or stratified soils; or moderately well-drained, fine and moderately fine textured or stratified soils; or somewhat poorly drained, medium to fine textured or stratified soils; or poorly drained soils with fluctuating water table |
| Total Acidity (milliequivalents per 100 grams) <sup>b</sup>               | <8   | 8–12   | ≥12   |
| Resistivity at Saturation (ohms per centimeter) <sup>c</sup>              | ≥5,000   | 2,000–5,000  | <2,000  |
| Conductivity of Saturated Extract (millimhos per centimeter) <sup>d</sup> | <0.3   | 0.3–0.8  | ≥0.8  |

Source: Natural Resources Conservation Service 2010b.

<sup>a</sup> Based on data in the publication *Underground Corrosion*, Table 99, p. 167, Circular 579, U.S. Department of Commerce, National Bureau of Standards.

<sup>b</sup> Total acidity is roughly equal to extractable acidity (as determined by Soil Survey Laboratories Method 6H1a, Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004).

<sup>c</sup> Roughly equivalent to resistivity of fine- and medium-textured soils measured at saturation (Method 8E1, Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November, Natural Resources Conservation Service 2004). Resistivity at saturation for coarse-textured soil is generally lower than when obtained at field capacity and may cause the soil to be placed in a higher corrosion class.

<sup>d</sup> Method 8A1a, Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004. The relationship between resistivity of a saturated soil paste (Method 8E1) and electrical conductivity of the saturation extract (Method 8A1a), is influenced by variations in the saturation percentage, salinity, and conductivity of the soil minerals. These two measurements generally correspond closely enough to place a soil in one corrosion class. (For reference, 1 millimho per centimeter = 1 deciseimen per meter.)

2  
3 In the Plan Area, most soil units are expected to have a high potential to cause corrosion to uncoated  
4 steel (Figure 10-7 and Appendix 10B, *Natural Resources Conservation Service Soil Suitability*  
5 *Ratings*).

### 10.1.1.5 Risk of Corrosion to Concrete

Corrosion to concrete results from a chemical reaction between a base (the concrete) and a weak acid (the soil solution). Construction activities may need to use special types of cement when local soils have a high risk of corrosion (Natural Resources Conservation Service 2010b). The rate of concrete deterioration depends on soil texture and acidity, the amount of sodium, or magnesium sulfate and calcium sulfate (gypsum) present in the soil. In particular, soils containing gypsum generally require a special cement to reduce risk of corrosion. The NRCS Soil Survey Handbook classifies risk of corrosion to concrete as low, moderate, or high, in accordance with the guidelines provided in Table 10-3.

**Table 10-3. Soil Classification for Risk of Corrosion to Concrete**

| Property                              | Limits <sup>a</sup>   |   |   |
|---------------------------------------|---|---|---|
|                                       | Low   | Moderate  | High  |
| Texture and Reaction                  | Sandy and organic soils with pH >6.5 or medium and fine textured soils with pH >6.0 | Sandy and organic soils with pH 5.5 to 6.5 or medium and fine textured soils with pH 5.0 to 6.0 | Sandy and organic soils with pH <5.5 or medium and fine textured soils with pH <5.0 |
| Sodium and/or Magnesium Sulfate (ppm) | <1,000  | 1,000–7,000   | >7,000  |
| Sodium Chloride (ppm)                 | <2,000  | 2,000–10,000  | >10,000   |

Source: Natural Resources Conservation Service 2010b.

pH = measure of acidity or alkalinity; ppm = part(s) per million.

<sup>a</sup> Based on data in *National Handbook of Conservation Practices*, Standard 606, Subsurface Drain, Natural Resources Conservation Service 1980.

In the Plan Area, most soil units are expected to have a low to moderate potential to cause corrosion to concrete (Figure 10-8).

## 10.1.2 Land Subsidence

Land subsidence is a gradual settling or sudden sinking of the earth's surface resulting from subsurface movement of earth materials (Galloway et al. 2000). Although subsidence can have various causes, such as aquifer compaction, drainage of organic soils, underground mining, extraction of oil and natural gas, natural compaction, tectonic movement (changes resulting from movements in the Earth's crust), and sinkholes, the primary cause in the Delta is decomposition of organic carbon in the peat soils. This section summarizes the scientific and technical literature on land subsidence in the Delta.

### 10.1.2.1 History

For more than 7,000 years, a balance existed between sediment influx to the Delta, production of organic sediment in the Delta, and export of sediment to San Francisco Bay. During this time, marsh conditions were supported. Much of the area was covered with dense stands of tule (*Scirpus lacustris*), with riparian plant species occupying higher stream banks (natural levees) where mineral soils were present (Weir 1950). The land elevation was at or near sea level, and the land surface was

1 inundated at high tide and when flood conditions were present. Equilibrium conditions promoted  
2 the development of peat soils to depths of up to approximately 30 feet in some areas (Weir 1950).

3 This equilibrium was first disrupted when large volumes of sediment influx occurred from hydraulic  
4 mining in the mid-1800s, then by subsequent reclamation of Delta tule marsh islands that took place  
5 from the late 1800s through about 1930 (Weir 1950). With passage of the Swamp and Overflow Act  
6 of 1850 (when title of lands in the Delta passed from federal to state control), the marshlands began  
7 to be drained for conversion to agricultural use. Levees were constructed around Delta islands to  
8 exclude floods and tidal overflow. Much of the construction material was channel sediment  
9 excavated by a clamshell dredge. Following levee construction, tule marshes on island interiors  
10 began to die and were burned, drainage ditches were constructed at the perimeter of levees, and  
11 pumps were installed to transfer drainage water from the island interiors into the adjacent  
12 waterways (Weir 1950). The land was cultivated when it was dry enough for plowing.

13 The ages of Delta islands are related to the date they were reclaimed. For example, Lower Jones  
14 Tract was drained and put into cultivation in 1902, cultivation on Bacon Island began in 1915, and  
15 Mildred Island was first farmed in 1921. Most of the Delta was in cultivation in 1922, when land  
16 subsidence was first investigated (Weir 1950). The Delta's present form dates to the 1930s, when  
17 approximately 100 islands and tracts had been drained and more than 1,000 miles of levees had  
18 been constructed (Ingebritsen et al. 2000).

### 19 **10.1.2.2 Causes of Subsidence**

20 The primary cause of land subsidence in the Delta has been attributed to microbial decomposition of  
21 peat soils (Ingebritsen et al. 2000; Deverel and Rojstaczer 1996). Waterlogged soils contain little  
22 oxygen, which is necessary for microbial decomposition of organic matter. Under anaerobic  
23 conditions, organic matter from plant materials accumulates faster than it can decompose. When the  
24 Delta islands were drained, the formerly saturated soils became oxygen rich and conditions favored  
25 microbial oxidation. When organic carbon is oxidized from peat soils, it is emitted as CO<sub>2</sub> gas to the  
26 atmosphere, thereby reducing the soil carbon pool and soil volume (Deverel and Rojstaczer 1996).  
27 The agricultural cultivation of the Delta's peat soils has, over time, contributed to the subsidence of  
28 most Delta islands, particularly in the West and Central Delta. Prior to agricultural development, the  
29 soil was waterlogged and anaerobic (oxygen-poor). Organic carbon accumulated faster than it could  
30 decompose. Drainage for agriculture led to aerobic (oxygen-rich) conditions that favor rapid  
31 microbial oxidation of the carbon in the peat soil. Most of the carbon loss is emitted as carbon  
32 dioxide gas to the atmosphere (Deverel and Rojstaczer 1996).

33 Other processes that may be contributing to land subsidence in the Delta are discussed below.

- 34 ● Anaerobic decomposition of peat soils. Although anaerobic decomposition is considered a minor  
35 contributor to subsidence, some studies from the 1960s found that considerable decomposition  
36 occurred immediately below the groundwater table and accelerated with cycles of soil wetting  
37 and drying (Delta Protection Commission 1993).
- 38 ● Soil compaction caused by consolidation and farm equipment. Shrinkage, consolidation, and  
39 compaction are responsible for the initial subsidence, specifically within about the first 3 years  
40 after the water table is lowered. After this, a degree of stability is reached and subsidence  
41 declines to a steady rate, primarily because of oxidation (Natural Resources Conservation  
42 Service 2010b).

- 1       • Soil shrinkage. Organic soils shrink up to 50% in volume when dried; when undecomposed peat  
2       soils are exposed to the atmosphere, they will shrink upon drying (Delta Protection Commission  
3       1993).
- 4       • Burning. This practice was common between 1900 and 1950, and was used to add nutrients to  
5       the soil, expose fresh peat, and control weeds and disease. Burning was especially common  
6       during World War II, when potatoes and sugar beets, crops with a high potassium requirement,  
7       were most in demand. Each burning event could result in loss of 3–5 inches of soil, and fields  
8       were typically burned every 3–5 years (Weir 1950). Burning has not been performed routinely  
9       since the 1960s.
- 10      • Wind erosion. Wind erosion was estimated to result in the removal of 0.25–0.5 inch of topsoil  
11      per year. Peat soils have a low bulk density (often less than 1 gram per cubic centimeter before  
12      decomposition). During cultivation, clouds of dust surround tractors unless the soil is moist. If  
13      bare soils are exposed when fields are not being cropped, such as occurred historically on  
14      asparagus fields in the springtime, large amounts of soil can be lost to wind erosion (Weir 1950).
- 15      • Dissolution of organic matter. This process is estimated to account for only about 1% of  
16      observed subsidence (Deverel and Rojstaczer 1996).
- 17      • Water, oil, and gas extraction. Water and gas extraction are not important factors in land  
18      subsidence in the Delta (Rojstaczer et al. 1991). Although slight groundwater-induced  
19      subsidence may occur during the summer months, elevations rebound during the winter  
20      months. On the other hand, groundwater extraction has historically resulted in substantial  
21      subsidence in the San Joaquin Valley outside of the Delta, and reduced imported water deliveries  
22      could lead to increased groundwater reliance and renewed subsidence in these areas  
23      (Ingebritsen et al. 2000).

### 24   **10.1.2.3        Rates of Subsidence and Current Conditions**

25       The rate of decomposition of organic soils is related to temperature and moisture conditions (Buol  
26       et al. 1980). The microbial activity that drives the oxidation of peat soils approximately doubles with  
27       a 10-degree increase in soil temperature. However, the rate of CO<sub>2</sub> loss is reduced when soils are wet  
28       and contain little oxygen (Deverel and Rojstaczer 1996). Therefore, activities that increase oxygen in  
29       the subsurface (e.g., construction of underdrains to improve drainage) lead to decomposition of peat  
30       soils, and the rate of decomposition increases during warmer times of the year.

31       Historical subsidence rates in the Delta have been found to strongly correlate with the organic  
32       matter content of the soil and the age of the reclaimed island (Rojstaczer and Deverel 1995). In  
33       1948, Lower Jones Tract, Mildred Island, and Bacon Island were all between 10 and 11 feet below  
34       sea level and were continuing to subside at the rate of 3–4 inches per year. Rojstaczer and Deverel  
35       (1995) quoted sources that suggest historical subsidence rates ranged from 1.8 to 4.6 inches per  
36       year, with higher rates associated with areas in the central Delta. Ingebritsen et al. (2000) indicated  
37       that long-term average rates of subsidence are 1–3 inches per year.

38       Rojstaczer and Deverel (1993) and Mount and Twiss (2005) also showed that subsidence rates on  
39       Lower Jones Tract, Mildred Island, and Bacon Island have slowed with time.

40       Deverel and Rojstaczer (1996) found that, while a certain amount of subsidence was caused by  
41       seasonal fluctuation in water table elevations, subsidence due primarily to biological oxidation of  
42       peat soils on three islands (Jersey Island, Orwood Tract, and Sherman Island) occurred at a rate of

1 0.27 inch per year, 0.32 inch per year, and 0.18 inch per year, respectively, in the 1990s. Dissolved  
 2 organic carbon flux contributed less than 1% of the measured subsidence. Flux of dissolved organic  
 3 carbon was greater and pH was lower in drainage waters when water table levels were seasonally  
 4 located in soil layers containing highly decomposed organic matter.

5 Geographically, the soils within the centers of Delta islands typically have greater organic matter  
 6 content than those near the margins close to levees. Consequently, the center areas also experience  
 7 greater subsidence, and the land surface tends toward a saucer shape with the lowest elevation at  
 8 island centers. Approximately 100 years following drainage of the Delta islands, many are 10–25  
 9 feet below sea level. Figure 10-9 shows the existing generalized elevations throughout most of the  
 10 Plan Area. Areas that are at elevations lower than -5 feet can be assumed to have subsided.

11 Drainage ditches now maintain the water table at about 2.5–5 feet below the land surface. With  
 12 continuing subsidence, however, ditches must be deepened periodically to keep the water table  
 13 below the crop root zone.

14 Some recent estimates, including those developed as part of the DWR's Delta Risk Management  
 15 Strategy, predict that 3–4 feet of additional subsidence will occur in the central portion of the Delta  
 16 by 2050 (California Department of Water Resources 2007).

#### 17 **10.1.2.4 Consequences of Land Subsidence**

18 Land subsidence has direct or indirect consequences on land use, water supply and quality, and  
 19 other operations and uses of the Delta. These consequences are discussed in this section.

#### 20 **Levee Instability**

21 As land subsides, the difference in water surface elevation between channels and the island interior  
 22 becomes greater. This hydraulic head difference between the water surface of the channels and the  
 23 island interiors increases hydrostatic forces on levees, which decreases levee stability and  
 24 contributes to seepage through and under levees (Mount and Twiss 2005). Furthermore, as the land  
 25 subsides, the shallow groundwater level becomes nearer to the ground surface, and drainage ditches  
 26 along the toe of the levee must be deepened to ensure that the water table remains below the crop  
 27 root zone. This practice decreases levee stability by reducing lateral support to levee foundations,  
 28 which also leads to increased risk of levee failure. Many of the Delta islands have experienced levee  
 29 breaches. Levee instability is described more thoroughly in Chapter 6, *Surface Water*.

#### 30 **Infrastructure Damage**

31 In addition to levees, subsidence can damage infrastructural improvements such as pipelines, roads,  
 32 railroads, canals, bridges, utility tower foundations, storm drains, and sanitary sewers, as well as  
 33 public and private buildings and water, oil, and gas well casings. These effects can be particularly  
 34 acute in areas of differential subsidence, in which the amount of ground level lowering varies over  
 35 short distances.

#### 36 **Water Supply Disruption**

37 Levee instability because of subsidence could disrupt the water source for more than two-thirds of  
 38 California's population. The presence of the western Delta islands is believed to inhibit the migration  
 39 of the salinity interface between the San Francisco Bay and the Delta. Were these islands to

1 experience a levee breach and become inundated, water in the southern Delta might become too  
 2 saline to use as drinking water (Ingebritsen et al. 2000). Effects related to salinity and water quality  
 3 are discussed in Chapter 8, *Water Quality*.

#### 4 **Greenhouse Gas Emissions and Climate Change**

5 On a global scale, soil organic carbon lost by oxidation and combustion can significantly contribute  
 6 to the amount of CO<sub>2</sub> in the atmosphere. Worldwide annual input of carbon to the atmosphere from  
 7 agricultural drainage of organic soils may be as much as 6% of that produced by fossil fuel  
 8 combustion; the Delta has been estimated to contribute 2 million tons of carbon per year to the  
 9 atmosphere through oxidation of peat soils (Rojstaczer and Deverel 1993). Increased carbon in the  
 10 Earth's atmosphere has been tied to increased concentrations of greenhouse gases and global  
 11 climate change (California Department of Water Resources 2005). Greenhouse gas emissions and  
 12 global climate change are discussed in Chapter 29, *Climate Change* and Chapter 22, *Air Quality and*  
 13 *Greenhouse Gas Emissions*.

#### 14 **Water Quality Degradation**

15 Land subsidence can indirectly affect water quality by reducing levee integrity and increasing the  
 16 risk of breaches. The present configuration of Delta islands may help ensure salinity intrusion does  
 17 not increase salinity levels in Delta waterways, which would potentially reduce suitability of these  
 18 waters for various uses, including drinking water supply and agricultural water supply. Although  
 19 not a major cause of subsidence, dissolution of peat soils contributes dissolved organic carbon in  
 20 drainage waters, which further reduces water quality. Water quality is discussed in Chapter 8, *Water*  
 21 *Quality*.

#### 22 **Soil Productivity Degradation**

23 As the land surface subsides, the plant root zone becomes nearer to the shallow groundwater level.  
 24 This is of particular significance in areas that are close to or below sea level, such as the organic soils  
 25 of the Delta. A shallow water table can cause saturation of the root zone, making a soil less  
 26 productive and limiting the types of crops that can be grown. The effects of subsidence on crop  
 27 production and types are further discussed in Chapter 14, *Agricultural Resources*.

## 28 **10.2 Regulatory Setting**

29 This section describes federal and state codes, plans, policies, regulations, and laws and regional or  
 30 local plans, policies, regulations, and ordinances that pertain to soil resources. The focus of this  
 31 section is on laws and regulations related to soil hazards. The codes, plans, policies, regulations, and  
 32 ordinances discussed below inform minimum design and construction requirements for some  
 33 aspects of the water conveyance facility and the other conservation measures (CM2–CM21) or  
 34 Environmental Commitments (3, 4, 6–12, 15 and 16). These act as performance standards for  
 35 engineers and construction contractors and their implementation is considered an environmental  
 36 commitment of the agencies implementing the proposed project. This commitment is discussed  
 37 further in Appendix 3B, *Environmental Commitments, AMMs, and CMs*.

## 1 **10.2.1 Federal Plans, Policies, and Regulations**

2 Federal laws and regulations that are relevant to soils include the portions of the Clean Water Act  
3 (CWA) and implementing regulations that establish requirements for stormwater discharges from  
4 construction sites. As noted, these laws and regulations are thoroughly described in Chapter 8,  
5 *Water Quality*. However, because they are related to activities applicable to soil resources, such as  
6 excavation and grading, they are summarized in this section.

### 7 **10.2.1.1 Clean Water Act Section 402, National Pollutant Discharge 8 Elimination System Program: Storm Water Permitting**

9 In November 1990, the U.S. Environmental Protection Agency (EPA) established regulations to  
10 mainly address construction related run-off and sedimentation into streams that established  
11 stormwater permit requirements for specific categories of industries, including construction (Phase  
12 I Rule). Under Phase I, a stormwater permit was required for construction projects that disturbed 5  
13 or more acres of land, and for large Municipal Separate Storm Sewer Systems (MS4s). In December  
14 1999, EPA promulgated regulations (Phase II Rule) that expanded the National Pollutant Discharge  
15 Elimination System (NPDES) to require a stormwater discharge permit for construction activities  
16 with a disturbance area of 1–5 acres and for small MS4s. In California, EPA has delegated  
17 responsibility for CWA implementation to the State Water Resources Control Board (State Water  
18 Board).

## 19 **10.2.2 State Plans, Policies, and Regulations**

### 20 **10.2.2.1 Porter-Cologne Water Pollution Control Act**

21 The Porter-Cologne Water Pollution Control Act (Porter-Cologne Act) (California Water Code,  
22 Division 7) is the state law governing water quality in California. Under the Porter-Cologne Act,  
23 responsibilities for coordination and control of water quality are assigned to the State Water Board  
24 and nine Regional Water Quality Control Boards (Regional Boards). The Delta and Suisun Marsh are  
25 in the jurisdictions of the Central Valley Regional Board and the San Francisco Bay Regional Board,  
26 respectively. These Regional Boards are responsible for ensuring that construction activities comply  
27 with the state general permit regulating construction activities (discussed below).

### 28 **10.2.2.2 National Pollutant Discharge Elimination System General Permit 29 for Storm Water Discharges Associated with Construction and 30 Land Disturbance Activities**

31 In 2009, the State Water Board adopted the General Permit for Storm Water Discharges Associated  
32 with Construction and Land Disturbance Activities, State Water Board Order No. 2009-0009-DWQ,  
33 NPDES Permit No. CAS000002 (General Permit) (as amended by Order No. 2012-0006-DWQ), which  
34 regulates stormwater discharges from construction sites that involve 1 acre or more of disturbed  
35 area. Coverage under the General Permit is obtained by submitting permit registration documents to  
36 the State Water Board, which include a risk level assessment and a site-specific stormwater  
37 pollution prevention plan (SWPPP) that identifies an effective combination of erosion control,  
38 sediment control, and non-stormwater best management practices (BMPs). The General Permit  
39 requires that the SWPPP define a program of regular inspections of the BMPs and in some cases

1 sampling of water quality parameters. Construction activities would require coverage under the  
2 General Permit.

### 3 **10.2.2.3 Municipal Separate Storm Sewer Systems Permits**

4 The Phase I Rule required that large MS4s obtain a stormwater discharge permit, and the Phase II  
5 Rule expands the requirement to small MS4s. Generally, Phase I MS4s are covered by individual  
6 permits while Phase II MS4s are covered by the General Permit. In the Plan Area, individual MS4  
7 permits have been issued for several municipal jurisdictions, which are identified in Chapter 8,  
8 *Water Quality*. Phase I and II MS4 permits require permittees to develop and implement stormwater  
9 management plans that include provisions for reducing pollutant discharges from construction  
10 activities. Local jurisdictions are responsible for enforcement of those provisions. Future  
11 construction activities would need to implement soil erosion and sediment control measures that  
12 are consistent with municipal stormwater management plan requirements.

### 13 **10.2.2.4 Nonpoint Source Implementation and Enforcement Policy**

14 The state's Nonpoint Source Implementation and Enforcement Policy describes how its nonpoint  
15 source (NPS) plan is to be implemented and enforced, in compliance with Section 319 of the CWA,  
16 Coastal Zone Act Reauthorization Amendments, and the Porter-Cologne Act. In contrast to point  
17 source pollution that enters water bodies from discrete conveyances, NPS pollution enters water  
18 bodies from diffuse sources, such as land runoff, seepage, or hydrologic modification. NPS pollution  
19 is controlled through implementation of management measures. The NPS program contains  
20 recommended management measures for developing areas and construction sites, as well as  
21 wetland and riparian areas. Requirements for soil erosion and sediment controls to prevent NPS  
22 sediment discharges to waterways may be incorporated into permits issued by the San Francisco  
23 Bay Conservation and Development Commission (BCDC) or other regulatory entities.

### 24 **10.2.2.5 McAteer-Petris Act**

25 BCDC was permanently established by the McAteer-Petris Act of 1969, which gave the agency  
26 jurisdiction over certain activities in San Francisco Bay and portions of Suisun Marsh below the 10-  
27 foot contour line (including islands, levees, and grasslands), and any creeks or streams that flow into  
28 the bay. BCDC's authority includes issuing permits for dredging, grading, or construction, and repair  
29 or remodeling of structures within areas in the agency's jurisdiction.

### 30 **10.2.2.6 Suisun Marsh Preservation Act of 1977 and Suisun Marsh 31 Protection Plan (1976)**

32 The Suisun Marsh Preservation Act of 1977 adopted and called for the implementation of the Suisun  
33 Marsh Protection Plan (San Francisco Bay Conservation and Development Commission 1976). BCDC  
34 is the state agency designated to administer the plan, certify consistency of local protection  
35 programs with the plan, hear appeals on local governmental decisions affecting Suisun Marsh, and  
36 decide what developments should be permitted within the primary management zone. The  
37 objectives of the plan, developed in coordination with the California Department of Fish and  
38 Wildlife, are to preserve and enhance the quality and diversity of the Suisun Marsh aquatic and  
39 wildlife habitats, and to ensure retention of upland areas adjacent to the Suisun Marsh in uses  
40 compatible with its protection (San Francisco Bay Conservation and Development Commission 1976).  
41 Activities in the Suisun Marsh that may be regulated under the Suisun Marsh Preservation Act

1 include dredging, reduction of agricultural land by flooding of islands, and erosion control measures.  
 2 If restoration activities are conducted in the Suisun Marsh in areas under BCDC jurisdiction, a permit  
 3 from that agency would include measures to control soil erosion and sedimentation.

#### 4 **10.2.2.7 California Building Code**

5 California's minimum standards for structural design and construction are provided in the California  
 6 Building Code (CBC) (California Code of Regulations [CCR], Title 24). The CBC provides standards for  
 7 various aspects of construction, including excavation, grading, and fill. It provides requirements for  
 8 classifying soils and identifying corrective actions when soil properties (e.g., expansive and  
 9 corrosive soils) could lead to structural damage. Water conveyance facility and restoration  
 10 component construction activities would require conforming to the CBC.

### 11 **10.2.3 Regional and Local Plans, Policies, and Regulations**

#### 12 **10.2.3.1 General Plans, Ordinances, and Codes**

13 Cities and counties have developed ordinances, policies, and other regulatory mechanisms for  
 14 controlling pollutant discharges in construction site runoff, including grading and erosion control  
 15 ordinances and drainage and land leveling ordinances. Development and implementation of local  
 16 control measures, including adoption of ordinances, are generally requirements of MS4 permits  
 17 issued by Regional Boards. An application for a grading permit typically includes vicinity and site  
 18 maps, a grading plan, and an engineered erosion, sediment, and runoff control plan. Local permits  
 19 are generally required for construction activities, and construction projects must conform to local  
 20 drainage and erosion control policies and ordinances.

21 Certain county general plans that cover the Plan Area also contain policies to conserve topsoil or soil  
 22 *as a resource*, without regard to its agricultural suitability or prime farmland status. Relevant  
 23 provisions of these county general plans are outlined below.

#### 24 **Contra Costa County General Plan**

25 A comprehensive update to the *Contra Costa County General Plan* was adopted on January 18, 2005,  
 26 to guide future growth, development, and resource conservation through 2020 (Contra Costa  
 27 County 2005). Amendments to the general plan occurred in 1996 and 2005 to reflect changes to the  
 28 land use map and the incorporation of the City of Oakley, and the Housing Element was updated in  
 29 2009 (Contra Costa County 2010).

30 Relevant goals of the Contra Costa County General Plan (Contra Costa County 2010) pertaining to  
 31 soils as a resource are listed below.

- 32 ● **Goal 8-P:** To encourage the conservation of soil resources to protect their long-term  
 33 productivity and economic value.
- 34 ● **Goal 8-Q:** To promote and encourage soil management practices that maintain the productivity  
 35 of soil resources.

36 The following policy pertaining to soils as a resource appears in the general plan.

- 37 ○ **Policy 8-63:** The County shall protect soil resources within its boundaries.

## 1 **Sacramento County General Plan**

2 The *Sacramento County General Plan*, amended on November 9, 2011, provides for growth and  
3 development in the unincorporated area through 2050.

4 Relevant policies of the Sacramento County General Plan (County of Sacramento 2011) pertaining to  
5 soils as a resource are listed below.

- 6 • **Policy AG-28:** The County shall actively encourage conservation of soil resources.
- 7 • **Policy CO-57:** In areas where top soil mining is permitted, it shall be done so as to maintain the  
8 long term.

## 9 **Solano County General Plan**

10 The *Solano County General Plan* was adopted on August 5, 2008. The Agriculture and Resources  
11 Elements of the general plan address conservation of agricultural land. The general plan is the guide  
12 for both land development and conservation in the unincorporated portions of the county  
13 and contains the policy framework necessary to fulfill the community's vision for Solano County in  
14 2030.

15 Relevant policies of the Solano County General Plan (Solano County 2008) pertaining to soils as a  
16 resource are listed below.

### 17 **Agriculture Element**

- 18 ○ **Policy AG.I-22:** Promote sustainable agricultural activities and practices that support and  
19 enhance the natural environment. These activities should minimize impacts on soil quality  
20 and erosion potential, water quantity and quality, energy use, air quality, and natural  
21 habitats. Sustainable agricultural practices should be addressed in the County's proposed  
22 Climate Action Plan to address climate change effects.

### 23 **Sacramento-San Joaquin Delta Policies**

- 24 ○ **Policy RS.P-21:** Preserve and protect the natural resources of the Delta including soils and  
25 riparian habitat. Lands managed primarily for wildlife habitat should be managed to provide  
26 inter-related habitats.

## 27 **Yolo County General Plan**

28 The *Yolo County 2030 Countywide General Plan* was adopted on November 10, 2009, and provides  
29 for growth and development in the unincorporated area through 2030. The general objective of the  
30 general plan is to guide decision making in the unincorporated areas in the county toward the most  
31 desirable future possible and to identify efficient urbanization with the preservation of productive  
32 farm resources and open space amenities (County of Yolo 2009). Among all the county general plans  
33 within the Primary Zone of the Delta, Yolo County contains the most specific policies relating to  
34 protection of soils as a resource.

35 Relevant policies and actions of the Yolo County general plan (County of Yolo 2009) pertaining to  
36 soils as a resource are listed below.

## 1 Conservation and Open Space Element

2 The following policies that pertain to soils as a resource appear in the conservation and open space  
3 element of the general plan.

- 4 ○ **Policy CO-2.14:** Ensure no net loss of oak woodlands, alkali sinks, rare soils, vernal pools or  
5 geological substrates that support rare endemic species, with the following exception. The  
6 limited loss of blue oak woodland and grasslands may be acceptable, where the  
7 fragmentation of large forests exceeding 10 acres is avoided, and where losses are mitigated.
- 8 ○ **Policy CO-3.5:** Preserve and protect the County’s unique geologic and physical features,  
9 which include geologic or soil “type localities”, and formations or outcrops of special  
10 interest.

11 The following action pertaining to soils as a resource appears in the conservation and open space  
12 element of the general plan.

- 13 ● **Action CO-A54:** The County’s unique geologic or physical features, which include geologic or  
14 soil “type localities” and formations or outcrops of special interest, shall be researched,  
15 inventoried, mapped, and data added to the County GIS database.

## 16 Agriculture & Economic Development Element

17 The following policy pertaining to soils as a resource appears in the agriculture and economic  
18 development element of the general plan.

- 19 ○ **Policy AG-2.6:** Work with appropriate local, State and federal agencies to conserve, study,  
20 and improve soils. Promote participation in programs that reduce soil erosion and increase  
21 soil productivity.

## 22 10.3 Environmental Consequences

23 This section describes potential direct (both temporary and permanent) and indirect effects on soils  
24 that would result with implementation of each alternative. Note that the discussion in this chapter  
25 separates each of the alternatives’ proposed features into three categories; *physical/structural*  
26 *components* and *operations*, both of which are evaluated at the project level; and *restoration actions*,  
27 which are evaluated at the programmatic level. Broadly, the types of effects that are evaluated are  
28 listed below.

- 29 ● Accelerated soil erosion from water and wind.
- 30 ● Loss of topsoil as a resource caused by excavation, overcovering, and inundation.
- 31 ● Land subsidence due to biological oxidation of peat soils.
- 32 ● Effects of corrosive, expansive, and compressible soils.

33 Potential adverse effects that are triggered by a seismic event (either earthquake-induced or  
34 construction-related) are assessed in Chapter 9, *Geology and Seismicity*. Potential effects of  
35 irrigation-induced salt loading to soils are assessed in Chapter 14, *Agricultural Resources*. Potential  
36 effects of eroded soil (i.e., sediment) reaching receiving waters are assessed in Chapter 8, *Water*  
37 *Quality*.

1 Soil-related effects would be restricted to the Plan Area and would be associated primarily with the  
 2 footprint of the proposed conveyance facilities and restoration areas. Because all conveyance and  
 3 restoration activities related to the alternatives would be in the Plan Area, soils in the Upstream of  
 4 the Delta Region and SWP/CVP Export Service Areas would not be affected by proposed  
 5 construction, operation, maintenance, or restoration activities. Therefore, this section does not  
 6 evaluate effects on soils in those geographic areas.

7 Additionally, eight of the proposed conservation measures related to reducing other stressors (listed  
 8 below and described in detail in Chapter 3, *Description of the Alternatives*), which would be  
 9 implemented under the BDCP alternatives, and some of which would be implemented as  
 10 Environmental Commitments under Alternatives 4A, 2D and 5A, are not anticipated to result in any  
 11 meaningful effects on soils in the Plan Area because the actions implemented under these  
 12 conservation measures or Environmental Commitments would not have a bearing on soils, nor  
 13 would they be expected to result in any direct or indirect, permanent or substantial temporary  
 14 changes in soil conditions. Accordingly, these measures are not addressed further in this effects  
 15 analysis.

- 16 • Methylmercury Management (Conservation Measure [CM]12/Environmental Commitment 12)
- 17 • Nonnative Aquatic Vegetation Control (CM13)
- 18 • Stockton Deep Water Ship Channel Dissolved Oxygen Levels (CM14)
- 19 • Predator Control (CM15/Environmental Commitment 15)
- 20 • Nonphysical Fish Barriers (CM16/Environmental Commitment16)
- 21 • Illegal Harvest Reduction (CM17)
- 22 • Recreational Users Invasive Species Program (CM20)
- 23 • Nonproject Diversions (CM21)

### 24 **10.3.1 Methods for Analysis**

25 This section describes the methods used to evaluate soil-related hazards and potential effects of the  
 26 alternatives in the Plan Area and the potential for the elements of the alternatives to increase human  
 27 health risk and loss of property or other associated risks. These effects would be associated with  
 28 construction activities, the footprint of disturbance from new facilities, and operation of the  
 29 alternatives. Lands outside of the Plan Area were not considered because there are no structures  
 30 being proposed and because changed operations upstream and within the water user service areas  
 31 do not increase soil hazards in those areas. Both quantitative and qualitative methods were used to  
 32 evaluate these effects, depending on the availability of data. Conservation and restoration activities  
 33 were evaluated on a programmatic level using qualitative methods to identify potential soil-related  
 34 effects.

35 The impact analysis for soils was performed using information on near-surface soils (i.e., the upper  
 36 5 feet) and maps of peat thickness, soil organic matter content, and topography. The emphasis in the  
 37 impact analysis was to identify where soils could be adversely affected by erosion or by excavation,  
 38 overcovering, or inundation. The impact analysis also focused on identifying those soil  
 39 characteristics that could pose a potentially serious threat to the integrity of structures. The analysis  
 40 determines whether these conditions and associated risks can be reduced to an acceptable level by  
 41 conformity with existing codes and standards, and by the application of accepted, proven

1 engineering design and construction practices. A range of specific design and construction  
2 approaches are normally available to address a specific soil condition. For example, the potential for  
3 expansive soils to affect structural integrity could be controlled by use of soil lime treatment, a post-  
4 tensioned foundation, or other measure. Irrespective of the engineering approach to be used, the  
5 same stability criteria must be met to comply with code and standard requirements. Design  
6 solutions would be guided by relevant building codes and state and federal standards for  
7 foundations, earthworks, and other project facilities.

8 The following description of the site evaluation and design process is intended to clarify how site-  
9 specific hazard conditions are identified and eventually fully addressed through data collection,  
10 analysis and compliance with existing design and construction requirements.

11 As the proposed project was developed by DWR in anticipation of agency and public review through  
12 the NEPA/CEQA process, the agency compiled information on the geotechnical characteristics of the  
13 near-surface soils for the project alternatives. This soil information has been compiled under the  
14 supervision of professional engineers and documented in the project's geotechnical data reports  
15 (California Department of Water Resources 2010f, 2010g, 2011) and conceptual engineering reports  
16 (CERs) (California Department of Water Resources 2009a, 2009b, 2010a, 2010b, 2010c, 2010d,  
17 2010e). The latter reports are not final, site-specific design-level reports but instead describe  
18 project alternative construction feasibility by identifying site conditions and constraints.

19 The NEPA/CEQA analysis for the project alternatives includes review of soil survey data, the  
20 geotechnical data reports, and CERs as well as other information to determine if potential adverse  
21 effects caused by soil hazards can be overcome by applying accepted and proven engineering design  
22 and construction practices.

23 The effects of soil hazards would be substantial if the risk of potential loss, injury or death cannot be  
24 addressed by an engineering solution. Significance thresholds do not require the elimination of the  
25 potential for structural damage from a construction site's soil conditions. Rather, the criteria require  
26 evaluation of whether site conditions can be overcome through engineering design solutions that  
27 reduce the substantial risk of people and structures to loss, injury or death. The codes and design  
28 standards ensure that foundations, earthwork, and other facilities are designed and constructed  
29 such that, while they may sustain damage caused by a soil hazards, the substantial risk of loss, injury  
30 or death due to structural failure or collapse is reduced to an acceptable level. The NEPA/CEQA  
31 evaluation determines whether conformity with existing federal, state, and local standards,  
32 guidelines, codes, ordinances, and other regulations and application of accepted and proven  
33 engineering design and construction practices would reduce the substantial risk of people and  
34 structures to loss, injury or death to acceptable level.

35 Design-level detail will not be fully developed until after the NEPA/CEQA process is complete. After  
36 NEPA/CEQA document certification and project approval, the final design will be developed, which  
37 will require additional geotechnical studies to identify additional site-specific conditions that the  
38 final engineering design will meet. These soil investigations will characterize, log, and test soils on a  
39 site-specific basis to determine their load-bearing capacity, shrink-swell capacity, corrosivity, and  
40 other parameters. The soil investigations and the recommendations that are derived from them will  
41 be presented in a geotechnical report by a California registered civil engineer or a California  
42 certified engineering geologist. The report will be prepared according to *Guidelines for Evaluating  
43 and Mitigating Seismic Hazards in California* (California Geological Survey 2008) and reviewed and  
44 approved by the project proponents.

1 This final design would meet the guidelines and standards included in Appendix 3B, *Environmental*  
 2 *Commitments, AMMs, and CMs*, for all the project components. In the present case, these components  
 3 include aspects of the canals, pipelines, intake structures, levees, temporary and permanent access  
 4 roads, borrow areas, and spoil storage sites.

5 Based on the final geotechnical report and code and standards requirements, the final design of  
 6 levees, foundations, and related engineering structures will be developed by a California registered  
 7 civil engineer or a California certified engineering geologist with participation and review by DWR,  
 8 and in some cases county building departments, to ensure that design standards are met. The design  
 9 and construction specifications would then be incorporated into the construction contract for  
 10 implementation. During project construction, new or unanticipated soil conditions may be found  
 11 that are different from those described in the detailed, site-specific geotechnical report that guides  
 12 the final design. Under these circumstances, the soil condition will be evaluated and an appropriate  
 13 method to meet the design specification will be determined by the project engineer and approved by  
 14 DWR.

### 15 **10.3.1.1 Impact Mechanisms**

#### 16 **Accelerated Water and Wind Erosion**

17 Soil disturbance (e.g., grading, excavating, tunneling, borrow material excavating, and stockpiling)  
 18 during construction can lead to soil loss from water and wind erosion unless adequate management  
 19 practices are implemented to control erosion and sediment transport.

#### 20 **Loss of Topsoil**

21 Loss of topsoil as a resource can be caused by excavation, overcovering, or inundation. The  
 22 condition (quality) and productivity of the topsoil can be degraded as a result of construction  
 23 activities, such as compaction.

#### 24 **Subsidence and Compressibility**

25 Soil subsidence could result from a variety of factors, but primarily from oxidation of soil organic  
 26 matter and primarily only in high organic matter content soils (i.e., peats and mucks). Subsidence  
 27 can cause damage or failure of structures, utilities, and levees.

28 Soil compression/settlement can occur when the soil is under load. Structures constructed on soils  
 29 with poor load bearing capability can be damaged or fail when part or all of the structure settles  
 30 under load. Utilities connecting to the subsided or settled facilities can also be damaged.

#### 31 **Soil Expansion and Contraction**

32 Soils with a high content of expansive clay are subject to shrinking and swelling with seasonal  
 33 changes in moisture content. Clay soils below the depth of the permanent water table are not subject  
 34 to shrinking and swelling. Soil expansion and contraction can cause damage or failure of  
 35 foundations, utilities, and pavements.

#### 36 **Soil Corrosion**

37 Soil may corrode uncoated steel; the hazard of corrosion is controlled by soil water content, texture,  
 38 acidity, and content of soluble salts. Soil may also corrode concrete; the hazard of corrosion is

1 controlled by soil texture, acidity, and the amount of sodium or magnesium sulfate and sodium  
 2 chloride present in the soil. Corrosion can cause failure of pipelines and other in-ground utilities,  
 3 culverts, foundations, footings, and other facilities containing concrete and steel in contact with the  
 4 soil.

### 5 **10.3.1.2 Construction Activity Effects**

6 The analysis of soil-related effects during construction is related to wind and water erosion hazard.  
 7 NRCS soil survey and geographic information system (GIS) data (i.e., SSURGO data [Natural  
 8 Resources Conservation Service 2010a]) for each county in the Plan Area were used to identify and  
 9 map variations in the soil's water and wind erosion hazard.

10 Because planned restoration activities under the BDCP alternatives are programmatic in nature, this  
 11 analysis took a programmatic approach to addressing impacts on soils at the restoration  
 12 opportunity areas (ROAs). Soils in the ROAs were evaluated to determine their susceptibility to  
 13 wind and water erosion during grading and other types of ground disturbance that would be  
 14 expected during restoration construction activities.

### 15 **10.3.1.3 Facility Effects**

16 The analysis methods for soil-related effects on facilities are based on the following.

#### 17 **Soil Expansion and Corrosion**

18 NRCS soil surveys and GIS data (i.e., SSURGO data [Natural Resources Conservation Service 2010a])  
 19 for each county in the Plan Area were used to identify and map variations in shrink-swell potential  
 20 and in corrosivity to concrete and uncoated steel. This information was used to identify areas where  
 21 such soils could adversely affect public safety and the structural integrity of proposed facilities, and  
 22 consequently, where specific design measures for facilities would need to be implemented to avoid  
 23 these effects.

#### 24 **Subsidence Potential**

25 GIS and NRCS SSURGO data on the organic matter content of the near-surface soils, a map of the  
 26 thickness of peat soils, and an elevation map were used to identify areas that are subject to  
 27 continued subsidence.

#### 28 **Soil Compressibility**

29 Soil compressibility/load bearing capability was assessed using NRCS soil surveys and GIS data (i.e.,  
 30 SSURGO data [Natural Resources Conservation Service 2010a]) for each county in the Plan Area.

### 31 **10.3.1.4 Operational Component Effects**

32 The potential effect on channel bank scour from changes in flow regimes was evaluated by  
 33 reviewing the current and expected operations channel flow rates.

34 The analysis of channel bank scour effects for the operational components relied mostly on the  
 35 results from Chapter 6, *Surface Water*—in particular, the expected change in channel flow rates (feet  
 36 per second). Soil erosion hazard as shown in Figure 10-5 was not used in the analysis because no

1 data are available to describe the erodibility of the soils that could be affected by the operational  
 2 components (i.e., those soils along channel banks). The soils along the channel banks may consist of  
 3 fill material (from levees) and may be partly or fully protected by riprap; these conditions make the  
 4 NRCS data on erosion hazard not applicable to assessing the hazard of channel bank erosion,  
 5 because the NRCS soil mapping upon which erosion hazard is based does not account for the local  
 6 soil characteristics and bank protection measures that may be present along the channel banks.

### 7 **10.3.2 Determination of Effects**

8 Effects on soils were considered adverse under NEPA and significant under CEQA if implementation  
 9 of an alternative would result in any of the following.

- 10
- 11 • Cause substantial soil erosion.
    - 12 ○ For purposes of this analysis, “substantial soil erosion” would occur when effluent
    - 13 monitoring indicates that the daily average turbidity of site runoff exceeds 250
    - 14 nephelometric turbidity units (NTUs). This measurement is in accordance with Construction
    - 15 General Permit (CGP) numeric action level requirements under site-specific SWPPPs.
    - 16 Regarding wind-caused erosion, Sacramento Metropolitan Air Quality Management
    - 17 Districts’ CEQA guidelines require fugitive dust control practices related to the potential for
    - 18 creating wind-borne dust. The best management practices outlined include suspending
    - 19 excavation, grading, and/or demolition activity when wind speeds exceed 20 mph. (These
    - 20 guidelines are sufficient to address dust control requirements of all the air quality
    - 21 management districts in the Plan Area.) Accordingly, continuing those activities when wind
    - 22 speed exceeds 20 mph would constitute an adverse effect with respect to wind erosion.
    - 23 (Neither substantial water erosion nor wind erosion effects are likely to occur because
    - 24 project proponents would comply with all CGP, SWPPP, air quality management district, and
    - 25 other permit requirements to stop work or adjust BMPs to remain within applicable
    - 26 thresholds.)
  - 27 • Cause a substantial loss of topsoil.
    - 28 ○ For purposes of this analysis, “substantial loss of topsoil” would be caused by activities that
    - 29 would overcover, inundate, or remove topsoil such that the loss is irreversible, for example,
    - 30 by paving over it.
  - 31 • Subject people, structures, or property to soil instability caused by soil subsidence.
    - 32 ○ For purposes of this analysis, an adverse effect (NEPA) or significant impact (CEQA) would
    - 33 exist if project construction or operation created an increased likelihood for the potential for
    - 34 loss, injury or death related to soil instability caused by soil subsidence which cannot be
    - 35 offset by an engineering solution that reduces the risk to people and structures to an
    - 36 acceptable level. “Engineering solution” means conformity with all applicable government
    - 37 and professional standards, codes, ordinances, and regulations for site assessment, design
    - 38 and construction practices, including the American Society of Civil Engineers Minimum
    - 39 Design Loads for Buildings and Other Structures, CBC, and U.S. Army Corps of Engineers
    - 40 (USACE) Design and Construction of Levees (see Section 10.3.1.1, *Impact Mechanisms*).
  - 41 • Create substantial risks to life or property as a result of being located on expansive, corrosive,  
 and compressible soil (as defined in Table 18-1-B of the Uniform Building Code [1994]).

- 1           ○ For purposes of this analysis, an adverse effect (NEPA) or significant impact (CEQA) would  
 2 exist if project construction or operation created an increased likelihood for the potential for  
 3 loss, injury or death related to location on expansive, corrosive, and compressible soils  
 4 which cannot be offset by an engineering solution that reduces the risk to people and  
 5 structures to an acceptable level. “Engineering solution” means conformity with all  
 6 applicable government and professional standards, codes, ordinances, and regulations for  
 7 site assessment, design and construction practices, including the DWR Interim Levee Design  
 8 Criteria for Urban and Urbanizing Area State Federal Project Levees; USACE Engineering  
 9 and Design—Earthquake Design and Evaluation for Civil Works Projects; USACE Design and  
 10 Construction of Levees; American Society of Civil Engineers Minimum Design Loads for  
 11 Buildings and Other Structures; and CBC requirements (see Section 10.3.1.1, *Impact*  
 12 *Mechanisms*).
- 13           ● Be located on a geologic unit or soil that is unstable or that would become unstable as a result of  
 14 the project and potentially result in an onsite or offsite landslide, lateral spreading, subsidence,  
 15 liquefaction, or collapse.
- 16           ○ For purposes of this analysis, any “geologic unit or soil that is unstable or would become  
 17 unstable” would be those identified as such in Appendix 10B, *Natural Resources*  
 18 *Conservation Service Soil Suitability Ratings*, which provides suitability and limitation ratings  
 19 by the Natural Resources Conservation Service for various engineering uses. This chapter  
 20 primarily addresses risks due to subsidence. Other causes of instability induced by  
 21 earthquake or construction are assessed in Chapter 9, *Geology and Seismicity*. An adverse  
 22 effect (NEPA) or significant impact (CEQA) would exist if the potential for loss, injury or  
 23 death related to soil instability cannot be offset by an engineering solution that reduces the  
 24 risk to people and structures to an acceptable level. “Engineering solution” means  
 25 conformity with all applicable government and professional standards, codes, ordinances,  
 26 and regulations for site assessment, design and construction practices, including the  
 27 American Society of Civil Engineers Minimum Design Loads for Buildings and Other  
 28 Structures, CBC, and USACE Design and Construction of Levees (see Section 10.3.1.1, *Impact*  
 29 *Mechanisms*).
- 30           ● Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater  
 31 disposal systems in areas where sewers are not available for the disposal of wastewater.

32 The effects criteria described above are carried forward for analysis in this chapter with the  
 33 exception of the criteria related to soils capable of adequately supporting the use of septic tanks or  
 34 alternative wastewater disposal systems. While pumping plants would include permanent restroom  
 35 facilities, which would be equipped with a sanitary gravity drainage leading to a wastewater holding  
 36 tank, effects are not anticipated to result from the facilities that would be constructed for the project  
 37 because these facilities would be minor (constructed to serve only small operations and  
 38 maintenance crews). Additionally, such facilities would require proper testing and permits from  
 39 regulatory agencies, which would reduce any adverse environmental effects to less than significant.

### 40 **10.3.2.1 Compatibility with Plans and Policies**

41 Constructing the proposed water conveyance facility (CM1) and implementing CM2–CM21 could  
 42 potentially result in incompatibilities with plans and policies related to soils. Section 10.2,  
 43 *Regulatory Setting*, provides an overview of federal, state, regional and agency-specific plans and  
 44 policies applicable to public services and utilities. This section summarizes ways in which the

1 proposed project is compatible or incompatible with those plans and policies. Potential  
 2 incompatibilities with local plans or policies, or with those not binding on the state or federal  
 3 governments, do not necessarily translate into adverse environmental effects under NEPA or CEQA.  
 4 Even where an incompatibility “on paper” exists, it does not by itself constitute an adverse physical  
 5 effect on the environment, but rather may indicate the potential for a proposed activity to have a  
 6 physical effect on the environment. The relationship between plans, policies, and regulations and  
 7 impacts on the physical environment is discussed in Chapter 13, *Land Use*, Section 13.2.3.

8 The construction and operation of all action alternatives would comply with all regulations related  
 9 to construction run-off and sedimentation, such as Section 402 of the Clean Water Act and Porter-  
 10 Cologne Water Pollution Control Act. Both of these are enforced by the State Water Board. As  
 11 discussed below, the proposed project will seek coverage under the General Permit for Storm Water  
 12 Discharges Associated with Construction and Land Disturbance Activities in accordance with State  
 13 Water Board Order No. 2009-0009-DWQ. In order to obtain coverage under the General Permit from  
 14 the State Water Board, the project proponents must submit a risk level assessment and a SWPPP,  
 15 which will include many of the BMPs required to further the aims of various state and regional  
 16 policies and plans.

### 17 **10.3.3 Effects and Mitigation Approaches**

#### 18 **10.3.3.1 No Action Alternative**

19 The No Action Alternative is the future condition at the year 2060 that would occur if none of the  
 20 action alternatives was approved and if no change from current management direction or the level  
 21 of management intensity occurred. The No Action Alternative includes projects and programs with  
 22 defined management or operational plans, including facilities under construction as of February 13,  
 23 2009, because those actions would be consistent with the continuation of existing management  
 24 direction or level of management for plans, policies, and operations by the project proponents and  
 25 other agencies. The No Action Alternative assumptions also include projects and programs that  
 26 received approvals and permits in 2009 to remain consistent with existing management direction. A  
 27 complete list and description of programs and plans considered under the No Action Alternative is  
 28 provided in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative,*  
 29 *and Cumulative Impact Conditions*. Under the No Action Alternative, the condition of soils would  
 30 continue largely as they have under Existing Conditions.

#### 31 **Accelerated Soil Erosion**

32 Under the No Action Alternative, it is anticipated that current rates of water and wind erosion would  
 33 continue in the future. Currently, erosion (primarily wind erosion) is largely a result of agricultural  
 34 practices. Additionally, accelerated water and wind erosion could take place in the Delta and  
 35 statewide as a result of implementation of numerous levee stabilization, dredge spoil disposal, and  
 36 habitat restoration projects. However, federal, state, and local regulations, codes, and permitting  
 37 programs would continue to require implementation of measures to prevent nonagricultural  
 38 accelerated erosion and sediment transport associated with construction.

## 1 **Loss of Topsoil**

2 The loss of topsoil as a result of excavation, overcovering, and inundation would continue in the  
 3 Delta and statewide under the No Action Alternative as a result of numerous land development and  
 4 habitat restoration projects. The land development projects would tend to cause loss of topsoil as a  
 5 result of excavation and overcovering, particularly by foundations, pavements, and other  
 6 impervious surfaces. Such losses of topsoil are effectively irreversible. In contrast, the loss of topsoil  
 7 associated with habitat restoration projects typically results from overcovering, such as placement  
 8 of dredge spoils in subsided areas, and inundation, such as the introduction of seasonal or perennial  
 9 water into nonwetland environments to establish seasonal wetlands or freshwater or tidal marshes.  
 10 In this latter scenario, the topsoil is effectively “lost” for as long as the area is inundated, but would  
 11 remain available for cropping or for livestock grazing if water management changes in the future.  
 12 Finally, most dredging projects have a spoil disposal/placement component, typically on land (as  
 13 opposed to in water). The disposal would therefore entail overcovering of and effective loss of  
 14 topsoil.

## 15 **Subsidence**

16 Land subsidence in the Delta and the Suisun Marsh would continue to varying degrees under the No  
 17 Action Alternative. Ingebritsen et al. (2000) indicated that long-term average rates of subsidence in  
 18 the Delta are 1–3 inches per year. It is anticipated that this rate of subsidence would continue.  
 19 Ongoing subsidence would result from biological oxidation of organic soils, thereby continuing to  
 20 threaten levee stability, which in turn affects water quality and water supply because levee failure  
 21 could cause saline water to enter the Delta. However, the rate of subsidence in the future may be  
 22 slower than the current rate as the organic soils become more consolidated over time.

23 Several projects are now underway that would have a beneficial effect on subsidence, some with the  
 24 explicit goal of controlling or reversing subsidence. These entail inundating areas underlain by peat  
 25 soils to restore or create tidal marsh habitat. The inundation would tend to reduce biological  
 26 oxidation rates of the soil organic matter. Depending on the vegetation type, soil organic matter  
 27 would accumulate over time in the restored marsh habitats, thereby raising the elevation of the  
 28 area. Although these projects would tend to control or reverse subsidence only on the islands at  
 29 which they are implemented, they would benefit the Delta as a whole by promoting the “blocking”  
 30 effect of Delta islands on sea water intrusion in the Delta. The subsidence control/reversal projects  
 31 would therefore help to maintain water quality and water supply in the Delta in the event of  
 32 widespread levee failure.

## 33 **Soil Expansion, Corrosion, and Compression**

34 Ongoing and reasonably foreseeable future projects in the Plan Area are likely to encounter  
 35 expansive, corrosive, and compressible soils. However, federal and state design guidelines and  
 36 building codes would continue to require that the facilities constructed as part of these projects  
 37 incorporate design measures to avoid the adverse effects of such soils.

## 38 **Ongoing Plans, Policies, and Programs**

39 The programs, plans, and projects included under the No Action Alternative are summarized in  
 40 Table 10-4, along with their anticipated effects on soils.

1 **Table 10-4. Effects on Soils from the Plans, Policies, and Programs for the No Action Alternative**

| Agency  | Program/Project   | Status                       | Description of Program/Project   | Effects on Soils  |
|---|---|------------------------------|--|---|
| California Department of Water Resources                    | Mayberry Farms Subsidence Reversal and Carbon Sequestration Project | Completed October 2010       | Permanently flooded a 308-acre parcel of DWR owned land (Hunting Club leased) and restored 274 acres of palustrine emergent wetlands within Sherman Island to create permanent wetlands and to monitor waterfowl, water quality, and greenhouse gases. | Reduced subsidence over approximately 308 acres and inundation of topsoil over approximately 274 acres. |
| DWR   | Dutch Slough Tidal Marsh Restoration Project                        | Planning phase               | Wetland and upland habitat restoration in area used for agriculture.   | Inundation and overcovering (by dredge spoils) of topsoil over much of 1,166-acre site.                 |
| Freeport Regional Water Authority and Bureau of Reclamation | Freeport Regional Water Project                                     | Completed late 2010          | Project included 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.  | Loss of approximately 50–70 acres of topsoil from excavation and overcovering.                          |
| Reclamation District 2093                                   | Liberty Island Conservation Bank                                    | Completed 2011               | This project included restoration of inaccessible, flood prone land to wildlife habitat.   | Inundation of approximately 186 acres of topsoil.   |
| City of Stockton  | Delta Water Supply Project (Phase 1)                                | 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.                   | Loss of 106 acres of topsoil from excavation and overcovering.  |
| DWR   | Delta Levees Flood Protection Program                               | Ongoing                      | Levee rehabilitation projects in the Delta.  | Unknown but probably small acreage of overcovering of topsoil.  |
| USACE   | Suisun Channel (Slough) Operations and Maintenance Project          | Ongoing                      | Maintenance dredging of an entrance channel in Suisun Bay, with turning basin.   | Unknown acreage of overcovering of topsoil from dredge material disposal.                               |
| DWR   | Central Valley Flood Management Planning Program                    | Planning phase               | Among other management actions, involves levee raising and construction of new levees for flood control purposes.  | Unknown acreage of overcovering of topsoil from levee earthwork.  |

| Agency                                   | Program/Project   | Status   | Description of Program/Project  | Effects on Soils  |
|--|---|--|---|---|
| Bureau of Reclamation                    | Delta-Mendota Canal/California Aqueduct Intertie            | Anticipated completion by 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.  | Loss of approximately 2 acres of topsoil from excavation and overcovering.  |
| California Department of Water Resources | North Delta Flood Control and Ecosystem Restoration Project | Final EIR certified and Notice of Determination filed in 2010. | Project is intended to improve flood management and provide ecosystem benefits in the North Delta area through actions such as construction of setback levees and configuration of flood bypass areas to create quality habitat for species of concern. These actions are focused on McCormack-Williamson Tract and Staten Island. The purpose of the Project is to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes. | Unknown but probably significant acreage of overcovering of topsoil from tidal inundation, excavation and overcovering.                             |
| NMFS/USFWS                               | 2008 and 2009 Biological Opinion                            | Ongoing  | The Biological Opinions issued by NMFS and USFWS establish certain RPAs and RPMs to be implemented. Some of the RPAs require habitat restoration which may require changes to existing levees and channel improvements.   | RPAs requiring habitat restoration may result in up to 8,000 acres of inundated topsoil and potential overcovering of topsoil from levee earthwork. |

1

2 In total, the plans and programs would result in the loss of at least 3,618 acres of topsoil from

3 overcovering or inundation. Because of the amount of topsoil that would be lost under the No Action

4 Alternative, these plans, policies, and programs would be deemed to have direct and adverse effects

5 on topsoil loss in the Delta.

6 Subsidence would be controlled or reversed on approximately 308 acres, resulting in a beneficial

7 effect.

8 **CEQA Conclusion:** In total, the plans and programs under the No Action Alternative (see Table 10-4

9 and Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and*

10 *Cumulative Impact Conditions*) would result in the loss of at least 3,618 acres of topsoil from

11 overcovering or inundation between the present and 2060. This would constitute a significant

12 impact. Subsidence would be controlled or reversed on approximately 308 acres, resulting in a

13 beneficial impact.

### 10.3.3.2 Alternative 1A—Dual Conveyance with Pipeline/Tunnel and Intakes 1–5 (15,000 cfs; Operational Scenario A)

#### Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities

Construction of water conveyance facilities would involve vegetation removal, constructing building pads and levees, excavation, overexcavation for facility foundations, surface grading, trenching, road construction, spoil and reusable tunnel material (RTM) storage, soil stockpiling, and other activities over approximately 7,500 acres during the course of constructing the facilities. Vegetation would be removed (via grubbing and clearing) and grading and other earthwork would be conducted at the intakes, pumping plants, the intermediate forebay, the Byron Tract Forebay, canal and gates between the Byron Tract Forebay tunnel shafts and the approach canal to the Banks Pumping Plant, borrow areas, RTM and spoil storage areas, setback and transition levees, sedimentation basins, solids handling facilities, transition structures, surge shafts and towers, substations, transmission line footings, access roads, concrete batch plants, fuel stations, bridge abutments, barge unloading facilities, and laydown areas. Some of the work would be conducted in agricultural areas that are fallow at the time. Some of the earthwork activities may also result in steepening of slopes and soil compaction, particularly for the embankments constructed for the intermediate forebay and the Byron Tract Forebay. These conditions tend to result in increased runoff rates, degradation of soil structure, and reduced soil infiltration capacity, all of which could cause accelerated erosion, resulting in loss of topsoil.

#### *Water Erosion*

The excavation, grading, and other soil disturbances described above that are conducted in gently sloping to level areas, such as the interiors of Delta islands, are expected to experience little or no accelerated water erosion because of the lack of runoff energy to entrain and transport soil particles. Any soil that is eroded within island interiors would tend to remain on the island, provided that existing or project levees are in place to serve as barriers from keeping the eroded soil (i.e., sediment) from entering receiving waters (Figure 10-5).

In contrast, graded and otherwise disturbed tops and sideslopes of existing and project levees and embankments are of greater concern for accelerated water erosion because of their steep gradients. Although soil eroded from the landside of levees would be deposited on the island interiors, soil eroded from the disturbed top and water side of levees could reach adjoining waterways. Soil eroded from natural slopes in upland environments could also reach receiving waters.

#### *Wind Erosion*

Most of the primary work areas that would involve extensive soil disturbance (i.e., staging areas, borrow areas, and intakes) within the Alternative 1A footprint are underlain by soils with a moderate or high susceptibility to wind erosion (Natural Resources Conservation Service 2010a) (Figure 10-6). Of the primary areas that would be disturbed, only the proposed borrow/spoil area southwest of Clifton Court Forebay and the Byron Tract Forebay generally have a low wind erosion hazard.

Construction activities (e.g., excavation, filling, grading, and vehicle traffic on unimproved roads) that could lead to accelerated wind erosion are generally the same as those for water erosion. These activities may result in vegetation removal and degradation of soil structure, both of which would

1 make the soil much more subject to wind erosion. Removal of vegetation cover and grading increase  
2 exposure to wind at the surface and obliterate the binding effect of plant roots on soil aggregates.  
3 These effects make the soil particles much more subject to entrainment by wind. However, most of  
4 the areas that would be extensively disturbed by construction activities are already routinely  
5 disturbed by agricultural activities, such from disking and harrowing. These activities would be  
6 associated with construction of the pumping plants, the intermediate forebay, most of the Byron  
7 Tract Forebay, borrow areas, RTM and spoil storage areas, sedimentation basins, solids handling  
8 facilities, substations, access roads, concrete batch plants, and laydown areas. Consequently, with  
9 the exception of loading and transporting of soil material to storage areas, the disturbance that  
10 would result from constructing the conveyance facilities in many areas would not substantially  
11 depart from the existing condition, provided that the length of time that the soil is left exposed  
12 during the year does not change compared to that associated with agricultural operations. Because  
13 the SWPPPs prepared for the various components of the project will be required to prescribe  
14 ongoing best management practices to control wind erosion (such as temporary seeding), the  
15 amount of time that the soil would be exposed during construction should not significantly differ  
16 from the existing condition.

17 Unlike water erosion, the potential adverse effects of wind erosion are generally not dependent on  
18 slope gradient and location relative to levees or water. Without proper management, the wind-  
19 eroded soil particles can be transported great distances.

20 Excavation of soil from borrow areas and transport of soil material to spoil storage areas would  
21 potentially subject soils to wind erosion. It is likely that approximately 8 million cubic yards of peat  
22 soil material would be disposed of as spoils; this material would be especially susceptible to wind  
23 erosion while being loaded onto trucks, transported, unloaded, and distributed.

24 **NEPA Effects:** These potential effects could be substantial because they could cause substantial  
25 accelerated erosion. However, as described in section 10.3.1, *Methods for Analysis*, and Appendix 3B,  
26 *Environmental Commitments, AMMs, and CMs*, DWR would be required to obtain coverage under the  
27 General Permit for Construction and Land Disturbance Activities, necessitating the preparation of a  
28 SWPPP and an erosion control plan. Many SWPPPs and erosion control plans are expected to be  
29 prepared for the project, with a given SWPPP and erosion control plan prepared for an individual  
30 component (e.g., one intake) or groups of component (e.g., all the intakes), depending on the manner  
31 in which the work is contracted. DWR would be responsible for preparing and implementing a  
32 SWPPP and erosion control plan as portions of the construction are contracted out and applications  
33 are made to the State Water Board for coverage under the General Permit.

34 The General Permit requires that SWPPPs be prepared by a Qualified SWPPP Developer (QSD) and  
35 implemented under the supervision of a Qualified SWPPP Practitioner (QSP). As part of the  
36 procedure to gain coverage under the General Permit, the QSD would determine the Risk Level (1, 2,  
37 or 3) of the project site, which involves an evaluation of the site's *Sediment Risk* and *Receiving Water*  
38 *Risk*. *Sediment Risk* is based on the tons per acre per year of sediment that the site could generate in  
39 the absence of erosion and sediment control BMPs. *Receiving Water Risk* is an assessment of  
40 whether the project site is in a sediment-sensitive watershed, such as those designated by the State  
41 Water Board as being impaired for sediment under Clean Water Act Section 303(d). Much of the  
42 northern half of the Plan Area is in a sediment-sensitive watershed; such areas would likely be Risk  
43 Level 2. The remaining areas, generally southwest of the San Joaquin River, are not in a sediment-  
44 sensitive watershed.

1 The results of the Risk Level determination partly drive the contents of the SWPPP. In accordance  
 2 with the General Permit, the SWPPP would describe site topographic, soil, and hydrologic  
 3 characteristics; construction activities and a project construction schedule; construction materials  
 4 to be used and other potential sources of pollutants at the project site; potential non-stormwater  
 5 discharges (e.g., trench dewatering); erosion and sediment control, non-stormwater, and  
 6 “housekeeping” BMPs to be implemented; a BMP implementation schedule; a site and BMP  
 7 inspection schedule; and ongoing personnel training requirements. The SWPPPs would also specify  
 8 the forms and records that must be uploaded to the State Water Board’s online Stormwater Multiple  
 9 Application and Report Tracking System (SMARTS), such as quarterly non-stormwater inspection  
 10 and annual compliance reports. In those parts of the Plan Area that are determined to be Risk Level  
 11 2 or 3, water sampling for pH and turbidity would be required; the SWPPP would specify sampling  
 12 locations and schedule, sample collection and analysis procedures, and recordkeeping and reporting  
 13 protocols.

14 The QSD for the SWPPPs would prescribe BMPs that are tailored to site conditions and project  
 15 component characteristics. Partly because the potential adverse effect on receiving waters depends  
 16 on location of a work area relative to a waterway, the BMPs would be site-specific, such that those  
 17 applied to level island-interior sites (e.g., RTM storage areas) would be different than those applied  
 18 to water-side levee conditions (e.g., intakes).

19 All SWPPPs, irrespective of the site and project characteristics, are likely to contain the following  
 20 BMPs.

- 21 ● Preservation of existing vegetation.
- 22 ● Perimeter control.
- 23 ● Fiber roll and/or silt fence sediment barriers.
- 24 ● Watering to control dust entrainment.
- 25 ● Tracking control and “housekeeping” measures for equipment refueling and maintenance.
- 26 ● Solid waste management.

27 Most sites would require temporary and permanent seeding and mulching. Sites that involve  
 28 disturbance or construction of steep slopes may require installation of erosion control blankets or  
 29 rock slope protection (e.g., setback levees at intakes). Turbidity curtains would be required for in-  
 30 water work. Excavations that will require dewatering (such as for underground utilities and  
 31 footings) will require proper storage of the water, such as land application or filtration. Soil and  
 32 material stockpiles (such as for borrow material) would require perimeter protection and covering  
 33 or watering to control wind erosion. Concrete washout facilities would be established to prevent  
 34 surface and ground water contamination. Such BMPs, if properly installed and maintained, would  
 35 ensure compliance with the pH and turbidity level requirements defined by the General Permit.

36 The QSD would be responsible for day-to-day implementation of the SWPPP, including BMP  
 37 inspections, maintenance, water quality sampling, and reporting to the State Water Board. In the  
 38 event that the water quality sampling results indicate an exceedance of allowable pH and turbidity  
 39 levels, the QSD would be required to modify the type and/or location of the BMPs by amending the  
 40 SWPPP; such modifications would be uploaded by the QSD to SMARTS.

41 Accelerated water and wind erosion as a result of construction of the proposed water conveyance  
 42 facility could occur under Alternative 1A, but proper implementation of the requisite SWPPP and

1 compliance with the General Permit (as discussed in Appendix 3B, *Environmental Commitments,*  
2 *AMMs, and CMs*) would ensure that there would not be substantial soil erosion resulting in daily site  
3 runoff turbidity in excess of 250 NTUs, and therefore, there would not be an adverse effect.

4 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
5 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
6 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
7 and reuse areas.

8 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
9 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
10 would seek coverage under the state General Permit for Construction and Land Disturbance  
11 Activities (as discussed in Appendix 3B, *Environmental Commitments, AMMs, and CMs*) necessitating  
12 the preparation of a SWPPP and an erosion control plan. Because implementation of the SWPPP and  
13 compliance with the General Permit would control accelerated soil erosion, there would not be  
14 substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs, and therefore,  
15 the impact would be less than significant. No mitigation is required.

16 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of**  
17 **Constructing the Proposed Water Conveyance Facilities**

18 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation during  
19 construction of Alternative 1A (e.g., forebays, borrow areas, tunnel shafts, levee foundations, intake  
20 facilities, pumping plants); overcovering (e.g., levees and embankments, spoil storage, pumping  
21 plants); and water inundation (e.g., sedimentation basins, solids lagoons). Table 10-5 presents an  
22 itemization of the effects on soils caused by excavation, overcovering, and inundation, based on GIS  
23 analysis by facility type. Because of the nature of the earthwork to construct many of the facilities,  
24 more than one mechanism of topsoil loss may be involved at a given facility. For example, levee  
25 construction would require both excavation to prepare the subgrade and overcovering to construct  
26 the levee. The table shows that the greatest extent of topsoil loss would be associated with  
27 overcovering, such as spoil/RTM storage areas, unless measures are undertaken to salvage the  
28 topsoil and reapply it on top of excavated borrow areas or on top of the spoils once they have been  
29 placed.

30 **Table 10-5. Approximate Topsoil Lost as a Result of Excavation, Overcovering, and Inundation**  
31 **Associated with the Proposed Water Conveyance Facility (Alternatives 1A, 2A, 6A)**

| Topsoil Loss Mechanism   | Acreage Affected |
|--|------------------|
| Excavation (forebays, intakes, shafts, borrow areas)           | 823              |
| Overcovering (spoil storage, reusable tunnel material storage) | 5,093            |
| Inundation (sedimentation basins, solids lagoons)              | 1,855            |
| Total  | 7,771            |

Note: Some mechanisms for topsoil loss entail more than one process of soil loss. For example, construction of setback levees would first require overexcavation for the levee foundation (i.e., excavation), then placement of fill material (i.e., overcovering).

32

1 Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil  
2 would not be excavated, overcovered, or inundated, such as at construction staging and laydown  
3 areas where the soil could be compacted or otherwise affected.

4 DWR has made an environmental commitment for Disposal Site Preparation which would require  
5 that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will  
6 be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,  
7 thereby lessening the effect. However, this effect would be adverse because it would result in a  
8 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
9 this effect.

10 The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and  
11 Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures  
12 for how excavated subsurface soil materials would be handled, stored, and disposed of. The  
13 commitment also specifies that temporary storage sites for spoils, RTM, and dredged material  
14 storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b  
15 supplements the environmental commitment, specifically by defining topsoil for the purposes of the  
16 mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

17 **CEQA Conclusion:** Construction of the water conveyance facilities would involve irreversible  
18 removal, overcovering, and inundation of topsoil over extensive areas, thereby resulting in a  
19 substantial loss of topsoil. Despite a commitment for Disposal Site Preparation, the impact on soils in  
20 the Plan Area would be significant. Mitigation Measures SOILS-2a and SOILS-2b would partially  
21 mitigate for these impacts, but not to a less-than-significant level because topsoil would be  
22 permanently lost over extensive areas. Therefore, this impact is considered significant and  
23 unavoidable.

#### 24 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

25 A requirement of the General Permit is to minimize the extent of soil disturbance during  
26 construction. As described in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, the  
27 SWPPPs prepared for construction activities will include a BMP that specifies the preservation  
28 of existing vegetation through installation of temporary construction markers to preclude  
29 unnecessary intrusion of heavy equipment into non-work areas. The BDCP proponents will  
30 ensure that the SWPPPs and BMPs limiting ground disturbance are included in the construction  
31 contracts and are properly executed during construction by the contractors.

32 However, the BMP specifying preservation of existing vegetation may only limit the extent of the  
33 surface area disturbed and not the area of excavated soils. Accordingly, soil-disturbing activities  
34 will be designed such that the area to be excavated, graded, or overcovered is the minimum  
35 necessary to achieve the purpose of the activity.

36 While minimizing the extent of soil disturbance will reduce the amount of topsoil lost, this will  
37 result in avoidance of this effect over only a small proportion of the total extent of the graded  
38 area that will be required to construct the habitat restoration areas, approximately 5% or less.  
39 Consequently, a large extent of topsoil will be affected even after implementation of this  
40 mitigation measure.

1           **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 2           **Topsoil Storage and Handling Plan**

3           Depending on the thickness of the topsoil<sup>3</sup> at a given construction or restoration site, up to 3 feet  
 4           of the topsoil will be salvaged from construction work areas, stockpiled, and then applied over  
 5           the surface of spoil and RTM storage areas and borrow areas to the maximum extent practicable.  
 6           Exceptions to this measure are areas smaller than 0.1 acre; areas of nonnative soil material, such  
 7           as levees, where the near-surface soil does not consist of native topsoil; where the soil would be  
 8           detrimental to plant growth; and any other areas identified by the soil scientist in evaluating  
 9           topsoil characteristics (discussed below). This mitigation measure will complement and is  
 10          related to activities recommended under Mitigation Measure AES-1c, in Chapter 17, *Aesthetics*  
 11          *and Visual Resources* as well as to the environmental commitment for Disposal and Reuse of  
 12          Spoils, RTM, and Dredged Material.

13          Topsoil excavated to install conveyance or to relocate utilities will be segregated from the  
 14          subsoil excavated from open-cut trenches, stockpiled, and reapplied to the surface after the pipe  
 15          has been installed.

16          The detailed design of the BDCP-related construction activities will incorporate an evaluation,  
 17          based on review of soil survey maps supplemented by field investigations and prepared by the  
 18          BDCP proponents that specifies the thickness of the topsoil that should be salvaged, and that  
 19          identifies areas in which no topsoil should be salvaged. The soil scientist will use the exceptions  
 20          listed above as the basis for identifying areas in which no topsoil should be salvaged. The BDCP  
 21          proponents will ensure that the evaluation is prepared by a qualified individual, that it  
 22          adequately addresses all conveyance facilities, and that areas identified for topsoil salvage are  
 23          incorporated into the project design and construction contracts and that the contractors  
 24          properly execute the salvage operations.

25          The BDCP proponents will also prepare topsoil stockpiling and handling plans for the individual  
 26          conveyance and restoration components, establishing such guidelines as the maximum  
 27          allowable thickness of soil stockpiles, temporary stockpile stabilization/revegetation measures,  
 28          and procedures for topsoil handling during salvaging and reapplication. The maximum  
 29          allowable stockpile thickness will depend on the amount of time that the stockpile needs to be in  
 30          place and is expected to range from approximately three to 10 feet. The plans will also specify  
 31          that, where practicable, the topsoil be salvaged, transported, and applied to its destination area  
 32          in one operation (i.e., without stockpiling) to minimize degradation of soil structure and the  
 33          increase in bulk density as a result of excessive handling. The stockpiling and handling plans will  
 34          also specify maximum allowable stockpile sideslope gradients, seed mixes to control wind and  
 35          water erosion, cover crop seed mixes to maintain soil organic matter and nutrient levels, and all  
 36          other measures to avoid soil degradation and soil erosional losses caused by excavating,  
 37          stockpiling, and transporting topsoil. For staging areas and similar areas in which topsoil would  
 38          not be excavated or overcovered, the stockpiling and handling plans will describe how the soil  
 39          will be decompacted or otherwise remediated after demobilization, such as the depth and  
 40          spacing of ripper shanks and number of passes made by the equipment. The intent of this

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<sup>3</sup> For the purposes of this mitigation measure, *topsoil* is defined as the O, Oi, Oe, Oa, A, Ap, A1, A2, A3, AB, and AC horizons. Three feet of topsoil was selected because it corresponds to the primary root zone depth of most crops grown in the Delta. With the exception of the Histosols (i.e., peat and muck soils), most of the topsoils in the Plan Area are less than 3 feet thick.

1 provision shall be to ensure that the soil will be returned to a similar bulk density and  
 2 productivity as it was before the site was used as a staging area as much as practicable. The  
 3 BDCP proponents will ensure that each plan is prepared by a qualified individual, that it  
 4 adequately addresses all relevant activities and facilities, and that its specifications are properly  
 5 executed during construction by the contractors.

6 Adherence to this measure will ensure that topsoil is appropriately salvaged, stockpiled, and  
 7 reapplied. Nevertheless, adverse soil quality effects can also be associated with stockpiling and  
 8 construction staging. Such effects commonly include increased bulk density, loss of soil carbon,  
 9 degraded aggregate stability, reduced growth of the mycorrhizal fungi, and reduced nutrient  
 10 cycling. Such effects may make the soil less productive after it is applied to its destination site,  
 11 compared to its pre-salvage condition. Depending on the inherent soil characteristics, the  
 12 manner in which it is handled and stockpiled, and the duration of its storage, the reapplied  
 13 topsoil may recover quickly to its original condition or require many years to return to its pre-  
 14 salvaged physical, chemical, and biological condition (Strohmayer 1999; Vogelsang and Bever  
 15 2010). Implementation will be in compliance with the SWPPP.

16 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 17 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the**  
 18 **Proposed Water Conveyance Facilities**

19 The intakes, pumping plants, and pipelines would be constructed in areas in which the near-surface  
 20 soils have approximately 2–4% organic matter content. Compared to organic soils, these mineral  
 21 soils would not be subject to appreciable subsidence caused by organic matter decomposition  
 22 because there is relatively little organic matter available to decompose. The tunnels would be  
 23 constructed at a depth below that of the peat (Figure 9-4); consequently, subsidence caused by  
 24 organic matter decomposition at tunnel depth is expected to be minimal. However, because of their  
 25 soils' higher organic matter content, without adequate engineering, the forebay levees and interior  
 26 could be subject to appreciable subsidence.

27 Damage to or collapse of the pipelines and tunnels could occur where these facilities are constructed  
 28 in soils and sediments that are subject to subsidence and differential settlement. Subsidence- or  
 29 differential sediment-induced damage or collapse of these facilities could cause a rapid release of  
 30 water to the surrounding soil, causing an interruption in water supply, and producing underground  
 31 cavities, depressions at the ground surface, and surface flooding. Facilities that have subsided would  
 32 be subject to flooding, and levees that have subsided would be subject to overtopping.

33 Damage to other conveyance facilities, such as intakes, pumping plants, transition structures, and  
 34 control structures, caused by subsidence/settlement under the facilities and consequent damage to  
 35 or failure of the facility could also occur. Facility damage or failure could cause a rapid release of  
 36 water to the surrounding area, resulting in flooding, thereby endangering people in the vicinity.

37 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 38 soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for Analysis*,  
 39 and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would be  
 40 conducted at all facilities to identify the types of soil avoidance or soil stabilization measures that  
 41 should be implemented to ensure that the facilities are constructed to withstand subsidence and  
 42 settlement and to conform to applicable state and federal standards. These studies would build upon  
 43 the geotechnical data reports (California Department of Water Resources 2010a, 2010b, 2011) and  
 44 the CERs (California Department of Water Resources 2010a, 2010b). Such standards include the

1 American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures, CBC,  
2 and USACE Design and Construction of Levees. The results of the studies, which would be conducted  
3 by a California registered civil engineer or California certified engineering geologist, would be  
4 presented in geotechnical reports. The reports would contain recommended measures to prevent  
5 subsidence. The geotechnical report will prepared in accordance with state guidelines, in particular  
6 *Guidelines for Evaluating and Mitigating Seismic Hazards in California* (California Geological Survey  
7 2008).

8 Liquid limit (i.e., the moisture content at which a soil passes from a solid to a liquid state) and  
9 organic matter content testing should be performed on soil samples collected during the site-  
10 specific field investigations to determine site-specific geotechnical properties. High organic matter  
11 content soils that are unsuitable for support of structures, roadways, and other facilities would be  
12 overexcavated and replaced with engineered fill, and the unsuitable soils disposed of offsite as spoil,  
13 as described in more detail below. Geotechnical evaluations would be conducted to identify soil  
14 materials that are suitable for engineering purposes.

15 Additional measures to address the potential adverse effects of organic soils could include  
16 construction of structural supports that extend below the depth of organic soils into underlying  
17 materials with suitable bearing strength. For example, the CER indicates that approximately 35 feet  
18 of soil would be excavated and a pile foundation supporting a common concrete mat would be  
19 required for the intake pumping plants. The piles would be 24-inches in diameter and concrete-  
20 filled, extending to 65 to 70 feet below the founding level of the plant. Piles extended to competent  
21 geologic beds beyond the weak soils would provide a solid foundation to support the pumping  
22 plants.

23 For the sedimentation basins, the CER indicates that most of the underlying soils would be  
24 excavated to a depth of 30 feet below grade and removed from the site and suitable soil material  
25 imported to the site to re-establish it to subgrade elevation. Removal of the weak soils and  
26 replacement with engineered fill using suitable soil material would provide a solid foundation for  
27 the sedimentation basins.

28 At the proposed Byron Tract Forebay, the CER specifies that because most of the soils within the  
29 footprints of the forebay and the forebay embankments have high organic matter content, they  
30 would be excavated and removed from the site. Removal of the weak soils to reach competent soils  
31 would provide a solid foundation upon which to construct the forebay and its embankment.

32 At the spillway and stilling basin for the intermediate spillway, the CER indicates that unsuitable  
33 soils would be excavated to competent material and that the spillway would incorporate water-  
34 stopped contraction joints at intervals to accommodate a degree of settlement and subsoil  
35 deformation. Removal of the weak soils to reach competent soils and providing a joint system would  
36 provide a solid foundation for the spillway and stilling basin and enable the spillway to withstand  
37 settlement and deformation without jeopardizing its integrity.

38 Certain methods and practices may be utilized during tunnel construction to help reduce and  
39 manage settlement risk. The CER indicates that the ground improvement techniques to control  
40 settlement at the shafts and tunnels may involve jet-grouting, permeation grouting, compaction  
41 grouting, or other methods that a contractor may propose. Jet-grouting involves use of high-  
42 pressure, high-velocity jets to hydraulically erode, mix and partially replace the surrounding soil  
43 with a cementitious grout slurry, thereby creating a cemented zone of high strength and low  
44 permeability around of tunnel bore. Permeation grouting involves introduction of a low-viscosity

1 grout (sodium silicate, microfine cement, acrylate or polyurethane) into the pores of the soil around  
 2 the tunnel bore, which increases the strength and cohesion of granular soils. Compaction grouting  
 3 involves injecting the soil surrounding the tunnel bore with a stiff, low slump grout under pressure,  
 4 forming a cemented mass that increases soil bearing capacity. These measures would have the effect  
 5 of better supporting the soil above the borehole and would prevent unacceptable settlement  
 6 between the borehole and the tunnel segments. Additionally, settlement monitoring points, the  
 7 number and location of which would be identified during detailed design, would be established  
 8 along the pipeline and tunnel routes during construction and the results reviewed regularly by a  
 9 professional engineer. The monitoring therefore would provide early detection of excessive  
 10 settlement such that corrective actions could be made before the integrity of the tunnel is  
 11 jeopardized.

12 Conforming to state and federal design standards would protect the integrity of the conveyance  
 13 facilities against any subsidence that takes place. As described in Section 10.3.1, *Methods for Analysis*  
 14 and in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, such design codes and standards  
 15 include the California Building Code and resource agency and professional engineering  
 16 specifications, such as the American Society of Civil Engineers *Minimum Design Loads for Buildings*  
 17 *and Other Structures*, ASCE 7-10, 2010. Conformance with these codes and standards is an  
 18 environmental commitment by DWR to safeguard the stability of cut and fill slopes and  
 19 embankments as the water conveyance features are operated. Conforming to the standards and  
 20 guidelines may necessitate such measures as excavation and removal of weak soils and replacement  
 21 with engineered fill using suitable, imported soil, construction on pilings driven into competent soil  
 22 material, and construction of facilities on cast-in-place slabs. These measures would reduce the  
 23 potential hazard of subsidence or settlement to acceptable levels by avoiding construction directly  
 24 on or otherwise stabilizing the soil material that is prone to subsidence. As a result, there would be  
 25 no adverse effect.

26 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
 27 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
 28 failure of the facility. However, DWR would be required to design and construct the facilities  
 29 according to state and federal design standards and guidelines (e.g., California Building Code,  
 30 American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures,  
 31 ASCE 7-10, 2010). Conforming to these codes would reduce the potential hazard of subsidence or  
 32 settlement to acceptable levels by avoiding construction directly on or otherwise stabilizing the soil  
 33 material that is prone to subsidence. Because these measures would reduce the potential hazard of  
 34 subsidence or settlement to meet design standards, this impact is considered less than significant.  
 35 No mitigation is required.

#### 36 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water** 37 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

38 The integrity of the water conveyance facilities, including tunnels, pipelines, intake facilities,  
 39 pumping plants, access roads and utilities, and other features, could be adversely affected by  
 40 expansive, corrosive, and compressible soils.

#### 41 **Expansive Soils**

42 Soil expansion is a concern only at soil depths that are subject to seasonal changes in moisture  
 43 content. Only a small portion of the Alternative 1A alignment possesses soils with high shrink-swell

1 potential (note areas of high linear extensibility in Figure 10-4). Most of these areas are in  
2 Sacramento (Dierssen association) and Alameda (Rincon-San Ysidro association) Counties.  
3 Proposed locations for construction features (such as tunnel intakes and their associated structures,  
4 borrow areas, spoils storage areas, RTM storage areas, and temporary access roads) are generally  
5 situated in areas of soils with low to moderate shrink-swell potential (see Figure 10-4). However, a  
6 borrow/spoils area, a temporary work area, a concrete batch plant and a fuel station location in the  
7 southern portion of the Alternative 1A alignment, south of Clifton Court Forebay and the proposed  
8 Byron Tract Forebay, may contain soils with high to very high shrink-swell potential.

9 Soils with a high shrink-swell potential (i.e., expansive soils) could damage facilities or cause the  
10 facilities to fail. For example, foundations and pavements could be cracked or shifted and pipelines  
11 could rupture.

### 12 ***Soils Corrosive to Concrete***

13 The near-surface (i.e., upper 5 feet) soil corrosivity to concrete is high throughout much of the  
14 Alternative 1A alignment. The near-surface soils at the five intake and pumping plant facilities  
15 generally have a low corrosivity to concrete. The near-surface soils at the tunnel shafts have a low to  
16 high corrosivity to concrete. Data on soil corrosivity to concrete below a depth of approximately 5  
17 feet (i.e., where pipelines, tunnels, and the deeper part of the tunnel shafts would be constructed)  
18 are not available. However, given the variability in the composition of the soils and geologic units on  
19 and within which the conveyance facilities would be constructed, corrosivity hazards are likely to  
20 range from low to high. Because soil corrosivity to concrete is high among the near-surface peat  
21 soils in the Delta, a high corrosivity is also expected to be present among the peat soils at depth. Site-  
22 specific soil investigations would need to be conducted to determine the corrosivity hazard at depth  
23 at each element of the conveyance facility. However, as described in 10.3.1, *Methods for Analysis*, and  
24 Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would be  
25 conducted at all facilities to identify site-specific soil corrosivity hazards. The resulting geotechnical  
26 report, prepared by a California registered civil engineer or a California certified engineering  
27 geologist, would describe these hazards and recommend the measures that should be implemented  
28 to ensure that the facilities are constructed to withstand corrosion and to conform to applicable  
29 state and federal standards, such as the CBC.

30 Soils that are moderately and highly corrosive to concrete may cause the concrete to degrade,  
31 thereby threatening the integrity of the facility. Degradation of concrete may cause pipelines and  
32 tunnels to leak or rupture and cause foundations to weaken.

### 33 ***Soils Corrosive to Uncoated Steel***

34 The near-surface soils along the Alternative 1A alignment generally are highly corrosive to uncoated  
35 steel. Sections of the southern end of the alignment are moderately corrosive to uncoated steel. Data  
36 on soil corrosivity to uncoated steel below a depth of approximately 5 feet (i.e., where pipelines,  
37 tunnels, and the deeper part of the tunnel shafts would be constructed) are not available. However,  
38 given the variability in the composition of the soils and geologic units on and within which the  
39 conveyance facilities would be constructed, corrosivity hazards are likely to range from low to high.  
40 Site-specific soil investigations would need to be conducted to determine the corrosivity hazard at  
41 depth at each element of the conveyance facility.

42 Soils that are moderately and highly corrosive to uncoated steel (including steel rebar embedded in  
43 concrete) may cause the concrete to degrade, threatening the integrity of these facilities.

## 1 **Compressible Soils**

2 Soils that are weakly consolidated or that have high organic matter content (such as peat or muck  
3 soils) present a risk to structures and infrastructure because of high compressibility and poor  
4 bearing capacity. Soils with high organic matter content tend to compress under load and may  
5 decrease in volume as organic matter is oxidized. Much of the Alternative 1A tunnel alignment is  
6 underlain by near-surface soils that consist of peat. The soils in the area where the intakes and their  
7 associated structures would be located have a relatively low organic matter content. Based on liquid  
8 limits reported in county soil surveys, near-surface soils in the Alternative 1A alignment vary from  
9 low to medium compressibility.

10 Damage to or collapse of the pipelines, intakes, pumping plants, transition structures, and control  
11 structures, could occur where these facilities are constructed in soils and sediments that are subject  
12 to subsidence and differential settlement. Because of compressible soils, such effects could occur at  
13 the five intakes, all the pumping plants, and the sedimentation basins. Subsidence- or differential  
14 sediment-induced damage or collapse of these facilities could cause a rapid release of water to the  
15 surrounding soil, causing an interruption in water supply and producing underground cavities,  
16 depressions at the ground surface, and surface flooding.

17 The tunnels would be constructed at a depth below the peat (Figure 9-4); therefore, subsidence  
18 caused by organic matter decomposition below the tunnels is expected to be minimal. Surface and  
19 subsurface settlement may occur during tunnel construction; however, certain methods and  
20 practices may be used during tunnel construction to help reduce and manage settlement risk.  
21 Chapter 9, *Geology and Seismicity*, discusses the risks of settlement during tunnel construction and  
22 methods to reduce the amount of settlement (Impact GEO-2).

23 Embankments that have subsided would be subject to overtopping, leading to flooding on the  
24 landside of the embankments. The embankment that would be subject to this hazard is the new  
25 Byron Tract Forebay.

26 **NEPA Effects:** Various facilities would be located on expansive, corrosive, and compressible soils.  
27 However, all facility design and construction would be executed in conformance with the CBC, which  
28 specifies measures to mitigate effects of expansive soils, corrosive soils, and soils subject to  
29 compression and subsidence. The CBC requires measures such as soil replacement, lime treatment,  
30 and post-tensioned foundations to offset expansive soils. The CBC requires such measures as using  
31 protective linings and coatings, dielectric (i.e., use of an electrical insulator polarized by an  
32 applied electric field) isolation of dissimilar materials, and active cathodic protection systems to  
33 prevent corrosion of concrete and steel.

34 Potential adverse effects of compressible soils and soils subject to subsidence could be addressed by  
35 overexcavation and replacement with engineered fill or by installation of structural supports (e.g.,  
36 pilings) to a depth below the peat where the soils have adequate load bearing strength, as required  
37 by the CBC and by USACE design standards. Geotechnical studies would be conducted at all the  
38 facilities to determine the specific measures that should be implemented to reduce these soil  
39 hazards to levels consistent with the CBC. Liquid limit and soil organic matter content testing would  
40 be performed on collected soil samples during the site-specific field investigations to determine site-  
41 specific geotechnical properties. Settlement monitoring points would be established along the route  
42 during tunnel construction and results reviewed regularly by a professional engineer.

1 The engineer would develop final engineering solutions to any hazardous condition, consistent with  
 2 the code and standards requirements of federal, state, and local oversight agencies. As described in  
 3 Section 10.3.1, *Methods for Analysis*, and in Appendix 3B, *Environmental Commitments, AMMs, and*  
 4 *CMs*, such design codes, guidelines, and standards include the California Building Code and resource  
 5 agency and professional engineering specifications, such as the DWR *Interim Levee Design Criteria*  
 6 *for Urban and Urbanizing Area State Federal Project Levees*, and USACE *Engineering and Design—*  
 7 *Earthquake Design and Evaluation for Civil Works Projects*.

8 By conforming to the CBC and other applicable design standards, potential effects associated with  
 9 expansive and corrosive soils and soils subject to compression and subsidence would be offset.  
 10 There would be no adverse effect.

11 **CEQA Conclusion:** Many of the Alternative 1A facilities would be constructed on surface soils that  
 12 are moderately or highly corrosive to concrete and uncoated steel, as well as soils that are  
 13 moderately or highly subject to compression under load. Corrosive soils could damage in-ground  
 14 facilities or shorten their service life. Compression/settlement of soils after a facility is constructed  
 15 could result in damage to or failure of the facility. Surface soils that are moderately to highly  
 16 expansive are present throughout the Alternative 1A alignment except in the central part of the  
 17 Delta, roughly between Staten Island and Bacon Island. Expansive soils could cause foundations,  
 18 underground utilities, and pavements to crack and fail. However, DWR would be required to design  
 19 and construct the facilities in conformance with state and federal design standards, guidelines, and  
 20 building codes. The CBC requires measures such as soil replacement, lime treatment, and post-  
 21 tensioned foundations to offset expansive soils. The CBC requires such measures as using protective  
 22 linings and coatings, dielectric (i.e., use of an electrical insulator polarized by an applied electric  
 23 field) isolation of dissimilar materials, and active cathodic protection systems to prevent corrosion  
 24 of concrete and steel in conformance with CBC requirements. Potential effects of compressible soils  
 25 and soils subject to subsidence could be addressed by overexcavation and replacement with  
 26 engineered fill or by installation of structural supports (e.g., pilings) to a depth below the peat where  
 27 the soils have adequate load bearing strength, as required by the CBC and by USACE design  
 28 standards. Conforming to these codes and standards (Appendix 3B, *Environmental Commitments,*  
 29 *AMMs, and CMs*) is an environmental commitment by DWR to ensure that potential effects  
 30 associated with expansive and corrosive soils and soils subject to compression and subsidence  
 31 would be offset. Therefore, the impact would be less than significant. No mitigation is required.

### 32 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 33 **Operations**

34 River channel bank erosion/scour is a natural process. The rate of natural erosion can increase  
 35 during high flows and as a result of wave effect on banks during high wind conditions.

36 In general, changes in river flow rates associated with BDCP operations would remain within the  
 37 range that presently occurs. However, the operational components would cause changes in the tidal  
 38 flows in some Delta channels, specifically those that lead into the major habitat restoration areas  
 39 (Suisun Marsh, Cache Slough, Yolo Bypass, and South Delta ROAs). In major channels leading to the  
 40 restoration areas (e.g., Lindsey, Montezuma, and Georgiana sloughs and Middle River), tidal flow  
 41 velocities may increase by an unknown amount; any significant increases could cause some localized  
 42 accelerated erosion/scour. However, detailed hydrodynamic (tidal) modeling would be conducted  
 43 prior to any BDCP habitat restoration work in these ROA areas, and the changes in the tidal  
 44 velocities in the major channels connecting to these restoration areas would be evaluated. If there is

1 any indication that tidal velocities would be substantially increased, the restoration project design  
 2 would be modified (such as by providing additional levee breaches or by requiring dredging in  
 3 portions of the connecting channels) so that bed scour would not increase sufficiently to cause an  
 4 erosion impact. Moreover, as presently occurs and as is typical with most naturally-functioning river  
 5 channels, local erosion and deposition within the tidal habitats is expected as part of the restoration.

6 For most of the existing channels that would not be subject to tidal flow restoration, there would be  
 7 no adverse effect to tidal flow volumes and velocities. The tidal prism would increase by 5–10%, but  
 8 the intertidal (i.e., mean higher high water [MHHW] to mean lower low water [MLLW]) cross-  
 9 sectional area also would be increased such that tidal flow velocities would be reduced by 10–20%  
 10 compared to the existing condition. Consequently, no appreciable increase in scour is anticipated.

11 **NEPA Effects:** The effect would not be adverse because there would be no net increase in river flow  
 12 rates and, accordingly, no net increase in channel bank scour.

13 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 14 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 15 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 16 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
 17 effect would be to reduce the channel flow rates by 10–20% compared to Existing  
 18 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
 19 than significant. No mitigation is required.

20 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
 21 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
 22 **CM11, CM18 and CM19**

23 Implementing CM2–CM11 would include breaching, lowering, or removing levees; constructing  
 24 setback levees and cross levees or berms; raising the land elevation by excavating relatively high  
 25 areas to provide fill for subsided areas or by importing fill material; surface grading; deepening  
 26 and/or widening tidal channels; excavating new channels; modifying channel banks; and other  
 27 activities. Moreover, excavation and grading to construct facilities, access roads, and other features  
 28 would be necessary under the two conservation measures that are not associated with the ROAs  
 29 (i.e., *CM18 Conservation Hatcheries* and *CM19 Urban Stormwater Treatment*). These activities could  
 30 cause adverse effects on soil erosion rates and cause a loss of topsoil, as discussed below.

31 **Water Erosion**

32 Activities associated with conservation measures that could lead to accelerated water erosion  
 33 include clearing, grubbing, demolition, grading, and other similar disturbances. Such activities  
 34 steepen slopes and compact soil. These activities tend to degrade soil structure, reduce soil  
 35 infiltration capacity, and increase runoff rates, all of which could cause accelerated erosion and  
 36 consequent loss of topsoil.

37 Gently sloping to level areas, such as where most of the restoration actions would occur, are  
 38 expected to experience little or no accelerated water erosion because of the lack of runoff energy to  
 39 entrain and transport soil particles.

40 Graded and otherwise disturbed tops and sideslopes of existing and project levees and  
 41 embankments are of greater concern for accelerated water erosion because of their steep gradients.

1 Soil eroded from the disturbed top and water side of levees could reach adjoining waterways (if  
2 present), unless erosion and sediment control measures are implemented.

### 3 **Wind Erosion**

4 Wind erosion potential varies widely among and within the ROAs (Figure 10-6). Areas within ROAs  
5 with high wind erodibility are largely correlated with the presence of organic soils. Wind erodibility  
6 in the Suisun Marsh, Cache Slough, and South Delta ROAs ranges from high to low. The Yolo Bypass  
7 ROA generally has a low wind erodibility hazard.

8 Implementation of conservation measures (e.g., excavation, filling, grading, and vehicle traffic on  
9 unimproved roads) that could lead to accelerated wind erosion are the same as those for water  
10 erosion. These activities may entail vegetation removal and degradation of soil structure, both of  
11 which would make the soil more subject to wind erosion. Removal of vegetation cover and grading  
12 increase soil exposure at the surface and obliterate the binding effect of plant roots on soil  
13 aggregates. These effects make the soil particles more subject to entrainment by wind.

14 Unlike water erosion, the potential for wind erosion is generally not dependent on slope gradient  
15 and location, nor is the potential affected by context relative to a receiving water. Without proper  
16 management, the wind-eroded soil particles can be transported great distances.

17 The transport of soil material from the conveyance facilities for use as fill in subsided areas within  
18 the ROAs could subject the soils to wind erosion, particularly if the fill material consists of peat. The  
19 peat would be especially susceptible to wind erosion while being loaded onto trucks, transported,  
20 unloaded, and distributed onto the restoration areas.

21 **NEPA Effects:** These effects could potentially result in substantial accelerated erosion. However, as  
22 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*,  
23 *AMMs*, and *CMs*, the BDCP proponents would be required to obtain coverage under the General  
24 Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP  
25 and an erosion control plan. The General Permit requires that SWPPPs be prepared by a QSD and  
26 requires SWPPPs be implemented under the supervision of a QSP. The QSD would select erosion and  
27 sediment control BMPs such as preservation of existing vegetation, seeding, mulching, fiber roll and  
28 silt fence barriers, erosion control blankets, watering to control dust entrainment, and other  
29 measures to comply with the practices and turbidity level requirements defined by the General  
30 Permit. Partly because the potential adverse effect on receiving waters depends on location of a  
31 work area relative to a waterway, the BMPs would be site-specific. The QSP would be responsible for  
32 day-to-day implementation of the SWPPP, including BMP inspections, maintenance, water quality  
33 sampling, and reporting to the State Water Board.

34 Proper implementation of the requisite SWPPP and compliance with the General Permit would  
35 ensure that accelerated water and wind erosion associated with implementation of the conservation  
36 measures would not be an adverse effect.

37 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
38 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP  
39 proponents would seek coverage under the state General Permit for Construction and Land  
40 Disturbance Activities (as discussed in Appendix 3B, *Environmental Commitments*, *AMMs*, and *CMs*).  
41 Permit conditions would include erosion and sediment control BMPs (such as revegetation, runoff  
42 control, and sediment barriers) and compliance with water quality standards. As a result of

1 implementation of Permit conditions, the impact would be less than significant. No mitigation is  
2 required.

3 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
4 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
5 **CM2–CM11**

6 Topsoil effectively would be lost as a resource as a result of its excavation (e.g., levee foundations,  
7 water control structures); overcovering (e.g., levees, embankments, application of fill material in  
8 subsided areas); and water inundation (e.g., aquatic habitat areas).

9 **NEPA Effects:** Implementation of habitat restoration activities at the ROAs would result in  
10 excavation, overcovering, or inundation of up to approximately 77,600 acres of topsoil (this total  
11 includes areas of tidal habitat restoration, which will be periodically inundated). This effect would  
12 be adverse because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and  
13 SOILS-2b would reduce the severity of this effect.

14 **CEQA Conclusion:** Significant impacts could occur if there is loss of topsoil from excavation,  
15 overcovering, and inundation associated with restoration activities as a result of implementing the  
16 proposed conservation measures. Implementation of CM2–CM11 would involve excavation,  
17 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas,  
18 thereby resulting in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would  
19 minimize and compensate for these impacts to a degree, but not to a less-than-significant level. This  
20 impact is considered significant and unavoidable.

21 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

22 Please see Mitigation Measure SOILS-2a under Impact SOILS-2.

23 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
24 **Topsoil Storage and Handling Plan**

25 Please see Mitigation Measure SOILS-2b under Impact SOILS-2.

26 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
27 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
28 **Proposed Conservation Measures CM2–CM11**

29 With the exception of the Suisun Marsh ROA, the ROAs are not in areas of high subsidence nor where  
30 the soils have a high organic matter content (Figures 10-2 and 10-9). Consequently, only the Suisun  
31 Marsh ROA would be expected to be subject to substantial subsidence. Based on its current  
32 elevation, the Suisun Marsh ROA has not experienced significant subsidence, despite the fact that the  
33 soils are organic and of considerable thickness (Figure 10-3).

34 Damage to or failure of the habitat levees could occur, where these are constructed in soils and  
35 sediments that are subject to subsidence and differential settlement. Levee damage or failure could  
36 cause surface flooding in the vicinity.

37 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
38 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
39 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would

1 be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to  
 2 ensure that levees, berms, and other features are constructed to withstand subsidence and  
 3 settlement and to conform to applicable state and federal standards. Such standards include the  
 4 USACE Design and Construction of Levee and DWR Interim Levee Design Criteria for Urban and  
 5 Urbanizing Area State-Federal Project Levees.

6 For example, high organic matter content soils and all soils otherwise subject to subsidence that are  
 7 unsuitable for supporting levees would be overexcavated and replaced with engineered fill, and the  
 8 unsuitable soils disposed of offsite as spoils. Geotechnical evaluations will be conducted to identify  
 9 soil materials that are suitable for engineering purposes. Liquid limit and organic content testing  
 10 should be performed on collected soil samples during the site-specific field investigations to  
 11 determine site-specific geotechnical properties.

12 With construction of all levees, berms, and other conservation features designed and constructed to  
 13 withstand subsidence and settlement and through conformance with applicable state and federal  
 14 design standards, this effect would not be adverse.

15 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
 16 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 17 to or failure of the facility. However, because the BDCP proponents would be required to design and  
 18 construct the facilities according to state and federal design standards and guidelines (which may  
 19 involve, for example, replacement of the organic soil), the impact would be less than significant. No  
 20 mitigation is required.

21 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
 22 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures**  
 23 **CM2-CM11**

24 ***Expansive Soils***

25 The ROAs generally have soils with moderate or high shrink-swell potential. The ROAs with a  
 26 significant extent of highly expansive soils are the Yolo Bypass and Cache Slough ROAs (Figure 10-  
 27 4). None appears to have appreciable areas of soils with very high expansiveness.

28 Potential adverse effects of expansive soils are a concern only to structural facilities within the  
 29 ROAs, such as water control structures. Seasonal shrinking and swelling of moderately or highly  
 30 expansive soils could damage water control structures or cause them to fail, resulting in a release of  
 31 water from the structure and consequent flooding, which would cause unplanned inundation of  
 32 aquatic habitat areas.

33 ***Corrosive Soils***

34 Soils in all the ROAs possess high potential for corrosion of uncoated steel, and the Suisun Marsh  
 35 ROA and portions of the West Delta ROA possess soils with high corrosivity to concrete.

36 ***Compressible Soils***

37 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
 38 Mokelumne, and South Delta ROAs. Areas of low to medium compressibility occur in the South Delta  
 39 ROA. Silts and clays with a liquid limit less than 35% are considered to have low compressibility.  
 40 Silts and clays with a liquid limit greater than 35% and less than 50% are considered to have

1 medium compressibility and greater than 50% are considered highly compressible. Organic soils  
 2 typically have high liquid limits (greater than 50%) and are therefore considered highly  
 3 compressible.

4 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
 5 compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
 6 studies and testing would be completed prior to construction within the ROAs. The site-specific  
 7 environmental evaluation would identify specific areas where engineering soil properties, including  
 8 soil compressibility, may require special consideration during construction of specific features  
 9 within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
 10 expansive, corrosive, and/or compressible soils would prevent adverse effects.

11 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
 12 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 13 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 14 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
 15 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
 16 However, because the BDCP proponents would be required to design and construct the facilities  
 17 according to state and federal design standards, guidelines, and building codes (which may involve,  
 18 for example, soil lime stabilization, cathodic protection of steel, and soil replacement), this impact  
 19 would be considered less than significant. No mitigation is required.

### 20 **10.3.3.3 Alternative 1B—Dual Conveyance with East Alignment and** 21 **Intakes 1–5 (15,000 cfs; Operational Scenario A)**

#### 22 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil** 23 **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

24 The mechanisms of this impact are similar to those described for Alternative 1A; however,  
 25 considerably more excavation would be necessary to construct the canal along the eastern  
 26 alignment than would be necessary for tunnel boring under Alternative 1A. Construction of water  
 27 conveyance facilities would involve vegetation removal; constructing building pads, levees, canals,  
 28 and tunnel siphons; excavation; overexcavation for facility foundations; surface grading; trenching;  
 29 road construction; spoil storage; soil stockpiling; and other activities over approximately 21,500  
 30 acres during the course of constructing the facilities. Vegetation would be removed (via grubbing  
 31 and clearing) grading and other earthwork would be conducted at the intakes, pumping plants, the  
 32 proposed Byron Tract Forebay, canal and gates between the Byron Tract Forebay tunnel shafts and  
 33 the approach canal to the Banks Pumping Plant, borrow areas, RTM and spoil storage areas, setback  
 34 and transition levees, sedimentation basins, solids handling facilities, transition structures, surge  
 35 shafts and towers, substations, transmission line footings, access roads, concrete batch plants, fuel  
 36 stations, bridge abutments, barge unloading facilities, and laydown areas. Some of the work would  
 37 be conducted in areas that are fallow at the time. Excavation of a large volume of borrow material  
 38 would be required to construct the canals. Some of the earthwork activities may also result in  
 39 steepening of slopes and soil compaction, particularly for the embankments constructed for the  
 40 intermediate forebay and the proposed Byron Tract Forebay. These conditions tend to result in  
 41 increased runoff rates, degradation of soil structure, and reduced soil infiltration capacity, all of  
 42 which could cause accelerated erosion, resulting in loss of topsoil.

1       **Water Erosion**

2       The excavation, grading, and other soil disturbances described above that are conducted in gently  
3       sloping to level areas, such as the interiors of Delta islands, are expected to experience little or no  
4       accelerated water erosion because of the lack of runoff energy to entrain and transport soil particles.  
5       Any soil that is eroded within island interiors would tend to remain on the island, provided that  
6       existing or project levees are in place to serve as barriers to keep the eroded soil (i.e., sediment)  
7       from entering receiving waters (see Figure 10-5).

8       In contrast, graded and otherwise disturbed tops and sideslopes of existing and project canals,  
9       levees, and embankments are of greater concern for accelerated water erosion because of their  
10      steeper gradients. Although soil eroded from the land side of levees would be deposited on the  
11      island interiors, soil eroded from the disturbed top and water side of levees could reach adjoining  
12      waterways. Soil eroded from natural slopes in upland environments could also reach receiving  
13      waters.

14      **Wind Erosion**

15      Many of the primary work areas that would involve extensive soil disturbance (i.e., the canals,  
16      staging areas, borrow/spoil areas, and intakes) within the Alternative 1B footprint are underlain by  
17      soils with a moderate or high susceptibility to wind erosion (Natural Resources Conservation  
18      Service 2010a) (Figure 10-6). Of the primary areas that would be disturbed, the proposed  
19      borrow/spoil area southwest of Clifton Court Forebay, the proposed Byron Tract Forebay and parts  
20      of the southern half of the alignment generally have a low wind erosion hazard.

21      Construction activities (e.g., excavation, filling, grading, and vehicle traffic on unimproved roads)  
22      that could lead to accelerated wind erosion are generally the same as those for water erosion. These  
23      activities may result in vegetation removal and degradation of soil structure, both of which would  
24      make the soil much more subject to wind erosion. Removal of vegetation cover and grading increase  
25      soil exposure at the surface and obliterate the binding effect of plant roots on soil aggregates. These  
26      effects make the soil particles much more subject to entrainment by wind. However, most of the  
27      areas that would be extensively disturbed by construction activities are already routinely disturbed  
28      by agricultural activities, such from disking and harrowing. These areas are the pumping plants,  
29      most of the proposed Byron Tract Forebay, borrow areas, RTM and spoil storage areas,  
30      sedimentation basins, solids handling facilities, substations, access roads, concrete batch plants, and  
31      laydown areas. Consequently, with the exception of loading and transporting of soil material to  
32      storage areas, the disturbance that would result from constructing the conveyance facilities in many  
33      areas would not substantially depart from the existing condition, provided that the length of time  
34      that the soil is left exposed during the year does not change compared to that associated with  
35      agricultural operations. Because the SWPPPs prepared for the various components of the project  
36      will be required to prescribe ongoing best management practices to control wind erosion (such as  
37      temporary seeding), the amount of time that the soil would be exposed during construction should  
38      not significantly differ from the existing condition.

39      Unlike water erosion, the potential adverse effects of wind erosion are generally not dependent on  
40      slope gradient and location relative to levees or water. Without proper management, the wind-  
41      eroded soil particles can be transported great distances.

1 Excavation of soil from borrow areas and transport of soil material to spoil storage areas would  
 2 potentially subject soils to wind erosion. It is likely that approximately 159 million cubic yards of  
 3 peat soil material would be disposed of as spoils; this material would be especially susceptible to  
 4 wind erosion while being loaded onto trucks, transported, unloaded, and distributed.

5 **NEPA Effects:** These potential effects could be substantial because they could cause accelerated  
 6 erosion. However, as described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B,  
 7 *Environmental Commitments, AMMs, and CMs*, DWR would be required to obtain coverage under the  
 8 General Permit for Construction and Land Disturbance Activities, necessitating the preparation of a  
 9 SWPPP and an erosion control plan. While the SWPPPs would not be prepared until just prior to  
 10 construction and application to the State Water Board for coverage under the General Permit, please  
 11 see the discussion under Alternative 1A, Impact SOILS-1, for more details on what SWPPPs would  
 12 entail, and likely BMPs which would be included.

13 Accelerated water and wind erosion as a result of construction of the proposed water conveyance  
 14 facility could occur under Alternative 1B, but proper implementation of the requisite SWPPP and  
 15 compliance with the General Permit (as discussed in Appendix 3B, *Environmental Commitments,*  
 16 *AMMs, and CMs*) would ensure that there would not be substantial soil erosion resulting in daily site  
 17 runoff turbidity in excess of 250 NTUs, and therefore, there would not be an adverse effect.

18 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
 19 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
 20 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
 21 and reuse areas.

22 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 23 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
 24 would seek coverage under the state General Permit for Construction and Land Disturbance  
 25 Activities (as discussed in Appendix 3B, *Environmental Commitments, AMMs, and CMs*), necessitating  
 26 the preparation of a SWPPP and an erosion control plan. As a result of implementation of the  
 27 SWPPP, and Permit conditions, there would not be substantial soil erosion resulting in daily site  
 28 runoff turbidity in excess of 250 NTUs, and therefore, the impact would be less than significant. No  
 29 mitigation is required.

### 30 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 31 **Constructing the Proposed Water Conveyance Facilities**

32 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation during  
 33 construction of the water conveyance facilities associated with Alternative 1B (e.g., forebays, canal  
 34 alignment, borrow areas, levee foundations, intake facilities, pumping plants); overcovering (e.g.,  
 35 levees and embankments, spoil storage, pumping plants); and water inundation (e.g., sedimentation  
 36 basins, solids lagoons). Table 10-6 presents an itemization of the effects on soils caused by  
 37 excavation, overcovering, and inundation, based on GIS analysis by facility type. Due to the nature of  
 38 the earthwork to construct many of the facilities, more than one mechanism of soil loss may be  
 39 involved at a given facility. For example, levee construction would require both excavation to  
 40 prepare the subgrade and overcovering to construct the levee. The table shows that the greatest  
 41 extent of topsoil loss would be associated with overcovering such as spoil storage areas, unless  
 42 measures are undertaken to salvage the topsoil and reapply it on top of excavated borrow areas or  
 43 on top of the spoils once they have been placed.

**Table 10-6. Topsoil Lost as a Result of Excavation, Overcovering, and Inundation Associated with the Proposed Water Conveyance Facility (Alternatives 1B, 2B, 6B)**

| Topsoil Loss Mechanism   | Acreage Affected |
|--|------------------|
| Excavation (forebays, intakes, canals, borrow areas)           | 7,926            |
| Overcovering (spoil storage, reusable tunnel material storage) | 13,055           |
| Inundation (sedimentation basins, solids lagoons)              | 851              |
| <b>Total</b>   | <b>21,832</b>    |

Note: Some mechanisms for topsoil loss entail more than one process of soil loss. For example, construction of setback levees would first require overexcavation for the levee foundation (i.e., excavation), then placement of fill material (i.e., overcovering).

Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil would not be excavated, overcovered, or inundated, such as at construction staging and laydown areas where the soil could be compacted or otherwise affected.

DWR has made an environmental commitment for Disposal Site Preparation which would require that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas, thereby lessening the effect. However, this effect would be adverse because it would result in substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of this effect.

The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures for how excavated subsurface soil materials would be handled, stored, and disposed of. The commitment also specifies that temporary storage sites for spoils, RTM, and dredged material storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b supplements the environmental commitment, specifically by defining topsoil for the purposes of the mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

**CEQA Conclusion:** Construction of the water conveyance facilities would involve irreversible removal, overcovering, and inundation of topsoil over large areas, thereby resulting in a substantial loss of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts, but not to a less-than-significant level because topsoil would be permanently lost over extensive areas. Therefore, this impact is considered significant and unavoidable.

**Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

**Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil Storage and Handling Plan**

Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

1 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 2 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the**  
 3 **Proposed Water Conveyance Facilities**

4 The northern half of the proposed canal alignment, the intakes, pumping plants, pipelines, and  
 5 Byron Tract Forebay adjacent to the Clifton Court Forebay would be constructed where the near-  
 6 surface soils contain less than approximately 2% organic matter; these areas therefore would not be  
 7 subject to appreciable subsidence caused by organic matter decomposition. The southern half of the  
 8 canal alignment, four siphons, and one tunnel would be constructed where the near-surface soils  
 9 have approximately 4–23% organic matter content (Figure 10-2); consequently, subsidence caused  
 10 by organic matter decomposition could be considerable. Without adequate engineering, part of the  
 11 canal, siphons, and a tunnel could be subject to appreciable subsidence.

12 Damage to or collapse of the canal, tunnels, siphons, bridge abutments, and other facilities could  
 13 occur where these facilities are constructed in soils and sediments that are subject to subsidence  
 14 and differential settlement. Subsidence or differential sediment-induced damage or collapse of  
 15 these facilities could cause a rapid release of water to the surrounding soil, causing an interruption  
 16 in water supply and producing underground cavities, depressions at the ground surface, and surface  
 17 flooding. Facilities that have subsided would be subject to flooding.

18 Damage to other conveyance facilities, such as intakes, pumping plants, transition structures, and  
 19 control structures, caused by subsidence/settlement under the facilities and consequent damage to  
 20 or failure of the facility, could also occur. Facility damage or failure could cause a rapid release of  
 21 water to the surrounding area, resulting in flooding, thereby endangering people in the vicinity.  
 22 However, existing subsidence and soil organic matter content is generally low in the areas where  
 23 these facilities are proposed, so there is little likelihood of this happening.

24 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 25 soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for Analysis*,  
 26 and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would be  
 27 conducted at all facilities to identify the types of soil avoidance or soil stabilization measures that  
 28 should be implemented to ensure that the facilities are constructed to withstand subsidence and  
 29 settlement and to conform to applicable state and federal standards. These investigations would  
 30 build upon the geotechnical data reports (California Department of Water Resources 2001a, 2010b,  
 31 2011) and the CERs (California Department of Water Resources 2009a, 2010c). Such standards  
 32 include the American Society of Civil Engineers Minimum Design Loads for Buildings and Other  
 33 Structures, CBC, and USACE Design and Construction of Levees. The results of the investigations,  
 34 which would be conducted by a California registered civil engineer or California certified  
 35 engineering geologist, would be presented in geotechnical reports. The reports would contain  
 36 recommended measures to prevent subsidence. The geotechnical report will prepared in  
 37 accordance with state guidelines, in particular *Guidelines for Evaluating and Mitigating Seismic*  
 38 *Hazards in California* (California Geological Survey 2008).

39 Liquid limit and organic matter content testing should be performed on soil samples collected  
 40 during the site-specific field investigations to determine site-specific geotechnical properties. High  
 41 organic matter content soils that are unsuitable for support of structures, bridge abutments,  
 42 roadways and other facilities would be overexcavated and replaced with engineered fill, and the  
 43 unsuitable soils disposed of offsite as spoil, as described in more detail below. Geotechnical  
 44 evaluations will be conducted to identify soil materials that are suitable for engineering purposes.

1 Additional measures to address the potential adverse effects of organic soils could include  
2 construction of structural supports that extend below the depth of organic soils into underlying  
3 materials with suitable bearing strength. For example, the CER indicates that approximately 35 feet  
4 of soil would be excavated and a pile foundation supporting a common concrete mat would be  
5 required for the intake pumping plants. The piles would be 24-inches in diameter and concrete-  
6 filled, extending to 65 to 70 feet below the founding level of the plant. Piles extended to competent  
7 geologic beds, beyond the weak soils would provide a solid foundation to support the pumping  
8 plants.

9 For the sedimentation basins, the CER indicates that most of the underlying soils would be  
10 excavated to a depth of 30 feet below grade and removed from the site and suitable soil material  
11 imported to the site to re-establish it to subgrade elevation. Removal of the weak soils and  
12 replacement with engineered fill using suitable soil material would provide a solid foundation for  
13 the sedimentation basins.

14 Certain methods and practices may be utilized during tunnel siphon construction to help reduce and  
15 manage settlement risk. The CER indicates that the ground improvement techniques to control  
16 settlement at the shafts and tunnels may involve jet-grouting, permeation grouting, compaction  
17 grouting, or other methods that a contractor may propose. These measures would have the effect of  
18 better supporting the soil above the borehole and would prevent unacceptable settlement between  
19 the borehole and the tunnel segments. Additionally, settlement monitoring points, the number and  
20 location of which would be identified during detailed design, would be established along the  
21 pipeline and tunnel routes during construction and the results reviewed regularly by a professional  
22 engineer. The monitoring therefore would provide early detection of excessive settlement such that  
23 corrective actions could be made before the integrity of the tunnel is jeopardized.

24 Conforming to state and federal design standards would ensure that any subsidence that occurs  
25 under the conveyance facilities would not jeopardize their integrity. As described in the Section  
26 10.3.1, *Methods for Analysis*, and in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, such  
27 design codes and standards include the California Building Code and resource agency and  
28 professional engineering specifications, such as the American Society of Civil Engineers Minimum  
29 Design Loads for Buildings and Other Structures, ASCE 7-10, 2010. Conforming to these codes and  
30 standards is an environmental commitment by DWR to ensure cut and fill slopes and embankments  
31 will be stable as the water conveyance features are operated. Conforming to the standards and  
32 guidelines may necessitate such measures as excavation and removal of weak soils and replacement  
33 with engineered fill using suitable, imported soil, construction on pilings driven into competent soil  
34 material, and construction of facilities on cast-in-place slabs. These measures would reduce the  
35 potential hazard of subsidence or settlement to acceptable levels by avoiding construction directly  
36 on or otherwise stabilizing the soil material that is prone to subsidence. There would be no adverse  
37 effect.

38 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
39 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
40 failure of the facility. However, DWR would be required to design and construct the facilities  
41 according to state and federal design standards and guidelines (e.g., California Building Code,  
42 American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures,  
43 ASCE 7-10, 2010). Conforming to these codes would reduce the potential hazard of subsidence or  
44 settlement to acceptable levels by avoiding construction directly on or otherwise stabilizing the soil  
45 material that is prone to subsidence. Because these measures would reduce the potential hazard of

1 subsidence or settlement to meet design standards, this impact is considered less than significant.  
2 No mitigation is required.

3 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
4 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

5 The integrity of the water conveyance facilities, including the canal, intake facilities, pumping plants,  
6 access roads and utilities, and other features, could be adversely affected by expansive, corrosive,  
7 and compressible soils.

8 ***Expansive Soils***

9 Soil expansion is a concern only at soil depths that are subject to seasonal changes in moisture  
10 content. The Alternative 1B alignment is underlain by soils with low to high shrink-swell potential  
11 (note areas of high linear extensibility in Figure 10-4). The majority of the soils with high shrink-  
12 swell potential are where the intakes, pumping plants, pipelines, sedimentation basin, one of the  
13 tunnels, and the northern third of the canal alignment are proposed. Most of these areas are in  
14 Sacramento County (Dierssen and Egbert-Valpac association soils). The remaining conveyance  
15 facilities would generally be located where the soils have low or moderate shrink-swell potential.  
16 Soil expansion-contraction is not expected to be a concern at these types of facilities.

17 Soils with a high shrink-swell potential (i.e., expansive soils) could damage facilities or cause the  
18 facilities to fail. For example, foundations and pavements could be cracked or shifted and pipelines  
19 could rupture.

20 ***Soils Corrosive to Concrete***

21 The near-surface (i.e., upper 5 feet) soil corrosivity to concrete ranges from low to high along the  
22 Alternative 1B alignment, although most of the alignment is in areas of low to moderate corrosivity.  
23 The near-surface soils at the five intake and pumping plant facilities generally have a moderate  
24 corrosivity to concrete. The near-surface soils at the proposed tunnel alignment near Walnut Grove  
25 and the northern siphons have a moderate corrosivity to concrete. The proposed tunnel alignment  
26 near Stockton and the Clifton Court Forebay have low corrosivity to concrete. Data on soil  
27 corrosivity to concrete below a depth of approximately 5 feet (i.e., where pipelines, tunnels, and the  
28 deeper part of the tunnel shafts will be constructed) are not available. However, given the variability  
29 in the composition of the soils and geologic units on and within which the conveyance facilities  
30 would be constructed, corrosivity hazards are likely to range from low to high. Site-specific soil  
31 investigations will need to be conducted to determine this. Because soil corrosivity to concrete is  
32 high among the near-surface peat soils in the Delta, a high corrosivity is also expected to be present  
33 among the peat soils at depth. Site-specific soil investigations would need to be conducted to  
34 determine the corrosivity hazard at depth at each element of the conveyance facility. However,  
35 as described in 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments, AMMs,*  
36 *and CMs*, geotechnical studies would be conducted at all facilities to identify site-specific soil  
37 corrosivity hazards. The resulting geotechnical report, prepared by a California registered civil  
38 engineer or a California certified engineering geologist, would describe these hazards and  
39 recommend the measures that should be implemented to ensure that the facilities are constructed  
40 to withstand corrosion and to conform to applicable state and federal standards, such as the CBC.

1 Soils that are moderately and highly corrosive to concrete may cause the concrete to degrade,  
 2 thereby threatening the integrity of the facility. Degradation of concrete may cause pipelines to leak  
 3 or rupture and cause foundations to weaken.

#### 4 ***Soils Corrosive to Uncoated Steel***

5 The near-surface soils along the Alternative 1B alignment have a moderate or high corrosivity to  
 6 uncoated steel. With the exception of a significantly sized area west of Stockton, virtually the entire  
 7 alignment has a high risk of corrosion to uncoated steel. Data on soil corrosivity to uncoated steel  
 8 below a depth of approximately 5 feet (i.e., where pipelines, tunnels, and siphons would be  
 9 constructed) are not available. However, given the variability in the composition of the soils and  
 10 geologic units on and within which the conveyance facilities would be constructed, corrosivity  
 11 hazards are likely to range from low to high. Site-specific soil investigations would need to be  
 12 conducted to determine the corrosivity hazard at depth at each element of the conveyance facility.

13 Soils that are moderately and highly corrosive to uncoated steel (including steel rebar embedded in  
 14 concrete) may cause the concrete to degrade, threatening the integrity of these facilities.

#### 15 ***Compressible Soils***

16 Soils that are weakly consolidated or that have high organic matter content (such as peat or muck  
 17 soils) present a risk to structures and infrastructure due to high compressibility and poor bearing  
 18 capacity. Soils with high organic matter content tend to compress under load and may decrease in  
 19 volume as organic matter is oxidized. The southern half of the Alternative 1B alignment is underlain  
 20 by near-surface soils with significant organic matter content. Although the intakes would generally  
 21 be located on mineral soils, according to the CER some of these soils are soft and have poor bearing  
 22 capacity. Some of the pumping plants and pipelines also would be located on such soils. Based on  
 23 liquid limits reported in county soil surveys, near-surface soils in the Alternative 1B alignment vary  
 24 from low to medium compressibility.

25 Part of the Byron Tract Forebay embankment would be subject to this hazard.

26 Damage to or collapse of the intakes, pumping plants, transition structures, and control structures,  
 27 could occur where these facilities are constructed in soils and sediments that are subject to  
 28 subsidence and differential settlement. Because of compressible soils, such effects could occur at the  
 29 five intakes, all the pumping plants, and the sedimentation basins, Subsidence- or differential  
 30 sediment-induced damage to or collapse of these facilities could cause a rapid release of water to  
 31 the surrounding soil, causing an interruption in water supply and producing underground cavities,  
 32 depressions at the ground surface, and surface flooding. Facilities that have subsided would be  
 33 subject to flooding and levees that have subsided would be subject to overtopping and consequent  
 34 flooding on the land side of the levee.

35 ***NEPA Effects:*** Various facilities would be located on expansive, corrosive, and compressible soils.  
 36 However, all facility design and construction would be executed in conformance with the CBC, which  
 37 specifies measures to mitigate effects of expansive soils, corrosive soils, and soils subject to  
 38 compression and subsidence. The CBC requires measures such as soil replacement, lime treatment,  
 39 and post-tensioned foundations to offset expansive soils, as well as such measures as using  
 40 protective linings and coatings, dielectric isolation of dissimilar materials, and active cathodic  
 41 protection systems to prevent corrosion of concrete and steel.

1 Potential adverse effects of compressible soils and soils subject to subsidence could be addressed by  
 2 overexcavation and replacement with engineered fill or by installation of structural supports (e.g.,  
 3 pilings) to a depth below the peat where the soils have adequate load bearing strength, as required  
 4 by the CBC and by USACE design standards. For example, the CER indicates that a deep foundation  
 5 (pile) length of 65 to 70 feet below the founding level of the in-river intake may be required for  
 6 adequate support of intake structures without excessive settlement. Geotechnical studies would be  
 7 conducted at all the facilities to determine what specific measures should be implemented at each  
 8 facility to reduce these soil hazards to levels consistent with the CBC. Liquid limit and soil organic  
 9 matter content testing would be performed on soil samples collected during the site-specific field  
 10 investigations to determine site-specific geotechnical properties. Settlement monitoring points  
 11 should be established along the route during tunnel construction and results reviewed regularly by  
 12 a professional engineer.

13 The engineer would develop final engineering solutions to any hazardous condition, consistent with  
 14 the code and standards requirements of federal, state, and local oversight agencies (e.g., California  
 15 Building Code, DWR Interim Levee Design Criteria for Urban and Urbanizing Area State Federal  
 16 Project Levees, and USACE Engineering and Design—Earthquake Design and Evaluation for Civil  
 17 Works Projects).

18 By conforming to the CBC and other applicable design standards, potential effects associated with  
 19 expansive and corrosive soils and soils subject to compression and subsidence would be offset.  
 20 There would be no adverse effect.

21 **CEQA Conclusion:** Many of the Alternative 1B facilities would be constructed on surface soils that  
 22 are moderately or highly subject to expansion, corrosive to concrete and uncoated steel, as well as  
 23 soils that are moderately or highly subject to compression under load. Expansive soils could cause  
 24 foundations, underground utilities, and pavements to crack and fail. Corrosive soils could damage  
 25 in-ground facilities or shorten their service life. Compression/settlement of soils after a facility is  
 26 constructed could result in damage to or failure of the facility. However, DWR would be required to  
 27 design and construct the facilities in conformance with state and federal design standards,  
 28 guidelines, and building codes (e.g., CBC and USACE design standards). Conforming to these codes  
 29 and standards (Appendix 3B, *Environmental Commitments, AMMs, and CMs*) is an environmental  
 30 commitment by DWR to ensure that potential adverse effects associated with expansive and  
 31 corrosive soils and soils subject to compression and subsidence would be offset. Therefore, the  
 32 impact would be less than significant. No mitigation is required.

### 33 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 34 **Operations**

35 Alternative 1B would use Operational Scenario A—the same scenario as Alternative 1A. Accordingly,  
 36 the effects associated with river channel bank erosion/scour would be the same.

37 **NEPA Effects:** As under Alternative 1A, the operational components would cause changes in the tidal  
 38 flows in some Delta channels, specifically those that lead into the major habitat restoration areas  
 39 (Suisun Marsh, Cache Slough, Yolo Bypass, and South Delta ROAs). However, detailed hydrodynamic  
 40 (tidal) modeling would be conducted prior to any BDCP habitat restoration work in these ROA areas,  
 41 and the changes in the tidal velocities in the major channels connecting to these restoration areas  
 42 would be evaluated. If there is any indication that tidal velocities would be substantially increased,  
 43 the restoration project design would be modified (such as by providing additional levee breaches or  
 44 by requiring dredging in portions of the connecting channels) so that bed scour would not increase

1 sufficiently to cause an erosion impact. Moreover, as presently occurs and as is typical with most  
2 naturally-functioning river channels, local erosion and deposition within the tidal habitats is  
3 expected as part of the restoration.

4 The effect would not be adverse because there would be no net increase in flow rates and therefore  
5 no net increase in channel bank scour.

6 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
7 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
8 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
9 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
10 effect would be to reduce the channel flow rates by 10–20% compared to Existing  
11 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
12 than significant. No mitigation is required.

13 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
14 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
15 **CM11, CM18 and CM19**

16 Implementation of conservation measures under Alternative 1B would be the same as under  
17 Alternative 1A. These activities would include breaching, lowering, or removing levees; constructing  
18 setback levees and cross levees or berms; raising the land elevation by excavating relatively high  
19 areas to provide fill for subsided areas or by importing fill material; surface grading; deepening  
20 and/or widening tidal channels; excavating new channels; modifying channel banks; excavation and  
21 grading to construct facilities, access roads, and other facilities; and other activities. These activities  
22 could cause adverse effects on soil erosion rates and cause a loss of topsoil through both water and  
23 wind erosion.

24 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
25 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*,  
26 *AMMs*, and *CMs*, the BDCP proponents would be required to obtain coverage under the General  
27 Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP  
28 and an erosion control plan.

29 Proper implementation of the requisite SWPPP and compliance with the General Permit would  
30 ensure that accelerated water and wind erosion associated with implementation of CM2–CM11  
31 would not be an adverse effect.

32 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
33 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP  
34 proponents would seek coverage under the state General Permit for Construction and Land  
35 Disturbance Activities (as discussed in Appendix 3B, *Environmental Commitments*, *AMMs*, and *CMs*).  
36 Permit conditions would include erosion and sediment control BMPs (such as revegetation, runoff  
37 control, and sediment barriers) and compliance with water quality standards. As a result of the  
38 implementation of Permit conditions, the impact would be less than significant. No mitigation is  
39 required.

1 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
 2 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
 3 **CM2–CM11**

4 Implementation of CM2–CM11 would be the same under Alternative 1B as under Alternative 1A.  
 5 Consequently, topsoil loss associated with excavation (e.g., levee foundations, water control  
 6 structures), overcovering (e.g., levees, embankments, application of fill material in subsided areas),  
 7 and water inundation (e.g., aquatic habitat areas) would also be the same as under Alternative 1A.

8 **NEPA Effects:** Implementation of habitat restoration activities at the ROAs would result in  
 9 excavation, overcovering, or inundation of a minimum of 77,600 acres of topsoil (this figure includes  
 10 areas of tidal habitat restoration, which will be periodically inundated.). This effect would be  
 11 adverse because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and  
 12 SOILS-2b would to reduce the severity of this effect.

13 **CEQA Conclusion:** Implementation of CM2–CM11 would involve excavation, overcovering, and  
 14 inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby resulting in a  
 15 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would minimize and  
 16 compensate for these impacts to a degree, but not to a less-than-significant level. Therefore, this  
 17 impact is considered significant and unavoidable.

18 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

19 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 20 1A.

21 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 22 **Topsoil Storage and Handling Plan**

23 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 24 1A.

25 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 26 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
 27 **Proposed Conservation Measures CM2–CM11**

28 Implementation of CM2–CM11 under Alternative 1B would be the same as under Alternative 1A.  
 29 Similarly, the potential for injury or death to occur as a result of damage to or failure of the habitat  
 30 levees where these are constructed in soils and sediments that are subject to subsidence and  
 31 differential settlement would also be the same as under Alternative 1A. Levee damage or failure  
 32 could cause surface flooding in the vicinity.

33 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 34 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 35 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 36 be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to  
 37 ensure that levees, berms, and other features are constructed to withstand subsidence and  
 38 settlement and to conform to applicable state and federal standards. Such standards include  
 39 USACE's *Design and Construction of Levees* and DWR's *Interim Levee Design Criteria for Urban and*  
 40 *Urbanizing Area State-Federal Project Levees*.

1 With construction of all levees, berms, and other conservation features designed and constructed to  
 2 withstand subsidence and settlement and through conformance with applicable state and federal  
 3 design standards, this effect would not be adverse.

4 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
 5 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 6 to or failure of the facility. However, because the BDCP proponents would be required to design and  
 7 construct the facilities according to state and federal design standards and guidelines (which may  
 8 involve, for example, replacement of the organic soil), the impact would be less than significant. No  
 9 mitigation is required.

10 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
 11 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures**  
 12 **CM2–CM11**

13 Implementation of CM2–CM11 under Alternative 1B would be the same as under Alternative 1A.  
 14 Accordingly, construction of conservation measures in areas of expansive, corrosive, or  
 15 compressible soils would have the same effects as under Alternative 1A.

16 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control  
 17 structures or cause them to fail, resulting in a release of water from the structure and consequent  
 18 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs  
 19 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West  
 20 Delta ROA possess soils with high corrosivity to concrete.

21 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
 22 Mokelumne, and South Delta ROAs.

23 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
 24 compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
 25 studies and testing would be completed prior to construction within the ROAs. The site-specific  
 26 environmental evaluation would identify specific areas where engineering soil properties, including  
 27 soil compressibility, may require special consideration during construction of specific features  
 28 within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
 29 expansive, corrosive and/or compressible soils would prevent adverse effects.

30 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
 31 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 32 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 33 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
 34 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
 35 However, because the BDCP proponents will be required to design and construct the facilities  
 36 according to state and federal design standards, guidelines, and building codes (which may involve,  
 37 for example, soil lime stabilization, cathodic protection of steel, and soil replacement), the impacts  
 38 would be less than significant. No mitigation is required.

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

#### Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities

The mechanisms of this impact are similar to those described for Alternative 1A; however, considerably more excavation would be necessary to construct the canal along the western alignment than would be necessary for tunnel boring under Alternative 1A. Construction of water conveyance facilities would involve vegetation removal; constructing building pads, levees, canals, and a tunnel; excavation; overexcavation for facility foundations; surface grading; trenching; road construction; spoil storage; soil stockpiling; and other activities over approximately 17,400 acres during the course of constructing the facilities. Vegetation would be removed (via grubbing and clearing) grading and other earthwork would be conducted at the intakes, pumping plants, the proposed Byron Tract Forebay, canal and gates between the Byron Tract Forebay tunnel shafts and the approach canal to the Banks Pumping Plant, borrow areas, RTM and spoil storage areas, setback and transition levees, sedimentation basins, solids handling facilities, transition structures, surge shafts and towers, substations, transmission line footings, access roads, concrete batch plants, fuel stations, bridge abutments, barge unloading facilities, and laydown areas. Some of the work would be conducted in areas that are fallow at the time. Excavation of a large volume of borrow material would be required to construct the canals. Some of the earthwork activities may also result in steepening of slopes and soil compaction, particularly for the embankments constructed for the intermediate forebay and the proposed Byron Tract Forebay. These conditions tend to result in increased runoff rates, degradation of soil structure, and reduced soil infiltration capacity, all of which could cause accelerated erosion, resulting in the loss of topsoil.

#### **Water Erosion**

The excavation, grading, and other soil disturbances described above that are conducted in gently sloping to level areas, such as the interiors of Delta islands, are expected to experience little or no accelerated water erosion because of the lack of runoff energy to entrain and transport soil particles. Any soil that is eroded within island interiors would tend to remain on the island, provided that existing or project levees are in place to serve as barriers to keep the eroded soil (i.e., sediment) from entering receiving waters (see Figure 10-5).

In contrast, graded and otherwise disturbed tops and sideslopes of existing and project canals, levees and embankments are of greater concern for accelerated water erosion because of their steeper gradients. Although soil eroded from the land side of levees would be deposited on the island interiors, soil eroded from the disturbed top and water side of levees could reach adjoining waterways. Soil eroded from natural slopes in upland environments could also reach receiving waters.

#### **Wind Erosion**

In the primary work areas that would involve extensive surface soil disturbance (i.e., the proposed Byron Tract Forebay on the northwestern side of Clifton Court Forebay, the canals, staging areas, borrow/spoil areas, and intakes), the soils generally have a low susceptibility to wind erosion (Natural Resources Conservation Service 2010a) (Figure 10-6).

1 Excavation of soil from borrow areas and transport of soil material to spoil storage areas potentially  
 2 would subject the soils to wind erosion. It is likely that approximately 50 million cubic yards of peat  
 3 soil material would be disposed of as spoils; this material would be especially susceptible to wind  
 4 erosion while being loaded onto trucks, transported, unloaded, and distributed.

5 **NEPA Effects:** These potential effects could be substantial because they could cause accelerated  
 6 erosion. However, as described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B,  
 7 *Environmental Commitments, AMMs, and CMs*, DWR would be required to obtain coverage under the  
 8 General Permit for Construction and Land Disturbance Activities, necessitating the preparation of a  
 9 SWPPP and an erosion control plan. While the SWPPPs would not be prepared until just prior to  
 10 construction and application to the State Water Board for coverage under the General Permit, please  
 11 see the discussion under Alternative 1A, Impact SOILS-1, for more details on what SWPPPs would  
 12 entail, and likely BMPs which would be included.

13 Accelerated water and wind erosion as a result of construction of the proposed water conveyance  
 14 facility could occur under Alternative 1C, but proper implementation of the requisite SWPPP and  
 15 compliance with the General Permit (as discussed in Appendix 3B, *Environmental Commitments,*  
 16 *AMMs, and CMs*) would ensure that there would not be substantial soil erosion resulting in daily site  
 17 runoff turbidity in excess of 250 NTUs, as a result of construction of the proposed water conveyance  
 18 facilities, and therefore, there would not be an adverse effect.

19 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
 20 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
 21 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
 22 and reuse areas.

23 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 24 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
 25 would seek coverage under the state General Permit for Construction and Land Disturbance  
 26 Activities (as discussed in Appendix 3B, *Environmental Commitments, AMMs, and CMs*), necessitating  
 27 the preparation of a SWPPP and an erosion control plan. As a result of implementation of the SWPPP  
 28 and compliance with the General Permit, where applicable, there would not be substantial soil  
 29 erosion resulting in daily site runoff turbidity in excess of 250 NTUs, and therefore, the impact  
 30 would be less than significant. No mitigation is required.

### 31 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 32 **Constructing the Proposed Water Conveyance Facilities**

33 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation during  
 34 construction of the water conveyance facilities associated with Alternative 1C (e.g., forebays, canal  
 35 alignment, borrow areas, levee foundations, intake facilities, pumping plants); overcovering (e.g.,  
 36 levees and embankments, spoil storage, pumping plants); and water inundation (e.g., sedimentation  
 37 basins, solids lagoons).

38 Table 10-7 presents an itemization of the effects on soils caused by excavation, overcovering, and  
 39 inundation, based on GIS analysis by facility type. Because of the nature of the earthwork to  
 40 construct many of the facilities, more than one mechanism of soil loss may be involved at a given  
 41 facility. For example, levee construction would require both excavation to prepare the subgrade and  
 42 overcovering to construct the levee. The table shows that the greatest extent of topsoil loss would be  
 43 associated with excavations such as for the canals, unless measures are undertaken to salvage the

1 topsoil and reapply it on top of the excavated borrow areas or on top of spoils once they have been  
2 placed.

3 **Table 10-7. Topsoil Lost as a Result of Excavation, Overcovering, and Inundation Associated with**  
4 **the Proposed Water Conveyance Facility (Alternatives 1C, 2C, 6C)**

| Topsoil Loss Mechanism   | Acreage Affected |
|--|------------------|
| Excavation (forebays, intakes, canals, shafts, borrow areas)   | 11,462           |
| Overcovering (spoil storage, reusable tunnel material storage) | 5,804            |
| Inundation (sedimentation basins, solids lagoons)              | 773              |
| <b>Total</b>   | <b>18,039</b>    |

Note: Some mechanisms for topsoil loss entail more than one process of soil loss. For example, construction of setback levees would first require overexcavation for the levee foundation (i.e., excavation), then placement of fill material (i.e., overcovering).

5

6 Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil  
7 would not be excavated, overcovered, or inundated, such as at construction staging and laydown  
8 areas where the soil could be compacted or otherwise affected.

9 DWR has made an environmental commitment for Disposal Site Preparation which would require  
10 that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will  
11 be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,  
12 thereby lessening the effect. However, this effect would be adverse because it would result in  
13 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
14 this effect.

15 The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and  
16 Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures  
17 for how excavated subsurface soil materials would be handled, stored, and disposed of. The  
18 commitment also specifies that temporary storage sites for spoils, RTM, and dredged material  
19 storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b  
20 supplements the environmental commitment, specifically by defining topsoil for the purposes of the  
21 mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

22 **CEQA Conclusion:** Construction of the water conveyance facilities would involve irreversible  
23 removal, overcovering, and inundation of topsoil over large areas, thereby resulting in a substantial  
24 loss of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan  
25 Area would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and  
26 compensate for these impacts, but not to a less-than-significant level because topsoil would be  
27 permanently lost over extensive areas. Therefore, this impact is considered significant and  
28 unavoidable.

29 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

30 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
31 1A.

1           **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 2           **Topsoil Storage and Handling Plan**

3           Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 4           1A.

5           **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 6           **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the**  
 7           **Proposed Water Conveyance Facilities**

8           The part of the alignment that includes the northern canal, intakes, pipelines, pumping plants,  
 9           sedimentation basins, and some of the siphons would be constructed where the near-surface soils  
 10          have approximately 2% organic matter content. Compared to organic soils, these mineral soils  
 11          would not be subject to appreciable subsidence caused by organic matter decomposition because  
 12          there is relatively little organic matter available to decompose. The remainder (southern) part of the  
 13          northern canal alignment is underlain by near-surface soils having 4–12.5% organic matter content  
 14          (Figure 10-2). The thickness of the peat ranges between 0 and 20 feet. The amount of existing  
 15          subsidence is 0–10 feet, with the deeper subsided areas existing where the intermediate pumping  
 16          plant is proposed. This southern part would be subject to appreciable subsidence.

17          The proposed tunnel section extends through an area where the near-surface soils have 4% to more  
 18          than 22.5% organic matter content. The thickness of the peat ranges between approximately 5 and  
 19          25 feet. The amount of existing subsidence ranges between 5 and more than 20 feet. Because the  
 20          tunnel section would be constructed below the peat, it would not be affected by subsidence caused  
 21          by organic matter decomposition.

22          The proposed southern canal alignment generally would pass through an area where the soils have  
 23          less than approximately 2% organic matter content and where there apparently has been no  
 24          evidence of subsidence caused by organic matter decomposition. Compared to organic soils, these  
 25          mineral soils would not be subject to appreciable subsidence caused by organic matter  
 26          decomposition because there is relatively little organic matter available to decompose. Only the  
 27          southern portion of the southern canal alignment (including the part of the new Byron Tract  
 28          Forebay) is underlain by peat soils up to 5 feet deep. Without adequate engineering, parts of the  
 29          canals, pipelines, intermediate pumping plant, some of the siphons, and other facilities could be  
 30          subject to appreciable subsidence.

31          Damage to or collapse of the canal, tunnels, siphons, bridge abutments, and other facilities could  
 32          occur, where these facilities are constructed in soils and sediments that are subject to subsidence  
 33          and differential settlement. Subsidence- or differential sediment-induced damage or collapse of  
 34          these facilities could cause a rapid release of water to the surrounding soil, causing an interruption  
 35          in water supply and producing underground cavities, depressions at the ground surface, and surface  
 36          flooding. Facilities that have subsided would be subject to flooding.

37          Damage to other conveyance facilities, such as intakes, pumping plants, transition structures, and  
 38          control structures, caused by subsidence/settlement under the facilities and consequent damage or  
 39          failure to the facility could also occur. Facility damage or failure could cause a rapid release of water  
 40          to the surrounding area, resulting in flooding, thereby endangering people in the vicinity. However,  
 41          the amount of existing subsidence and soil organic matter content is generally low in the areas  
 42          where these facilities are proposed, so the likelihood of this occurring is low.

1 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
2 soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for Analysis*,  
3 and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would be  
4 conducted at all facilities to identify the types of soil avoidance or soil stabilization measures that  
5 should be implemented to ensure that the facilities are constructed to withstand subsidence and  
6 settlement and to conform to applicable state and federal standards. These investigations would  
7 build upon the geotechnical data reports (California Department of Water Resources 2001a, 2010b,  
8 2011) and the CERs (California Department of Water Resources 2009b, 2010d). Such standards  
9 include the American Society of Civil Engineers Minimum Design Loads for Buildings and Other  
10 Structures, California Building Code, and USACE Design and Construction of Levees. The results of  
11 the investigations, which would be conducted by a California registered civil engineer or California  
12 certified engineering geologist, would be presented in geotechnical reports. The reports would  
13 contain recommended measures to prevent subsidence. The geotechnical report will prepared in  
14 accordance with state guidelines, in particular *Guidelines for Evaluating and Mitigating Seismic*  
15 *Hazards in California* (California Geological Survey 2008).

16 Liquid limit and organic content testing should be performed on soil samples collected during the  
17 site-specific field investigations to determine site-specific geotechnical properties. High organic  
18 matter content soils that are unsuitable for support of structures, bridge abutments, roadways and  
19 other facilities would be overexcavated and replaced with engineered fill, and the unsuitable soils  
20 disposed of offsite as spoil, as described in more detail below. Geotechnical evaluations would be  
21 conducted to identify soil materials that are suitable for engineering purposes.

22 Additional measures to address the potential adverse effects of organic soils could include  
23 construction of structural supports that extend below the depth of organic soils into underlying  
24 materials with suitable bearing strength. For example, the CER indicates that approximately 35 feet  
25 of soil would be excavated and a pile foundation supporting a common concrete mat would be  
26 required for the intake pumping plants. The piles would be 24-inches in diameter and concrete-  
27 filled, extending to 65 to 70 feet below the founding level of the plant. Piles extended to competent  
28 geologic beds, beyond the weak soils would provide a solid foundation to support the pumping  
29 plants.

30 For the sedimentation basins, the CER indicates that most of the underlying soils would be  
31 excavated to a depth of 30 feet below grade and removed from the site and suitable soil material  
32 imported to the site to re-establish it to subgrade elevation. Removal of the weak soils and  
33 replacement with engineered fill using suitable soil material would provide a solid foundation for  
34 the sedimentation basins.

35 Certain methods and practices may be utilized during tunnel construction to help reduce and  
36 manage settlement risk. The CER indicates that the ground improvement techniques to control  
37 settlement at the shafts and tunnels may involve jet-grouting, permeation grouting, compaction  
38 grouting, or other methods that a contractor may propose. These measures would have the effect of  
39 better supporting the soil above the borehole and would prevent unacceptable settlement between  
40 the borehole and the tunnel segments. Additionally, settlement monitoring points, the number and  
41 location of which would be identified during detailed design, would be established along the  
42 pipeline and tunnel routes during construction and the results reviewed regularly by a professional  
43 engineer. The monitoring therefore would provide early detection of excessive settlement such that  
44 corrective actions could be made before the integrity of the tunnel is jeopardized. Conforming to  
45 state and federal design standards would ensure that any subsidence that occurs under the

1 conveyance facilities would not jeopardize their integrity. As described in the Section 10.3.1,  
 2 *Methods for Analysis* and in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, such design  
 3 codes and standards include the California Building Code and resource agency and professional  
 4 engineering specifications, such as the American Society of Civil Engineers *Minimum Design Loads*  
 5 *for Buildings and Other Structures*, ASCE/SEI 7-10, 2010. Conforming to these codes and standards is  
 6 an environmental commitment by DWR to ensure cut and fill slopes and embankments will be stable  
 7 as the water conveyance features are operated. Conforming to the standards and guidelines may  
 8 necessitate such measures as excavation and removal of weak soils and replacement with  
 9 engineered fill using suitable, imported soil, construction on pilings driven into competent soil  
 10 material, and construction of facilities on cast-in-place slabs. These measures would reduce the  
 11 potential hazard of subsidence or settlement to acceptable levels by avoiding construction directly  
 12 on or otherwise stabilizing the soil material that is prone to subsidence. There would be no adverse  
 13 effect.

14 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
 15 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
 16 failure of the facility. However, DWR would be required to design and construct the facilities  
 17 according to state and federal design standards and guidelines (e.g., California Building Code,  
 18 American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures,  
 19 ASCE/SEI 7-10, 2010). Conforming to these codes would reduce the potential hazard of subsidence  
 20 or settlement to acceptable levels by avoiding construction directly on or otherwise stabilizing the  
 21 soil material that is prone to subsidence. Because these measures would reduce the potential hazard  
 22 of subsidence or settlement to meet design standards, the impact would be less than significant. No  
 23 mitigation is required.

24 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 25 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

26 The integrity of the water conveyance facilities, including the canal, intake facilities, pumping plants,  
 27 access roads and utilities, and other features could be adversely affected by expansive, corrosive,  
 28 and compressible soils.

29 **Expansive Soils**

30 Soil expansion is a concern only at soil depths that are subject to seasonal changes in moisture  
 31 content. The Alternative 1C alignment is underlain by soils with low to high shrink-swell potential  
 32 (note areas of high linear extensibility in Figure 10-4), with the majority of the soils with high  
 33 shrink-swell potential occurring where the intakes, pumping plants, pipelines, and sedimentation  
 34 basin are proposed. Most of these areas are in Sacramento County (Dierssen and Egbert-Valpac  
 35 association soils) and in Contra Costa County (Sacramento-Omni association soils). The remaining  
 36 conveyance features generally would be located where the soils have low or moderate shrink-swell  
 37 potential, although soil expansion-contraction is not expected to be a concern at these types of  
 38 facilities.

39 Soils with a high shrink-swell potential (i.e., expansive soils) could damage facilities or cause the  
 40 facilities to fail. For example, foundations and pavements could crack or shift and pipelines could  
 41 rupture.

1       **Soils Corrosive to Concrete**

2       The near-surface (i.e., upper 5 feet) soil corrosivity to concrete is low or moderate along the  
 3       Alternative 1C alignment in the parts of the alignment proposed for the intakes, pumping plants,  
 4       siphons, bridges, and all other facilities except the tunnel, which will be below the depth of the near-  
 5       surface soils. Data on soil corrosivity to concrete below approximately 5 feet (i.e., where pipelines,  
 6       tunnels, and the deeper part of the tunnel shafts will be constructed) are not available. However,  
 7       given the variability in the composition of the soils and geologic units on and within which the  
 8       conveyance facilities would be constructed, corrosivity hazards are likely to range from low to high.  
 9       Because soil corrosivity to concrete is high among the near-surface peat soils on the Delta, a high  
 10       corrosivity is also expected to be present among the peat soils at depth at each element of the  
 11       conveyance facility. Site-specific soil investigations will need to be conducted to determine this  
 12       hazard. As described in 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*,  
 13       *AMMs*, and *CMs*, geotechnical studies would be conducted at all facilities to identify site-specific soil  
 14       corrosivity hazards. The resulting geotechnical report, prepared by a California registered civil  
 15       engineer or a California certified engineering geologist, would describe these hazards and  
 16       recommend the measures that should be implemented to ensure that the facilities are constructed  
 17       to withstand corrosion and to conform to applicable state and federal standards, such as the CBC.

18       Soils that are moderately and highly corrosive to concrete may cause the concrete to degrade,  
 19       thereby threatening the integrity of the facility. Degradation of concrete may cause pipelines to leak  
 20       or rupture and cause foundations to weaken.

21       **Soils Corrosive to Uncoated Steel**

22       Virtually all the near-surface soils along the Alternative 1C alignment have a high corrosivity to  
 23       uncoated steel. The only the exception is an area of moderate corrosivity east of the Cache Slough  
 24       ROA. Data on soil corrosivity to uncoated steel below approximately 5 feet (i.e., where pipelines,  
 25       tunnels, and siphons would be constructed) are not available. However, given the variability in the  
 26       composition of the soils and geologic units on and within which the conveyance facilities would be  
 27       constructed, corrosivity hazards are likely to range from low to high. Site-specific soil investigations  
 28       will need to be conducted to determine the level of hazard.

29       Soils that are moderately and highly corrosive to uncoated steel (including steel rebar embedded in  
 30       concrete) may cause the concrete to degrade, threatening the integrity of these facilities.

31       **Compressible Soils**

32       Soils that are weakly consolidated or that have high organic matter content (such as peat or muck  
 33       soils) present a risk to structures and infrastructure due to high compressibility and poor bearing  
 34       capacity. Soils with high organic matter content tend to compression under load and may decrease  
 35       in volume as organic matter is oxidized. The non-tunnel sections of the alignment are underlain by  
 36       soils that have an organic matter content of less than 2–4%. Although the intakes would generally be  
 37       located on mineral soils, according to the CER some of these soils are soft and have poor bearing  
 38       capacity. Some of the pumping plants and pipelines also would be located on such soils. Based on  
 39       liquid limits reported in county soil surveys, near-surface soils within the Alternative 1C alignment  
 40       vary from low to medium compressibility.

41       Part of the Byron Tract Forebay embankment would be subject to this hazard.

1 Damage to or collapse of the intakes, pumping plants, transition structures, and control structures,  
2 could occur where these facilities are constructed in soils and sediments that are subject to  
3 subsidence and differential settlement. Subsidence- or differential sediment-induced damage or  
4 collapse of these facilities could cause a rapid release of water to the surrounding soil, causing an  
5 interruption in water supply and producing underground cavities, depressions at the ground  
6 surface, and surface flooding. Facilities that have subsided would be subject to flooding and levees  
7 that have subsided would be subject to overtopping and consequent flooding on the land side of the  
8 levee.

9 The tunnel siphons or culvert siphons would be constructed at a depth below the peat (Figure 9-4);  
10 consequently, subsidence caused by organic matter decomposition below the tunnels/culverts is  
11 expected to be minimal. Surface and subsurface settlement may occur during tunnel construction;  
12 however, certain methods and practices may be utilized during tunnel/culvert construction to help  
13 reduce and manage settlement risk. Chapter 9, *Geology and Seismicity*, discusses the risks of  
14 settlement during tunnel construction and methods to reduce the amount of settlement (Impact  
15 GEO-2).

16 **NEPA Effects:** Various facilities would be located on expansive, corrosive, and compressible soils.  
17 However, all facility design and construction would be executed in conformance with the CBC, which  
18 specifies measures to mitigate effects of expansive soils, corrosive soils, and soils subject to  
19 compression and subsidence. The CBC requires measures such as soil replacement, lime treatment,  
20 and post-tensioned foundations to offset expansive soils, as well as such measures as using  
21 protective linings and coatings, dielectric isolation of dissimilar materials, and active cathodic  
22 protection systems to prevent corrosion of concrete and steel.

23 Potential adverse effects of compressible soils and soils subject to subsidence could be addressed by  
24 overexcavation and replacement with engineered fill or by installation of structural supports (e.g.,  
25 pilings) to a depth below the peat where the soils have adequate load bearing strength, as required  
26 by the CBC and by USACE design standards. For example, the CER indicates that a deep foundation  
27 (pile) length of 65–70 feet below the founding level of the in-river intake may be required for  
28 adequate support of intake structures without excessive settlement. Geotechnical studies would be  
29 conducted at all the facilities to determine what specific measures should be implemented at each  
30 facility to reduce these soil hazards to levels consistent with the CBC. Liquid limit and soil organic  
31 matter content testing would be performed on soil samples collected during the site-specific field  
32 investigations to determine site-specific geotechnical properties. Settlement monitoring points  
33 should be established along the route during tunnel construction and results reviewed regularly by  
34 a professional engineer.

35 The engineer would develop final engineering solutions to any hazardous condition, consistent with  
36 the code and standards requirements of federal, state, and local oversight agencies. As described in  
37 Section 10.3.1, *Methods for Analysis*, and in Appendix 3B, *Environmental Commitments, AMMs, and*  
38 *CMs*, such design codes, guidelines, and standards include the California Building Code and resource  
39 agency and professional engineering specifications, such as the DWR Interim Levee Design Criteria  
40 for Urban and Urbanizing Area State Federal Project Levees, and USACE Engineering and Design—  
41 Earthquake Design and Evaluation for Civil Works Projects.

42 By conforming to the CBC and other applicable design standards, potential effects associated with  
43 expansive and corrosive soils and soils subject to compression and subsidence would be offset.  
44 There would be no adverse effect.

1 **CEQA Conclusion:** Many of the Alternative 1C facilities would be constructed on soils that are  
 2 subject to expansion, corrosive to concrete and uncoated steel, as well as soils that are moderately  
 3 or highly subject to compression under load. Expansive soils could cause foundations, underground  
 4 utilities, and pavements to crack and fail. Corrosive soils could damage in-ground facilities or  
 5 shorten their service life. Compression or settlement of soils after a facility is constructed could  
 6 result in damage to or failure of the facility. However, because DWR would be required to design and  
 7 construct the facilities in conformance with state and federal design standards, guidelines, and  
 8 building codes (e.g., CBC and USACE design standards). Conforming to these codes and standards  
 9 (Appendix 3B, *Environmental Commitments, AMMs, and CMs*) is an environmental commitment by  
 10 DWR to ensure that potential adverse effects associated with expansive and corrosive soils and soils  
 11 subject to compression and subsidence would be offset. Therefore, the impact would be less than  
 12 significant. No mitigation is required.

13 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**  
 14 **Operations**

15 Alternative 1C would use Operational Scenario A—the same scenario as Alternative 1A. Accordingly,  
 16 the effects associated with river channel bank erosion/scour would be the same.

17 **NEPA Effects:** As under Alternative 1A, the operational components would cause changes in the tidal  
 18 flows in some Delta channels, specifically those that lead into the major habitat restoration areas  
 19 (Suisun Marsh, Cache Slough, Yolo Bypass, and South Delta ROAs); however, detailed hydrodynamic  
 20 (tidal) modeling would be conducted prior to any BDCP habitat restoration work in these ROA areas,  
 21 and the changes in the tidal velocities in the major channels connecting to these restoration areas  
 22 would be evaluated. If there is any indication that tidal velocities would be substantially increased,  
 23 the restoration project design would be modified (such as by providing additional levee breaches or  
 24 by requiring dredging in portions of the connecting channels) so that bed scour would not increase  
 25 sufficiently to cause an erosion impact. Moreover, as presently occurs and as is typical with most  
 26 naturally-functioning river channels, local erosion and deposition within the tidal habitats is  
 27 expected as part of the restoration.

28 The effect would not be adverse because there would be no net increase in flow rates and therefore  
 29 no net increase in channel bank scour.

30 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 31 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 32 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 33 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
 34 effect would be to reduce the channel flow rates by 10–20% compared to Existing  
 35 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
 36 than significant. No mitigation is required.

37 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
 38 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
 39 **CM11, CM18 and CM19**

40 Implementation of conservation measures under Alternative 1C would be the same as under  
 41 Alternative 1A. These activities would include breaching, lowering, or removing levees; constructing  
 42 setback levees and cross levees or berms; raising the land elevation by excavating relatively high  
 43 areas to provide fill for subsided areas or by importing fill material; surface grading, deepening

1 and/or widening tidal channels; excavating channels; excavation and grading to construct facilities,  
 2 access roads, and other facilities; and other activities. These activities could cause adverse effects on  
 3 soil erosion rates and cause a loss of topsoil through both water and wind erosion.

4 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
 5 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*,  
 6 *AMMs*, and *CMs*, the BDCP proponents would be required to obtain coverage under the General  
 7 Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP  
 8 and an erosion control plan.

9 Proper implementation of the requisite SWPPP and compliance with the General Permit would  
 10 ensure that accelerated water and wind erosion associated with implementation of the conservation  
 11 measures would not be an adverse effect.

12 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 13 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP  
 14 proponents would seek coverage under the state General Permit for Construction and Land  
 15 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such  
 16 as revegetation, runoff control, and sediment barriers), and compliance with water quality  
 17 standards. As a result of implementation of Permit conditions, the impact would be less than  
 18 significant. No mitigation is required.

19 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
 20 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
 21 **CM2–CM11**

22 Implementation of conservation measures would be the same under Alternative 1C as under  
 23 Alternative 1A. Consequently, topsoil loss associated with excavation (e.g., levee foundations, water  
 24 control structures), overcovering (e.g., levees, embankments, application of fill material in subsided  
 25 areas), and water inundation (e.g., aquatic habitat areas) would also be the same as under  
 26 Alternative 1A.

27 **NEPA Effects:** Implementation of habitat restoration activities at the ROAs would result in  
 28 excavation, overcovering, or inundation of a minimum of 77,600 acres of topsoil (this figure includes  
 29 areas of tidal habitat restoration, which will be periodically inundated.). This effect would be  
 30 adverse because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and  
 31 SOILS-2b would reduce the severity of this effect.

32 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,  
 33 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas,  
 34 thereby resulting in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would  
 35 minimize and compensate for these impacts to a degree, but not to a less-than-significant level.  
 36 Therefore, this impact is considered significant and unavoidable.

37 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

38 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 39 1A.

1           **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 2           **Topsoil Storage and Handling Plan**

3           Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 4           1A.

5           **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 6           **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
 7           **Proposed Conservation Measures CM2–CM11**

8           Implementation of the proposed conservation measures under Alternative 1C would be the same as  
 9           under Alternative 1A. Damage to or failure of the habitat levees could occur where these are  
 10          constructed in soils and sediments that are subject to subsidence and differential settlement would  
 11          also be the same as under Alternative 1A. Levee damage or failure could cause surface flooding in  
 12          the vicinity.

13          **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 14          unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 15          *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 16          be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to  
 17          ensure that levees, berms, and other features are constructed to withstand subsidence and  
 18          settlement and to conform to applicable state and federal standards. Such standards include the  
 19          USACE Design and Construction of Levee and DWR Interim Levee Design Criteria for Urban and  
 20          Urbanizing Area State-Federal Project Levees.

21          With construction of all levees, berms, and other conservation features designed and constructed to  
 22          withstand subsidence and settlement and through conformance with applicable state and federal  
 23          design standards, this effect would not be adverse.

24          **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
 25          subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 26          to or failure of the facility. However, because the BDCP proponents would be required to design and  
 27          construct the facilities according to state and federal design standards and guidelines (which may  
 28          involve, for example, replacement of the organic soil), the impact would be less than significant. No  
 29          mitigation is required.

30          **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
 31          **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures**  
 32          **CM2–CM11**

33          Implementation of the proposed conservation measures under Alternative 1C would be the same as  
 34          under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,  
 35          corrosive, or compressible soils would have the same effects as under Alternative 1A. Seasonal  
 36          shrinking and swelling of moderately or highly expansive soils could damage water control  
 37          structures or cause them to fail, resulting in a release of water from the structure and consequent  
 38          flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs  
 39          possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West  
 40          Delta ROA possess soils with high corrosivity to concrete.

41          Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
 42          Mokelumne, and South Delta ROAs.

1 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
 2 compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
 3 studies and testing would be completed prior to construction within the ROAs. The site-specific  
 4 environmental evaluation would identify specific areas where engineering soil properties, including  
 5 soil compressibility, may require special consideration during construction of specific features  
 6 within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
 7 expansive, corrosive and/or compressible soils would prevent adverse effects of such soils.

8 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
 9 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 10 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 11 Corrosive soils could damage in-ground facilities or shorten their service life.  
 12 Compression/settlement of soils after a facility is constructed could result in damage to or failure of  
 13 the facility. However, because the BDCP proponents would be required to design and construct the  
 14 facilities according to state and federal design standards, guidelines, and building codes (which may  
 15 involve, for example, soil lime stabilization, cathodic protection of steel, and soil replacement), the  
 16 impact would be less than significant. No mitigation is required.

### 17 **10.3.3.5 Alternative 2A—Dual Conveyance with Pipeline/Tunnel and Five** 18 **Intakes (15,000 cfs; Operational Scenario B)**

#### 19 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil** 20 **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

21 Alternative 2A would include the same physical/structural components as Alternative 1A, but could  
 22 entail two different intake and intake pumping plant locations. These locations would be where soils  
 23 have similar erosion hazards and would not substantially change the project effects on water soil  
 24 erosion. The effects of Alternative 2A would, therefore, be the same as under Alternative 1A. See the  
 25 discussion of Impact SOILS-1 under Alternative 1A.

26 **NEPA Effects:** Construction of the proposed water conveyance facility under Alternative 2A could  
 27 cause substantial accelerated erosion. However, as described in Section 10.3.1, *Methods for Analysis*,  
 28 and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, DWR would be required to obtain  
 29 coverage under the General Permit for Construction and Land Disturbance Activities, necessitating  
 30 the preparation of a SWPPP and an erosion control plan. Proper implementation of the requisite  
 31 SWPPP and compliance with the General Permit (as discussed in Appendix 3B) would ensure that  
 32 there would not be substantial soil erosion resulting in daily site runoff turbidity in excess of 250  
 33 NTUs as a result of construction of the proposed water conveyance facility, and therefore, there  
 34 would not be an adverse effect.

35 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
 36 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
 37 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
 38 and reuse areas.

39 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 40 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
 41 would seek coverage under the state General Permit for Construction and Land Disturbance  
 42 Activities, necessitating the preparation of a SWPPP and an erosion control plan. As a result of

1 implementation of the requisite SWPPP, and compliance with the General Permit, there would not  
 2 be substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs and the effect  
 3 would be less than significant. No mitigation is required.

4 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of**  
 5 **Constructing the Proposed Water Conveyance Facilities**

6 Alternative 2A would include the same physical/structural components as Alternative 1A, but could  
 7 entail two different intake and intake pumping plant locations. Construction operations would be  
 8 the same as under Alternative 1A, and therefore the effects on topsoil under Alternative 2A would be  
 9 the same as Alternative 1A. See the discussion of Impact SOILS-2 under Alternative 1A.

10 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g.,  
 11 forebays, borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants):  
 12 overcovering (e.g., levees and embankments, spoil storage, pumping plants); and water inundation  
 13 (e.g., sedimentation basins, solids lagoons). DWR has made an environmental commitment for  
 14 Disposal Site Preparation which would require that a portion of the temporary sites selected for  
 15 storage of spoils, RTM, and dredged material will be set aside for topsoil storage and the topsoil  
 16 would be saved for reapplication to disturbed areas, thereby lessening the effect. However, this  
 17 effect would be adverse because it would result in a substantial loss of topsoil. Mitigation Measures  
 18 SOILS-2a and SOILS-2b would reduce the severity of this effect.

19 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
 20 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss  
 21 of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area  
 22 would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate  
 23 for these impacts, but not to a less-than-significant level because topsoil would be permanently lost  
 24 over extensive areas. Therefore, this impact is considered significant and unavoidable.

25 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

26 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 27 1A.

28 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 29 **Topsoil Storage and Handling Plan**

30 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 31 1A.

32 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 33 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the**  
 34 **Proposed Water Conveyance Facilities**

35 Alternative 2A would include the same physical/structural components as Alternative 1A, but could  
 36 entail two different intake and intake pumping plant locations. These locations would be where soils  
 37 have similar subsidence hazards and, without adequate engineering, certain structures could be  
 38 subject to appreciable subsidence resulting in potentially adverse effects. Damage to or collapse of  
 39 the project facilities could occur if they are constructed in soils and sediments that are subject to  
 40 subsidence or differential settlement.

1 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 2 soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for Analysis*,  
 3 and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would be  
 4 conducted at all facilities to identify the types of soil avoidance or soil stabilization measures that  
 5 should be implemented to ensure that the facilities are constructed to withstand subsidence and  
 6 settlement and to conform to applicable state and federal standards. These investigations would  
 7 build upon the geotechnical data reports (California Department of Water Resources 2001a, 2010b,  
 8 2011) and the CERs (California Department of Water Resources 2010a, 2010b). As discussed under  
 9 Alternative 1A, conforming to state and federal design standards, including conduct of site-specific  
 10 geotechnical evaluations, would ensure that appropriate design measures are incorporated into the  
 11 project and any subsidence that takes place under the project facilities would not jeopardize their  
 12 integrity. There would be no adverse effect.

13 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
 14 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
 15 failure of the facility. However, DWR would be required to design and construct the facilities in  
 16 conformance with state and federal design standards and guidelines (e.g., California Building Code,  
 17 American Society of Civil Engineers *Minimum Design Loads for Buildings and Other Structures*,  
 18 ASCE/SEI 7-10, 2010). Conforming to these codes would reduce the potential hazard of subsidence  
 19 or settlement to acceptable levels by avoiding construction directly on or otherwise stabilizing the  
 20 soil material that is prone to subsidence. Because these measures would reduce the potential hazard  
 21 of subsidence or settlement to meet design standards, the impact would be less than significant. No  
 22 mitigation is required.

23 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 24 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

25 Alternative 2A would include the same physical/structural components as Alternative 1A, but could  
 26 entail two different intake and intake pumping plant locations. These different locations would be  
 27 where the soils have similar properties of expansiveness, corrosivity, and compressibility. The  
 28 effects under Alternative 2A would, however, be the same as 1A. See discussion of Impact SOILS-4  
 29 under Alternative 1A.

30 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake  
 31 facilities, pumping plants, access roads and utilities, and other features could be adversely affected  
 32 because they would be located on expansive, corrosive, and compressible soils. However, all facility  
 33 design and construction would be executed in conformance with the CBC, which specifies measures  
 34 to mitigate effects of expansive soils, corrosive soils, and soils subject to compression and  
 35 subsidence. By conforming to the CBC and other applicable design standards, potential effects  
 36 associated with expansive and corrosive soils and soils subject to compression and subsidence  
 37 would be offset. There would be no adverse effect.

38 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to  
 39 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils  
 40 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils  
 41 could damage in-ground facilities or shorten their service life. Compression or settlement of soils  
 42 after a facility is constructed could result in damage to or failure of the facility. However, DWR  
 43 would be required to design and construct the facilities in conformance with state and federal  
 44 design standards, guidelines, and building codes (e.g., CBC and USACE design standards).

1 Conforming to these codes and standards is an environmental commitment by DWR to ensure that  
 2 potential adverse effects associated with expansive and corrosive soils and soils subject to  
 3 compression and subsidence would be offset. Therefore, this impact would be less than significant.  
 4 No mitigation is required.

5 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**  
 6 **Operations**

7 Alternative 2A would have different operations from those under Alternative 1A. However,  
 8 operations under Alternative 2A would have a potential effect on accelerated bank erosion similar to  
 9 those under Alternative 1A. The effects under Alternative 2A would, therefore, be similar to those  
 10 under Alternative 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

11 **NEPA Effects:** Detailed hydrodynamic (tidal) modeling would be conducted prior to any BDCP  
 12 habitat restoration work in these ROA areas, and the changes in the tidal velocities in the major  
 13 channels connecting to these restoration areas would be evaluated. If there is any indication that  
 14 tidal velocities would be substantially increased, the restoration project design would be modified  
 15 (such as by providing additional levee breaches or by requiring dredging in portions of the  
 16 connecting channels) so that bed scour would not increase sufficiently to cause an erosion impact.  
 17 Moreover, as presently occurs and as is typical with most naturally-functioning river channels, local  
 18 erosion and deposition within the tidal habitats is expected as part of the restoration.

19 The effect would not be adverse because there would be no net increase in river flow rates and,  
 20 accordingly, no net increase in channel bank scour.

21 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 22 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 23 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 24 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
 25 effect would be to reduce the channel flow rates by 10–20% compared to Existing  
 26 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
 27 than significant. No mitigation is required.

28 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
 29 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
 30 **CM11, CM18 and CM19**

31 Implementation of conservation measures under Alternative 2A would be the same as under  
 32 Alternative 1A. Implementation of the conservation measures would involve ground disturbance  
 33 and construction activities that could lead to accelerated soil erosion rates and consequent loss of  
 34 topsoil. See the discussion of Impact SOILS-6 under Alternative 1A.

35 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
 36 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments,*  
 37 *AMMs, and CMs*, the BDCP proponents would be required to obtain coverage under the General  
 38 Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP  
 39 and an erosion control plan. Proper implementation of the requisite SWPPP, site-specific BMPs, and  
 40 compliance with the General Permit would ensure that accelerated water and wind erosion as a  
 41 result of implementing conservation measures would not be an adverse effect.

1 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 2 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP  
 3 proponents would seek coverage under the state General Permit for Construction and Land  
 4 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such  
 5 as revegetation, runoff control, and sediment barriers), and compliance with water quality  
 6 standards. As a result of implementation of Permit conditions, the impact would be less than  
 7 significant. No mitigation is required.

8 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
 9 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
 10 **CM2–CM11**

11 Conservation measures would be the same under Alternative 2A as under Alternative 1A. Topsoil  
 12 effectively would be lost as a resource as a result of its excavation, overcovering, and water  
 13 inundation over extensive areas of the Plan Area. See the discussion of Impact SOILS-7 under  
 14 Alternative 1A.

15 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.  
 16 Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of this effect.

17 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,  
 18 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas,  
 19 thereby resulting in a substantial loss of topsoil. The impact would be significant. Mitigation  
 20 Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts to a degree,  
 21 but not to a less-than-significant level. Therefore, this impact is considered significant and  
 22 unavoidable.

23 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

24 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 25 1A.

26 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 27 **Topsoil Storage and Handling Plan**

28 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 29 1A.

30 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 31 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
 32 **Proposed Conservation Measures CM2–CM11**

33 Conservation measures would be the same under Alternative 2A as under Alternative 1A. Damage to  
 34 or failure of the habitat levees could occur where these are constructed in soils and sediments that  
 35 are subject to subsidence and differential settlement. These soil conditions have the potential to  
 36 exist in the Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the vicinity.  
 37 See the discussion of Impact SOILS-8 under Alternative 1A.

38 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 39 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 40 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would

1 be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to  
 2 ensure that levees, berms, and other features are constructed to withstand subsidence and  
 3 settlement and to conform to applicable state and federal standards.

4 With construction of all levees, berms, and other conservation features designed and constructed to  
 5 withstand subsidence and settlement and through conformance with applicable state and federal  
 6 design standards, this effect would not be adverse.

7 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
 8 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 9 to or failure of the facility. However, because the BDCP proponents would be required to design and  
 10 construct the facilities according to state and federal design standards and guidelines (which may  
 11 involve, for example, replacement of the organic soil), the impact would be less than significant. No  
 12 mitigation is required.

13 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,  
 14 and Compressible Soils as a Result of Implementing the Proposed Conservation Measures  
 15 CM2-CM11**

16 Implementation of the proposed conservation measures under Alternative 2A would be the same as  
 17 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,  
 18 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the  
 19 discussion of Impact SOILS-9 under Alternative 1A.

20 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control  
 21 structures or cause them to fail, resulting in a release of water from the structure and consequent  
 22 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs  
 23 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West  
 24 Delta ROA possess soils with high corrosivity to concrete.

25 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
 26 Mokelumne, and South Delta ROAs.

27 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
 28 compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
 29 studies and testing would be completed prior to construction within the ROAs. The site-specific  
 30 environmental evaluation would identify specific areas where engineering soil properties, including  
 31 soil compressibility, may require special consideration during construction of specific features  
 32 within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
 33 expansive, corrosive and/or compressible soils would prevent adverse effects of such soils.

34 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
 35 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 36 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 37 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
 38 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
 39 However, because the BDCP proponents would be required to design and construct the facilities  
 40 according to state and federal design standards, guidelines, and building codes (which may involve,  
 41 for example, soil lime stabilization, cathodic protection of steel, and soil replacement), this impact  
 42 would be considered less than significant. No mitigation is required.

### 10.3.3.6 Alternative 2B—Dual Conveyance with East Alignment and Five Intakes (15,000 cfs; Operational Scenario B)

#### Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities

Alternative 2B would include the same physical/structural components as Alternative 1B, but could entail two different intake and intake pumping plant locations. These locations would be where the soils have similar erosion hazards and would not substantially change the project effects on soil erosion. The effects under Alternative 2B would, therefore, be the same as under Alternative 1B. See the discussion of Impact SOILS-1 under Alternative 1A.

**NEPA Effects:** Construction of the proposed water conveyance facility under Alternative 2B could cause substantial accelerated erosion. However, as described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, DWR would be required to obtain coverage under the General Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP and compliance with the General Permit would ensure that there would not be substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs as a result of construction of the proposed water conveyance facility, and therefore, there would not be an adverse effect.

Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal, and reuse areas.

**CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of water conveyance facilities could cause accelerated water and wind erosion of soil. However, because DWR would seek coverage under the state General Permit for Construction and Land Disturbance Activities (as discussed in Appendix 3B, *Environmental Commitments, AMMs, and CMs*), necessitating the preparation of a SWPPP and an erosion control plan. As a result of implementation of the SWPPP and compliance with the General Permit, there would not be substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs, and therefore, the impact would be less than significant. No mitigation is required.

#### Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of Constructing the Proposed Water Conveyance Facilities

Alternative 2B would include the same physical/structural components as Alternative 1B, but could entail two different intake and intake pumping plant locations. Construction operations would be the same as those under Alternative 1B, and therefore the effects on topsoil under Alternative 2B would be the same as those under Alternative 1B. See the discussion of Impact SOILS-2 under Alternative 1B.

**NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., forebays, canal alignment, borrow areas, levee foundations, intake facilities, pumping plants); overcovering (e.g., levees and embankments, spoil storage, pumping plants); and water inundation (e.g., sedimentation basins solids lagoons). DWR has made an environmental commitment for Disposal Site Preparation which would require that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will be set aside for topsoil storage and the topsoil

1 would be saved for reapplication to disturbed areas, thereby lessening the effect. However, this  
 2 effect would be adverse because it would result in substantial loss of topsoil. Mitigation Measures  
 3 SOILS-2a and SOILS-2b would reduce the severity of this effect.

4 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
 5 overcovering, and inundation of topsoil over large areas, thereby resulting in a substantial loss of  
 6 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area  
 7 would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate  
 8 for these impacts, but not to a less-than-significant level because topsoil would be permanently lost  
 9 over extensive areas. Therefore, this impact is considered significant and unavoidable.

#### 10 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

11 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 12 1A.

#### 13 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a** 14 **Topsoil Storage and Handling Plan**

15 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 16 1A.

#### 17 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and** 18 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the** 19 **Proposed Water Conveyance Facilities**

20 Alternative 2B would include the same physical/structural components as Alternative 1B, but could  
 21 entail two different intake and intake pumping plant locations. Soils in these locations would have  
 22 similar subsidence hazards and would not substantially change the project effects on subsidence.  
 23 The effects under Alternative 2B would, therefore, be the same as those under Alternative 1B. See  
 24 the discussion of Impact SOILS-3 under Alternative 1B.

25 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 26 soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for Analysis*,  
 27 and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would be  
 28 conducted at all facilities to identify the types of soil avoidance or soil stabilization measures that  
 29 should be implemented to ensure that the facilities are constructed to withstand subsidence and  
 30 settlement and to conform to applicable state and federal standards. These investigations would  
 31 build upon the geotechnical data reports (California Department of Water Resources 2001a, 2010b,  
 32 2011) and the CERs (California Department of Water Resources 2009a, 2010c). As discussed under  
 33 Alternative 1B, conforming to state and federal design standards, including conduct of site-specific  
 34 geotechnical evaluations, would ensure that appropriate design measures are incorporated into the  
 35 project and any subsidence that takes place under the project facilities would not jeopardize their  
 36 integrity.

37 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
 38 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
 39 failure of the facility. However, because DWR would be required to design and construct the  
 40 facilities in conformance with state and federal design standards and guidelines (e.g., California  
 41 Building Code, American Society of Civil Engineers *Minimum Design Loads for Buildings and Other*

1 *Structures*, ASCE/SEI 7-10, 2010). Conforming to these codes would reduce the potential hazard of  
 2 subsidence or settlement to acceptable levels by avoiding construction directly on or otherwise  
 3 stabilizing the soil material that is prone to subsidence. Because these measures would reduce the  
 4 potential hazard of subsidence or settlement to meet design standards, this impact is considered  
 5 less than significant. No mitigation is required.

6 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 7 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

8 Alternative 2B would include the same physical/structural components as Alternative 1B, but could  
 9 entail two different intake and intake pumping plant locations. These different locations would be  
 10 where the soils have similar properties of expansiveness, corrosivity, and compressibility. The  
 11 effects under Alternative 2B would, therefore, be the same as those under Alternative 1B. See the  
 12 discussion of Impact SOILS-4 under Alternative 1B.

13 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake  
 14 facilities, pumping plants, access roads and utilities, and other features could be adversely affected  
 15 because they would be located on expansive, corrosive, and compressible soils. However, all facility  
 16 design and construction would be executed in conformance with the CBC, which specifies measures  
 17 to mitigate effects of expansive soils, corrosive soils, and soils subject to compression and  
 18 subsidence. By conforming to the CBC and other applicable design standards, potential effects  
 19 associated with expansive and corrosive soils and soils subject to compression and subsidence  
 20 would be offset. There would be no adverse effect.

21 **CEQA Conclusion:** Many of the Alternative 2B facilities would be constructed on soils that are  
 22 subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 23 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 24 Corrosive soils could damage in-ground facilities or shorten their service life.  
 25 Compression/settlement of soils after a facility is constructed could result in damage to or failure of  
 26 the facility. However, DWR would be required to design and construct the facilities in conformance  
 27 with state and federal design standards, guidelines, and building codes (e.g., CBC and USACE design  
 28 standards). Conforming to these codes and standards is an environmental commitment by DWR to  
 29 ensure that potential adverse effects associated with expansive and corrosive soils and soils subject  
 30 to compression and subsidence would be offset. Therefore, the impact would be less than significant.  
 31 No mitigation is required.

32 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**  
 33 **Operations**

34 Alternative 2B would have operations different from those under Alternative 1A. However,  
 35 operations under Alternative 2B would have a potential effect on accelerated bank erosion similar to  
 36 those under Alternative 1A. The effects under Alternative 2B would, therefore, be similar to those of  
 37 Alternative 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

38 **NEPA Effects:** Detailed hydrodynamic (tidal) modeling would be conducted prior to any BDCP  
 39 habitat restoration work in these ROA areas, and the changes in the tidal velocities in the major  
 40 channels connecting to these restoration areas would be evaluated. If there is any indication that  
 41 tidal velocities would be substantially increased, the restoration project design would be modified  
 42 (such as by providing additional levee breaches or by requiring dredging in portions of the  
 43 connecting channels) so that bed scour would not increase sufficiently to cause an erosion impact.

1 Moreover, as presently occurs and as is typical with most naturally-functioning river channels, local  
 2 erosion and deposition within the tidal habitats is expected as part of the restoration. The effect  
 3 would not be adverse because there would be no net increase in river flow rates and therefore no  
 4 net increase in channel bank scour.

5 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 6 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 7 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 8 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
 9 effect would be to reduce the channel flow rates by 10–20% compared to Existing  
 10 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
 11 than significant. No mitigation is required.

12 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
 13 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
 14 **CM11, CM18 and CM19**

15 Implementation of conservation measures under Alternative 2B would be the same as under  
 16 Alternative 1A. Implementation of the conservation measures would involve ground disturbance  
 17 and construction activities that could lead to accelerated soil erosion rates and consequent loss of  
 18 topsoil. See the discussion of Impact SOILS-6 under Alternative 1A.

19 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
 20 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments,*  
 21 *AMMs, and CMs*, the BDCP proponents would be required to obtain coverage under the General  
 22 Permit for Construction and Land Disturbance Activities, necessitating preparation of a SWPPP and  
 23 an erosion control plan. Proper implementation of the requisite SWPPP and compliance with the  
 24 General Permit would ensure that accelerated water and wind erosion associated with  
 25 implementation of the conservation measures would not be an adverse effect.

26 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 27 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP  
 28 proponents would seek coverage under the state General Permit for Construction and Land  
 29 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such  
 30 as revegetation, runoff control, and sediment barriers), and compliance with water quality  
 31 standards. As a result of implementation of Permit conditions, the impact would be less than  
 32 significant. No mitigation is required.

33 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
 34 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
 35 **CM2–CM11**

36 Implementation of conservation measures would be the same under Alternative 2B as under  
 37 Alternative 1A. Consequently, topsoil loss associated with excavation, overcovering, and water  
 38 inundation over extensive areas of the Plan Area would also be the same as under Alternative 1A.  
 39 See the discussion of Impact SOILS-7 under Alternative 1A.

40 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.  
 41 Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of this effect.

1 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,  
 2 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas,  
 3 thereby resulting in a substantial loss of topsoil. The impact would be significant. Mitigation  
 4 Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts, but not to a  
 5 less-than-significant level. Therefore, this impact is considered significant and unavoidable.

6 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

7 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 8 1A.

9 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 10 **Topsoil Storage and Handling Plan**

11 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 12 1A.

13 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 14 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
 15 **Proposed Conservation Measures CM2–CM11**

16 Conservation measures would be the same under Alternative 2B as under Alternative 1A. Damage to  
 17 or failure of the habitat levees could occur where these are constructed in soils and sediments that  
 18 are subject to subsidence and differential settlement would also be the same as Alternative 1A.  
 19 Levee damage or failure could cause surface flooding in the vicinity. See the discussion of Impact  
 20 SOILS-8 under Alternative 1A.

21 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 22 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 23 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 24 be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to  
 25 ensure that levees, berms, and other features are constructed to withstand subsidence and  
 26 settlement and to conform to applicable state and federal standards.

27 With construction of all levees, berms, and other conservation features designed and constructed to  
 28 withstand subsidence and settlement and through conformance with applicable state and federal  
 29 design standards, this effect would not be adverse.

30 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
 31 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 32 to or failure of the facility. However, because the BDCP proponents would be required to design and  
 33 construct the facilities according to state and federal design standards and guidelines (which may  
 34 involve, for example, replacement of the organic soil), the impact would be less than significant. No  
 35 mitigation is required.

36 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
 37 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures**  
 38 **CM2–CM11**

39 Implementation of the proposed conservation measures under Alternative 2B would be the same as  
 40 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,

1 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the  
2 discussion of Impact SOILS-9 under Alternative 1A.

3 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control  
4 structures or cause them to fail, resulting in a release of water from the structure and consequent  
5 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs  
6 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West  
7 Delta ROA possess soils with high corrosivity to concrete.

8 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
9 Mokelumne, and South Delta ROAs.

10 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
11 compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
12 studies and testing would be completed prior to construction within the ROAs. The site-specific  
13 environmental evaluation would identify specific areas where engineering soil properties, including  
14 soil compressibility, may require special consideration during construction of specific features  
15 within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
16 expansive, corrosive and/or compressible soils would prevent adverse effects of such soils. See the  
17 discussion of Impact SOILS-9 under Alternative 1A.

18 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
19 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
20 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
21 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
22 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
23 However, because the BDCP proponents would be required to design and construct the facilities  
24 according to state and federal design standards, guidelines, and building codes (which may involve,  
25 for example, soil lime stabilization, cathodic protection of steel, and soil replacement), the impacts  
26 would be considered less than significant. No mitigation is required.

### 27 **10.3.3.7 Alternative 2C—Dual Conveyance with West Alignment and** 28 **Intakes W1–W5 (15,000 cfs; Operational Scenario B)**

#### 29 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil** 30 **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

31 Alternative 2C would include the same physical/structural components as Alternative 1C. The  
32 effects under Alternative 2C would, therefore, be the same as under Alternative 1C. See the  
33 discussion of Impact SOILS-1 under Alternative 1C.

34 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative  
35 2C could cause substantial accelerated erosion. However, as described in Section 10.3.1, *Methods for*  
36 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, DWR would be required to  
37 obtain coverage under the General Permit for Construction and Land Disturbance Activities,  
38 necessitating the preparation of a SWPPP and an erosion control plan. Proper implementation of the  
39 requisite SWPPP and compliance with the General Permit (as discussed in Appendix 3B) would  
40 ensure that there would not be substantial soil erosion resulting in daily site runoff turbidity in  
41 excess of 250 NTUs as a result of construction of the proposed water conveyance facility, and  
42 therefore, there would not be an adverse effect.

1 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
 2 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
 3 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
 4 and reuse areas.

5 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 6 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
 7 would seek coverage under the state General Permit for Construction and Land Disturbance  
 8 Activities (as discussed in Appendix 3B, *Environmental Commitments, AMMs, and CMs*), necessitating  
 9 the preparation of a SWPPP and an erosion control plan. As a result of implementation of the  
 10 requisite SWPPP and compliance with the General Permit, there would not be substantial soil  
 11 erosion resulting in daily site runoff turbidity in excess of 250 NTUs, and therefore, the impact  
 12 would be less than significant. No mitigation is required.

### 13 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 14 **Constructing the Proposed Water Conveyance Facilities**

15 Alternative 2C would include the same physical/structural components as Alternative 1C. The  
 16 effects under Alternative 2C would, therefore, be the same as those under Alternative 1C. See the  
 17 discussion of Impact SOILS-2 under Alternative 1C.

18 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g.,  
 19 forebays, canal alignment, borrow areas, levee foundations, intake facilities, pumping plants);  
 20 overcovering (e.g., levees and embankments, spoil storage, pumping plants); and water inundation  
 21 (e.g., sedimentation basins solids lagoons). DWR has made an environmental commitment for  
 22 Disposal Site Preparation which would require that a portion of the temporary sites selected for  
 23 storage of spoils, RTM, and dredged material will be set aside for topsoil storage and the topsoil  
 24 would be saved for reapplication to disturbed areas, thereby lessening the effect. However, this  
 25 effect would be adverse because it would result in substantial loss of topsoil. Mitigation Measures  
 26 SOILS-2a and SOILS-2b would reduce the severity of this effect.

27 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
 28 overcovering, and inundation of topsoil over large areas, thereby resulting in a substantial loss of  
 29 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area  
 30 would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate  
 31 for these impacts, but not to a less-than-significant level because topsoil would be permanently lost  
 32 over extensive areas. Therefore, this impact is considered significant and unavoidable.

### 33 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

34 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 35 1A.

### 36 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a** 37 **Topsoil Storage and Handling Plan**

38 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 39 1A.

1 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 2 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the**  
 3 **Proposed Water Conveyance Facilities**

4 Alternative 2C would include the same physical/structural components as Alternative 1C. The  
 5 effects of Alternative 2C would, therefore, be the same as those under Alternative 1C. See the  
 6 discussion of Impact SOILS-3 under Alternative 1A.

7 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 8 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 9 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 10 be conducted at all facilities to identify the types of soil stabilization that should be implemented to  
 11 ensure that the facilities are constructed to withstand subsidence and settlement and to conform to  
 12 applicable state and federal standards. These investigations would build upon the geotechnical data  
 13 reports (California Department of Water Resources 2001a, 2010b, 2011) and the CERs (California  
 14 Department of Water Resources 2009b, 2010d). As discussed under Alternative 1C, conforming to  
 15 state and federal design standards, including conduct of site-specific geotechnical evaluations,  
 16 would ensure that appropriate design measures are incorporated into the project and any  
 17 subsidence that takes place under the project facilities would not jeopardize their integrity.

18 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
 19 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
 20 failure of the facility. However, because DWR would be required to design and construct the  
 21 facilities in conformance with state and federal design standards and guidelines (e.g., California  
 22 Building Code, American Society of Civil Engineers *Minimum Design Loads for Buildings and Other*  
 23 *Structures*, ASCE/SEI 7-10, 2010). Conforming to these codes would reduce the potential hazard of  
 24 subsidence or settlement to acceptable levels by avoiding construction directly on or otherwise  
 25 stabilizing the soil material that is prone to subsidence. Because these measures would reduce the  
 26 potential hazard of subsidence or settlement to meet design standards, the impact would be less  
 27 than significant. No mitigation is required.

28 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 29 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

30 Alternative 2C would include the same physical/structural components as Alternative 1C. The  
 31 effects of Alternative 2C would, therefore, be the same as those of Alternative 1C. See discussion of  
 32 Impact SOILS-4 under Alternative 1C.

33 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake  
 34 facilities, pumping plants, access roads and utilities, and other features could be adversely affected  
 35 because they would be located on expansive, corrosive, and compressible soils. However, all facility  
 36 design and construction would be executed in conformance with the CBC, which specifies measures  
 37 to mitigate effects of expansive soils, corrosive soils, and soils subject to compression and  
 38 subsidence. By conforming to the CBC and other applicable design standards, potential effects  
 39 associated with expansive and corrosive soils and soils subject to compression and subsidence  
 40 would be offset. There would be no adverse effect.

41 **CEQA Conclusion:** Many of the Alternative 2C facilities would be constructed on soils that are  
 42 subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 43 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.

1 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
 2 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
 3 However, because DWR would be required to design and construct the facilities in conformance  
 4 with state and federal design standards, guidelines, and building codes (e.g., CBC and USACE design  
 5 standards). Conforming to these codes and standards is an environmental commitment by DWR to  
 6 ensure that potential adverse effects associated with expansive and corrosive soils and soils subject  
 7 to compression and subsidence would be offset. Therefore, the impact would be less than significant.  
 8 No mitigation is required.

9 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**  
 10 **Operations**

11 Alternative 2C would have operations different from those of Alternative 1A. However, operations  
 12 under Alternative 2C would have a potential effect on accelerated bank erosion similar to those  
 13 under Alternative 1A. The effects of Alternative 2C would, therefore, be similar to those of  
 14 Alternative 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

15 **NEPA Effects:** Detailed hydrodynamic (tidal) modeling would be conducted prior to any BDCP  
 16 habitat restoration work in these ROA areas, and the changes in the tidal velocities in the major  
 17 channels connecting to these restoration areas would be evaluated. If there is any indication that  
 18 tidal velocities would be substantially increased, the restoration project design would be modified  
 19 (such as by providing additional levee breaches or by requiring dredging in portions of the  
 20 connecting channels) so that bed scour would not increase sufficiently to cause an erosion impact.  
 21 Moreover, as presently occurs and as is typical with most naturally-functioning river channels, local  
 22 erosion and deposition within the tidal habitats is expected as part of the restoration. The effect  
 23 would not be adverse because there would be no net increase in river flow rates and therefore no  
 24 net increase in channel bank scour.

25 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 26 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 27 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 28 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
 29 effect would be to reduce the channel flow rates by 10–20% compared to Existing  
 30 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
 31 than significant. No mitigation is required.

32 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
 33 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
 34 **CM11, CM18 and CM19**

35 Implementation of conservation measures under Alternative 2C would be the same as under  
 36 Alternative 1A. Implementation of the conservation measures would involve ground disturbance  
 37 and construction activities that could lead to accelerated soil erosion rates and consequent loss of  
 38 topsoil. See the discussion of Impact SOILS-6 under Alternative 1A.

39 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
 40 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments,*  
 41 *AMMs, and CMs*, the BDCP proponents would be required to obtain coverage under the General  
 42 Permit for Construction and Land Disturbance Activities, necessitating preparation of a SWPPP and  
 43 an erosion control plan. Proper implementation of the requisite SWPPP, site-specific BMPs, and

1 compliance with the General Permit would ensure that accelerated water and wind erosion as a  
2 result of implementing conservation measures would not be an adverse effect.

3 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
4 conservation measures could cause accelerated water and wind erosion of soil. However, the BDCP  
5 proponents would seek coverage under the state General Permit for Construction and Land  
6 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such  
7 as revegetation, runoff control, and sediment barriers) and compliance with water quality  
8 standards. As a result of implementation of Permit conditions, the impact would be less than  
9 significant. No mitigation is required.

10 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
11 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
12 **CM2-CM11**

13 Conservation measures would be the same under Alternative 2C as under Alternative 1A. Topsoil  
14 effectively would be lost as a resource as a result of its excavation, overcovering, and water  
15 inundation over extensive areas of the Plan Area. See the discussion of Impact SOILS-7 under  
16 Alternative 1A.

17 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.  
18 Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of this effect.

19 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,  
20 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas,  
21 thereby resulting in a substantial loss of topsoil. The impact would be significant. Mitigation  
22 Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts to a degree,  
23 but not to a less-than-significant level. Therefore, this impact is considered significant and  
24 unavoidable.

25 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

26 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
27 1A.

28 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
29 **Topsoil Storage and Handling Plan**

30 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
31 1A.

32 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
33 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
34 **Proposed Conservation Measures CM2-CM11**

35 Conservation measures would be the same under Alternative 2C as under Alternative 1A. Injury or  
36 death could result from damage to or failure of the habitat levees where these are constructed in  
37 soils and sediments that are subject to subsidence and differential settlement. These soil conditions  
38 have the potential to exist in the Suisun Marsh ROA. Levee damage or failure could cause surface  
39 flooding in the vicinity. See the discussion of Impact SOILS-8 under Alternative 1A.

1 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 2 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 3 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 4 be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to  
 5 ensure that levees, berms, and other features are constructed to withstand subsidence and  
 6 settlement and to conform to applicable state and federal standards.

7 With construction of all levees, berms, and other conservation features designed and constructed to  
 8 withstand subsidence and settlement and through conformance with applicable state and federal  
 9 design standards, this effect would not be adverse.

10 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
 11 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 12 to or failure of the facility, potentially resulting in loss, injury, or death. However, because the BDCP  
 13 proponents would be required to design and construct the facilities according to state and federal  
 14 design standards and guidelines (which may involve, for example, replacement of the organic soil),  
 15 the impact would be less than significant. No mitigation is required.

16 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
 17 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures**  
 18 **CM2–CM11**

19 Construction of the proposed conservation measures under Alternative 2C would be the same as  
 20 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,  
 21 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the  
 22 discussion of Impact SOILS-9 under Alternative 1A.

23 **NEPA Effects:** Seasonal shrinking and swelling of moderately or highly expansive soils could damage  
 24 water control structures or cause them to fail, resulting in a release of water from the structure and  
 25 consequent flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all  
 26 the ROAs possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of  
 27 the West Delta ROA possess soils with high corrosivity to concrete.

28 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
 29 Mokelumne, and South Delta ROAs.

30 The conservation measures could be located on expansive, corrosive, and compressible soils.  
 31 However, ROA-specific environmental effect evaluations and geotechnical studies and testing would  
 32 be completed prior to construction within the ROAs. The site-specific environmental evaluation  
 33 would identify specific areas where engineering soil properties, including soil compressibility, may  
 34 require special consideration during construction of specific features within ROAs. Conformity with  
 35 USACE, CBC, and other design standards for construction on expansive, corrosive and/or  
 36 compressible soils would prevent adverse effects of such soils.

37 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
 38 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 39 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 40 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
 41 settlement of soils after a facility is constructed could result in damage to or failure of the facility,  
 42 potentially resulting in loss, injury, or death. However, because the BDCP proponents would be

1 required to design and construct the facilities according to state and federal design standards,  
 2 guidelines, and building codes (which may involve, for example, soil lime stabilization, cathodic  
 3 protection of steel, and soil replacement), this impact would be considered less than significant. No  
 4 mitigation is required.

### 5 **10.3.3.8 Alternative 3—Dual Conveyance with Pipeline/Tunnel and** 6 **Intakes 1 and 2 (6,000 cfs; Operational Scenario A)**

#### 7 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil** 8 **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

9 Alternative 3 would include the same physical/structural components as Alternative 1A, except that  
 10 it would entail three fewer intakes and three fewer pumping plants. These differences would result  
 11 in slightly less accelerated erosion effects than Alternative 1A. The effects of Alternative 3 would,  
 12 however, be similar to those of Alternative 1A. See the discussion of Impact SOILS-1 under  
 13 Alternative 1A.

14 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative  
 15 3 could cause substantial accelerated erosion. However, as described in Section 10.3.1, *Methods for*  
 16 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, DWR would be required to  
 17 obtain coverage under the General Permit for Construction and Land Disturbance Activities,  
 18 necessitating the preparation of a SWPPP and an erosion control plan. Proper implementation of the  
 19 requisite SWPPP and compliance with the General Permit would ensure that there would not be  
 20 substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs as a result of  
 21 construction of the proposed water conveyance facility, and therefore, would not be an adverse  
 22 effect.

23 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
 24 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
 25 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
 26 and reuse areas.

27 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 28 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
 29 would seek coverage under the state General Permit for Construction and Land Disturbance  
 30 Activities (as discussed in Appendix 3B, *Environmental Commitments, AMMs, and CMs*), necessitating  
 31 preparation of a SWPPP and an erosion control plan. As a result of implementation of the requisite  
 32 SWPPP and compliance with the General Permit, where applicable, there would not be substantial  
 33 soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs and the effect would be less  
 34 than significant. No mitigation is required.

#### 35 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 36 **Constructing the Proposed Water Conveyance Facilities**

37 Alternative 3 would include the same physical/structural components as Alternative 1A, except that  
 38 it would entail three fewer intakes and three fewer pumping plants. These differences would result  
 39 in slightly less effects on topsoil loss than Alternative 1A. The effects of Alternative 3 would,  
 40 however, be similar to those of Alternative 1A. See the discussion of Impact SOILS-2 under  
 41 Alternative 1A.

1 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g.,  
 2 forebays, borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants);  
 3 overcovering (e.g., levees and embankments, spoil storage, pumping plants); and water inundation  
 4 (e.g., sedimentation basins solids lagoons). DWR has made an environmental commitment for  
 5 Disposal Site Preparation which would require that a portion of the temporary sites selected for  
 6 storage of spoils, RTM, and dredged material will be set aside for topsoil storage and the topsoil  
 7 would be saved for reapplication to disturbed areas, thereby lessening the effect. However, this  
 8 effect would be adverse because it would result in a substantial loss of topsoil. Mitigation Measures  
 9 SOILS-2a and SOILS-2b would reduce the severity of this effect.

10 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
 11 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss  
 12 of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area  
 13 would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate  
 14 for these impacts, but not to a less than significant level because topsoil would be permanently lost  
 15 over extensive areas. Therefore, this impact is considered significant and unavoidable.

#### 16 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

17 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 18 1A.

#### 19 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a** 20 **Topsoil Storage and Handling Plan**

21 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 22 1A.

#### 23 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and** 24 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the** 25 **Proposed Water Conveyance Facilities**

26 Alternative 3 would include the same physical/structural components as Alternative 1A, but would  
 27 entail three fewer intakes and three fewer pumping plants. These differences would result in slightly  
 28 less effects related to subsidence than Alternative 1A. The effects of Alternative 3 would, however,  
 29 be similar to those of Alternative 1A. See the discussion of Impact SOILS-3 under Alternative 1A.

30 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 31 soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for Analysis*,  
 32 and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would be  
 33 conducted at all facilities to identify the types of soil avoidance or soil stabilization that should be  
 34 implemented to ensure that the facilities are constructed to withstand subsidence and settlement  
 35 and to conform to applicable state and federal standards. These investigations would build upon the  
 36 geotechnical data reports (California Department of Water Resources 2001a, 2010b, 2011) and the  
 37 CERs (California Department of Water Resources 2010a, 2010b). As discussed under Alternative 1A,  
 38 conforming to state and federal design standards, including conduct of site-specific geotechnical  
 39 evaluations, would ensure that appropriate design measures are incorporated into the project and  
 40 any subsidence that takes place under the project facilities would not jeopardize their integrity.

1 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
 2 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
 3 failure of the facility, potentially resulting in loss, injury, or death. However, because DWR would be  
 4 required to design and construct the facilities according to state and federal design standards and  
 5 guidelines (e.g., California Building Code, American Society of Civil Engineers Minimum Design  
 6 Loads for Buildings and Other Structures, ASCE/SEI 7-10, 2010). Conforming to these codes would  
 7 reduce the potential hazard of subsidence or settlement to acceptable levels by avoiding  
 8 construction directly on or otherwise stabilizing the soil material that is prone to subsidence.  
 9 Because these measures would reduce the potential hazard of subsidence or settlement to meet  
 10 design standards, the impact would be less than significant. No mitigation is required.

11 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 12 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

13 Alternative 3 would include the same physical/structural components as Alternative 1A, except that  
 14 it would entail three fewer intakes and three fewer pumping plants. These differences would result  
 15 in slightly less effects related to expansive, corrosive, and compressible soils than Alternative 1A.  
 16 The effects of Alternative 3 would, however, be similar to those of Alternative 1A. See discussion of  
 17 Impact SOILS-4 under Alternative 1A.

18 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake  
 19 facilities, pumping plants, access roads and utilities, and other features could be adversely affected  
 20 because they would be located on expansive, corrosive, and compressible soils. However, all facility  
 21 design and construction would be executed in conformance with the CBC, which specifies measures  
 22 to mitigate effects of expansive soils, corrosive soils, and soils subject to compression and  
 23 subsidence. By conforming to the CBC and other applicable design standards, potential effects  
 24 associated with expansive and corrosive soils and soils subject to compression and subsidence  
 25 would be offset. There would be no adverse effect.

26 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to  
 27 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils  
 28 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils  
 29 could damage in-ground facilities or shorten their service life. Compression/settlement of soils after  
 30 a facility is constructed could result in damage to or failure of the facility, potentially resulting in  
 31 loss, injury, or death. However, DWR would be required to design and construct the facilities  
 32 according to state and federal design standards, guidelines, and building codes (e.g., CBC and USACE  
 33 design standards). Conforming to these codes and standards is an environmental commitment by  
 34 DWR to ensure that potential adverse effects associated with expansive and corrosive soils and soils  
 35 subject to compression and subsidence would be offset. Therefore, this impact would be less than  
 36 significant. No mitigation is required.

37 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**  
 38 **Operations**

39 Alternative 3 would have operations similar to those of Alternative 1A, but of a lesser magnitude with  
 40 respect to potential effects on accelerated bank erosion because the flow from the north Delta would  
 41 be 6,000 cfs rather than 15,000 cfs. The effects of Alternative 3 would, however, be similar to those  
 42 of Alternative 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

1 **NEPA Effects:** Detailed hydrodynamic (tidal) modeling would be conducted prior to any BDCP  
 2 habitat restoration work in these ROA areas, and the changes in the tidal velocities in the major  
 3 channels connecting to these restoration areas would be evaluated. If there is any indication that  
 4 tidal velocities would be substantially increased, the restoration project design would be modified  
 5 (such as by providing additional levee breaches or by requiring dredging in portions of the  
 6 connecting channels) so that bed scour would not increase sufficiently to cause an erosion impact.  
 7 Moreover, as presently occurs and as is typical with most naturally-functioning river channels, local  
 8 erosion and deposition within the tidal habitats is expected as part of the restoration. The effect  
 9 would not be adverse because there would be no net increase in river flow rates and, accordingly, no  
 10 net increase in channel bank scour.

11 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 12 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 13 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 14 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
 15 effect would be to reduce the channel flow rates by 10–20% compared to Existing  
 16 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
 17 than significant. No mitigation is required.

18 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
 19 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
 20 **CM11, CM18 and CM19**

21 Implementation of conservation measures under Alternative 3 would be the same as under  
 22 Alternative 1A. Implementation of the conservation measures would involve ground disturbance  
 23 and construction activities that could lead to accelerated soil erosion rates and consequent loss of  
 24 topsoil. See the discussion of Impact SOILS-6 under Alternative 1A.

25 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
 26 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*,  
 27 *AMMs, and CMs*, the BDCP proponents and their contractors would be required to obtain coverage  
 28 under the General Permit for Construction and Land Disturbance Activities, necessitating the  
 29 preparation of a SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP,  
 30 site-specific BMPs, and compliance with the General Permit would ensure that accelerated water  
 31 and wind erosion as a result of implementing conservation measures would not be an adverse effect.

32 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 33 restoration areas could cause accelerated water and wind erosion of soil. the BDCP proponents and  
 34 their contractors would seek coverage under the state General Permit for Construction and Land  
 35 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such  
 36 as revegetation, runoff control, and sediment barriers) and compliance with water quality  
 37 standards. As a result of implementation of Permit conditions, the impact would be less than  
 38 significant. No mitigation is required.

39 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
 40 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
 41 **CM2–CM11**

42 Conservation measures would be the same under Alternative 3 as under Alternative 1A. Topsoil  
 43 effectively would be lost as a resource as a result of its excavation, overcovering, and water

1 inundation over extensive areas of the Plan Area. See the discussion of Impact SOILS-7 under  
2 Alternative 1A.

3 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.  
4 Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of this effect.

5 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,  
6 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas,  
7 thereby resulting in a substantial loss of topsoil. The impact would be significant. Mitigation  
8 Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts to a degree,  
9 but not to a less-than-significant level. Therefore, this impact is considered significant and  
10 unavoidable.

#### 11 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

12 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
13 1A.

#### 14 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a** 15 **Topsoil Storage and Handling Plan**

16 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
17 1A.

#### 18 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and** 19 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the** 20 **Proposed Conservation Measures CM2–CM11**

21 Conservation measures would be the same under Alternative 3 as under Alternative 1A. Injury or  
22 death could result from damage to or failure of the habitat levees where these are constructed in  
23 soils and sediments that are subject to subsidence and differential settlement. These soil conditions  
24 have the potential to exist in the Suisun Marsh ROA. Levee damage or failure could cause surface  
25 flooding in the vicinity. See the discussion of Impact SOILS-8 under Alternative 1A.

26 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
27 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
28 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
29 be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to  
30 ensure that levees, berms, and other features are constructed to withstand subsidence and  
31 settlement and to conform to applicable state and federal standards.

32 With construction of all levees, berms, and other conservation features designed and constructed to  
33 withstand subsidence and settlement and through conformance with applicable state and federal  
34 design standards, this effect would not be adverse.

35 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
36 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
37 to or failure of the facility, potentially resulting in loss, injury, or death. However, because the BDCP  
38 proponents would be required to design and construct the facilities according to state and federal  
39 design standards and guidelines (which may involve, for example, replacement of the organic soil),  
40 the impact would be less than significant. No mitigation is required.

1 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
 2 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures**  
 3 **CM2–CM11**

4 Implementation of the proposed conservation measures under Alternative 3 would be the same as  
 5 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,  
 6 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the  
 7 discussion of Impact SOILS-9 under Alternative 1A.

8 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control  
 9 structures or cause them to fail, resulting in a release of water from the structure and consequent  
 10 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs  
 11 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West  
 12 Delta ROA possess soils with high corrosivity to concrete.

13 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
 14 Mokelumne, and South Delta ROAs.

15 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
 16 compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
 17 studies and testing would be completed prior to construction within the ROAs. The site-specific  
 18 environmental evaluation would identify specific areas where engineering soil properties, including  
 19 soil compressibility, may require special consideration during construction of specific features  
 20 within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
 21 expansive, corrosive and/or compressible soils would prevent adverse effects of such soils.

22 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
 23 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 24 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 25 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
 26 settlement of soils after a facility is constructed could result in damage to or failure of the facility,  
 27 potentially resulting in loss, injury, or death. However, because the BDCP proponents would be  
 28 required to design and construct the facilities according to state and federal design standards,  
 29 guidelines, and building codes (which may involve, for example, soil lime stabilization, cathodic  
 30 protection of steel, and soil replacement), this impact would be considered less than significant. No  
 31 mitigation is required.

32 **10.3.3.9 Alternative 4—Dual Conveyance with Modified Pipeline/Tunnel**  
 33 **and Intakes 2, 3, and 5 (9,000 cfs; Operational Scenario H)**

34 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil**  
 35 **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

36 Construction of water conveyance facilities would involve vegetation removal, constructing building  
 37 pads and levees, excavation, overexcavation for facility foundations, surface grading, trenching, road  
 38 construction, spoil and RTM storage, soil stockpiling, and other activities over 7,377 acres during the  
 39 course of constructing the facilities. Vegetation would be removed (via grubbing and clearing) and  
 40 grading and other earthwork would be conducted at the three intakes; pumping plant; intermediate  
 41 forebay; expanded Clifton Court Forebay, canal and gates between the expanded Clifton Court  
 42 Forebay; twin tunnel shafts; offsite pre-cast tunnel segment plants and onsite storage yards;

1 approach canals to the Banks and Jones Pumping Plants; onsite and offsite borrow areas; RTM and  
 2 spoil storage areas; setback and transition levees; sedimentation basins' solids handling facilities;  
 3 transition structures; surge shafts and towers; substations; transmission line footings; access roads;  
 4 concrete batch plants; fuel stations; bridge abutments; barge unloading facilities; and laydown  
 5 areas. (Borrow areas and pre-cast tunnel segment plants would be in areas already proposed for  
 6 disturbance and therefore are evaluated by this EIR/EIS, or would be at new locations outside the  
 7 Plan Area. Areas outside of the Plan Area would likely occur at existing permitted facilities. Any new  
 8 locations would undergo additional technical and environmental review, including that for Soils  
 9 impacts.) Some of the work would be conducted in areas that are fallow at the time. Some of the  
 10 earthwork activities may also result in steepening of slopes and soil compaction, particularly for the  
 11 embankments constructed for the intermediate forebay and the expanded Clifton Court Forebay.  
 12 These conditions tend to result in increased runoff rates, degradation of soil structure, and reduced  
 13 soil infiltration capacity, all of which could cause accelerated erosion, resulting in loss of topsoil.

#### 14 **Water Erosion**

15 The excavation, grading, and other soil disturbances described above that are conducted in gently  
 16 sloping to level areas, such as the interiors of Delta islands, are expected to experience little or no  
 17 accelerated water erosion because of the lack of runoff energy to entrain and transport soil particles  
 18 (Figure 10-5). Any soil that is eroded within island interiors would tend to remain on the island,  
 19 provided that existing or project levees are in place to serve as barriers from keeping the eroded soil  
 20 (i.e., sediment) from entering receiving waters.

21 In contrast, graded and otherwise disturbed tops and sideslopes of existing and project levees and  
 22 embankments are of greater concern for accelerated water erosion because of their steep gradients.  
 23 Although soil eroded from the landside of levees would be deposited on the island interiors, soil  
 24 eroded from the disturbed top and water side of levees could reach adjoining waterways. Soil  
 25 eroded from natural slopes in upland environments could also reach receiving waters.

#### 26 **Wind Erosion**

27 Most of the primary work areas that would involve extensive soil disturbance (i.e., staging areas,  
 28 borrow areas, and intakes) within the Alternative 4 footprint are underlain by soils with a moderate  
 29 or high susceptibility to wind erosion (Natural Resources Conservation Service 2010a) (Figure 10-  
 30 6). Of the primary areas that would be disturbed, only a portion of the proposed borrow/spoil area  
 31 west of Clifton Court Forebay generally has a low wind erosion hazard.

32 Construction activities (e.g., excavation, filling, grading, and vehicle traffic on unimproved roads)  
 33 that could lead to accelerated wind erosion are generally the same as those for water erosion. These  
 34 activities may result in vegetation removal and degradation of soil structure, both of which would  
 35 make the soil much more subject to wind erosion. Removal of vegetation cover and grading increase  
 36 exposure to wind at the surface and obliterate the binding effect of plant roots on soil aggregates.  
 37 These effects make the soil particles much more subject to entrainment by wind. However, most of  
 38 the areas that would be extensively disturbed by construction activities are already routinely  
 39 disturbed by agricultural activities, such from disking and harrowing. These areas are the  
 40 intermediate forebay, most of the expanded Clifton Court Forebay, borrow areas, RTM and spoil  
 41 storage areas, sedimentation basins, solids handling facilities, substations, access roads, concrete  
 42 batch plants, and laydown areas. Consequently, with the exception of loading and transporting of  
 43 soil material to storage areas, the disturbance that would result from constructing the conveyance  
 44 facilities in many areas would not substantially depart from the existing condition, provided that the

1 length of time that the soil is left exposed during the year does not change compared to that  
2 associated with agricultural operations. Because the SWPPPs prepared for the various components  
3 of the project will be required to prescribe ongoing best management practices to control wind  
4 erosion (such as temporary seeding), the amount of time that the soil would be exposed during  
5 construction should not significantly differ from the existing condition.

6 Unlike water erosion, the potential adverse effects of wind erosion are generally not dependent on  
7 slope gradient and location relative to levees or water. Without proper management, the wind-  
8 eroded soil particles can be transported great distances.

9 Some of the soil excavated at tunnel shafts, siphon foundations, certain borrow areas, the Clifton  
10 Court forebays, tunnel and safe haven work areas, ventilation access shafts, concrete batch plants, a  
11 launch/reception shaft, a fuel station, a substation and transmission line, and the Highway 12  
12 interchange and transported to spoil storage areas would consist of organic soil. This material  
13 would be especially susceptible to wind erosion while being loaded onto trucks, transported,  
14 unloaded, and distributed.

15 **NEPA Effects:** These potential effects could be substantial because they could cause accelerated  
16 erosion. However, as described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B,  
17 *Environmental Commitments, AMMs, and CMs*, DWR would be required to obtain coverage under the  
18 General Permit for Construction and Land Disturbance Activities, necessitating the preparation of a  
19 SWPPP and an erosion control plan. Many SWPPPs and erosion control plans are expected to be  
20 prepared for the project, with a given SWPPP and erosion control plan prepared for an individual  
21 component (e.g., one intake) or groups of component (e.g., all the intakes), depending on the manner  
22 in which the work is contracted. DWR would be responsible for preparing and implementing a  
23 SWPPP and erosion control plan as portions of the construction are contracted out and applications  
24 are made to the State Water Board for coverage under the General Permit.

25 The General Permit requires that SWPPPs be prepared by a QSD and implemented under the  
26 supervision of a QSP. As part of the procedure to gain coverage under the General Permit, the QSD  
27 would determine the Risk Level (1, 2, or 3) of the project site, which involves an evaluation of the  
28 site's *Sediment Risk* and *Receiving Water Risk*. *Sediment Risk* is based on the tons per acre per year of  
29 sediment that the site could generate in the absence of erosion and sediment control BMPs.  
30 *Receiving Water Risk* is an assessment of whether the project site is in a sediment-sensitive  
31 watershed, such as those designated by the State Water Board as being impaired for sediment under  
32 Clean Water Act Section 303(d). Much of the northern half of the Plan Area is in a sediment-sensitive  
33 watershed; such areas would likely be Risk Level 2. The remaining areas, generally southwest of the  
34 San Joaquin River, are not in a sediment-sensitive watershed and therefore may potentially be  
35 classified as Risk Level 1.

36 The results of the Risk Level determination partly drive the contents of the SWPPP. In accordance  
37 with the General Permit, the SWPPP would describe site topographic, soil, and hydrologic  
38 characteristics; construction activities and a project construction schedule; construction materials  
39 to be used and other potential sources of pollutants at the project site; potential non-stormwater  
40 discharges (e.g., trench dewatering); erosion and sediment control, non-stormwater, and  
41 "housekeeping" BMPs to be implemented; a BMP implementation schedule; a site and BMP  
42 inspection schedule; and ongoing personnel training requirements. The SWPPPs would also specify  
43 the forms and records that must be uploaded to the State Water Board's online SMARTS, such as  
44 quarterly non-stormwater inspection and annual compliance reports. In those parts of the Plan Area

1 that are determined to be Risk Level 2 or 3, water sampling for pH and turbidity would be required;  
 2 the SWPPP would specify sampling locations and schedule, sample collection and analysis  
 3 procedures, and recordkeeping and reporting protocols.

4 The QSD for the SWPPPs would prescribe BMPs that are tailored to site conditions and project  
 5 component characteristics. Partly because the potential adverse effect on receiving waters depends  
 6 on location of a work area relative to a waterway, the BMPs would be site-specific, such that those  
 7 applied to level island-interior sites (e.g., RTM storage areas) would be different than those applied  
 8 to water-side levee conditions (e.g., intakes).

9 All SWPPPs, irrespective of the site and project characteristics, are likely to contain the following  
 10 BMPs.

- 11 • Preservation of existing vegetation.
- 12 • Perimeter control.
- 13 • Fiber roll and/or silt fence sediment barriers.
- 14 • Watering to control dust entrainment.
- 15 • Tracking control and “housekeeping” measures for equipment refueling and maintenance.
- 16 • Solid waste management.

17 Most sites would require temporary and permanent seeding and mulching. Sites that involve  
 18 disturbance or construction of steep slopes may require installation of erosion control blankets or  
 19 rock slope protection (e.g., setback levees at intakes). Turbidity curtains would be required for in-  
 20 water work. Excavations that will require dewatering (such as for underground utilities and  
 21 footings) will require proper disposal of the water, such as land application or filtration. Soil and  
 22 material stockpiles (such as for borrow material) would require perimeter protection and covering  
 23 or watering to control wind erosion. Concrete washout facilities would be established to prevent  
 24 surface and ground water contamination. Such BMPs, if properly installed and maintained, would  
 25 ensure compliance with the pH and turbidity level requirements defined by the General Permit.

26 The QSP would be responsible for day-to-day implementation of the SWPPP, including BMP  
 27 inspections, maintenance, water quality sampling, and reporting to the State Water Board. In the  
 28 event that the water quality sampling results indicate an exceedance of allowable pH and turbidity  
 29 levels, the QSD would be required to modify the type and/or location of the BMPs by amending the  
 30 SWPPP; such modifications would be uploaded by the QSD to SMARTS.

31 Accelerated water and wind erosion as a result of construction of the proposed water conveyance  
 32 facility could occur under Alternative 4, but proper implementation of the requisite SWPPP and  
 33 compliance with the General Permit (as discussed in Appendix 3B, *Environmental Commitments,*  
 34 *AMMs, and CMs*) would ensure that there would not be substantial soil erosion resulting in daily site  
 35 runoff turbidity in excess of 250 NTUs as a result of construction of the proposed water conveyance  
 36 facility, and therefore, there would not be an adverse effect.

37 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
 38 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
 39 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
 40 and reuse areas.

1 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 2 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
 3 would seek coverage under the state General Permit for Construction and Land Disturbance  
 4 Activities (as discussed in Appendix 3B, *Environmental Commitments, AMMs, and CMs*), necessitating  
 5 preparation of a SWPPP and an erosion control plan. As a result of implementation of the requisite  
 6 SWPPP and compliance with the General Permit, there would not be substantial soil erosion  
 7 resulting in daily site runoff turbidity in excess of 250 NTUs, and therefore, the impact would be less  
 8 than significant. No mitigation is required.

9 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of**  
 10 **Constructing the Proposed Water Conveyance Facilities**

11 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation during  
 12 construction of Alternative 4 (e.g., intake facilities, forebays, tunnel shafts, levee foundations,  
 13 borrow areas); overcovering (e.g., spoil and reusable tunnel material storage areas); and water  
 14 inundation (e.g., sedimentation basins solids lagoons). Table 10-8 presents an itemization of the  
 15 effects on soils caused by excavation, overcovering, and inundation, based on GIS analysis by facility  
 16 type. Because of the nature of the earthwork to construct many of the facilities, more than one  
 17 mechanism of topsoil loss may be involved at a given facility. For example, levee construction would  
 18 require both excavation to prepare the subgrade and overcovering to construct the levee. The table  
 19 shows that the greatest extent of topsoil loss would be associated with overcovering such as  
 20 spoil/RTM storage areas, unless measures are undertaken to salvage the topsoil and reapply it on  
 21 top of excavated borrow areas or on top of the spoils once they have been placed.

22 **Table 10-8. Topsoil Lost as a Result of Excavation, Overcovering, and Inundation Associated with**  
 23 **the Proposed Water Conveyance Facility (Alternatives 4 and 4A)**

| Topsoil Loss Mechanism  | Acreage Affected |
|---|------------------|
| Excavation (forebays, intakes, shafts, levee foundations, borrow areas) | 4,394            |
| Overcovering (spoil storage, reusable tunnel material storage)          | 3,096            |
| Inundation (sedimentation basins solids lagoons)                        | 100              |
| Total   | 7,590            |

Note: Some mechanisms for topsoil loss entail more than one process of soil loss. For example, construction of setback levees would first require overexcavation for the levee foundation (i.e., excavation), then placement of fill material (i.e., overcovering).

24  
 25 Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil  
 26 would not be excavated, overcovered, or inundated, such as at construction staging and laydown  
 27 areas where the soil could be compacted or otherwise affected.

28 DWR has made an environmental commitment (Disposal and Reuse of Spoils, Reusable Tunnel  
 29 Material (RTM), and Dredged Material) to address disposal site preparation which would require  
 30 that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will  
 31 be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,  
 32 thereby lessening the effect. However, this effect would be adverse because it would result in a  
 33 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
 34 this effect, but not to a less-than-significant level because topsoil would be permanently lost over  
 35 extensive areas.

1 The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and  
 2 Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures  
 3 for how excavated subsurface soil materials would be handled, stored, and disposed of. The  
 4 commitment also specifies that temporary storage sites for spoils, RTM, and dredged material  
 5 storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b  
 6 supplements the environmental commitment, specifically by defining topsoil for the purposes of the  
 7 mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

8 **CEQA Conclusion:** Construction of the water conveyance facilities would involve irreversible  
 9 removal, overcovering, and inundation of topsoil over extensive areas, thereby resulting in a  
 10 substantial loss of topsoil despite a commitment for Disposal and Reuse of Spoils, RTM, and Dredged  
 11 Material that would address disposal site preparation. The impact on soils in the Plan Area would be  
 12 significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these  
 13 impacts by reducing the amount of topsoil lost, but not to a less-than-significant level because  
 14 topsoil would be permanently lost over extensive areas. Therefore, this impact is considered  
 15 significant and unavoidable.

#### 16 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

17 A requirement of the General Permit is to minimize the extent of soil disturbance during  
 18 construction. As described in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, the  
 19 SWPPPs prepared for BDCP construction activities will include a BMP that specifies the  
 20 preservation of existing vegetation through installation of temporary construction markers to  
 21 preclude unnecessary intrusion of heavy equipment into non-work areas. The BDCP proponents  
 22 will ensure that the SWPPP BMPs limiting ground disturbance are included in the construction  
 23 contracts and are properly executed during construction by the contractors.

24 However, the BMP specifying preservation of existing vegetation may only limit the extent of the  
 25 surface area disturbed and not the area of excavated soils. Accordingly, soil-disturbing activities  
 26 will be designed such that the area to be excavated, graded, or overcovered is the minimum  
 27 necessary to achieve the purpose of the activity.

28 While minimizing the extent of soil disturbance will reduce the amount of topsoil lost, this will  
 29 result in avoidance of this effect over only a small proportion of the total extent of the graded  
 30 area that will be required to construct the habitat restoration areas, perhaps less than 5%.  
 31 Consequently, a large extent of topsoil will be affected even after implementation of this  
 32 mitigation measure.

#### 33 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a** 34 **Topsoil Storage and Handling Plan**

35 Depending on the thickness of the topsoil<sup>4</sup> at a given construction or restoration site, up to 3 feet  
 36 of the topsoil will be salvaged from construction work areas, stockpiled, and then applied over  
 37 the surface of spoil and RTM storage areas and borrow areas to the maximum extent practicable.  
 38 Exceptions to this measure are areas smaller than 0.1 acre; areas of nonnative soil material, such

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<sup>4</sup> For the purposes of this mitigation measure, *topsoil* is defined as the O, Oi, Oe, Oa, A, Ap, A1, A2, A3, AB, and AC horizons. Three feet of topsoil was selected because it corresponds to the primary root zone depth of most crops grown in the Delta. With the exception of the Histosols (i.e., peat and muck soils), most of the topsoils in the Plan Area are less than 3 feet thick.

1 as levees, where the near-surface soil does not consist of native topsoil; where the soil would be  
2 detrimental to plant growth; and any other areas identified by the soil scientist in evaluating  
3 topsoil characteristics (discussed below). This mitigation measure will complement and is  
4 related to activities recommended under Mitigation Measure AES-1c, in Chapter 17, *Aesthetics*  
5 *and Visual Resources*, as well as to the environmental commitment for Disposal and Reuse of  
6 Spoils, RTM, and Dredged Material.

7 Topsoil excavated to install conveyance or to relocate utilities will be segregated from the  
8 subsoil excavated from open-cut trenches, stockpiled, and reapplied to the surface after the pipe  
9 has been installed.

10 The detailed design of the BDCP-related construction activities will incorporate an evaluation,  
11 based on review of soil survey maps supplemented by field investigations and prepared by the  
12 BDCP proponents, that specifies the thickness of the topsoil that should be salvaged, and that  
13 identifies areas in which no topsoil should be salvaged. The soil scientist will use the exceptions  
14 listed above as the basis for identifying areas in which no topsoil should be salvaged. The BDCP  
15 proponents will ensure that the evaluation is prepared by a qualified individual, that it  
16 adequately addresses all conveyance facilities, and that areas identified for topsoil salvage are  
17 incorporated into the project design and construction contracts and that the contractors  
18 properly execute the salvage operations.

19 The BDCP proponents will also prepare topsoil stockpiling and handling plans for the individual  
20 conveyance and restoration components, establishing such guidelines as the maximum  
21 allowable thickness of soil stockpiles, temporary stockpile stabilization/revegetation measures,  
22 and procedures for topsoil handling during salvaging and reapplication. The maximum  
23 allowable stockpile thickness will depend on the amount of time that the stockpile needs to be in  
24 place and is expected to range from approximately three to 10 feet. The plans will also specify  
25 that, where practicable, the topsoil be salvaged, transported, and applied to its destination area  
26 in one operation (i.e., without stockpiling) to minimize degradation of soil structure and the  
27 increase in bulk density as a result of excessive handling. The stockpiling and handling plans will  
28 also specify maximum allowable stockpile sideslope gradients, seed mixes to control wind and  
29 water erosion, cover crop seed mixes to maintain soil organic matter and nutrient levels, and all  
30 other measures to avoid soil degradation and soil erosional losses caused by excavating,  
31 stockpiling, and transporting topsoil. For staging areas and similar areas in which topsoil would  
32 not be excavated or overcovered, the stockpiling and handling plans will describe how the soil  
33 will be decompacted or otherwise remediated after demobilization, such as the depth and  
34 spacing of ripper shanks and number of passes made by the equipment. The intent of this  
35 provision shall be to ensure that the soil will be returned to a similar bulk density and  
36 productivity as it was before the site was used as a staging area as much as practicable. The  
37 BDCP proponents will ensure that each plan is prepared by a qualified individual, that it  
38 adequately addresses all relevant activities and facilities, and that its specifications are properly  
39 executed during construction by the contractors.

40 Adherence to this measure will ensure that topsoil is appropriately salvaged, stockpiled, and  
41 reapplied. Nevertheless, adverse soil quality effects can also be associated with stockpiling and  
42 construction staging. Such effects commonly include increased bulk density, loss of soil carbon,  
43 degraded aggregate stability, reduced growth of the mycorrhizal fungi, and reduced nutrient  
44 cycling. Such effects may make the soil less productive after it is applied to its destination site,  
45 compared to its pre-salvage condition. Depending on the inherent soil characteristics, the

1 manner in which it is handled and stockpiled, and the duration of its storage, the reapplied  
 2 topsoil may recover quickly to its original condition or require many years to return to its pre-  
 3 salvage physical, chemical, and biological condition (Strohmayer 1999; Vogelsang and Bever  
 4 2010). Implementation will be in compliance with the SWPPP.

5 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 6 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the**  
 7 **Proposed Water Conveyance Facilities**

8 The three intakes, the pumping plant, and pipelines would be constructed in areas in which the  
 9 near-surface soils have approximately 2–4% organic matter content. Compared to organic soils,  
 10 these mineral soils would not be subject to appreciable subsidence caused by organic matter  
 11 decomposition because there is relatively little organic matter available to decompose. The tunnels  
 12 would be constructed at a depth below that of the peat (Figure 9-4); consequently, subsidence  
 13 caused by organic matter decomposition at tunnel depth is expected to be minimal. However,  
 14 because of their soils' higher organic matter content, without adequate engineering the forebay  
 15 levees and interior could be subject to appreciable subsidence.

16 Damage to or collapse of the pipelines and tunnels could occur where these facilities are constructed  
 17 in soils and sediments that are subject to subsidence and differential settlement. Subsidence- or  
 18 differential sediment-induced damage or collapse of these facilities could cause a rapid release of  
 19 water to the surrounding soil, causing an interruption in water supply, and producing underground  
 20 cavities, depressions at the ground surface, and surface flooding. Facilities that have subsided would  
 21 be subject to flooding, and levees that have subsided would be subject to overtopping.

22 Damage to other conveyance facilities, such as intakes, pumping plant, transition structures, and  
 23 control structures, caused by subsidence/settlement under the facilities and consequent damage to  
 24 or failure of the facility could also occur. Facility damage or failure could cause a rapid release of  
 25 water to the surrounding area, resulting in flooding, thereby endangering people in the vicinity.

26 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 27 soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for Analysis*,  
 28 and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies (as described  
 29 in the Geotechnical Exploration Plan—Phase 2 [California Department of Water Resources 2014])  
 30 would be conducted at all facilities to identify the types of soil avoidance or soil stabilization  
 31 measures that should be implemented to ensure that the facilities are constructed to withstand  
 32 subsidence and settlement and to conform to applicable state and federal standards. These  
 33 investigations would build upon the geotechnical data reports (California Department of Water  
 34 Resources 2001a, 2010b, 2011) and the CERs (California Department of Water Resources 2010a,  
 35 2010b, 2015), as well as the results of the investigations that will be conducted under the  
 36 Geotechnical Exploration Plan—Phase 2 (California Department of Water Resources 2014). Such  
 37 standards include the American Society of Civil Engineers Minimum Design Loads for Buildings and  
 38 Other Structures, CBC, and USACE Design and Construction of Levees. The results of the  
 39 investigations, which would be conducted by a California registered civil engineer or California  
 40 certified engineering geologist, would be presented in geotechnical reports. The reports would  
 41 contain recommended measures to prevent subsidence. The geotechnical report will be prepared in  
 42 accordance with state guidelines, in particular *Guidelines for Evaluating and Mitigating Seismic*  
 43 *Hazards in California* (California Geological Survey 2008).

1 Liquid limit (i.e., the moisture content at which a soil passes from a solid to a liquid state) and  
2 organic matter content testing should be performed on soil samples collected during the site-  
3 specific field investigations to determine site-specific geotechnical properties. High organic matter  
4 content soils that are unsuitable for support of structures, roadways, and other facilities would be  
5 overexcavated and replaced with engineered fill, and the unsuitable soils disposed of offsite as spoil,  
6 as described in more detail below. Geotechnical evaluations would be conducted to identify soil  
7 materials that are suitable for engineering purposes.

8 Additional measures to address the potential adverse effects of organic soils could include  
9 construction of structural supports that extend below the depth of organic soils into underlying  
10 materials with suitable bearing strength.

11 For the sedimentation basins, the CER indicates that most of the underlying soils would be  
12 excavated to a depth of 30 feet below grade and removed from the site and suitable soil material  
13 imported to the site to reestablish it to subgrade elevation. Removal of the weak soils and  
14 replacement with engineered fill using suitable soil material would provide a solid foundation for  
15 the sedimentation basins.

16 At the proposed expanded Clifton Court Forebay, the CER specifies that because most of the soils  
17 within the footprints of the forebay and the forebay embankments have high organic matter content,  
18 they would be excavated and removed from the site. Removal of the weak soils to reach competent  
19 soils would provide a solid foundation upon which to construct the forebay and its embankment.

20 At the spillway and stilling basin for the intermediate spillway, the CER indicates that unsuitable  
21 soils would be excavated to competent material and that the spillway would incorporate water-  
22 stopped contraction joints at intervals to accommodate a degree of settlement and subsoil  
23 deformation. Removal of the weak soils to reach competent soils and providing a joint system would  
24 provide a solid foundation for the spillway and stilling basin and enable the spillway to withstand  
25 settlement and deformation without jeopardizing its integrity.

26 Certain methods and practices may be utilized during tunnel construction to help reduce and  
27 manage settlement risk. The CER indicates that the ground improvement techniques to control  
28 settlement at the shafts and tunnels may involve jet-grouting, permeation grouting, compaction  
29 grouting, or other methods that a contractor may propose. Jet-grouting involves use of high-  
30 pressure, high-velocity jets to hydraulically erode, mix and partially replace the surrounding soil  
31 with a cementitious grout slurry, thereby creating a cemented zone of high strength and low  
32 permeability around of tunnel bore. Permeation grouting involves introduction of a low-viscosity  
33 grout (sodium silicate, microfine cement, acrylate or polyurethane) into the pores of the soil around  
34 the tunnel bore, which increases the strength and cohesion of granular soils. Compaction grouting  
35 involves injecting the soil surrounding the tunnel bore with a stiff, low slump grout under pressure,  
36 forming a cemented mass that increases soil bearing capacity. These measures would have the effect  
37 of better supporting the soil above the borehole and would prevent unacceptable settlement  
38 between the borehole and the tunnel segments. Additionally, settlement monitoring points, the  
39 number and location of which would be identified during detailed design, would be established  
40 along the pipeline and tunnel routes during construction and the results reviewed regularly by a  
41 professional engineer. The monitoring therefore would provide early detection of excessive  
42 settlement such that corrective actions could be made before the integrity of the tunnel is  
43 jeopardized.

1 This potential effect could be substantial because the facilities could be located on soils that are  
 2 subject to subsidence. However, as described in Section 10.3.1, *Methods for Analysis*, and Appendix  
 3 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would be conducted at all  
 4 facilities to identify the types of soil avoidance or soil stabilization that should be implemented to  
 5 ensure that the facilities are constructed to withstand subsidence and settlement and to conform to  
 6 applicable state and federal standards. These investigations would build upon the geotechnical data  
 7 reports (California Department of Water Resources 2001a, 2010b, 2011) and the CERs (California  
 8 Department of Water Resources 2010a, 2010b, 2015), as well as the results of the investigations  
 9 that will be conducted under the Geotechnical Exploration Plan—Phase 2 (California Department of  
 10 Water Resources 2014). Additionally, conforming to state and federal design codes and standards,  
 11 including the California Building Code and resource agency and professional engineering  
 12 specifications, such as the American Society of Civil Engineers Minimum Design Loads for Buildings  
 13 and Other Structures, ASCE/SEI 7-10, 2010, would ensure that appropriate design measures are  
 14 incorporated into the project and any subsidence that takes place under the project facilities would  
 15 not jeopardize their integrity. Conforming to these codes and standards is an environmental  
 16 commitment by DWR to ensure cut and fill slopes and embankments will be stable as the water  
 17 conveyance features are operated (Appendix 3B). Conforming to the standards and guidelines may  
 18 necessitate such measures as excavation and removal of weak soils and replacement with  
 19 engineered fill using suitable, imported soil, construction on pilings driven into competent soil  
 20 material, and construction of facilities on cast-in-place slabs. These measures would reduce the  
 21 potential hazard of subsidence or settlement to acceptable levels by avoiding construction directly  
 22 on or otherwise stabilizing the soil material that is prone to subsidence.

23 **CEQA Conclusion:** Significant impacts could occur if there is property loss, personal injury, or death  
 24 from instability, failure, or damage from construction on or in soils subject to subsidence as a result  
 25 of constructing the proposed water conveyance facilities. Some of the conveyance facilities would be  
 26 constructed on soils that are subject to subsidence. Subsidence occurring after the facility is  
 27 constructed could result in damage to or failure of the facility. However, DWR would be required to  
 28 design and construct the facilities according to state and federal design standards and guidelines  
 29 (e.g., California Building Code, American Society of Civil Engineers Minimum Design Loads for  
 30 Buildings and Other Structures, ASCE/SEI 7-10, 2010). Conforming to these codes would reduce the  
 31 potential hazard of subsidence or settlement to acceptable levels by avoiding construction directly  
 32 on or otherwise stabilizing the soil material that is prone to subsidence. Because these measures  
 33 would reduce the potential hazard of subsidence or settlement to meet design standards, this impact  
 34 is considered less than significant. No mitigation is required.

#### 35 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water** 36 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

37 The integrity of the water conveyance facilities, including tunnels, pipelines, intake facilities,  
 38 pumping plant, access roads and utilities, and other features could be adversely affected because  
 39 they would be located on expansive, corrosive, and compressible soils.

#### 40 **Expansive Soils**

41 Soil expansion is a concern only at soil depths that are subject to seasonal changes in moisture  
 42 content. The Alternative 4 alignment is underlain by soils with low to high shrink-swell potential,  
 43 which is depicted as soil linear extensibility in Figure 10-4. The majority of the soils with high  
 44 shrink-swell potential (i.e., expansive soils) are where the intakes, pumping plant, pipelines,

1 sedimentation basin, borrow areas, spoils storage areas, certain RTM storage areas, and the  
2 northern third of the canal alignment are proposed. Most of these areas are in Sacramento County  
3 where Dierssen and Egbert-Valpac association soils occur. The remaining conveyance facilities are  
4 generally situated in areas of soils with low to moderate shrink-swell potential. However, a  
5 borrow/spoils area, a temporary work area, three concrete batch plants and three fuel station  
6 locations along the Alternative 4 alignment may contain soils with high to very high shrink-swell  
7 potential.

8 Soils with a high shrink-swell potential could damage facilities or cause the facilities to fail. For  
9 example, foundations and pavements could be cracked or shifted and pipelines could rupture.

### 10 ***Soils Corrosive to Concrete***

11 The near-surface (i.e., upper 5 feet) soil corrosivity to concrete ranges from low to high along the  
12 Alternative 4 alignment, with approximately half of the alignment is in areas of low to moderate  
13 corrosivity. The near-surface soils at the three intake facilities generally have a moderate corrosivity  
14 to concrete. The near-surface soils at the tunnel shafts have a low to high corrosivity to concrete.  
15 Data on soil corrosivity to concrete below a depth of approximately 5 feet (i.e., where pipelines,  
16 tunnels, and the deeper part of the tunnel shafts would be constructed) are not available. However,  
17 given the variability in the composition of the soils and geologic units on and within which the  
18 conveyance facilities would be constructed, corrosivity hazards are likely to range from low to high.  
19 Because soil corrosivity to concrete is high among the near-surface peat soils in the Delta, a high  
20 corrosivity is also expected to be present among the peat soils at depth. Site-specific soil  
21 investigations would need to be conducted to determine the corrosivity hazard at depth at each  
22 element of the conveyance facility. However, as described in 10.3.1, *Methods for Analysis*, and  
23 Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies (as described in  
24 the Geotechnical Exploration Plan—Phase 2 [California Department of Water Resources 2014])  
25 would be conducted at all facilities to identify site-specific soil corrosivity hazards. The resulting  
26 geotechnical report, prepared by a California registered civil engineer or a California certified  
27 engineering geologist, would describe these hazards and recommend the measures that should be  
28 implemented to ensure that the facilities are constructed to withstand corrosion and to conform to  
29 applicable state and federal standards, such as the CBC.

30 Soils that are moderately and highly corrosive to concrete may cause the concrete to degrade,  
31 thereby threatening the integrity of the facility. Degradation of concrete may cause pipelines and  
32 tunnels to leak or rupture and cause foundations to weaken.

### 33 ***Soils Corrosive to Uncoated Steel***

34 The near-surface soils along the Alternative 4 alignment generally are highly corrosive to uncoated  
35 steel. Sections of the southern end of the alignment are moderately corrosive to uncoated steel. Data  
36 on soil corrosivity to uncoated steel below a depth of approximately 5 feet (i.e., where pipelines,  
37 tunnels, and the deeper part of the tunnel shafts would be constructed) are not available. However,  
38 given the variability in the composition of the soils and geologic units on and within which the  
39 conveyance facilities would be constructed, corrosivity hazards are likely to range from low to high.  
40 Site-specific soil investigations would need to be conducted to determine the corrosivity hazard at  
41 depth at each element of the conveyance facility.

42 Soils that are moderately and highly corrosive to uncoated steel (including steel rebar embedded in  
43 concrete) may cause the concrete to degrade, threatening the integrity of these facilities.

## 1 **Compressible Soils**

2 Soils that are weakly consolidated or that have high organic matter content (such as peat or muck  
3 soils) present a risk to structures and infrastructure because of high compressibility and poor  
4 bearing capacity. Soils with high organic matter content tend to compression under load and may  
5 decrease in volume as organic matter is oxidized. Much of the Alternative 4 tunnel alignment is  
6 underlain by near-surface soils that consist of peat. However, the soils in the area where the intakes  
7 would be located have a relatively low organic matter content. Based on liquid limits reported in  
8 county soil surveys, near-surface soils in the Alternative 4 alignment vary from low to medium  
9 compressibility.

10 Damage to or collapse of the pipelines, intakes, pumping plant, transition structures, and control  
11 structures could occur where these facilities are constructed in soils and sediments that are subject  
12 to subsidence and differential settlement. Because of compressible soils, such effects could occur at  
13 the three intakes, the pumping plant, and the sedimentation basins, Subsidence- or differential  
14 sediment-induced damage or collapse of these facilities could cause a rapid release of water to the  
15 surrounding soil, causing an interruption in water supply and producing underground cavities,  
16 depressions at the ground surface, and surface flooding.

17 The tunnels would be constructed at a depth below the peat (Figure 9-4); therefore, subsidence  
18 caused by organic matter decomposition below the tunnels is expected to be minimal. Surface and  
19 subsurface settlement may occur during tunnel construction; however, certain methods and  
20 practices may be used during tunnel construction to help reduce and manage settlement risk.  
21 Chapter 9, *Geology and Seismicity*, discusses the risks of settlement during tunnel construction and  
22 methods to reduce the amount of settlement (Impact GEO-2).

23 Embankments that have subsided would be subject to overtopping, leading to flooding on the  
24 landside of the embankments. The embankment that would be subject to this hazard is the  
25 expanded Clifton Court Forebay.

26 **NEPA Effects:** Various facilities would be located on expansive, corrosive, and compressible soils.  
27 However, all facility design and construction would be executed in conformance with the CBC, which  
28 specifies measures to mitigate effects of expansive soils, corrosive soils, and soils subject to  
29 compression and subsidence. The CBC requires measures such as soil replacement, lime treatment,  
30 and post-tensioned foundations to offset expansive soils. The CBC requires such measures as using  
31 protective linings and coatings, dielectric (i.e., use of an electrical insulator polarized by an  
32 applied electric field) isolation of dissimilar materials, and active cathodic protection systems to  
33 prevent corrosion of concrete and steel.

34 Potential adverse effects of compressible soils and soils subject to subsidence could be addressed by  
35 overexcavation and replacement with engineered fill or by installation of structural supports (e.g.,  
36 pilings) to a depth below the peat where the soils have adequate load bearing strength, as required  
37 by the CBC and by USACE design standards. Geotechnical studies would be conducted at all the  
38 facilities to determine the specific measures that should be implemented to reduce these soil  
39 hazards to levels consistent with the CBC. Liquid limit and soil organic matter content testing would  
40 be performed on collected soil samples during the site-specific field investigations to determine site-  
41 specific geotechnical properties. Settlement monitoring points should be established along the route  
42 during tunnel construction and results reviewed regularly by a professional engineer.

1 The engineer would develop final engineering solutions to any hazardous condition, consistent with  
 2 the code and standards requirements of federal, state, and local oversight agencies. As described in  
 3 Section 10.3.1, *Methods for Analysis*, and in Appendix 3B, *Environmental Commitments, AMMs, and*  
 4 *CMs*, such design codes, guidelines, and standards include the California Building Code and resource  
 5 agency and professional engineering specifications, such as the DWR Interim Levee Design Criteria  
 6 for Urban and Urbanizing Area State Federal Project Levees, and USACE Engineering and Design—  
 7 Earthquake Design and Evaluation for Civil Works Projects.

8 By conforming to the CBC and other applicable design standards, potential effects associated with  
 9 expansive and corrosive soils and soils subject to compression and subsidence would be offset.  
 10 There would be no adverse effect.

11 **CEQA Conclusion:** Significant impacts could occur if there is risk to life and property as a result of  
 12 constructing the proposed water conveyance facilities in areas of expansive, corrosive, and  
 13 compressible soils. Many of the Alternative 4 facilities would be constructed on soils that are subject  
 14 to expansion and are moderately or highly corrosive to concrete and uncoated steel, as well as soils  
 15 that are moderately or highly subject to compression under load. Corrosive soils could damage in-  
 16 ground facilities or shorten their service life. Compression/settlement of soils after a facility is  
 17 constructed could result in damage to or failure of the facility. Surface soils that are moderately to  
 18 highly expansive exist throughout the Alternative 4 alignment except in the central part of the Delta  
 19 between approximately Staten Island and Bacon Island. Expansive soils could cause foundations,  
 20 underground utilities, and pavements to crack and fail. However, DWR would be required to design  
 21 and construct the facilities according to state and federal design standards, guidelines, and building  
 22 codes. The CBC requires measures such as soil replacement, lime treatment, and post-tensioned  
 23 foundations to offset expansive soils. The CBC requires such measures as using protective linings  
 24 and coatings, dielectric (i.e., use of an electrical insulator polarized by an applied electric field)  
 25 isolation of dissimilar materials, and active cathodic protection systems to prevent corrosion of  
 26 concrete and steel in conformance with CBC requirements. Potential adverse effects of compressible  
 27 soils and soils subject to subsidence could be addressed by overexcavation and replacement with  
 28 engineered fill or by installation of structural supports (e.g., pilings) to a depth below the peat where  
 29 the soils have adequate load bearing strength, as required by the CBC and by USACE design  
 30 standards. Conforming to these codes and standards (Appendix 3B, *Environmental Commitments,*  
 31 *AMMs, and CMs*) is an environmental commitment by DWR to ensure that potential adverse effects  
 32 associated with expansive and corrosive soils and soils subject to compression and subsidence  
 33 would be offset. Therefore, this impact would be less than significant. No mitigation is required.

#### 34 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 35 **Operations**

36 River channel bank erosion/scour is a natural process. The rate of natural erosion can increase  
 37 during high flows and as a result of wave effect on banks during high wind conditions.

38 In general, changes in river flow rates associated with BDCP operations would remain within the  
 39 range that presently occurs. However, the operational components would cause changes in the tidal  
 40 flows in some Delta channels, specifically those that lead into the major habitat restoration areas  
 41 (Suisun Marsh, Cache Slough, Yolo Bypass, and South Delta ROAs). In major channels leading to the  
 42 restoration areas, tidal flow velocities may increase; this may cause some localized accelerated  
 43 erosion/scour. Alternative 4 would have effects of a lesser magnitude with respect to potential

1 accelerated bank erosion because the flow from the north Delta would be 9,000 cfs rather than  
2 15,000 cfs, as it is under some of the other action alternatives.

3 However, the increased flows would be offset as part of the conservation measures by the dredging  
4 of these major channels, which would create a larger channel cross-section. The larger cross section  
5 would allow river flow rates to be similar to that of other high tidal flows in the region. Moreover, as  
6 presently occurs and as is typical with most naturally-functioning river channels, local erosion and  
7 deposition within the tidal habitats is expected as part of the restoration.

8 For most of the existing channels that would not be subject to tidal flow restoration, there would be  
9 no adverse effect to tidal flow volumes and velocities. The tidal prism would increase by 5–10%, but  
10 the intertidal (i.e., MHHW to MLLW) cross-sectional area also would be increased such that tidal  
11 flow velocities would be reduced by 10–20% compared to the existing condition. Consequently, no  
12 appreciable increase in scour is anticipated.

13 **NEPA Effects:** The effect would not be adverse because there would be no net increase in river flow  
14 rates and therefore no net increase in channel bank scour.

15 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
16 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
17 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
18 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
19 effect would be to reduce the channel flow rates by 10–20% compared to Existing  
20 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
21 than significant. No mitigation is required.

22 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
23 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
24 **CM11, CM18 and CM19**

25 Conservation measures would include breaching, lowering, or removing levees; constructing  
26 setback levees and cross levees or berms; raising the land elevation by excavating relatively high  
27 areas to provide fill for subsided areas or by importing fill material; surface grading; deepening  
28 and/or widening tidal channels; excavating new channels; modifying channel banks; and other  
29 activities. Moreover, excavation and grading to construct facilities, access roads, and other features  
30 would be necessary under the two conservation measures that are not associated with the ROAs  
31 (i.e., *CM18 Conservation Hatcheries* and *CM19 Urban Stormwater Treatment*). These activities could  
32 lead to accelerated soil erosion rates and consequent loss of topsoil.

33 **Water Erosion**

34 Activities associated with conservation measures that could lead to accelerated water erosion  
35 include clearing, grubbing, demolition, grading, and other similar disturbances. Such activities  
36 steepen slopes and compact soil. These activities tend to degrade soil structure, reduce soil  
37 infiltration capacity, and increase runoff rates, all of which could cause accelerated erosion and  
38 consequent loss of topsoil.

39 Gently sloping to level areas, such as where most of the restoration actions would occur, are  
40 expected to experience little or no accelerated water erosion because of the lack of runoff energy to  
41 entrain and transport soil particles.

1 Graded and otherwise disturbed tops and sideslopes of existing and project levees and  
 2 embankments are of greater concern for accelerated water erosion because of their steep gradients.  
 3 Soil eroded from the disturbed top and water side of levees could reach adjoining waterways (if  
 4 present), unless erosion and sediment control measures are implemented.

#### 5 **Wind Erosion**

6 Wind erosion potential varies widely among and within the ROAs (Figure 10-6). Areas within ROAs  
 7 with high wind erodibility are largely correlated with the presence of organic soils. Wind erodibility  
 8 in the Suisun Marsh, Cache Slough, and South Delta ROAs ranges from high to low. The Yolo Bypass  
 9 ROA generally has a low wind erodibility hazard.

10 Conservation measures construction activities (e.g., excavation, filling, grading, and vehicle traffic on  
 11 unimproved roads) that could lead to accelerated wind erosion are the same as those for water  
 12 erosion. These activities may entail vegetation removal and degradation of soil structure, both of  
 13 which would make the soil more subject to wind erosion. Removal of vegetation cover and grading  
 14 increase soil exposure at the surface and obliterate the binding effect of plant roots on soil  
 15 aggregates. These effects make the soil particles more subject to entrainment by wind.

16 Unlike water erosion, the potential for wind erosion is generally not dependent on slope gradient  
 17 and location, nor is the potential affected by context relative to a receiving water. Without proper  
 18 management, the wind-eroded soil particles can be transported great distances.

19 The transport of soil material from the conveyance facilities for use as fill in subsided areas within  
 20 the ROAs could subject the soils to wind erosion, particularly if the fill material consists of peat. The  
 21 peat would be especially susceptible to wind erosion while being loaded onto trucks, transported,  
 22 unloaded, and distributed onto the restoration areas.

23 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
 24 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*,  
 25 *AMMs, and CMs*, the BDCP proponents would be required to obtain coverage under the General  
 26 Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP  
 27 and an erosion control plan. The General Permit requires that SWPPPs be prepared by a QSD and  
 28 requires SWPPPs be implemented under the supervision of a QSP. The QSD would select erosion and  
 29 sediment control BMPs such as preservation of existing vegetation, seeding, mulching, fiber roll and  
 30 silt fence barriers, erosion control blankets, watering to control dust entrainment, and other  
 31 measures to comply with the practices and turbidity level requirements defined by the General  
 32 Permit. Partly because the potential effect on receiving waters depends on location of a work area  
 33 relative to a waterway, the BMPs would be site-specific. The QSP would be responsible for day-to-  
 34 day implementation of the SWPPP, including BMP inspections, maintenance, water quality sampling,  
 35 and reporting to the State Water Board. Proper implementation of the requisite SWPPP, site-specific  
 36 BMPs, and compliance with the General Permit would ensure that accelerated water and wind  
 37 erosion as a result of implementing conservation measures would not be an adverse effect.

38 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 39 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP  
 40 proponents would seek coverage under the state General Permit for Construction and Land  
 41 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such  
 42 as revegetation, runoff control, and sediment barriers) and compliance with water quality

1 standards. As a result of implementation of Permit conditions, the impact would be less than  
2 significant. No mitigation is required.

3 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
4 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
5 **CM2–CM11**

6 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., levee  
7 foundations, water control structures); overcovering (e.g., levees, embankments, application of fill  
8 material in subsided areas); and water inundation (e.g., aquatic habitat areas) over extensive areas  
9 of the Plan Area. Based on calculations using a geographic information system, implementation of  
10 habitat restoration activities at the ROAs would result in excavation, overcovering, or inundation of  
11 a minimum of 77,600 acres of topsoil (this total includes areas of tidal habitat restoration, which will  
12 be periodically inundated). This effect would be adverse because it would result in a substantial loss  
13 of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of this effect.

14 **CEQA Conclusion:** Significant impacts could occur if there is loss of topsoil from excavation,  
15 overcovering, and inundation associated with restoration activities as a result of implementing the  
16 proposed conservation measures. Implementation of CM2 through CM11 would involve excavation,  
17 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas,  
18 thereby resulting in a substantial loss of topsoil. Therefore, the impact would be significant.  
19 Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts to a  
20 degree by minimizing topsoil loss, but not to a less than significant level because topsoil would still  
21 be permanently lost over extensive areas. Therefore, this impact is considered significant and  
22 unavoidable.

23 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

24 Please see Mitigation Measure SOILS-2a under Impact SOILS-2.

25 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
26 **Topsoil Storage and Handling Plan**

27 Please see Mitigation Measure SOILS-2b under Impact SOILS-2.

28 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
29 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
30 **Proposed Conservation Measures CM2–CM11**

31 With the exception of the Suisun Marsh ROA, the ROAs are not in areas of high subsidence nor where  
32 the soils have a high organic matter content (Figures 10-2 and 10-9). Consequently, only the Suisun  
33 Marsh ROA would be expected to be subject to substantial subsidence. Based on its current  
34 elevation, the Suisun Marsh ROA has not experienced significant subsidence, despite the fact that the  
35 soils are organic and of considerable thickness (Figure 10-3).

36 **NEPA Effects:** Damage to or failure of the habitat levees could occur where these are constructed in  
37 soils and sediments that are subject to subsidence and differential settlement. These soil conditions  
38 have the potential to exist in the Suisun Marsh ROA. Levee damage or failure could cause surface  
39 flooding in the vicinity. This potential effect could be substantial because the facilities could be  
40 located on unstable soils that are subject to subsidence. However, as described in Section 10.3.1,

1 *Methods for Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical  
 2 studies would be conducted at all the ROAs to identify the types of soil stabilization that should be  
 3 implemented to ensure that levees, berms, and other features are constructed to withstand  
 4 subsidence and settlement and to conform to applicable state and federal standards. Such standards  
 5 include the USACE Design and Construction of Levee and DWR Interim Levee Design Criteria for  
 6 Urban and Urbanizing Area State-Federal Project Levees.

7 For example, high organic matter content soils and all soils otherwise subject to subsidence that are  
 8 unsuitable for supporting levees would be overexcavated and replaced with engineered fill, and the  
 9 unsuitable soils disposed of offsite as spoils. Geotechnical evaluations will be conducted to identify  
 10 soil materials that are suitable for engineering purposes. Liquid limit and organic content testing  
 11 should be performed on collected soil samples during the site-specific field investigations to  
 12 determine site-specific geotechnical properties.

13 With construction of all levees, berms, and other conservation features designed and constructed to  
 14 withstand subsidence and settlement and through conformance with applicable state and federal  
 15 design standards, this effect would not be adverse.

16 **CEQA Conclusion:** Significant impacts could occur if there is property loss, personal injury, or death  
 17 from instability, failure, and damage from construction on soils subject to subsidence as a result of  
 18 implementing the proposed conservation measures. Some of the restoration area facilities would be  
 19 constructed on soils that are subject to subsidence. Subsidence occurring after the facility is  
 20 constructed could result in damage to or failure of the facility. However, because the BDCP  
 21 proponents would be required to design and construct the facilities according to state and federal  
 22 design standards and guidelines (which may involve, for example, replacement of the organic soil),  
 23 the impact would be less than significant. No mitigation is required.

24 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,  
 25 and Compressible Soils as a Result of Implementing the Proposed Conservation Measures  
 26 CM2–CM11**

27 ***Expansive Soils***

28 The ROAs generally have soils with moderate or high shrink-swell potential. The ROAs with a  
 29 significant extent of highly expansive soils are the Yolo Bypass and Cache Slough ROAs (Figure 10-  
 30 4). None appears to have appreciable areas of soils with very high expansiveness.

31 Potential adverse effects of expansive soils are a concern only to structural facilities within the  
 32 ROAs, such as water control structures. Seasonal shrinking and swelling of moderately or highly  
 33 expansive soils could damage water control structures or cause them to fail, resulting in a release of  
 34 water from the structure and consequent flooding, which would cause unplanned inundation of  
 35 aquatic habitat areas.

36 ***Corrosive Soils***

37 Soils in all the ROAs possess high potential for corrosion of uncoated steel, and the Suisun ROA and  
 38 portions of the West Delta ROA possess soils with high corrosivity to concrete.

1       **Compressible Soils**

2       Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
3       Mokelumne, and South Delta ROAs. Areas of low to medium compressibility occur in the South Delta  
4       ROA. Silts and clays with a liquid limit less than 35% are considered to have low compressibility.  
5       Silts and clays with a liquid limit greater than 35% and less than 50% are considered to have  
6       medium compressibility and greater than 50% are considered highly compressible. Organic soils  
7       typically have high liquid limits (greater than 50%) and are therefore considered highly  
8       compressible.

9       **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
10       compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
11       studies and testing would be completed prior to construction within the ROAs. The site-specific  
12       environmental evaluation would identify specific areas where engineering soil properties, including  
13       soil compressibility, may require special consideration during construction of specific features  
14       within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
15       expansive, corrosive and/or compressible soils would prevent adverse effects of such soils.

16       **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
17       are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
18       Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
19       Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
20       settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
21       However, because the BDCP proponents would be required to design and construct the facilities  
22       according to state and federal design standards, guidelines, and building codes (which may involve,  
23       for example, soil lime stabilization, cathodic protection of steel, and soil replacement), this impact  
24       would be considered less than significant. No mitigation is required.

25       **10.3.3.10           Alternative 5—Dual Conveyance with Pipeline/Tunnel and**  
26       **Intake 1 (3,000 cfs; Operational Scenario C)**

27       **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil**  
28       **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

29       Alternative 5 would include the same physical/structural components as Alternative 1A, except that  
30       it would entail four fewer intakes and four fewer pumping plants. These differences would result in  
31       slightly less accelerated erosion impacts than Alternative 1A. The impacts of Alternative 5 would,  
32       however, be similar to those of Alternative 1A. See the discussion of Impact SOILS-1 under  
33       Alternative 1A.

34       **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative  
35       5 could cause substantial accelerated erosion. However, as described in Section 10.3.1, *Methods for*  
36       *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, DWR would be required to  
37       obtain coverage under the General Permit for Construction and Land Disturbance Activities,  
38       necessitating the preparation of an erosion control plan. Proper implementation of the requisite  
39       SWPPP and compliance with the General Permit would ensure that there would not be substantial  
40       soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs as a result of construction  
41       of the proposed water conveyance facility, and therefore, there would not be an adverse effect.

1 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
 2 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
 3 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
 4 and reuse areas.

5 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 6 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
 7 would seek coverage under the state General Permit for Construction and Land Disturbance  
 8 Activities, necessitating the preparation of a SWPPP and an erosion control plan. As a result of  
 9 implementation of the requisite SWPPP and compliance with the General Permit, there would not be  
 10 substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs and the effect  
 11 would be less than significant. No mitigation is required.

## 12 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 13 **Constructing the Proposed Water Conveyance Facilities**

14 **NEPA Effects:** Alternative 5 would include the same physical/structural components as Alternative  
 15 1A, except that it would entail four fewer intakes and four fewer pumping plants. These differences  
 16 would result in slightly less effects on topsoil loss than Alternative 1A. The impacts of Alternative 5  
 17 would, however, be similar to those of Alternative 1A. See the discussion of Impact SOILS-2 under  
 18 Alternative 1A.

19 Topsoil effectively would be lost as a resource as a result of its excavation (e.g., forebays, borrow  
 20 areas, tunnel shafts, levee foundations, intake facilities, pumping plants); overcovering (e.g., levees  
 21 and embankments, spoil storage, pumping plants; and water inundation (e.g., sedimentation basins,  
 22 solids lagoons).

23 Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil  
 24 would not be excavated, overcovered, or inundated, such as at construction staging and laydown  
 25 areas where the soil could be compacted or otherwise affected.

26 DWR has made an environmental commitment for Disposal Site Preparation which would require  
 27 that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will  
 28 be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,  
 29 thereby lessening the effect. However, this effect would be adverse because it would result in a  
 30 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
 31 this effect.

32 The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and  
 33 Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures  
 34 for how excavated subsurface soil materials would be handled, stored, and disposed of. The  
 35 commitment also specifies that temporary storage sites for spoils, RTM, and dredged material  
 36 storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b  
 37 supplements the environmental commitment, specifically by defining topsoil for the purposes of the  
 38 mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

39 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
 40 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss  
 41 of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area  
 42 would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate

1 for these impacts, but not to a less-than-significant level because topsoil would be permanently lost  
2 over extensive areas. Therefore, this impact is considered significant and unavoidable.

3 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

4 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
5 1A.

6 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a  
7 Topsoil Storage and Handling Plan**

8 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
9 1A.

10 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and  
11 Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the  
12 Proposed Water Conveyance Facilities**

13 Alternative 5 would include the same physical/structural components as Alternative 1A, except that  
14 it would entail four fewer intakes and four fewer pumping plants. These differences would result in  
15 slightly less effects related to subsidence than Alternative 1A. The impacts of Alternative 5 would,  
16 however, be similar to those under Alternative 1A. See the discussion of Impact SOILS-3 under  
17 Alternative 1A.

18 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
19 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
20 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
21 be conducted at all facilities to identify the types of soil avoidance or soil stabilization measures that  
22 should be implemented to ensure that the facilities are constructed to withstand subsidence and  
23 settlement and to conform to applicable state and federal standards. These investigations would  
24 build upon the geotechnical data reports (California Department of Water Resources 2001a, 2010b,  
25 2011) and the CERs (California Department of Water Resources 2010a, 2010b, 2015). As discussed  
26 under Alternative 1A, conforming to state and federal design standards, including conduct of site-  
27 specific geotechnical evaluations, would ensure that appropriate design measures are incorporated  
28 into the project and any subsidence that takes place under the project facilities would not jeopardize  
29 their integrity.

30 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
31 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
32 failure of the facility. However, because DWR would be required to design and construct the  
33 facilities according to state and federal design standards and guidelines (e.g., California Building  
34 Code, American Society of Civil Engineers Minimum Design Loads for Buildings and Other  
35 Structures, ASCE/SEI 7-10, 2010). Conforming to these codes would reduce the potential hazard of  
36 subsidence or settlement to acceptable levels by avoiding construction directly on or otherwise  
37 stabilizing the soil material that is prone to subsidence. Because these measures would reduce the  
38 potential hazard of subsidence or settlement to meet design standards, the impact would be less  
39 than significant. No mitigation is required.

1 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 2 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

3 Alternative 5 would include the same physical/structural components as Alternative 1A, except it  
 4 would entail four fewer intakes and four fewer pumping plants. These differences would result in  
 5 slightly fewer effects related to expansive, corrosive, and compressible soils than under Alternative  
 6 1A. The effects under Alternative 5 would, however, be similar to those of Alternative 1A. See  
 7 discussion of Impact SOILS-4 under Alternative 1A.

8 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake  
 9 facilities, pumping plants, access roads and utilities, and other features could be adversely affected  
 10 because they would be located on expansive, corrosive, and compressible soils. However, all facility  
 11 design and construction would be executed in conformance with the CBC, which specifies measures  
 12 to mitigate effects of expansive soils, corrosive soils, and soils subject to compression and  
 13 subsidence. By conforming to the CBC and other applicable design standards, potential effects  
 14 associated with expansive and corrosive soils and soils subject to compression and subsidence  
 15 would be offset. There would be no adverse effect.

16 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to  
 17 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils  
 18 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils  
 19 could damage in-ground facilities or shorten their service life. Compression/settlement of soils after  
 20 a facility is constructed could result in damage to or failure of the facility. However, because DWR  
 21 would be required to design and construct the facilities according to state and federal design  
 22 standards, guidelines, and building codes (e.g., CBC and USACE design standards). Conforming to  
 23 these codes and standards is an environmental commitment by DWR to ensure that potential  
 24 adverse effects associated with expansive and corrosive soils and soils subject to compression and  
 25 subsidence would be offset. Therefore, this impact would be less than significant. No mitigation is  
 26 required.

27 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**  
 28 **Operations**

29 Alternative 5 would have operations similar to those under Alternative 1A, but of a lesser magnitude  
 30 with respect to potential effects on accelerated bank erosion because the flow from the north Delta  
 31 would be 3,000 cfs rather than 15,000 cfs. The effects under Alternative 5 would, however, be  
 32 similar to those under Alternative 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

33 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be  
 34 adverse because, as part of the conservation measures, major channels would be dredged to create a  
 35 larger cross-section that would offset increased tidal velocities. The effect would not be adverse  
 36 because there would be no net increase in river flow rates and therefore no net increase in channel  
 37 bank scour.

38 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 39 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 40 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 41 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
 42 effect would be to reduce the channel flow rates by 10–20% compared to Existing

1 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
2 than significant. No mitigation is required.

3 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
4 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
5 **CM11, CM18 and CM19**

6 Implementation of conservation measures under Alternative 5 would be the same as under  
7 Alternative 1A, except that only 25,000 acres of tidal habitat would be restored. The effects under  
8 Alternative 5 on accelerated erosion would, therefore, be similar to those under Alternative 1A, but  
9 of a lesser magnitude. Implementation of the conservation measures would involve ground  
10 disturbance and construction activities that could lead to accelerated soil erosion rates and  
11 consequent loss of topsoil. See the discussion of Impact SOILS-6 under Alternative 1A.

12 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
13 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments,*  
14 *AMMs, and CMs*, the BDCP proponents would be required to obtain coverage under the General  
15 Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP  
16 and an erosion control plan. Proper implementation of the requisite SWPPP, site-specific BMPs, and  
17 compliance with the General Permit would ensure that accelerated water and wind erosion as a  
18 result of implementing conservation measures would not be an adverse effect.

19 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
20 restoration areas could cause accelerated water and wind erosion of soil. However, the project BDCP  
21 proponents would seek coverage under the state General Permit for Construction and Land  
22 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such  
23 as revegetation, runoff control, and sediment barriers) and compliance with water quality  
24 standards. As a result of implementation of Permit conditions, the impact would be less than  
25 significant. No mitigation is required.

26 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
27 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
28 **CM2–CM11**

29 Conservation measures would be the same under Alternative 5 as under Alternative 1A. Topsoil  
30 would be lost as a resource as a result of its excavation, overcovering, and water inundation—except  
31 that only 25,000 acres of tidal habitat would be restored. The impacts of Alternative 5 on the loss of  
32 topsoil would, therefore, be similar to those under Alternative 1A, but of a lesser magnitude. See the  
33 discussion of Impact SOILS-7 under Alternative 1A.

34 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.  
35 Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of this effect.

36 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,  
37 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas,  
38 thereby resulting in a substantial loss of topsoil. The impact would be significant. Mitigation  
39 Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts to a degree,  
40 but not to a less-than-significant level. Therefore, this impact is considered significant and  
41 unavoidable.

1           **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

2           Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
3           1A.

4           **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
5           **Topsoil Storage and Handling Plan**

6           Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
7           1A.

8           **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
9           **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
10          **Proposed Conservation Measures CM2–CM11**

11          Conservation measures would be the same under Alternative 5 as under Alternative 1A, except that  
12          only 25,000 acres of tidal habitat would be restored. The impacts of Alternative 5 related to  
13          subsidence would, therefore, be similar to those under Alternative 1A, but of a lesser magnitude.  
14          Damage to or failure of the habitat levees could occur where these are constructed in soils and  
15          sediments that are subject to subsidence and differential settlement. These soil conditions have the  
16          potential to exist in the Suisun Marsh ROA. Levee damage or failure could cause surface flooding in  
17          the vicinity. See the discussion of Impact SOILS-8 under Alternative 1A.

18          **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
19          unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
20          *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
21          be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to  
22          ensure that levees, berms, and other features are constructed to withstand subsidence and  
23          settlement and to conform to applicable state and federal standards.

24          With construction of all levees, berms, and other conservation features designed and constructed to  
25          withstand subsidence and settlement and through conformance with applicable state and federal  
26          design standards, this effect would not be adverse.

27          **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
28          subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
29          to or failure of the facility. However, because the BDCP proponents would be required to design and  
30          construct the facilities according to state and federal design standards and guidelines (which may  
31          involve, for example, replacement of the organic soil), the impact would be less than significant. No  
32          mitigation is required.

33          **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
34          **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures**  
35          **CM2–CM11**

36          Implementation of the proposed conservation measures under Alternative 5 would be the same as  
37          under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,  
38          corrosive, or compressible soils would have the same effects as under Alternative 1A. See the  
39          discussion of Impact SOILS-9 under Alternative 1A.

1 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control  
 2 structures or cause them to fail, resulting in a release of water from the structure and consequent  
 3 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs  
 4 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West  
 5 Delta ROA possess soils with high corrosivity to concrete.

6 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
 7 Mokelumne, and South Delta ROAs.

8 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
 9 compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
 10 studies and testing would be completed prior to construction within the ROAs. The site-specific  
 11 environmental evaluation would identify specific areas where engineering soil properties, including  
 12 soil compressibility, may require special consideration during construction of specific features  
 13 within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
 14 expansive, corrosive and/or compressible soils would prevent adverse effects of such soils.

15 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
 16 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 17 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 18 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
 19 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
 20 However, because the BDCP proponents would be required to design and construct the facilities  
 21 according to state and federal design standards, guidelines, and building codes (which may involve,  
 22 for example, soil lime stabilization, cathodic protection of steel, and soil replacement), this impact  
 23 would be considered less than significant. No mitigation is required.

### 24 **10.3.3.11 Alternative 6A—Isolated Conveyance with Pipeline/Tunnel and** 25 **Intakes 1–5 (15,000 cfs; Operational Scenario D)**

#### 26 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil** 27 **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

28 Alternative 6A would involve physical/structural components similar to Alternative 1A, but existing  
 29 connections between the SWP and CVP south Delta export facilities would be severed. These  
 30 connections would be in soils similar to that in Alternative 1A and would not substantially change  
 31 the project effects related to accelerated erosion. The impacts of Alternative 6A would, therefore, be  
 32 similar to those of Alternative 1A. See the discussion of Impact SOILS-1 under Alternative 1A.

33 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative  
 34 6A could cause substantial accelerated erosion. However, as described in Section 10.3.1, *Methods for*  
 35 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, DWR would be required to  
 36 obtain coverage under the General Permit for Construction and Land Disturbance Activities,  
 37 necessitating the preparation of a SWPPP and an erosion control plan. Proper implementation of the  
 38 requisite SWPPP and compliance with the General Permit would ensure that there would not be  
 39 substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs as a result of  
 40 construction of the proposed water conveyance facility, and therefore, there would not be an  
 41 adverse effect.

1 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
 2 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
 3 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
 4 and reuse areas.

5 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 6 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
 7 would seek coverage under the state General Permit for Construction and Land Disturbance  
 8 Activities (as discussed in Appendix 3B, *Environmental Commitments, AMMs, and CMs*), necessitating  
 9 the preparation of a SWPPP and an erosion control plan. As a result of implementation of the  
 10 requisite SWPPP and compliance with the General Permit, there would not be substantial soil  
 11 erosion resulting in daily site runoff turbidity in excess of 250 NTUs and the effect would be less  
 12 than significant. No mitigation is required.

### 13 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 14 **Constructing the Proposed Water Conveyance Facilities**

15 Alternative 6A would involve physical/structural components similar to Alternative 1A, but existing  
 16 connections between the SWP and CVP south Delta export facilities would be severed. These  
 17 connections would involve construction operations similar to those of Alternative 1A and would not  
 18 substantially change the project effects relating to the loss of topsoil. The impacts of Alternative 6A  
 19 would, therefore, be similar to those of Alternative 1A. See the discussion of Impact SOILS-2 under  
 20 Alternative 1A.

21 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g.,  
 22 forebays, borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants);  
 23 overcovering (e.g., levees and embankments, spoil storage, pumping plants); and water inundation  
 24 (e.g., sedimentation basins, solids lagoons).

25 Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil  
 26 would not be excavated, overcovered, or inundated, such as at construction staging and laydown  
 27 areas where the soil could be compacted or otherwise affected.

28 DWR has made an environmental commitment for Disposal Site Preparation which would require  
 29 that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will  
 30 be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,  
 31 thereby lessening the effect. However, this effect would be adverse because it would result in a  
 32 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
 33 this effect.

34 The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and  
 35 Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures  
 36 for how excavated subsurface soil materials would be handled, stored, and disposed of. The  
 37 commitment also specifies that temporary storage sites for spoils, RTM, and dredged material  
 38 storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b  
 39 supplements the environmental commitment, specifically by defining topsoil for the purposes of the  
 40 mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

41 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
 42 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss

1 of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area  
 2 would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate  
 3 for these impacts, but not to a less-than-significant level because topsoil would be permanently lost  
 4 over extensive areas. Therefore, this impact is considered significant and unavoidable.

5 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

6 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 7 1A.

8 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 9 **Topsoil Storage and Handling Plan**

10 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 11 1A.

12 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 13 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the**  
 14 **Proposed Water Conveyance Facilities**

15 Alternative 6A would involve physical/structural components similar to Alternative 1A, but existing  
 16 connections between the SWP and CVP south Delta export facilities would be severed. These  
 17 connections would be in soils similar to those under Alternative 1A and would not substantially  
 18 change the project effects relating to subsidence. The impacts of Alternative 6A would, therefore, be  
 19 similar to those under Alternative 1A. See the discussion of Impact SOILS-3 under Alternative 1A.

20 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 21 soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for Analysis*,  
 22 and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would be  
 23 conducted at all facilities to identify the types of soil avoidance or soil stabilization measures that  
 24 should be implemented to ensure that the facilities are constructed to withstand subsidence and  
 25 settlement and to conform to applicable state and federal standards. These investigations would  
 26 build upon the geotechnical data reports (California Department of Water Resources 2001a, 2010b,  
 27 2011) and the CERs (California Department of Water Resources 2010a, 2010b). As discussed under  
 28 Alternative 1A, conforming to state and federal design standards, including conduct of site-specific  
 29 geotechnical evaluations, would ensure that appropriate design measures are incorporated into the  
 30 project and any subsidence that takes place under the project facilities would not jeopardize their  
 31 integrity.

32 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
 33 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
 34 failure of the facility. However, because DWR would be required to design and construct the  
 35 facilities according to state and federal design standards and guidelines (e.g., California Building  
 36 Code, American Society of Civil Engineers Minimum Design Loads for Buildings and Other  
 37 Structures, ASCE/SEI 7-10, 2010). Conforming to these codes would reduce the potential hazard of  
 38 subsidence or settlement to acceptable levels by avoiding construction directly on or otherwise  
 39 stabilizing the soil material that is prone to subsidence. Because these measures would reduce the  
 40 potential hazard of subsidence or settlement to meet design standards, the impact would be less  
 41 than significant. No mitigation is required.

1 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 2 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

3 Alternative 6A would involve physical/structural components similar to Alternative 1A, but existing  
 4 connections between the SWP and CVP south Delta export facilities would be severed. These  
 5 connections would be in soils similar to Alternative 1A and would not substantially change the  
 6 project effects related to soil expansion, corrosivity, and compression. The effects of Alternative 6A  
 7 would, therefore, be similar to those under Alternative 1A. See the discussion of Impact SOILS-4  
 8 under Alternative 1A.

9 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake  
 10 facilities, pumping plants, access roads and utilities, and other features could be adversely affected  
 11 because they would be located on expansive, corrosive, and compressible soils. However, all facility  
 12 design and construction would be executed in conformance with the CBC, which specifies measures  
 13 to mitigate effects of expansive soils, corrosive soils, and soils subject to compression and  
 14 subsidence. By conforming to the CBC and other applicable design standards, potential effects  
 15 associated with expansive and corrosive soils and soils subject to compression and subsidence  
 16 would be offset. There would be no adverse effect.

17 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to  
 18 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils  
 19 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils  
 20 could damage in-ground facilities or shorten their service life. Compression/settlement of soils after  
 21 a facility is constructed could result in damage to or failure of the facility. However, because DWR  
 22 would be required to design and construct the facilities in conformance with state and federal  
 23 design standards, guidelines, and building codes (e.g., CBC and USACE design standards).  
 24 Conforming to these codes and standards is an environmental commitment by DWR to ensure that  
 25 potential adverse effects associated with expansive and corrosive soils and soils subject to  
 26 compression and subsidence would be offset. Therefore, this impact would be less than significant.  
 27 No mitigation is required.

28 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**  
 29 **Operations**

30 Alternative 6A would have operations different than those under Alternative 1A. However,  
 31 operations under Alternative 6A would have a potential effect on accelerated bank erosion similar to  
 32 that of Alternative 1A. The effects under Alternative 6A would, therefore, be similar to those under  
 33 Alternative 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

34 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be  
 35 adverse because, as part of the conservation measures, major channels would be dredged to create a  
 36 larger cross-section that would offset increased tidal velocities. The effect would not be adverse  
 37 because there would be no net increase in river flow rates and therefore no net increase in channel  
 38 bank scour.

39 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 40 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 41 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 42 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
 43 effect would be to reduce the channel flow rates by 10–20% compared to Existing

1 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
2 than significant. No mitigation is required.

3 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
4 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
5 **CM11, CM18 and CM19**

6 Implementation of conservation measures under Alternative 6A would be the same as under  
7 Alternative 1A. Implementation of the conservation measures would involve ground disturbance  
8 and construction activities that could lead to accelerated soil erosion rates and consequent loss of  
9 topsoil. See the discussion of Impact SOILS-6 under Alternative 1A.

10 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
11 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*,  
12 *AMMs, and CMs*, the BDCP proponents would be required to obtain coverage under the General  
13 Permit for Construction and Land Disturbance Activities, necessitating preparation of a SWPPP and  
14 an erosion control plan. Proper implementation of the requisite SWPPP, site-specific BMPs, and  
15 compliance with the General Permit would ensure that accelerated water and wind erosion as a  
16 result of implementing conservation measures would not be an adverse effect.

17 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
18 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP  
19 proponents would seek coverage under the state General Permit for Construction and Land  
20 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such  
21 as revegetation, runoff control, and sediment barriers) and compliance with water quality  
22 standards. As a result of implementation of Permit conditions, the impact would be less than  
23 significant. No mitigation is required.

24 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
25 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
26 **CM2–CM11**

27 Conservation measures would be the same under Alternative 6A as under Alternative 1A. Topsoil  
28 effectively would be lost as a resource as a result of its excavation, overcovering, and water  
29 inundation over extensive areas of the Plan Area. See the discussion of Impact SOILS-7 under  
30 Alternative 1A.

31 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.  
32 Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of this effect.

33 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,  
34 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas,  
35 thereby resulting in a substantial loss of topsoil. The impact would be significant. Mitigation  
36 Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts to a degree,  
37 but not to a less-than-significant level. Therefore, this impact is considered significant and  
38 unavoidable.

39 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

40 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
41 1A.

1           **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 2           **Topsoil Storage and Handling Plan**

3           Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 4           1A.

5           **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 6           **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
 7           **Proposed Conservation Measures CM2–CM11**

8           Conservation measures would be the same under Alternative 6A as under Alternative 1A. Damage to  
 9           or failure of the habitat levees could occur where these are constructed in soils and sediments that  
 10          are subject to subsidence and differential settlement. These soil conditions have the potential to  
 11          exist in the Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the vicinity.  
 12          See the discussion of Impact SOILS-8 under Alternative 1A.

13          **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 14          unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 15          *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 16          be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to  
 17          ensure that levees, berms, and other features are constructed to withstand subsidence and  
 18          settlement and to conform to applicable state and federal standards.

19          With construction of all levees, berms, and other conservation features designed and constructed to  
 20          withstand subsidence and settlement and through conformance with applicable state and federal  
 21          design standards, this effect would not be adverse.

22          **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
 23          subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 24          to or failure of the facility. However, because the BDCP proponents would be required to design and  
 25          construct the facilities according to state and federal design standards and guidelines (which may  
 26          involve, for example, replacement of the organic soil), the impact would be less than significant. No  
 27          mitigation is required.

28          **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
 29          **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures**  
 30          **CM2–CM11**

31          Implementation of the proposed conservation measures under Alternative 6A would be the same as  
 32          under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,  
 33          corrosive, or compressible soils would have the same effects as under Alternative 1A. See the  
 34          discussion of Impact SOILS-9 under Alternative 1A.

35          Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control  
 36          structures or cause them to fail, resulting in a release of water from the structure and consequent  
 37          flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs  
 38          possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West  
 39          Delta ROA possess soils with high corrosivity to concrete.

40          Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
 41          Mokelumne, and South Delta ROAs.

1 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
 2 compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
 3 studies and testing would be completed prior to construction within the ROAs. The site-specific  
 4 environmental evaluation would identify specific areas where engineering soil properties, including  
 5 soil compressibility, may require special consideration during construction of specific features  
 6 within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
 7 expansive, corrosive and/or compressible soils would prevent adverse effects of such soils.

8 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
 9 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 10 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 11 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
 12 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
 13 However, because the BDCP proponents would be required to design and construct the facilities  
 14 according to state and federal design standards, guidelines, and building codes (which may involve,  
 15 for example, soil lime stabilization, cathodic protection of steel, and soil replacement), this impact  
 16 would be considered less than significant. No mitigation is required.

### 17 **10.3.3.12 Alternative 6B—Isolated Conveyance with East Alignment and** 18 **Intakes 1–5 (15,000 cfs; Operational Scenario D)**

#### 19 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil** 20 **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

21 Alternative 6B would involve physical/structural components similar to Alternative 1B, but existing  
 22 connections between the SWP and CVP south Delta export facilities would be severed. These  
 23 connections would be in soils similar to those in Alternative 1B and would not substantially change  
 24 the project effects relating to accelerated erosion. The impacts of Alternative 6B would, therefore, be  
 25 similar to those of Alternative 1B. See the discussion of Impact SOILS-1 under Alternative 1B.

26 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative  
 27 6B could cause substantial accelerated erosion. However, as described in Section 10.3.1, *Methods for*  
 28 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, DWR would be required to  
 29 obtain coverage under the General Permit for Construction and Land Disturbance Activities,  
 30 necessitating the preparation of a SWPPP and an erosion control plan. Proper implementation of the  
 31 requisite SWPPP and compliance with the General Permit would ensure that there would not be  
 32 substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs as a result of  
 33 construction of the proposed water conveyance facility, and therefore, there would not be an  
 34 adverse effect.

35 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
 36 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
 37 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
 38 and reuse areas.

39 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 40 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
 41 would seek coverage under the state General Permit for Construction and Land Disturbance  
 42 Activities (as discussed in Appendix 3B, *Environmental Commitments, AMMs, and CMs*), necessitating

1 the preparation of a SWPPP and an erosion control plan. As a result of implementation of the SWPPP  
 2 and compliance with the General Permit, there would not be substantial soil erosion resulting in  
 3 daily site runoff turbidity in excess of 250 NTUs and the impact would be a less than significant. No  
 4 mitigation is required.

5 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of**  
 6 **Constructing the Proposed Water Conveyance Facilities**

7 Alternative 6B would involve physical/structural components similar to Alternative 1B, but existing  
 8 connections between the SWP and CVP south Delta export facilities would be severed. These  
 9 connections would involve construction operations similar to those under Alternative 1B and would  
 10 not substantially change the project effects relating to the loss of topsoil. The impacts of Alternative  
 11 6B would, therefore, be similar to those under Alternative 1B. See the discussion of Impact SOILS-2  
 12 under Alternative 1B.

13 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., canal  
 14 alignment, forebays, borrow areas, levee foundations, intake facilities, pumping plants);  
 15 overcovering (e.g., levees and embankments, spoil storage, pumping plants); and water inundation  
 16 (e.g., sedimentation basins, solids lagoons).

17 Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil  
 18 would not be excavated, overcovered, or inundated, such as at construction staging and laydown  
 19 areas where the soil could be compacted or otherwise affected.

20 DWR has made an environmental commitment for Disposal Site Preparation which would require  
 21 that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will  
 22 be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,  
 23 thereby lessening the effect. However, this effect would be adverse because it would result in  
 24 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
 25 this effect.

26 The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and  
 27 Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures  
 28 for how excavated subsurface soil materials would be handled, stored, and disposed of. The  
 29 commitment also specifies that temporary storage sites for spoils, RTM, and dredged material  
 30 storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b  
 31 supplements the environmental commitment, specifically by defining topsoil for the purposes of the  
 32 mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

33 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
 34 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss  
 35 of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area  
 36 would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate  
 37 for these impacts, but not to a less-than-significant level because topsoil would be permanently lost  
 38 over extensive areas. Therefore, this impact is considered significant and unavoidable.

39 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

40 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 41 1A.

1           **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 2           **Topsoil Storage and Handling Plan**

3           Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 4           1A.

5           **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 6           **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the**  
 7           **Proposed Water Conveyance Facilities**

8           Alternative 6B would involve physical/structural components similar to Alternative 1B, but existing  
 9           connections between the SWP and CVP south Delta export facilities would be severed. These  
 10          connections would be in soils similar to those under Alternative 1B and would not substantially  
 11          change the project effects relating to subsidence. The impacts of Alternative 6B would, therefore, be  
 12          similar to those under Alternative 1B. See the discussion of Impact SOILS-3 under Alternative 1B.

13          **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 14          unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 15          *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 16          be conducted at all facilities to identify the types of soil avoidance or soil stabilization measures that  
 17          should be implemented to ensure that the facilities are constructed to withstand subsidence and  
 18          settlement and to conform to applicable state and federal standards. These investigations would  
 19          build upon the geotechnical data reports (California Department of Water Resources 2001a, 2010b,  
 20          2011) and the CERs (California Department of Water Resources 2009a, 2010c). As discussed under  
 21          Alternative 1B, conforming to state and federal design standards, including conduct of site-specific  
 22          geotechnical evaluations, would ensure that appropriate design measures are incorporated into the  
 23          project and any subsidence that takes place under the project facilities would not jeopardize their  
 24          integrity.

25          **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
 26          to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
 27          failure of the facility. However, because DWR would be required to design and construct the  
 28          facilities according to state and federal design standards and guidelines (e.g., California Building  
 29          Code, American Society of Civil Engineers Minimum Design Loads for Buildings and Other  
 30          Structures, ASCE/SEI 7-10, 2010). Conforming to these codes would reduce the potential hazard of  
 31          subsidence or settlement to acceptable levels by avoiding construction directly on or otherwise  
 32          stabilizing the soil material that is prone to subsidence. Because these measures would reduce the  
 33          potential hazard of subsidence or settlement to meet design standards, the impact would be less  
 34          than significant. No mitigation is required.

35          **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 36          **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

37          Alternative 6B would involve physical/structural components similar to Alternative 1B, but existing  
 38          connections between the SWP and CVP south Delta export facilities would be severed. These  
 39          connections would be in soils similar to Alternative 1B and would not substantially change the  
 40          project effects relating to soil expansion, corrosivity, and compression. The effects under Alternative  
 41          6B would, therefore, be similar to those under Alternative 1B. See discussion of Impact SOILS-4  
 42          under Alternative 1B.

1 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake  
 2 facilities, pumping plants, access roads and utilities, and other features could be adversely affected  
 3 because they would be located on expansive, corrosive, and compressible soils. However, all facility  
 4 design and construction would be executed in conformance with the CBC, which specifies measures  
 5 to mitigate effects of expansive soils, corrosive soils, and soils subject to compression and  
 6 subsidence. By conforming to the CBC and other applicable design standards, potential effects  
 7 associated with expansive and corrosive soils and soils subject to compression and subsidence  
 8 would be offset. There would be no adverse effect.

9 **CEQA Conclusion:** Many of the Alternative 6B facilities would be constructed on soils that are  
 10 subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 11 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 12 Corrosive soils could damage in-ground facilities or shorten their service life.  
 13 Compression/settlement of soils after a facility is constructed could result in damage to or failure of  
 14 the facility. However, because DWR would be required to design and construct the facilities in  
 15 conformance with state and federal design standards, guidelines, and building codes (e.g., CBC and  
 16 USACE design standards). Conforming to these codes and standards is an environmental  
 17 commitment by DWR to ensure that potential adverse effects associated with expansive and  
 18 corrosive soils and soils subject to compression and subsidence would be offset. Therefore, the  
 19 impact would be less than significant. No mitigation is required.

#### 20 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 21 **Operations**

22 Alternative 6B would have operations that are different than that of Alternative 1A. However,  
 23 operations under Alternative 6B would have a potential effect on accelerated bank erosion similar to  
 24 Alternative 1A. The effects of Alternative 6B would, therefore, be similar to those under Alternative  
 25 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

26 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be  
 27 adverse because as part of the conservation measures, major channels would be dredged to create a  
 28 larger cross-section that would offset increased tidal velocities. The effect would not be adverse  
 29 because there would be no net increase in river flow rates and accordingly, no net increase in  
 30 channel bank scour.

31 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 32 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 33 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 34 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
 35 effect would be to reduce the channel flow rates by 10–20% compared to Existing  
 36 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
 37 than significant. No mitigation is required.

#### 38 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other** 39 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–** 40 **CM11, CM18 and CM19**

41 Implementation of conservation measures under Alternative 6B would be the same as under  
 42 Alternative 1A. Implementation of the conservation measures would involve ground disturbance

1 and construction activities that could lead to accelerated soil erosion rates and consequent loss of  
2 topsoil. See the discussion of Impact SOILS-6 under Alternative 1A.

3 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
4 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*,  
5 *AMMs, and CMs*, the BDCP proponents would be required to obtain coverage under the General  
6 Permit for Construction and Land Disturbance Activities, necessitating preparation of a SWPPP and  
7 an erosion control plan. Proper implementation of the requisite SWPPP, site-specific BMPs, and  
8 compliance with the General Permit would ensure that accelerated water and wind erosion  
9 associated with construction of the conservation measures would not be an adverse effect.

10 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
11 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP  
12 proponents would seek coverage under the state General Permit for Construction and Land  
13 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such  
14 as revegetation, runoff control, and sediment barriers) and compliance with water quality  
15 standards. As a result of implementation of Permit conditions, the impact would be less than  
16 significant. No mitigation is required.

17 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
18 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
19 **CM2–CM11**

20 Implementation of the conservation measures would be the same under Alternative 6B as under  
21 Alternative 1A. Consequently, topsoil loss associated with excavation, overcovering, and water  
22 inundation over extensive areas of the Plan Area would also be the same as under Alternative 1A.  
23 See the discussion of Impact SOILS-7 under Alternative 1A.

24 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.  
25 Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of this effect.

26 **CEQA Conclusion:** Construction of the restoration areas would involve excavation, overcovering,  
27 and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby resulting in  
28 a substantial loss of topsoil. The impact would be significant. Mitigation Measures SOILS-2a and  
29 SOILS-2b would minimize and compensate for these impacts, but not to a less-than-significant level.  
30 Therefore, this impact is considered significant and unavoidable.

31 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

32 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
33 1A.

34 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
35 **Topsoil Storage and Handling Plan**

36 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
37 1A.

1 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 2 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
 3 **Proposed Conservation Measures CM2-CM11**

4 Conservation measures would be the same under Alternative 6B as under Alternative 1A. See  
 5 description and findings under Alternative 1A. Similarly, damage to or failure of the habitat levees  
 6 could occur where these are constructed in soils and sediments that are subject to subsidence and  
 7 differential settlement would also be the same as Alternative 1A. Levee damage or failure could  
 8 cause surface flooding in the vicinity. See the discussion of Impact SOILS-8 under Alternative 1A.

9 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 10 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 11 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 12 be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to  
 13 ensure that levees, berms, and other features are constructed to withstand subsidence and  
 14 settlement and to conform to applicable state and federal standards.

15 With construction of all levees, berms, and other conservation features designed and constructed to  
 16 withstand subsidence and settlement and through conformance with applicable state and federal  
 17 design standards, this effect would not be adverse.

18 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
 19 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 20 to or failure of the facility. However, because the BDCP proponents would be required to design and  
 21 construct the facilities according to state and federal design standards and guidelines (which may  
 22 involve, for example, replacement of the organic soil), the impact would be less than significant. No  
 23 mitigation is required.

24 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
 25 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures**  
 26 **CM2-CM11**

27 Implementation of the proposed conservation measures under Alternative 6B would be the same as  
 28 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,  
 29 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the  
 30 discussion of Impact SOILS-9 under Alternative 1A.

31 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control  
 32 structures or cause them to fail, resulting in a release of water from the structure and consequent  
 33 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs  
 34 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West  
 35 Delta ROA possess soils with high corrosivity to concrete.

36 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
 37 Mokelumne, and South Delta ROAs.

38 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
 39 compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
 40 studies and testing would be completed prior to construction within the ROAs. The site-specific  
 41 environmental evaluation would identify specific areas where engineering soil properties, including  
 42 soil compressibility, may require special consideration during construction of specific features

1 within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
2 expansive, corrosive and/or compressible soils would prevent adverse effects of such soils.

3 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
4 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
5 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
6 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
7 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
8 However, because the BDCP proponents would be required to design and construct the facilities  
9 according to state and federal design standards, guidelines, and building codes (which may involve,  
10 for example, soil lime stabilization, cathodic protection of steel, and soil replacement), this impact  
11 would be considered less than significant. No mitigation is required.

### 12 **10.3.3.13 Alternative 6C—Isolated Conveyance with West Alignment and** 13 **Intakes W1–W5 (15,000 cfs; Operational Scenario D)**

#### 14 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil** 15 **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

16 Alternative 6C would involve physical/structural components similar to Alternative 1C, but existing  
17 connections between the SWP and CVP south Delta export facilities would be severed. These  
18 connections would be in soils similar to those in Alternative 1C and would not substantially change  
19 the project effects relating to accelerated erosion. The impacts of Alternative 6C would, therefore, be  
20 similar to those of Alternative 1C. See the discussion of Impact SOILS-1 under Alternative 1C.

21 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative  
22 6C could cause substantial accelerated erosion. However, as described in Section 10.3.1, *Methods for*  
23 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, DWR would be required to  
24 obtain coverage under the General Permit for Construction and Land Disturbance Activities,  
25 necessitating the preparation of a SWPPP and an erosion control plan. Proper implementation of the  
26 requisite SWPPP and compliance with the General Permit would ensure that there would not be  
27 substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs as a result of  
28 construction of the proposed water conveyance facility, and therefore, there would not be an  
29 adverse effect.

30 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
31 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
32 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
33 and reuse areas.

34 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
35 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
36 would seek coverage under the state General Permit for Construction and Land Disturbance  
37 Activities (as discussed in Appendix 3B, *Environmental Commitments, AMMs, and CMs*), necessitating  
38 the preparation of a SWPPP and an erosion control plan. Because of implementation of the requisite  
39 SWPPP and compliance with the General Permit, there would not be substantial soil erosion  
40 resulting in daily site runoff turbidity in excess of 250 NTUs and the effect would be less than  
41 significant. No mitigation is required.

1 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of**  
 2 **Constructing the Proposed Water Conveyance Facilities**

3 Alternative 6C would involve physical/structural components similar to Alternative 1C, but existing  
 4 connections between the SWP and CVP south Delta export facilities would be severed. These  
 5 connections would involve construction operations similar to those under Alternative 1C and would  
 6 not substantially change the project effects relating to the loss of topsoil. The impacts of Alternative  
 7 6C would, therefore, be similar to those under Alternative 1C. See the discussion of Impact SOILS-2  
 8 under Alternative 1C.

9 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g.,  
 10 forebays, borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants);  
 11 overcovering (e.g., levees and embankments, spoil storage, pumping plants); and water inundation  
 12 (e.g., sedimentation basins, solids lagoons).

13 Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil  
 14 would not be excavated, overcovered, or inundated, such as at construction staging and laydown  
 15 areas where the soil could be compacted or otherwise affected.

16 DWR has made an environmental commitment for Disposal Site Preparation which would require  
 17 that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will  
 18 be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,  
 19 thereby lessening the effect. However, this effect would be adverse because it would result in a  
 20 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
 21 this effect.

22 The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and  
 23 Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures  
 24 for how excavated subsurface soil materials would be handled, stored, and disposed of. The  
 25 commitment also specifies that temporary storage sites for spoils, RTM, and dredged material  
 26 storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b  
 27 supplements the environmental commitment, specifically by defining topsoil for the purposes of the  
 28 mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

29 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
 30 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss  
 31 of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area  
 32 would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate  
 33 for these impacts, but not to a less than significant level because topsoil would be permanently lost  
 34 over extensive areas. Therefore, this impact is considered significant and unavoidable.

35 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

36 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 37 1A.

38 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 39 **Topsoil Storage and Handling Plan**

40 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 41 1A.

1 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 2 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the**  
 3 **Proposed Water Conveyance Facilities**

4 Alternative 6C would involve physical/structural components similar to Alternative 1C, but existing  
 5 connections between the SWP and CVP south Delta export facilities would be severed. These  
 6 connections would be in soils similar to those under Alternative 1C and would not substantially  
 7 change the project effects relating to subsidence. The impacts of Alternative 6C would, therefore, be  
 8 similar to those under Alternative 1C. See the discussion of Impact SOILS-3 under Alternative 1C.

9 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 10 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 11 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 12 be conducted at all facilities to identify the types of soil stabilization that should be implemented to  
 13 ensure that the facilities are constructed to withstand subsidence and settlement and to conform to  
 14 applicable state and federal standards. As discussed under Alternative 1C, conforming to state and  
 15 federal design standards, including conduct of site-specific geotechnical evaluations, would ensure  
 16 that appropriate design measures are incorporated into the project and any subsidence that takes  
 17 place under the project facilities would not jeopardize their integrity.

18 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
 19 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
 20 failure of the facility. However, because DWR would be required to design and construct the  
 21 facilities according to state and federal design standards and guidelines (e.g., California Building  
 22 Code, American Society of Civil Engineers Minimum Design Loads for Buildings and Other  
 23 Structures, ASCE/SEI 7-10, 2010). Conforming to these codes would reduce the potential hazard of  
 24 subsidence or settlement to acceptable levels by avoiding construction directly on or otherwise  
 25 stabilizing the soil material that is prone to subsidence. Because these measures would reduce the  
 26 potential hazard of subsidence or settlement to meet design standards, the impact would be less  
 27 than significant. No mitigation is required.

28 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 29 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

30 Alternative 6C would involve physical/structural components similar to Alternative 1C, but existing  
 31 connections between the SWP and CVP south Delta export facilities would be severed. These  
 32 connections would be in soils similar to Alternative 1C and would not substantially change the  
 33 project effects related to soil expansion, corrosivity, and compression. The effects under Alternative  
 34 6C would, therefore, be similar to those under Alternative 1C. See the discussion if Impact SOILS-4  
 35 under Alternative 1C.

36 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake  
 37 facilities, pumping plants, access roads and utilities, and other features could be adversely affected  
 38 because they would be located on expansive, corrosive, and compressible soils. However, all facility  
 39 design and construction would be executed in conformance with the CBC, which specifies measures  
 40 to mitigate effects of expansive soils, corrosive soils, and soils subject to compression and  
 41 subsidence. By conforming to the CBC and other applicable design standards, potential effects  
 42 associated with expansive and corrosive soils and soils subject to compression and subsidence  
 43 would be offset. There would be no adverse effect.

1 **CEQA Conclusion:** Many of the Alternative 6C facilities would be constructed on soils that are  
 2 subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 3 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 4 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
 5 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
 6 However, because DWR would be required to design and construct the facilities in conformance  
 7 with state and federal design standards, guidelines, and building codes (e.g., CBC and USACE design  
 8 standards). Conforming to these codes and standards is an environmental commitment by DWR to  
 9 ensure that potential adverse effects associated with expansive and corrosive soils and soils subject  
 10 to compression and subsidence would be offset. Therefore, the impact would be less than significant.  
 11 No mitigation is required.

12 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**  
 13 **Operations**

14 Alternative 6C would have operations that are different from those under Alternative 1A. However,  
 15 operations under Alternative 6C would have a potential effect on accelerated bank erosion similar to  
 16 Alternative 1A. The effects of Alternative 6C would, therefore, be similar to those under Alternative  
 17 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

18 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be  
 19 adverse because, as part of the conservation measures, major channels would be dredged to create a  
 20 larger cross-section that would offset increased tidal velocities. The effect would not be adverse  
 21 because there would be no net increase in river flow rates and therefore no net increase in channel  
 22 bank scour.

23 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 24 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 25 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 26 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
 27 effect would be to reduce the channel flow rates by 10–20% compared to Existing  
 28 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
 29 than significant. No mitigation is required.

30 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
 31 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
 32 **CM11, CM18 and CM19**

33 Implementation of conservation measures under Alternative 6C would be the same as under  
 34 Alternative 1A. Implementation of the conservation activities would involve ground disturbance and  
 35 construction activities that could lead to accelerated soil erosion rates and consequent loss of  
 36 topsoil. See the discussion of Impact SOILS-6 under Alternative 1A.

37 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
 38 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*,  
 39 *AMMs, and CMs*, the BDCP proponents would be required to obtain coverage under the General  
 40 Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP  
 41 and an erosion control plan. Proper implementation of the requisite SWPPP, site-specific BMPs, and  
 42 compliance with the General Permit would ensure that accelerated water and wind erosion as a  
 43 result of implementing conservation measures would not be an adverse effect.

1 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 2 conservation measures could cause accelerated water and wind erosion of soil. However, because  
 3 the BDCP proponents would seek coverage under the state General Permit for Construction and  
 4 Land Disturbance Activities, which will require implementation of erosion and sediment control  
 5 BMPs (such as revegetation, runoff control, and sediment barriers) and compliance with water  
 6 quality standards, the impact would be less than significant. No mitigation is required.

7 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
 8 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
 9 **CM2–CM11**

10 Conservation measures would be the same under Alternative 6C as under Alternative 1A. Topsoil  
 11 effectively would be lost as a resource as a result of its excavation, overcovering, and water  
 12 inundation over extensive areas of the Plan Area. See the discussion of Impact SOILS-7 under  
 13 Alternative 1A.

14 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.  
 15 Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of this effect.

16 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,  
 17 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas,  
 18 thereby resulting in a substantial loss of topsoil. The impact would be significant. Mitigation  
 19 Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts to a degree,  
 20 but not to a less-than-significant level because topsoil would be permanently lost over extensive  
 21 areas. Therefore, this impact is considered significant and unavoidable.

22 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

23 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 24 1A.

25 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 26 **Topsoil Storage and Handling Plan**

27 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 28 1A.

29 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 30 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
 31 **Proposed Conservation Measures CM2–CM11**

32 Conservation measures would be the same under Alternative 6C as under Alternative 1A. Damage to  
 33 or failure of the habitat levees could occur where these are constructed in soils and sediments that  
 34 are subject to subsidence and differential settlement. These soil conditions have the potential to  
 35 exist in the Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the vicinity.  
 36 See the discussion of Impact SOILS-8 under Alternative 1A.

37 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 38 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 39 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 40 be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to

1 ensure that levees, berms, and other features are constructed to withstand subsidence and  
2 settlement and to conform to applicable state and federal standards.

3 With construction of all levees, berms, and other conservation features designed and constructed to  
4 withstand subsidence and settlement and through conformance with applicable state and federal  
5 design standards, this effect would not be adverse.

6 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
7 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
8 to or failure of the facility. However, because the BDCP proponents would be required to design and  
9 construct the facilities according to state and federal design standards and guidelines (which may  
10 involve, for example, replacement of the organic soil), the impact would be less than significant. No  
11 mitigation is required.

12 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,  
13 and Compressible Soils as a Result of Implementing the Proposed Conservation Measures  
14 CM2-CM11**

15 Implementation of the proposed conservation measures under Alternative 6C would be the same as  
16 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,  
17 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the  
18 discussion of Impact SOILS-9 under Alternative 1A.

19 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control  
20 structures or cause them to fail, resulting in a release of water from the structure and consequent  
21 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs  
22 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West  
23 Delta ROA possess soils with high corrosivity to concrete.

24 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
25 Mokelumne, and South Delta ROAs.

26 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
27 compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
28 studies and testing would be completed prior to construction within the ROAs. The site-specific  
29 environmental evaluation would identify specific areas where engineering soil properties, including  
30 soil compressibility, may require special consideration during construction of specific features  
31 within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
32 expansive, corrosive and/or compressible soils would prevent adverse effects of such soils.

33 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
34 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
35 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
36 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
37 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
38 However, because the BDCP proponents would be required to design and construct the facilities  
39 according to state and federal design standards, guidelines, and building codes (which may involve,  
40 for example, soil lime stabilization, cathodic protection of steel, and soil replacement), this impact  
41 would be considered less than significant. No mitigation is required.

1 **10.3.3.14 Alternative 7—Dual Conveyance with Pipeline/Tunnel, Intakes 2,**  
 2 **3, and 5, and Enhanced Aquatic Conservation (9,000 cfs;**  
 3 **Operational Scenario E)**

4 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil**  
 5 **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

6 Alternative 7 would include the same physical/structural components as Alternative 1A, except that  
 7 it would entail two fewer intakes and two fewer pumping plants. These differences would result in  
 8 slightly less accelerated erosion effects on soils than under Alternative 1A. The effects of Alternative  
 9 7 would, however, be similar to those of Alternative 1A. See the discussion of Impact SOILS-1 under  
 10 Alternative 1A.

11 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative  
 12 7 could cause substantial accelerated erosion. However, as described in Section 10.3.1, *Methods for*  
 13 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, DWR would be required to  
 14 obtain coverage under the General Permit for Construction and Land Disturbance Activities,  
 15 necessitating the preparation of a SWPPP and an erosion control plan. Proper implementation of the  
 16 requisite SWPPP and compliance with the General Permit would ensure that there would not be  
 17 substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs as a result of  
 18 construction of the proposed water conveyance facility, and therefore, there would not be an  
 19 adverse effect.

20 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
 21 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
 22 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
 23 and reuse areas.

24 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 25 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
 26 would seek coverage under the state General Permit for Construction and Land Disturbance  
 27 Activities (as discussed in Appendix 3B, *Environmental Commitments, AMMs, and CMs*), necessitating  
 28 preparation of a SWPPP and an erosion control plan. Because of implementation of the requisite  
 29 SWPPP and compliance with the General Permit, there would not be substantial soil erosion  
 30 resulting in daily site runoff turbidity in excess of 250 NTUs and the effect would be less than  
 31 significant. No mitigation is required.

32 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of**  
 33 **Constructing the Proposed Water Conveyance Facilities**

34 Alternative 7 would include the same physical/structural components as Alternative 1A, except that  
 35 it would entail two fewer intakes and two fewer pumping plants. These differences would result in  
 36 slightly less effects on topsoil loss than Alternative 1A. The impacts of Alternative 7 would, however,  
 37 be similar to those of Alternative 1A. See the discussion of Impact SOILS-2 under Alternative 1A.

38 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g.,  
 39 forebays, borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants);  
 40 overcovering (e.g., levees and embankments, spoil storage, pumping plants); and water inundation  
 41 (e.g., sedimentation basins, solids lagoons).

1 Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil  
 2 would not be excavated, overcovered, or inundated, such as at construction staging and laydown  
 3 areas where the soil could be compacted or otherwise affected.

4 DWR has made an environmental commitment for Disposal Site Preparation which would require  
 5 that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will  
 6 be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,  
 7 thereby lessening the effect. However, this effect would be adverse because it would result in a  
 8 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
 9 this effect.

10 The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and  
 11 Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures  
 12 for how excavated subsurface soil materials would be handled, stored, and disposed of. The  
 13 commitment also specifies that temporary storage sites for spoils, RTM, and dredged material  
 14 storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b  
 15 supplements the environmental commitment, specifically by defining topsoil for the purposes of the  
 16 mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

17 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
 18 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss  
 19 of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area  
 20 would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate  
 21 for these impacts, but not to a less-than-significant level because topsoil would be permanently lost  
 22 over extensive areas. Therefore, this impact is considered significant and unavoidable.

#### 23 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

24 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 25 1A.

#### 26 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a** 27 **Topsoil Storage and Handling Plan**

28 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 29 1A.

#### 30 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and** 31 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the** 32 **Proposed Water Conveyance Facilities**

33 Alternative 7 would include the same physical/structural components as Alternative 1A, except that  
 34 it would entail two fewer intakes and two fewer pumping plants. These differences would result in  
 35 slightly less effects related to subsidence than under Alternative 1A. The impacts of Alternative 7  
 36 would, however, be similar to those under Alternative 1A. See the discussion of Impact SOILS-3  
 37 under Alternative 1A.

38 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 39 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 40 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 41 be conducted at all facilities to identify the types of soil avoidance or soil stabilization measures that

1 should be implemented to ensure that the facilities are constructed to withstand subsidence and  
 2 settlement and to conform to applicable state and federal standards. These investigations would  
 3 build upon the geotechnical data reports (California Department of Water Resources 2001a, 2010b,  
 4 2011) and the CERs (California Department of Water Resources 2010a, 2010b). As discussed under  
 5 Alternative 1A, conforming to state and federal design standards, including conduct of site-specific  
 6 geotechnical evaluations, would ensure that appropriate design measures are incorporated into the  
 7 project and any subsidence that takes place under the project facilities would not jeopardize their  
 8 integrity.

9 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
 10 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
 11 failure of the facility. However, DWR would be required to design and construct the facilities  
 12 according to state and federal design standards and guidelines (e.g., California Building Code,  
 13 American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures,  
 14 ASCE/SEI 7-10, 2010). Conforming to these codes would reduce the potential hazard of subsidence  
 15 or settlement to acceptable levels by avoiding construction directly on or otherwise stabilizing the  
 16 soil material that is prone to subsidence. Because these measures would reduce the potential hazard  
 17 of subsidence or settlement to meet design standards, the impact would be less than significant. No  
 18 mitigation is required.

19 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 20 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

21 Alternative 7 would include the same physical/structural components as Alternative 1A, except that  
 22 it would entail two fewer intakes and two fewer pumping plants. These differences would result in  
 23 slightly less effects related to expansive, corrosive, and compressible soils than under Alternative  
 24 1A. The effects of Alternative 7 would, however, be similar to those under Alternative 1A. See the  
 25 discussion if SOILS-4 under Alternative 1A.

26 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake  
 27 facilities, pumping plants, access roads and utilities, and other features could be adversely affected  
 28 because they would be located on expansive, corrosive, and compressible soils. However, all facility  
 29 design and construction would be executed in conformance with the CBC, which specifies measures  
 30 to mitigate effects of expansive soils, corrosive soils, and soils subject to compression and  
 31 subsidence. By conforming to the CBC and other applicable design standards, potential effects  
 32 associated with expansive and corrosive soils and soils subject to compression and subsidence  
 33 would be offset. There would be no adverse effect.

34 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to  
 35 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils  
 36 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils  
 37 could damage in-ground facilities or shorten their service life. Compression/settlement of soils after  
 38 a facility is constructed could result in damage to or failure of the facility. However, because DWR  
 39 would be required to design and construct the facilities in conformance with state and federal  
 40 design standards, guidelines, and building codes (e.g., CBC and USACE design standards).  
 41 Conforming to these codes and standards is an environmental commitment by DWR to ensure that  
 42 potential adverse effects associated with expansive and corrosive soils and soils subject to  
 43 compression and subsidence would be offset. Therefore, this impact would be less than significant.  
 44 No mitigation is required.

1 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**  
2 **Operations**

3 Alternative 7 would have operations similar to those under Alternative 1A, but of a lesser magnitude  
4 with respect to potential effects on accelerated bank erosion because the flow from the north Delta  
5 would be 9,000 cfs rather than 15,000 cfs. The effects of Alternative 7 would, however, be similar to  
6 those under Alternative 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

7 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be  
8 adverse because, as part of the conservation measures, major channels would be dredged to create a  
9 larger cross-section that would offset increased tidal velocities. The effect would not be adverse  
10 because there would be no net increase in river flow rates and therefore no net increase in channel  
11 bank scour.

12 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
13 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
14 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
15 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
16 effect would be to reduce the channel flow rates by 10–20% compared to Existing  
17 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
18 than significant. No mitigation is required.

19 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
20 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
21 **CM11, CM18 and CM19**

22 Implementation of conservation measures under Alternative 7 would be the same as those under  
23 Alternative 1A, with the additional restoration of 20 linear miles of channel margin habitat and  
24 10,000 acres of seasonally inundated floodplain habitat. The effects under Alternative 7 would,  
25 therefore, be similar to those under Alternative 1A but of a greater magnitude. See discussion of  
26 Impact SOILS-6 under Alternative 1A.

27 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
28 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*,  
29 *AMMs*, and *CMs*, the BDCP proponents would be required to obtain coverage under the General  
30 Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP  
31 and an erosion control plan. These requirements would apply to the additional 20 linear miles of  
32 channel margin habitat and additional 10,000 acres of seasonally inundated floodplain habitat  
33 under Alternative 7. Proper implementation of the requisite SWPPP, site-specific BMPs, and  
34 compliance with the General Permit would ensure that accelerated water and wind erosion as a  
35 result of implementing conservation measures would not be an adverse effect.

36 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
37 restoration areas could cause accelerated water and wind erosion of soil. However, because the  
38 BDCP proponents would seek coverage under the state General Permit for Construction and Land  
39 Disturbance Activities, which will require implementation of erosion and sediment control BMPs  
40 (such as revegetation, runoff control, and sediment barriers) and compliance with water quality  
41 standards, the impact would be less than significant. No mitigation is required.

1 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
 2 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
 3 **CM2–CM11**

4 Conservation measures under Alternative 7 would be the same as those under Alternative 1A, with  
 5 the additional restoration of 20 linear miles of channel margin habitat and 10,000 acres of  
 6 seasonally inundated floodplain habitat. The effects under Alternative 7 would, therefore, be similar  
 7 to those under Alternative 1A but of a greater magnitude. See discussion of Impact SOILS-7 under  
 8 Alternative 1A.

9 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.  
 10 Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of this effect.

11 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,  
 12 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas,  
 13 thereby resulting in a substantial loss of topsoil. The impact would be significant. Mitigation  
 14 Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts to a degree,  
 15 but not to a less-than-significant level. Therefore, this impact is considered significant and  
 16 unavoidable.

17 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

18 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 19 1A.

20 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 21 **Topsoil Storage and Handling Plan**

22 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 23 1A.

24 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 25 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
 26 **Proposed Conservation Measures CM2–CM11**

27 Conservation measures under Alternative 7 would be the same as those under Alternative 1A,  
 28 except that an additional 20 linear miles of channel margin habitat and an additional 10,000 acres of  
 29 seasonally inundated floodplain habitat would be restored. Under Alternative 7, the additional  
 30 10,000 acres of seasonally inundated floodplain habitat could lessen the rate of subsidence in the  
 31 restored areas, assuming that the restoration areas are subject to subsidence. Therefore, there could  
 32 be a beneficial effect on soils in these areas. Otherwise, Alternative 7 would be similar to those  
 33 under Alternative 1A. Damage to or failure of the habitat levees could occur where these are  
 34 constructed in soils and sediments that are subject to subsidence and differential settlement. These  
 35 soil conditions have the potential to exist in the Suisun Marsh ROA. Levee damage or failure could  
 36 cause surface flooding in the vicinity. See the discussion of Impact SOILS-8 under Alternative 1A.

37 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 38 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 39 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 40 be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to

1 ensure that levees, berms, and other features are constructed to withstand subsidence and  
2 settlement and to conform to applicable state and federal standards.

3 With construction of all levees, berms, and other conservation features designed and constructed to  
4 withstand subsidence and settlement and through conformance with applicable state and federal  
5 design standards, this effect would not be adverse.

6 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
7 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
8 to or failure of the facility. However, because the BDCP proponents would be required to design and  
9 construct the facilities according to state and federal design standards and guidelines (which may  
10 involve, for example, replacement of the organic soil), the impact would be less than significant.  
11 Under this alternative, the additional 10,000 acres of seasonally inundated floodplain habitat could  
12 lessen the rate of subsidence in the restored areas, assuming that the restoration areas are subject  
13 to subsidence. This could be a beneficial impact on soils in these areas. No mitigation is required.

14 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
15 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures**  
16 **CM2-CM11**

17 Implementation of the proposed conservation measures under Alternative 7 would be the same as  
18 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,  
19 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the  
20 discussion of Impact SOILS-9 under Alternative 1A.

21 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control  
22 structures or cause them to fail, resulting in a release of water from the structure and consequent  
23 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs  
24 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West  
25 Delta ROA possess soils with high corrosivity to concrete.

26 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
27 Mokelumne, and South Delta ROAs.

28 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
29 compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
30 studies and testing would be completed prior to construction within the ROAs. The site-specific  
31 environmental evaluation would identify specific areas where engineering soil properties, including  
32 soil compressibility, may require special consideration during construction of specific features  
33 within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
34 expansive, corrosive and/or compressible soils would prevent adverse effects of such soils.

35 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
36 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
37 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
38 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
39 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
40 However, because the BDCP proponents would be required to design and construct the facilities  
41 according to state and federal design standards, guidelines, and building codes (which may involve,

1 for example, soil lime stabilization, cathodic protection of steel, and soil replacement), this impact  
2 would be considered less than significant. No mitigation is required.

### 3 **10.3.3.15 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 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil** 7 **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

8 Alternative 8 would include the same physical/structural components as Alternative 1A, except that  
9 it would entail two fewer intakes and two fewer pumping plants. These differences would result in  
10 slightly less accelerated erosion effects than under Alternative 1A. The effects of Alternative 8  
11 would, however, be similar to those of Alternative 1A. See the discussion of Impact SOILS-1 under  
12 Alternative 1A.

13 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative  
14 8 could cause substantial accelerated erosion. However, as described in Section 10.3.1, *Methods for*  
15 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, DWR would be required to  
16 obtain coverage under the General Permit for Construction and Land Disturbance Activities,  
17 necessitating the preparation of a SWPPP and an erosion control plan. Proper implementation of the  
18 requisite SWPPP and compliance with the General Permit would ensure that there would not be  
19 substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs as a result of  
20 construction of the proposed water conveyance facility, therefore, there would not be an adverse  
21 effect.

22 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
23 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
24 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
25 and reuse areas.

26 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
27 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
28 would seek coverage under the state General Permit for Construction and Land Disturbance  
29 Activities (as discussed in Appendix 3B, *Environmental Commitments, AMMs, and CMs*), necessitating  
30 preparation of a SWPPP and an erosion control plan. Because of implementation of the requisite  
31 SWPPP and compliance with the General Permit, there would not be substantial soil erosion  
32 resulting in daily site runoff turbidity in excess of 250 NTUs and the effect would be less than  
33 significant. No mitigation is required.

#### 34 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 35 **Constructing the Proposed Water Conveyance Facilities**

36 Alternative 8 would include the same physical/structural components as Alternative 1A, except that  
37 it would entail two fewer intakes and two fewer pumping plants. These differences would result in  
38 slightly less effects on topsoil loss than Alternative 1A. The effects of Alternative 8 would, however,  
39 be similar to those of Alternative 1A. See the discussion of Impact SOILS-2 under Alternative 1A.

1 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g.,  
 2 forebays, borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants);  
 3 overcovering (e.g., levees and embankments, spoil storage, pumping plants); and water inundation  
 4 (e.g., sedimentation basins, solids lagoons).

5 Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil  
 6 would not be excavated, overcovered, or inundated, such as at construction staging and laydown  
 7 areas where the soil could be compacted or otherwise affected.

8 DWR has made an environmental commitment for Disposal Site Preparation which would require  
 9 that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will  
 10 be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,  
 11 thereby lessening the effect. However, this effect would be adverse because it would result in a  
 12 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
 13 this effect.

14 The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and  
 15 Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures  
 16 for how excavated subsurface soil materials would be handled, stored, and disposed of. The  
 17 commitment also specifies that temporary storage sites for spoils, RTM, and dredged material  
 18 storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b  
 19 supplements the environmental commitment, specifically by defining topsoil for the purposes of the  
 20 mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

21 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
 22 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss  
 23 of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area  
 24 would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate  
 25 for these impacts, but not to a less-than-significant level because topsoil would be permanently lost  
 26 over extensive areas. Therefore, this impact is considered significant and unavoidable.

#### 27 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

28 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 29 1A.

#### 30 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a** 31 **Topsoil Storage and Handling Plan**

32 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 33 1A.

#### 34 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and** 35 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the** 36 **Proposed Water Conveyance Facilities**

37 Alternative 8 would include the same physical/structural components as Alternative 1A, except that  
 38 it would entail two fewer intakes and two fewer pumping plants. These differences would result in  
 39 slightly less effects related to subsidence than Alternative 1A. The effects of Alternative 8 would,  
 40 however, be similar to those under Alternative 1A. See the discussion of Impact SOILS-3 under  
 41 Alternative 1A.

1 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 2 soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for Analysis*,  
 3 and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would be  
 4 conducted at all facilities to identify the types of soil avoidance or soil stabilization measures that  
 5 should be implemented to ensure that the facilities are constructed to withstand subsidence and  
 6 settlement and to conform to applicable state and federal standards. These investigations would  
 7 build upon the geotechnical data reports (California Department of Water Resources 2001a, 2010b,  
 8 2011) and the CERs (California Department of Water Resources 2010a, 2010b). As discussed under  
 9 Alternative 1A, conforming to state and federal design standards, including conduct of site-specific  
 10 geotechnical evaluations, would ensure that appropriate design measures are incorporated into the  
 11 project and any subsidence that takes place under the project facilities would not jeopardize their  
 12 integrity.

13 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
 14 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
 15 failure of the facility. However, because DWR would be required to design and construct the  
 16 facilities according to state and federal design standards and guidelines (e.g., California Building  
 17 Code, American Society of Civil Engineers Minimum Design Loads for Buildings and Other  
 18 Structures, ASCE/SEI 7-10, 2010). Conforming to these codes would reduce the potential hazard of  
 19 subsidence or settlement to acceptable levels by avoiding construction directly on or otherwise  
 20 stabilizing the soil material that is prone to subsidence. Because these measures would reduce the  
 21 potential hazard of subsidence or settlement to meet design standards, the impact would be less  
 22 than significant. No mitigation is required.

23 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 24 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

25 Alternative 8 would include the same physical/structural components as Alternative 1A, except that  
 26 it would entail two fewer intakes and two fewer pumping plants. These differences would result in  
 27 slightly less effects related to expansive, corrosive, and compressible soils than Alternative 1A. The  
 28 impacts of Alternative 8 would, however, be similar to those under Alternative 1A. See the  
 29 discussion of Impact SOILS-4 under Alternative 1A.

30 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake  
 31 facilities, pumping plants, access roads and utilities, and other features could be adversely affected  
 32 because they would be located on expansive, corrosive, and compressible soils. However, all facility  
 33 design and construction would be executed in conformance with the CBC, which specifies measures  
 34 to mitigate effects of expansive soils, corrosive soils, and soils subject to compression and  
 35 subsidence. By conforming to the CBC and other applicable design standards, potential effects  
 36 associated with expansive and corrosive soils and soils subject to compression and subsidence  
 37 would be offset. There would be no adverse effect.

38 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to  
 39 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils  
 40 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils  
 41 could damage in-ground facilities or shorten their service life. Compression/settlement of soils after  
 42 a facility is constructed could result in damage to or failure of the facility. However, because DWR  
 43 would be required to design and construct the facilities according to state and federal design  
 44 standards, guidelines, and building codes (e.g., CBC and USACE design standards). Conforming to

1 these codes and standards is an environmental commitment by DWR to ensure that potential  
 2 adverse effects associated with expansive and corrosive soils and soils subject to compression and  
 3 subsidence would be offset. Therefore, this impact would be less than significant. No mitigation is  
 4 required.

5 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**  
 6 **Operations**

7 Alternative 8 would have operations similar to those under Alternative 1A, but of a lesser magnitude  
 8 with respect to potential effects on accelerated bank erosion because the flow from the north Delta  
 9 would be 9,000 cfs rather than 15,000 cfs. The effects of Alternative 8 would, however, be similar to  
 10 those under Alternative 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

11 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be  
 12 adverse because, as part of the conservation measures, major channels would be dredged to create a  
 13 larger cross-section that would offset increased tidal velocities. The effect would not be adverse  
 14 because there would be no net increase in river flow rates and therefore no net increase in channel  
 15 bank scour.

16 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 17 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 18 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 19 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
 20 effect would be to reduce the channel flow rates by 10–20% compared to Existing  
 21 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
 22 than significant. No mitigation is required.

23 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
 24 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
 25 **CM11, CM18 and CM19**

26 Implementation of conservation measures under Alternative 8 would be similar to those under  
 27 Alternative 1A. Implementation of the conservation measures would involve ground disturbance  
 28 and construction activities that could lead to accelerated soil erosion rates and consequent loss of  
 29 topsoil. See the discussion of Impact SOILS-6 under Alternative 1A.

30 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
 31 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*,  
 32 *AMMs, and CMs*, the BDCP proponents would be required to obtain coverage under the General  
 33 Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP  
 34 and an erosion control plan. Proper implementation of the requisite SWPPP, site-specific BMPs, and  
 35 compliance with the General Permit would ensure that accelerated water and wind erosion as a  
 36 result of implementing conservation measures would not be an adverse effect.

37 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 38 restoration areas could cause accelerated water and wind erosion of soil. However, because the  
 39 BDCP proponents would seek coverage under the state General Permit for Construction and Land  
 40 Disturbance Activities, which will require implementation of erosion and sediment control BMPs  
 41 (such as revegetation, runoff control, and sediment barriers) and compliance with water quality  
 42 standards, the impact would be less than significant. No mitigation is required.

1 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
 2 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
 3 **CM2–CM11**

4 Conservation measures under Alternative 8 would be similar to those under Alternative 1A. Topsoil  
 5 effectively would be lost as a resource as a result of its excavation, overcovering, and water  
 6 inundation over extensive areas of the Plan Area. See the discussion of Impact SOILS-7 under  
 7 Alternative 1A.

8 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.  
 9 Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of this effect.

10 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,  
 11 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas,  
 12 thereby resulting in a substantial loss of topsoil. The impact would be significant. Mitigation  
 13 Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts to a degree,  
 14 but not to a less-than-significant level. Therefore, this impact is considered significant and  
 15 unavoidable.

16 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

17 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 18 1A.

19 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 20 **Topsoil Storage and Handling Plan**

21 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 22 1A.

23 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 24 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
 25 **Proposed Conservation Measures CM2–CM11**

26 Conservation measures under Alternative 8 would be similar to those under Alternative 1A. Damage  
 27 to or failure of the habitat levees could occur where these are constructed in soils and sediments  
 28 that are subject to subsidence and differential settlement. These soil conditions have the potential to  
 29 exist in the Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the vicinity.  
 30 See the discussion of Impact SOILS-8 under Alternative 1A.

31 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 32 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 33 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 34 be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to  
 35 ensure that levees, berms, and other features are constructed to withstand subsidence and  
 36 settlement and to conform to applicable state and federal standards.

37 With construction of all levees, berms, and other conservation features designed and constructed to  
 38 withstand subsidence and settlement and through conformance with applicable state and federal  
 39 design standards, this effect would not be adverse.

1 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
 2 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 3 to or failure of the facility. However, because the BDCP proponents would be required to design and  
 4 construct the facilities according to state and federal design standards and guidelines (which may  
 5 involve, for example, replacement of the organic soil), the impact would be less than significant. No  
 6 mitigation is required.

7 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,  
 8 and Compressible Soils as a Result of Implementing the Proposed Conservation Measures  
 9 CM2–CM11**

10 Implementation of the proposed conservation measures under Alternative 8 would be the same as  
 11 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,  
 12 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the  
 13 discussion of Impact SOILS-9 under Alternative 1A.

14 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control  
 15 structures or cause them to fail, resulting in a release of water from the structure and consequent  
 16 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs  
 17 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West  
 18 Delta ROA possess soils with high corrosivity to concrete.

19 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
 20 Mokelumne, and South Delta ROAs.

21 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
 22 compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
 23 studies and testing would be completed prior to construction within the ROAs. The site-specific  
 24 environmental evaluation would identify specific areas where engineering soil properties, including  
 25 soil compressibility, may require special consideration during construction of specific features  
 26 within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
 27 expansive, corrosive and/or compressible soils would prevent adverse effects of such soils.

28 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
 29 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 30 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 31 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
 32 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
 33 However, because the BDCP proponents would be required to design and construct the facilities  
 34 according to state and federal design standards, guidelines, and building codes (which may involve,  
 35 for example, soil lime stabilization, cathodic protection of steel, and soil replacement), this impact  
 36 would be considered less than significant. No mitigation is required.

1 **10.3.3.16 Alternative 9—Through Delta/Separate Corridors (15,000 cfs;**  
 2 **Operational Scenario G)**

3 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil**  
 4 **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

5 Construction of water conveyance facilities under Alternative 9 would involve an array of intakes,  
 6 pumping plants, pipelines, culvert siphons, canals, borrow areas, enlargement of a channel, and  
 7 other facilities. Some of the facilities would primarily involve in-water work and would have no  
 8 bearing on soils. The locations of some of the Alternative 9 facilities would be different than those of  
 9 the other alternatives. At the primary two such locations, operable barriers would be constructed;  
 10 these would involve grading for the work/staging areas, which would result in accelerated erosion.  
 11 However, the soil disturbance work would be subject to the same regulatory compliance  
 12 requirements to control erosion as under Alternative 1A. The impacts of Alternative 9 would,  
 13 therefore, be similar to but of much lesser extent than under Alternative 1A. See the discussion of  
 14 Impact SOILS-1 under Alternative 1A.

15 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative  
 16 9 could cause substantial accelerated erosion. However, as described in Section 10.3.1, *Methods for*  
 17 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, DWR would be required to  
 18 obtain coverage under the General Permit for Construction and Land Disturbance Activities,  
 19 necessitating the preparation of a SWPPP and an erosion control plan. Proper implementation of the  
 20 requisite SWPPP and compliance with the General Permit would ensure that there would not be  
 21 substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs as a result of  
 22 construction of the proposed water conveyance facility, and therefore, there would not be an  
 23 adverse effect.

24 Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
 25 Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
 26 excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
 27 and reuse areas.

28 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 29 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
 30 would seek coverage under the state General Permit for Construction and Land Disturbance  
 31 Activities (as discussed in Appendix 3B, *Environmental Commitments, AMMs, and CMs*), necessitating  
 32 the preparation of a SWPPP and an erosion control plan. Because of implementation of the requisite  
 33 SWPPP and compliance with the General Permit, there would not be substantial soil erosion  
 34 resulting in daily site runoff turbidity in excess of 250 NTUs and the effect would be less than  
 35 significant. No mitigation is required.

36 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of**  
 37 **Constructing the Proposed Water Conveyance Facilities**

38 Construction of water conveyance facilities under Alternative 9 would involve an array of intakes,  
 39 pumping plants, pipelines, culvert siphons, canals, borrow areas, enlargement of a channel, and  
 40 other facilities. (Some of the facilities would primarily involve in-water work and would have no  
 41 bearing on soils.) The locations of some of the Alternative 9 facilities would be different from those  
 42 of the other alternatives. At the primary two such locations, operable barriers would be constructed;

1 these would involve construction operations similar to those under Alternative 1A. The effects of  
 2 Alternative 9 would, therefore, be similar but of much lesser extent than under Alternative 1A. See  
 3 the discussion of Impact SOILS-2 under Alternative 1A.

4 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g.,  
 5 borrow areas, intake facilities, pumping plants); overcovering (e.g., spoil storage, pumping plants);  
 6 and water inundation.

7 Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil  
 8 would not be excavated, overcovered, or inundated, such as at construction staging and laydown  
 9 areas where the soil could be compacted or otherwise affected.

10 DWR has made an environmental commitment for Disposal Site Preparation which would require  
 11 that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will  
 12 be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,  
 13 thereby lessening the effect. However, this effect would be adverse because it would result in a  
 14 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
 15 this effect.

16 The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and  
 17 Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures  
 18 for how excavated subsurface soil materials would be handled, stored, and disposed of. The  
 19 commitment also specifies that temporary storage sites for spoils, RTM, and dredged material  
 20 storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b  
 21 supplements the environmental commitment, specifically by defining topsoil for the purposes of the  
 22 mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

23 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
 24 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss  
 25 of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area  
 26 would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate  
 27 for these impacts, but not to a less-than-significant level because topsoil would be permanently lost  
 28 over extensive areas. Therefore, this impact is considered significant and unavoidable.

#### 29 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

30 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 31 1A.

#### 32 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a** 33 **Topsoil Storage and Handling Plan**

34 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 35 1A.

#### 36 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and** 37 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the** 38 **Proposed Water Conveyance Facilities**

39 Construction of water conveyance facilities under Alternative 9 would involve an array of intakes,  
 40 pumping plants, pipelines, culvert siphons, canals, borrow areas, enlargement of a channel, and

1 other facilities. (Some of the facilities would primarily involve in-water work and would have no  
 2 bearing on soils.) The locations of some of the Alternative 9 facilities would be different from those  
 3 of any of the other alternatives. At the primary two such locations, operable barriers would be  
 4 constructed; this area would be subject to the same engineering design standards as under  
 5 Alternative 1A. The impacts of Alternative 9 would, therefore, be similar but of much lesser extent  
 6 than those under Alternative 1A. See the discussion of Impact SOILS-3 under Alternative 1A.

7 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 8 soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for Analysis*,  
 9 and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would be  
 10 conducted at all facilities to identify the types of soil avoidance or soil stabilization measures that  
 11 should be implemented to ensure that the facilities are constructed to withstand subsidence and  
 12 settlement and to conform to applicable state and federal standards. These investigations would  
 13 build upon the geotechnical data reports (California Department of Water Resources 2001a, 2010b,  
 14 2011) and the CERs (California Department of Water Resources 2010e). As discussed under  
 15 Alternative 1A, conforming to state and federal design standards, including conduct of site-specific  
 16 geotechnical evaluations, would ensure that appropriate design measures are incorporated into the  
 17 project and any subsidence that takes place under the project facilities would not jeopardize their  
 18 integrity.

19 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
 20 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
 21 failure of the facility. However, DWR would be required to design and construct the facilities  
 22 according to state and federal design standards and guidelines (e.g., California Building Code,  
 23 American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures,  
 24 ASCE/SEI 7-10, 2010). Conforming to these codes would reduce the potential hazard of subsidence  
 25 or settlement to acceptable levels by avoiding construction directly on or otherwise stabilizing the  
 26 soil material that is prone to subsidence. Because these measures would reduce the potential hazard  
 27 of subsidence or settlement to meet design standards, the impact would be less than significant. No  
 28 mitigation is required.

#### 29 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water** 30 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

31 Construction of water conveyance facilities under Alternative 9 would involve an array of intakes,  
 32 pumping plants, pipelines, culvert siphons, canals, borrow areas, enlargement of a channel, and  
 33 other facilities. (Some of the facilities would primarily involve in-water work and would have no  
 34 bearing on soils.) The locations of some of the Alternative 9 facilities would be different than under  
 35 the other alternatives. At the primary two such locations, operable barriers would be constructed;  
 36 this area would be subject to the same engineering design standards for expansive, corrosive, and  
 37 compressible soils as under Alternative 1A. The impacts of Alternative 9 would, therefore, be similar  
 38 to but of much lesser extent than under Alternative 1A. See the discussion of Impact SOILS-4 under  
 39 Alternative 1A.

40 **NEPA Effects:** The integrity of the water conveyance facilities, including intake facilities, pumping  
 41 plants, access roads and utilities, and other features could be adversely affected because they would  
 42 be located on expansive, corrosive, and compressible soils. However, all facility design and  
 43 construction would be executed in conformance with the CBC, which specifies measures to mitigate  
 44 effects of expansive soils, corrosive soils, and soils subject to compression and subsidence. By

1 conforming to the CBC and other applicable design standards, potential effects associated with  
 2 expansive and corrosive soils and soils subject to compression and subsidence would be offset.  
 3 There would be no adverse effect.

4 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to  
 5 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils  
 6 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils  
 7 could damage in-ground facilities or shorten their service life. Compression/settlement of soils after  
 8 a facility is constructed could result in damage to or failure of the facility. However, DWR would be  
 9 required to design and construct the facilities in conformance with state and federal design  
 10 standards, guidelines, and building codes (e.g., CBC and USACE design standards). Conforming to  
 11 these codes and standards is an environmental commitment by DWR to ensure that potential  
 12 adverse effects associated with expansive and corrosive soils and soils subject to compression and  
 13 subsidence would be offset. Therefore, this impact would be less than significant. No mitigation is  
 14 required.

15 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**  
 16 **Operations**

17 **NEPA Effects:** Operations under Alternative 9 would be different than those under the other  
 18 alternatives. All flows would be moved through existing, new, and expanded channels and canals by  
 19 operating the south Delta pumps. The cross-sectional area of those existing channels that could be  
 20 subject to increased scour (i.e., three reaches of Old River and Victoria Canal) would be expanded to  
 21 increase their flow capacity; the banks of other channels and canals may be armored with riprap to  
 22 protect them from scour. Therefore, changes in channel flow rates are expected to be within the  
 23 range that presently occurs. The effects under Alternative 9 would, therefore, be the similar to the  
 24 No Action Alternative.

25 **CEQA Conclusion:** Changes in flows through existing, new, and expanded channels and canals and  
 26 other changes in operational flow regimes could lead to increases in channel bank scour. However,  
 27 where such changes are expected to occur (e.g., three reaches of Old River and Victoria Canal), the  
 28 project would also entail expansion of the channel cross-section to increase the tidal prism at these  
 29 locations. The net effect would be to reduce the channel flow rates by 10–20% compared to Existing  
 30 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less  
 31 than significant. No mitigation is required.

32 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
 33 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–**  
 34 **CM11, CM18 and CM19**

35 Implementation of conservation measures under Alternative 9 would be similar to those under  
 36 Alternative 1A. Implementation of the conservation measures would involve ground disturbance  
 37 and construction activities that could lead to accelerated soil erosion rates and consequent loss of  
 38 topsoil. See the discussion of Impact SOILS-6 under Alternative 1A.

39 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
 40 described in Section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments,*  
 41 *AMMs, and CMs*, the BDCP proponents would be required to obtain coverage under the General  
 42 Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP  
 43 and an erosion control plan. Proper implementation of the requisite SWPPP, site-specific BMPs, and

1 compliance with the General Permit would ensure that accelerated water and wind erosion as a  
2 result of implementing conservation measures would not be an adverse effect.

3 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
4 restoration areas could cause accelerated water and wind erosion of soil. However, because the  
5 BDCP proponents would seek coverage under the state General Permit for Construction and Land  
6 Disturbance Activities, which will require implementation of erosion and sediment control BMPs  
7 (such as revegetation, runoff control, and sediment barriers) and compliance with water quality  
8 standards, the impact would be less than significant. No mitigation is required.

9 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated**  
10 **with Restoration Activities as a Result of Implementing the Proposed Conservation Measures**  
11 **CM2–CM11**

12 Conservation measures under Alternative 9 would be similar to those under Alternative 1A. See  
13 description and findings under Alternative 1A. Topsoil effectively would be lost as a resource as a  
14 result of its excavation, overcovering, and water inundation over extensive areas of the Plan Area.  
15 See the discussion of Impact SOILS-7 under Alternative 1A.

16 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.  
17 Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of this effect.

18 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,  
19 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas,  
20 thereby resulting in a substantial loss of topsoil. The impact would be significant. Mitigation  
21 Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts to a degree,  
22 but not to a less-than-significant level. Therefore, this impact is considered significant and  
23 unavoidable.

24 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

25 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
26 1A.

27 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
28 **Topsoil Storage and Handling Plan**

29 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
30 1A.

31 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
32 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
33 **Proposed Conservation Measures CM2–CM11**

34 Conservation measures under Alternative 9 would be similar to those under Alternative 1A. Damage  
35 to or failure of the habitat levees could occur where these are constructed in soils and sediments  
36 that are subject to subsidence and differential settlement. These soil conditions have the potential to  
37 exist in the Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the vicinity.  
38 See the discussion of Impact SOILS-8 under Alternative 1A.

1 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 2 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 3 *Analysis*, and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 4 be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to  
 5 ensure that levees, berms, and other features are constructed to withstand subsidence and  
 6 settlement and to conform to applicable state and federal standards.

7 With construction of all levees, berms, and other conservation features designed and constructed to  
 8 withstand subsidence and settlement and through conformance with applicable state and federal  
 9 design standards, this effect would not be adverse.

10 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
 11 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 12 to or failure of the facility. However, because the BDCP proponents would be required to design and  
 13 construct the facilities according to state and federal design standards and guidelines (which may  
 14 involve, for example, replacement of the organic soil), the impact would be less than significant. No  
 15 mitigation is required.

16 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
 17 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures**  
 18 **CM2–CM11**

19 Implementation of the proposed conservation measures under Alternative 9 would be the same as  
 20 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,  
 21 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the  
 22 discussion of Impact SOILS-9 under Alternative 1A.

23 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control  
 24 structures or cause them to fail, resulting in a release of water from the structure and consequent  
 25 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs  
 26 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West  
 27 Delta ROA possess soils with high corrosivity to concrete.

28 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/  
 29 Mokelumne, and South Delta ROAs.

30 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and  
 31 compressible soils. However, ROA-specific environmental effect evaluations and geotechnical  
 32 studies and testing would be completed prior to construction within the ROAs. The site-specific  
 33 environmental evaluation would identify specific areas where engineering soil properties, including  
 34 soil compressibility, may require special consideration during construction of specific features  
 35 within ROAs. Conformity with USACE, CBC, and other design standards for construction on  
 36 expansive, corrosive and/or compressible soils would prevent adverse effects of such soils.

37 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that  
 38 are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 39 Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 40 Corrosive soils could damage in-ground facilities or shorten their service life. Compression or  
 41 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
 42 However, because the BDCP proponents would be required to design and construct the facilities

1 according to state and federal design standards, guidelines, and building codes (which may involve,  
 2 for example, soil lime stabilization, cathodic protection of steel, and soil replacement), this impact  
 3 would be considered less than significant. No mitigation is required.

## 4 **10.3.4 Effects and Mitigation Approaches—Alternatives 4A,** 5 **2D, and 5A**

### 6 **10.3.4.1 No Action Alternative Early Long-Term**

7 The effects of the No Action Alternative (ELT) would be expected to be similar to those effects  
 8 described for the No Action Alternative Late Long-Term (LLT) in Section 10.3.3.1. The No Action  
 9 Alternative (ELT) includes projects and programs with defined management or operational plans,  
 10 including facilities under construction because those actions would be consistent with the  
 11 continuation of existing management direction or level of management for plans, policies, and  
 12 operations by the project proponents and other agencies. Under the No Action Alternative (ELT), the  
 13 condition of soils would continue largely as they have under Existing Conditions. Due to the shorter  
 14 time frame compared to the No Action Alternative (LLT), the magnitude of total impacts to soils  
 15 resulting from construction associated with development and habitat restoration activities within  
 16 the Plan Area would be less under the ELT timeframe than that considered in 2060 due to less  
 17 development in the region.

#### 18 **Accelerated Soil Erosion**

19 As with the No Action Alternative (LLT), current rates of water and wind erosion would continue  
 20 under the No Action Alternative (ELT) as a result of agricultural practices as well as levee  
 21 stabilization, dredge spoil disposal, and habitat restoration projects. There would be less erosion  
 22 than under the No Action Alternative (LLT) due to a smaller extent of farming and project  
 23 construction that would be completed during this timeframe. Federal, state, and local regulations,  
 24 codes, and permitting programs would continue to require implementation of measures to prevent  
 25 nonagricultural accelerated erosion and sediment transport associated with construction.

#### 26 **Loss of Topsoil**

27 The loss of topsoil as a result of excavation, overcovering, and inundation would continue in the  
 28 Delta and statewide under the No Action Alternative ELT as a result of numerous land development  
 29 and habitat restoration projects. However, it would be less than under the No Action Alternative  
 30 (LLT) described in Section 10.3.3.1 due to the shorter timeframe.

#### 31 **Subsidence**

32 Land subsidence in the Delta and the Suisun Marsh would continue to varying degrees under the No  
 33 Action Alternative (ELT). It is anticipated that the current rate of subsidence would continue.  
 34 Several projects are now underway that would have a beneficial effect on subsidence, some with the  
 35 explicit goal of controlling or reversing subsidence. While fewer projects would be implemented  
 36 during the ELT, the level of subsidence would also be less than under the No Action Alternative  
 37 (LLT).

38 Subsidence would be controlled or reversed on approximately 308 acres, resulting in a beneficial  
 39 effect.

## 1       **Soil Expansion, Corrosion, and Compression**

2       Ongoing and reasonably foreseeable future projects in the Plan Area are likely to encounter  
3       expansive, corrosive, and compressible soils. However, federal and state design guidelines and  
4       building codes would continue to require that the facilities constructed as part of these projects  
5       incorporate design measures to avoid the adverse effects of such soils.

## 6       **Ongoing Plans, Policies, and Programs**

7       Plans and programs that would occur in the No Action Alternative (ELT) would result in the loss of  
8       at least 3,618 acres of topsoil from overcovering or inundation. Because of the amount of topsoil  
9       that would be lost under the No Action alternative (ELT), these plans, policies, and programs would  
10      be deemed to have direct and adverse effects on topsoil loss in the Delta.

11      **CEQA Conclusion:** In total, the plans and programs under the No Action Alternative (ELT) would  
12      result in the loss of at least 3,618 acres of topsoil from overcovering or inundation between the  
13      present and 2025. This would constitute a significant impact. Subsidence would be controlled or  
14      reversed on approximately 308 acres, resulting in a beneficial impact.

### 15      **10.3.4.2           Alternative 4A—Dual Conveyance with Modified** 16                            **Pipeline/Tunnel and Intakes 2, 3, and 5 (9,000 cfs; Operational** 17                            **Scenario H)**

#### 18      **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil** 19      **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

20      Alternative 4A would include the same physical/structural components as Alternative 4. These  
21      locations would be where soils have similar erosion hazards and would not substantially change the  
22      project effects on water soil erosion. The effects of Alternative 4A would, therefore, be the same as  
23      under Alternative 4. See the discussion of Impact SOILS-1 under Alternative 4.

24      **NEPA Effects:** Construction of the proposed water conveyance facility under Alternative 4A could  
25      cause substantial accelerated erosion. However, as described in Section 10.3.1, *Methods for Analysis*  
26      and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, DWR would be required to obtain  
27      coverage under the General Permit for Construction and Land Disturbance Activities, necessitating  
28      the preparation of a SWPPP and an erosion control plan. Proper implementation of the requisite  
29      SWPPP and compliance with the General Permit (as discussed in Appendix 3B) would ensure that  
30      there would not be substantial soil erosion resulting in daily site runoff turbidity in excess of 250  
31      NTUs as a result of construction of the proposed water conveyance facility, and therefore, there  
32      would not be an adverse effect.

33      Additionally, implementation of the environmental commitment Disposal and Reuse of Spoils,  
34      Reusable Tunnel Material (RTM), and Dredged Material would help reduce wind blowing of  
35      excavated soils, particularly peat soils, during transport and placement at spoils storage, disposal,  
36      and reuse areas.

37      **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
38      water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
39      would seek coverage under the state General Permit for Construction and Land Disturbance  
40      Activities, necessitating the preparation of a SWPPP and an erosion control plan. As a result of

1 implementation of the requisite SWPPP, and compliance with the General Permit, there would not  
 2 be substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs and the effect  
 3 would be less than significant. No mitigation is required.

4 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering and Inundation as a Result of**  
 5 **Constructing the Proposed Water Conveyance Facilities**

6 Alternative 4A would include the same physical/structural components as Alternative 4 and  
 7 construction would be the same as under Alternative 4. Therefore, the effects on topsoil under  
 8 Alternative 4A would be the same as Alternative 4. See the discussion of Impact SOILS-2 under  
 9 Alternative 4.

10 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g.,  
 11 forebays, borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants):  
 12 overcovering (e.g., levees and embankments, spoil storage, pumping plants); and water inundation  
 13 (e.g., sedimentation basins, solids lagoons).

14 Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil  
 15 would not be excavated, overcovered, or inundated, such as at construction staging and laydown  
 16 areas where the soil could be compacted or otherwise affected.

17 DWR has made an environmental commitment for Disposal Site Preparation which would require  
 18 that a portion of the temporary sites selected for storage of spoils, RTM and dredged material will be  
 19 set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,  
 20 thereby lessening the effect. However, this effect would be adverse because it would result in a  
 21 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
 22 this effect.

23 The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and  
 24 Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures  
 25 for how excavated subsurface soil materials would be handled, stored, and disposed of. The  
 26 commitment also specifies that temporary storage sites for spoils, RTM, and dredged material  
 27 storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b  
 28 supplements the environmental commitment, specifically by defining topsoil for the purposes of the  
 29 mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

30 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
 31 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss  
 32 of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area  
 33 would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate  
 34 for these impacts, but not to a less-than-significant level because topsoil would be permanently lost  
 35 over extensive areas. Therefore, this impact is considered significant and unavoidable.

36 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

37 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 4.

38 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 39 **Topsoil Storage and Handling Plan**

40 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 4.

1 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 2 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the**  
 3 **Proposed Water Conveyance Facilities**

4 Alternative 4A would include the same physical/structural components as Alternative 4 and  
 5 therefore the effects from potential soil subsidence under Alternative 4A would be the same as  
 6 Alternative 4. See the discussion of Impact SOILS-3 under Alternative 4.

7 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 8 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 9 *Analysis* and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies (as  
 10 described in the Geotechnical Exploration Plan—Phase 2 [California Department of Water  
 11 Resources 2014]) would be conducted at all facilities to identify the types of soil avoidance or soil  
 12 stabilization measures that should be implemented to ensure that the facilities are constructed to  
 13 withstand subsidence and settlement and to conform to applicable state and federal standards.  
 14 These investigations would build upon the geotechnical data reports (California Department of  
 15 Water Resources 2001a, 2010b, 2011) and the CERs (California Department of Water Resources  
 16 2010a, 2010b, 2015), as well as the results of the investigations that will be conducted under the  
 17 Geotechnical Exploration Plan—Phase 2 (California Department of Water Resources 2014). As  
 18 discussed under Alternative 4, conforming to state and federal design standards, including conduct  
 19 of site-specific geotechnical evaluations, would ensure that appropriate design measures are  
 20 incorporated into the project and any subsidence that takes place under the project facilities would  
 21 not jeopardize their integrity. Therefore, there would not be an adverse effect.

22 **CEQA Conclusion:** Significant impacts could occur if there is property loss, personal injury, or death  
 23 from instability, failure, or damage from construction on or in soils subject to subsidence as a result  
 24 of constructing the proposed water conveyance facilities. Some of the conveyance facilities would be  
 25 constructed on soils that are subject to subsidence. Subsidence occurring after the facility is  
 26 constructed could result in damage to or failure of the facility. However, DWR would be required to  
 27 design and construct the facilities according to state and federal design standards and guidelines  
 28 (e.g., California Building Code, American Society of Civil Engineers Minimum Design Loads for  
 29 Buildings and Other Structures, ASCE/SEI 7-10, 2010) (see Appendix 3B, *Environmental*  
 30 *Commitments, AMMs, and CMs*). Conforming to these codes would reduce the potential hazard of  
 31 subsidence or settlement to acceptable levels by avoiding construction directly on or otherwise  
 32 stabilizing the soil material that is prone to subsidence. Because these measures would reduce the  
 33 potential hazard of subsidence or settlement to meet design standards, the impact would be less  
 34 than significant. No mitigation is required.

35 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 36 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

37 Alternative 4A would include the same physical/structural components as Alternative 4 and  
 38 therefore the effects related to expansive, corrosive, and compressible soils under Alternative 4A  
 39 would be the same as Alternative 4. See the discussion of Impact SOILS-4 under Alternative 4.

40 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake  
 41 facilities, pumping plants, access roads and utilities, and other features could be adversely affected  
 42 because they would be located on expansive, corrosive, and compressible soils. However, all facility  
 43 design and construction would be executed in conformance with the CBC which specifies measures  
 44 to mitigate effects of expansive soils, corrosive soils, and soils subject to compression and

1 subsidence. By conforming to the CBC and other applicable design standards, potential effects  
 2 associated with expansive and corrosive soils and soils subject to compression and subsidence  
 3 would be offset (see Appendix 3B, *Environmental Commitments, AMMs, and CMs*). There would be no  
 4 adverse effect.

5 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to  
 6 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils  
 7 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils  
 8 could damage in-ground facilities or shorten their service life. Compression/settlement of soils after  
 9 a facility is constructed could result in damage to or failure of the facility. However, because DWR  
 10 would be required to design and construct the facilities in conformance with state and federal  
 11 design standards, guidelines, and building codes (e.g., CBC and USACE design standards).  
 12 Conforming to these codes and standards is an environmental commitment by DWR to ensure that  
 13 potential adverse effects associated with expansive and corrosive soils and soils subject to  
 14 compression and subsidence would be offset (see Appendix 3B, *Environmental Commitments, AMMs,*  
 15 *and CMs*). Therefore, this impact would be less than significant. No mitigation is required.

#### 16 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 17 **Operations**

18 Alternative 4A would have operations similar to those under Alternative 4 and therefore the  
 19 potential effects on accelerated bank erosion because the flow from the north Delta under  
 20 Alternative 4A would be the same as Alternative 4. See the discussion of Impact SOILS-5 under  
 21 Alternative 4.

22 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be  
 23 adverse because, as described in Chapter 3, Section 3.6.2, *Conservation Components*, as part of the  
 24 Environmental Commitment 4, major channels could be dredged to create a larger cross-section that  
 25 would offset increased tidal velocities. The effect would not be adverse because there would be no  
 26 net increase in river flow rates and therefore no net increase in channel bank scour.

27 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 28 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 29 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 30 entail expansion of the channel cross-section to increase the tidal prism at these locations as  
 31 described in Chapter 3, Section 3.6.2, *Conservation Components*. The net effect would be to reduce  
 32 the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no appreciable  
 33 increase in scour is anticipated. The impact would be less than significant. No mitigation is required.

#### 34 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other** 35 **Disturbances Associated with Implementation of Proposed Environmental Commitments 3, 4,** 36 **6-11**

37 Effects under Alternative 4A on accelerated erosion would be similar in mechanism to those  
 38 described for Alternative 4, but to a substantially lesser magnitude based on the Environmental  
 39 Commitments proposed under Alternative 4A. See the discussion of Impact SOILS-6 under  
 40 Alternative 4.

41 Implementation of some of the Environmental Commitments would involve ground disturbance and  
 42 construction activities that could lead to accelerated soil erosion rates and consequent loss of

1 topsoil. Implementation of Environmental Commitments 3, 4, and 6–11 could involve breaching,  
 2 modification or removal of existing levees and construction of new levees and embankments. Levee  
 3 modifications, including levee breaching or lowering, may be performed to reintroduce tidal  
 4 exchange, reconnect remnant sloughs, restore natural remnant meandering tidal channels,  
 5 encourage development of dendritic channel networks, and improve floodwater conveyance. Some  
 6 of the Environmental Commitments would also require constructing setback levees and cross levees  
 7 or berms; raising the land elevation by excavating relatively high areas to provide fill for subsided  
 8 areas or by importing fill material; surface grading; deepening and/or widening tidal channels;  
 9 excavating new channels; modifying channel banks; and other activities. These activities could lead  
 10 to accelerated soil erosion rates and consequent loss of topsoil.

11 Construction of conservation hatcheries and implementation of urban stormwater treatment are not  
 12 part of Alternative 4A.

13 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as  
 14 described in Section 10.3.1, *Methods for Analysis* and Appendix 3B, *Environmental Commitments,*  
 15 *AMMs, and CMs*, the project proponents would be required to obtain coverage under the General  
 16 Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP  
 17 and an erosion control plan. Proper implementation of the requisite SWPPP, site-specific BMPs, and  
 18 compliance with the General Permit would ensure that accelerated water and wind erosion as a  
 19 result of implementing conservation measures would not be an adverse effect.

20 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 21 restoration areas could cause accelerated water and wind erosion of soil. However, the project  
 22 proponents would seek coverage under the state General Permit for Construction and Land  
 23 Disturbance Activities (see Appendix 3B, *Environmental Commitments, AMMs, and CMs*). Permit  
 24 conditions would include erosion and sediment control BMPs (such as revegetation, runoff control,  
 25 and sediment barriers) and compliance with water quality standards. As a result of implementation  
 26 of permit conditions, the impact would be less than significant. No mitigation is required.

27 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering and Inundation Associated**  
 28 **with Restoration Activities as a Result of Implementing the Proposed Environmental**  
 29 **Commitments 3–4, 6–11**

30 Effects from implementation of Environmental Commitments under Alternative 4A on loss of topsoil  
 31 would be similar in mechanism to those described for Alternative 4, but to a substantially lesser  
 32 magnitude based on the smaller acreages of restoration proposed by the Environmental  
 33 Commitments under Alternative 4A. See the discussion of Impact SOILS-7 under Alternative 4.

34 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., levee  
 35 foundations, water control structures); overcovering (e.g., levees, embankments, application of fill  
 36 material in subsided areas); and water inundation (e.g., aquatic habitat areas) over areas of the Plan  
 37 Area. Based on calculations using a geographic information system, implementation of habitat  
 38 restoration activities at the ROAs would result in excavation, overcovering, or inundation of a  
 39 minimum of 1,176 acres of topsoil. This effect would be adverse because it would result in a  
 40 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
 41 this effect.

1 **CEQA Conclusion:** Significant impacts could occur if there is loss of topsoil from excavation,  
 2 overcovering, and inundation associated with restoration activities as a result of implementing the  
 3 proposed Environmental Commitments. Implementation of several Environmental Commitments  
 4 would involve excavation, overcovering, and inundation (to create aquatic habitat areas) of topsoil  
 5 over extensive areas, thereby resulting in a substantial loss of topsoil of over 1,000 acres. Therefore,  
 6 the impact would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and  
 7 compensate for these impacts to a degree by minimizing topsoil loss, but not to a less-than-  
 8 significant level because topsoil would still be permanently lost over extensive areas. Therefore, this  
 9 impact is considered significant and unavoidable.

10 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

11 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
 12 1A

13 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 14 **Topsoil Storage and Handling Plan**

15 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
 16 1A

17 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 18 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
 19 **Proposed Environmental Commitments 3, 4, 6–11**

20 Effects from implementation of Environmental Commitments under Alternative 4A related to  
 21 subsidence would be similar in mechanism to those described for Alternative 4, but to a  
 22 substantially lesser magnitude based on the Environmental Commitments proposed under  
 23 Alternative 4A. Damage to or failure of the habitat levees could occur where these are constructed in  
 24 soils and sediments that are subject to subsidence and differential settlement. These soil conditions  
 25 have the potential to exist in the Suisun Marsh ROA. Levee damage or failure could cause surface  
 26 flooding in the vicinity. See the discussion of Impact SOILS-8 under Alternative 4.

27 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 28 unstable soils that are subject to subsidence. However, as described in Section 10.3.1, *Methods for*  
 29 *Analysis* and Appendix 3B, *Environmental Commitments, AMMs, and CMs*, geotechnical studies would  
 30 be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to  
 31 ensure that levees, berms, and other features are constructed to withstand subsidence and  
 32 settlement and to conform to applicable state and federal standards.

33 With construction of all levees, berms, and other conservation features designed and constructed to  
 34 withstand subsidence and settlement and through conformance with applicable state and federal  
 35 design standards, this effect would not be adverse.

36 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
 37 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 38 to or failure of the facility. However, because the project proponents would be required to design  
 39 and construct the facilities according to state and federal design standards and guidelines (which  
 40 may involve, for example, replacement of the organic soil), the impact would be less than significant.  
 41 No mitigation is required.

1 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
 2 **and Compressible Soils as a Result of Implementing the Proposed Environmental**  
 3 **Commitments 3, 4, 6–11**

4 Effects from implementation of Environmental Commitments under Alternative 4A in areas of  
 5 expansive, corrosive, or compressible soils would be similar in mechanism to those described for  
 6 Alternative 4, but to a substantially lesser magnitude based on the Environmental Commitments  
 7 proposed under Alternative 4A. See the discussion of Impact SOILS-9 under Alternative 1A.

8 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control  
 9 structures or cause them to fail, resulting in a release of water from the structure and consequent  
 10 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs  
 11 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West  
 12 Delta ROA possess soils with high corrosivity to concrete.

13 Highly compressible soils are in the Cache Slough, Yolo Bypass Cosumnes/Mokelumne, and South  
 14 Delta ROAs.

15 **NEPA Effects:** The Environmental Commitments could be located on expansive, corrosive, and  
 16 compressible soils. However, ROA-specific geotechnical studies and testing would be completed  
 17 prior to construction within the ROAs. The site-specific studies and testing would identify specific  
 18 areas where engineering soil properties, including soil compressibility, may require special  
 19 consideration during construction of specific features within ROAs (see Appendix 3B, *Environmental*  
 20 *Commitments, AMMs, and CMs*). Conformity with USACE, CBC, and other design standards for  
 21 construction on expansive, corrosive and/or compressible soils would prevent adverse effects of  
 22 such soils.

23 **CEQA Conclusion:** Some of the restoration facilities would be constructed on soils that are subject to  
 24 expansion, corrosive to concrete and uncoated steel, and compression under load. Expansive soils  
 25 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils  
 26 could damage in-ground facilities or shorten their service life. Compression or settlement of soils  
 27 after a facility is constructed could result in damage to or failure of the facility. However, as outlined  
 28 in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, because the project proponents  
 29 would be required to design and construct the facilities according to state and federal design  
 30 standards, guidelines, and building codes (which may involve, for example, soil lime stabilization,  
 31 cathodic protection of steel, and soil replacement), this impact would be considered less than  
 32 significant. No mitigation is required.

33 **10.3.4.3 Alternative 2D—Dual Conveyance with Modified**  
 34 **Pipeline/Tunnel and Intakes 1, 2, 3, 4, and 5 (15,000 cfs;**  
 35 **Operational Scenario B)**

36 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil**  
 37 **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

38 Alternative 2D would include the same physical/structural components as Alternative 4 but would  
 39 include two additional intakes. These intakes would be identical to where the intakes are sited for  
 40 Alternative 1A. These differences would present a slightly higher hazard of accelerated soil erosion  
 41 because the primary work areas that would involve more extensive soil disturbance (i.e., staging  
 42 areas, borrow areas, and intakes) within the Alternative 2D footprint are underlain by soils with a

1 moderate or high susceptibility to wind erosion (Natural Resources Conservation Service 2010a)  
 2 (Figure 10-6). However, the addition of two additional intakes would not substantially change the  
 3 project effects on water soil erosion. The effects of Alternative 2D would, therefore, be similar to  
 4 those under Alternative 4. See the discussion of Impact SOILS-1 under Alternative 4.

5 **NEPA Effects:** Construction of the proposed water conveyance facility under Alternative 2D could  
 6 cause substantial accelerated erosion. DWR would be required to obtain coverage under the General  
 7 Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP  
 8 and an erosion control plan (described in detail under Alternative 4). Proper implementation of the  
 9 requisite SWPPP and compliance with the General Permit (as discussed in Appendix 3B,  
 10 *Environmental Commitments, AMMs, and CMs*) would ensure that there would not be substantial soil  
 11 erosion resulting in daily site runoff turbidity in excess of 250 NTUs as a result of construction of the  
 12 proposed water conveyance facility. Additionally, implementation of the environmental  
 13 commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material  
 14 would help reduce wind blowing of excavated soils, particularly peat soils, during transport and  
 15 placement at spoils storage, disposal, and reuse areas. Therefore, there would not be an adverse  
 16 effect.

17 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 18 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
 19 would seek coverage under the state General Permit for Construction and Land Disturbance  
 20 Activities, necessitating the preparation of a SWPPP and an erosion control plan. As a result of  
 21 implementation of the requisite SWPPP, and compliance with the General Permit, there would not  
 22 be substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs and the effect  
 23 would be less than significant. No mitigation is required.

## 24 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering and Inundation as a Result of** 25 **Constructing the Proposed Water Conveyance Facilities**

26 Alternative 2D would include the same physical/structural components as Alternative 4 but would  
 27 include two additional intakes. Construction operations would be the same as under Alternative 4  
 28 but occur over a larger area, and therefore the effects on topsoil under Alternative 2D would be  
 29 slightly greater than those under Alternative 4, but would otherwise be similar. See the discussion of  
 30 Impact SOILS-2 under Alternative 4.

31 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g.,  
 32 forebays, borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants):  
 33 overcovering (e.g., levees and embankments, spoil storage, pumping plants); and water inundation  
 34 (e.g., sedimentation basins, solids lagoons).

35 Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil  
 36 would not be excavated, overcovered, or inundated, such as at construction staging and laydown  
 37 areas where the soil could be compacted or otherwise affected.

38 DWR has made an environmental commitment for Disposal Site Preparation which would require  
 39 that a portion of the temporary sites selected for storage of spoils, RTM and dredged material will be  
 40 set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,  
 41 thereby lessening the effect. However, this effect would be adverse because it would result in a  
 42 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
 43 this effect.

1 The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and  
 2 Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures  
 3 for how excavated subsurface soil materials would be handled, stored, and disposed of. The  
 4 commitment also specifies that temporary storage sites for spoils, RTM, and dredged material  
 5 storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b  
 6 supplements the environmental commitment, specifically by defining topsoil for the purposes of the  
 7 mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

8 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
 9 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss  
 10 of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the project  
 11 area would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and  
 12 compensate for these impacts, but not to a less-than-significant level because topsoil would be  
 13 permanently lost over extensive areas. Therefore, this impact is considered significant and  
 14 unavoidable.

15 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

16 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 4.

17 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 18 **Topsoil Storage and Handling Plan**

19 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 4.

20 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 21 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the**  
 22 **Proposed Water Conveyance Facilities**

23 Alternative 2D would include the same physical/structural components as Alternative 4, but would  
 24 include two additional intakes. The locations of these intakes would be identical to the intake sites  
 25 proposed under Alternative 1A and would be constructed in areas in which the near-surface soils  
 26 have approximately 2–4% organic matter content. Compared to organic soils, these mineral soils  
 27 would not be subject to appreciable subsidence caused by organic matter decomposition because  
 28 there is relatively little organic matter available to decompose. However, without adequate  
 29 engineering, certain structures (such as the forebay levees and interior) could be subject to  
 30 appreciable subsidence resulting in potentially adverse effects. Damage to or collapse of the project  
 31 facilities could occur if they are constructed in soils and sediments that are subject to subsidence or  
 32 differential settlement. Therefore the effects from potential soil subsidence under Alternative 2D  
 33 would be similar to those under Alternative 4, but greater due to two additional structures. See the  
 34 discussion of Impact SOILS-3 under Alternative 4.

35 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 36 unstable soils that are subject to subsidence. Geotechnical studies (as described in the Geotechnical  
 37 Exploration Plan—Phase 2 [California Department of Water Resources 2014]) would be conducted  
 38 at all facilities to identify the types of soil avoidance or soil stabilization measures that should be  
 39 implemented to ensure that the facilities are constructed to withstand subsidence and settlement  
 40 and to conform to applicable state and federal standards (Appendix 3B, *Environmental*  
 41 *Commitments, AMMs, and CMs*). These investigations would build upon the geotechnical data reports  
 42 (California Department of Water Resources 2010a, 2010b, 2011) and the CERs (California

1 Department of Water Resources 2010a, 2010b, 2015), as well as the results of the investigations  
 2 that will be conducted under the Geotechnical Exploration Plan—Phase 2 (California Department of  
 3 Water Resources 2014). Conforming to state and federal design standards (described in detail under  
 4 Alternative 4), including conduct of site-specific geotechnical evaluations, would ensure that  
 5 appropriate design measures are incorporated into the project and any subsidence that takes place  
 6 under the project facilities would not jeopardize their integrity. Therefore, there would not be an  
 7 adverse effect.

8 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject  
 9 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or  
 10 failure of the facility. However, as stated in Appendix 3B, *Environmental Commitments, AMMs, and*  
 11 *CMs*, DWR would be required to design and construct the facilities according to state and federal  
 12 design standards and guidelines (e.g., California Building Code, American Society of Civil Engineers  
 13 Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 7-10, 2010). Conforming to  
 14 these codes would reduce the potential hazard of subsidence or settlement to acceptable levels by  
 15 avoiding construction directly on or otherwise stabilizing the soil material that is prone to  
 16 subsidence. Because these measures would reduce the potential hazard of subsidence or settlement  
 17 to meet design standards, the impact would be less than significant. No mitigation is required.

18 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 19 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

20 Alternative 2D would include the same physical/structural components as Alternative 4, but would  
 21 include two additional intakes. These intakes would be located where the intakes were sited for  
 22 Alternative 1A. Some of the intakes would be built on soils with high shrink-swell potential (note  
 23 areas of high linear extensibility in Figure 10-4). The remainder of the alignment would have similar  
 24 properties of expansiveness, corrosivity, and compressibility as discussed under Alternative 4.  
 25 Therefore, the effects under Alternative 2D would therefore be similar to those under Alternative 4,  
 26 but slightly greater. See discussion of Impact SOILS-4 under Alternative 4.

27 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake  
 28 facilities, pumping plants, access roads and utilities, and other features could be adversely affected  
 29 because they would be located on expansive, corrosive, and compressible soils. However, all facility  
 30 design and construction would be executed in conformance with the CBC (described in detail under  
 31 Alternative 4), which specifies measures to mitigate effects of expansive soils, corrosive soils, and  
 32 soils subject to compression and subsidence. By conforming to the CBC and other applicable design  
 33 standards, potential effects associated with expansive and corrosive soils and soils subject to  
 34 compression and subsidence would be offset. There would be no adverse effect.

35 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to  
 36 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils  
 37 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils  
 38 could damage in-ground facilities or shorten their service life. Compression/settlement of soils after  
 39 a facility is constructed could result in damage to or failure of the facility. However, because DWR  
 40 would be required to design and construct the facilities in conformance with state and federal  
 41 design standards, guidelines, and building codes (e.g., CBC and USACE design standards).  
 42 Conforming to these codes and standards is an environmental commitment by DWR to ensure that  
 43 potential adverse effects associated with expansive and corrosive soils and soils subject to

1 compression and subsidence would be offset (see Appendix 3B, *Environmental Commitments, AMMs,*  
2 *and CMs*). Therefore, this impact would be less than significant. No mitigation is required.

### 3 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 4 **Operations**

5 Alternative 2D has identical operations to Alternative 2A but would have the same potential effect  
6 on accelerated bank erosion as under Alternative 4. See the discussion of Impact SOILS-5 under  
7 Alternative 4.

8 **NEPA Effects:** River channel bank erosion/scour is a natural process. The rate of natural erosion can  
9 increase during high flows and as a result of wave effect on banks during high wind conditions.

10 In general, changes in river flow rates associated with project operations would remain within the  
11 range that presently occurs. However, the operational components would cause changes in the tidal  
12 flows in some Delta channels, specifically those that lead into the major habitat restoration areas  
13 (Suisun Marsh, Cache Slough, Yolo Bypass, and South Delta ROAs). In major channels leading to the  
14 restoration areas, tidal flow velocities may increase; this may cause some localized accelerated  
15 erosion/scour.

16 However, the increased flows would be offset by implementation of Environmental Commitment 4  
17 which could involve dredging of these major channels, which would create a larger channel cross-  
18 section (see description of restoration actions in Chapter 3, *Description of Alternatives*, Section  
19 3.6.2). The larger cross-section would allow river flow rates to be similar to that of other high tidal  
20 flows in the region. Moreover, as presently occurs and as is typical with most naturally-functioning  
21 river channels, local erosion and deposition within the tidal habitats is expected as part of the  
22 restoration.

23 For most of the existing channels that would not be subject to tidal flow restoration, there would be  
24 no adverse effect to tidal flow volumes and velocities. The tidal prism would increase by 5–10%, but  
25 the intertidal (i.e., MHHW to MLLW) cross-sectional area also would be increased such that tidal  
26 flow velocities would be reduced by 10–20% compared to Existing Conditions. Consequently, no  
27 appreciable increase in scour is anticipated.

28 The effect would not be adverse because there would be no net increase in river flow rates and,  
29 accordingly, no net increase in channel bank scour.

30 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
31 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
32 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
33 entail expansion of the channel cross-section to increase the tidal prism at these locations described  
34 in Chapter 3, *Description of Alternatives*, Section 3.6.2. The net effect would be to reduce the channel  
35 flow rates by 10–20% compared to Existing Conditions. Consequently, no appreciable increase in  
36 scour is anticipated. The impact would be less than significant. No mitigation is required.

### 37 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other** 38 **Disturbances Associated with Implementation of Proposed Environmental Commitments 3, 4,** 39 **6-11**

40 Effects on accelerated erosion from implementation of Environmental Commitments under  
41 Alternative 2D, would be similar in mechanism and magnitude to those described for Alternative 4A.

1 Any differences would be due to differing acreages or locations, but would be slight. See the  
2 discussion of Impact SOILS-6 under Alternative 4A.

3 **NEPA Effects:** Implementation of some of the Environmental Commitments under Alternative 2D  
4 would involve ground disturbance and construction activities that could lead to accelerated soil  
5 erosion rates and consequent loss of topsoil. However, as described in Appendix 3B, *Environmental*  
6 *Commitments, AMMs, and CMs*, the project proponents would be required to obtain coverage under  
7 the General Permit for Construction and Land Disturbance Activities, necessitating the preparation  
8 of a SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP, site-specific  
9 BMPs, and compliance with the General Permit would ensure that accelerated water and wind  
10 erosion as a result of implementing Environmental Commitments would not be an adverse effect.

11 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
12 restoration areas could cause accelerated water and wind erosion of soil. However, the project  
13 proponents would seek coverage under the state General Permit for Construction and Land  
14 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs and  
15 compliance with water quality standards. As a result of implementation of permit conditions, the  
16 impact would be less than significant. No mitigation is required.

17 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering and Inundation Associated**  
18 **with Restoration Activities as a Result of Implementing the Proposed Environmental**  
19 **Commitments 3, 4, 6-11**

20 Effects from implementation of Environmental Commitments under Alternative 2D on loss of topsoil  
21 would be similar in mechanism to those described for Alternative 4A. Differences in Environmental  
22 Commitments, as described in Chapter 3, would be slight. See the discussion of Impact SOILS-7  
23 under Alternative 4A.

24 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., levee  
25 foundations, water control structures); overcovering (e.g., levees, embankments, application of fill  
26 material in subsided areas); and water inundation (e.g., aquatic habitat areas) over areas of the Plan  
27 Area. Based on calculations using a geographic information system, implementation of habitat  
28 restoration activities at the ROAs would result in excavation, overcovering, or inundation of a  
29 minimum of 1,000 acres of topsoil. This effect would be adverse because it would result in a  
30 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
31 this effect.

32 **CEQA Conclusion:** Significant impacts could occur if there is loss of topsoil from excavation,  
33 overcovering, and inundation associated with restoration activities as a result of implementing the  
34 proposed Environmental Commitments. Implementation of several Environmental Commitments  
35 would involve excavation, overcovering, and inundation (to create aquatic habitat areas) of topsoil  
36 over extensive areas, thereby resulting in a substantial loss of topsoil of over 1,000 acres. The  
37 impact would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and  
38 compensate for these impacts to a degree, but not to a less-than-significant level. Therefore, this  
39 impact is considered significant and unavoidable.

40 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

41 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 4.

1           **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 2           **Topsoil Storage and Handling Plan**

3           Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 4.

4           **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 5           **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
 6           **Proposed Environmental Commitments 3, 4, 6-11**

7           Effects from implementation of Environmental Commitments under Alternative 2D related to  
 8           subsidence would be similar in mechanism to those described for Alternative 4A. See the discussion  
 9           of Impact SOILS-8 under Alternative 4A.

10          **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 11          unstable soils that are subject to subsidence. However, as described in Appendix 3B, *Environmental*  
 12          *Commitments, AMMs, and CMs*, geotechnical studies would be conducted at all the ROAs to identify  
 13          the types of soil stabilization that should be implemented to ensure that levees, berms, and other  
 14          features are constructed to withstand subsidence and settlement and to conform to applicable state  
 15          and federal standards.

16          With construction of all levees, berms, and other conservation features designed and constructed to  
 17          withstand subsidence and settlement and through conformance with applicable state and federal  
 18          design standards, this effect would not be adverse.

19          **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
 20          subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 21          to or failure of the facility. However, as outlined in Appendix 3B, *Environmental Commitments, AMMs,*  
 22          *and CMs*, because the project proponents would be required to design and construct the facilities  
 23          according to state and federal design standards and guidelines (which may involve, for example,  
 24          replacement of the organic soil), the impact would be less than significant. No mitigation is required.

25          **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
 26          **and Compressible Soils as a Result of Implementing the Proposed Environmental**  
 27          **Commitments 3, 4, 6-11**

28          Effects from implementation of Environmental Commitments under Alternative 2D, resulting from  
 29          construction of conservation actions in areas of expansive, corrosive, or compressible soils would be  
 30          similar in mechanism to those described for Alternative 4A. See the discussion of Impact SOILS-9  
 31          under Alternative 4A.

32          **NEPA Effects:** ROA specific geotechnical studies and testing would be completed prior to  
 33          construction of the Environmental Commitments within the ROAs. The site-specific studies and tests  
 34          would identify specific areas where engineering soil properties, including soil compressibility, may  
 35          require special consideration during construction of specific features within ROAs. Conformity with  
 36          USACE, CBC and other design standards for construction on expansive, corrosive and/or  
 37          compressible soils described in Alternative 4 would prevent adverse effects of such soils.

38          **CEQA Conclusion:** Some of the Environmental Commitments facilities could be constructed on soils  
 39          that are subject to expansion, corrosive to concrete and uncoated steel, and compression under load.  
 40          Expansive soils could cause foundations, underground utilities, and pavements to crack and fail.  
 41          Corrosive soils could damage in-ground facilities or shorten their service life. Compression or

1 settlement of soils after a facility is constructed could result in damage to or failure of the facility.  
 2 However, as outlined in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, because the  
 3 project proponents would be required to design and construct the facilities according to state and  
 4 federal design standards, guidelines, and building codes (which may involve, for example, soil lime  
 5 stabilization, cathodic protection of steel, and soil replacement), this impact would be considered  
 6 less than significant. No mitigation is required.

#### 7 **10.3.4.4 Alternative 5A—Dual Conveyance with Modified** 8 **Pipeline/Tunnel and Intake 2 (3,000 cfs; Operational Scenario C)**

##### 9 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil** 10 **Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

11 Alternative 5A would include the same physical/structural components as Alternative 4 but would  
 12 include two fewer intakes. These differences would result in slightly less potential accelerated  
 13 erosion impacts than Alternative 4. The impacts of Alternative 5A would, however, be similar to  
 14 those of Alternative 4. See the discussion of Impact SOILS-1 under Alternative 4.

15 **NEPA Effects:** Construction of the proposed water conveyance facility under Alternative 5A could  
 16 cause substantial accelerated erosion. DWR would be required to obtain coverage under the General  
 17 Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP  
 18 and an erosion control plan (described in detail under Alternative 4). Proper implementation of the  
 19 requisite SWPPP and compliance with the General Permit (as discussed in Appendix 3B,  
 20 *Environmental Commitments, AMMs, and CMs*) would ensure that there would not be substantial soil  
 21 erosion resulting in daily site runoff turbidity in excess of 250 NTUs as a result of construction of the  
 22 proposed water conveyance facility. Additionally, implementation of the environmental  
 23 commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material  
 24 would help reduce wind blowing of excavated soils, particularly peat soils, during transport and  
 25 placement at spoils storage, disposal, and reuse areas. Therefore, there would not be an adverse  
 26 effect.

27 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 28 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR  
 29 would seek coverage under the state General Permit for Construction and Land Disturbance  
 30 Activities, necessitating the preparation of a SWPPP and an erosion control plan. As a result of  
 31 implementation of the requisite SWPPP, and compliance with the General Permit, there would not  
 32 be substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs and the effect  
 33 would be less than significant. No mitigation is required.

##### 34 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering and Inundation as a Result of** 35 **Constructing the Proposed Water Conveyance Facilities**

36 Alternative 5A would include the same physical/structural components as Alternative 4 but would  
 37 entail two fewer intakes. These differences would result in slightly less effects on topsoil loss than  
 38 under Alternative 4. The impacts of Alternative 5A would, however, be similar to those of  
 39 Alternative 4. See the discussion of Impact SOILS-2 under Alternative 4.

40 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g.,  
 41 forebays, borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants):

1 overcovering (e.g., levees and embankments, spoil storage, pumping plants); and water inundation  
2 (e.g., sedimentation basins, solids lagoons).

3 Soil quality (also referred to as soil health) degradation could also occur at sites in which the topsoil  
4 would not be excavated, overcovered, or inundated, such as at construction staging and laydown  
5 areas where the soil could be compacted or otherwise affected.

6 DWR has made an environmental commitment for Disposal Site Preparation which would require  
7 that a portion of the temporary sites selected for storage of spoils, RTM and dredged material will be  
8 set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,  
9 thereby lessening the effect. However, this effect would be adverse because it would result in a  
10 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
11 this effect.

12 The environmental commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and  
13 Dredged Material in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, describes measures  
14 for how excavated subsurface soil materials would be handled, stored, and disposed of. The  
15 commitment also specifies that temporary storage sites for spoils, RTM, and dredged material  
16 storage provide for the storage of salvaged topsoil. In addition, Mitigation Measure SOILS-2b  
17 supplements the environmental commitment, specifically by defining topsoil for the purposes of the  
18 mitigation measure and by providing details on topsoil salvaging, handling, and storage procedures.

19 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,  
20 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss  
21 of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the project  
22 area would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and  
23 compensate for these impacts, but not to a less-than-significant level because topsoil would be  
24 permanently lost over extensive areas. Therefore, this impact is considered significant and  
25 unavoidable.

#### 26 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

27 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 4.

#### 28 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a** 29 **Topsoil Storage and Handling Plan**

30 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 4.

### 31 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and** 32 **Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the** 33 **Proposed Water Conveyance Facilities**

34 Alternative 5A would include the same physical/structural components as Alternative 4, except that  
35 it would entail two fewer intakes. These differences would result in slightly less effects related to  
36 subsidence than under Alternative 4. The impacts of Alternative 5A would, however, be similar to  
37 those under Alternative 4. See the discussion of Impact SOILS-3 under Alternative 4 in.

38 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
39 unstable soils that are subject to subsidence. Geotechnical studies (as described in the Geotechnical  
40 Exploration Plan—Phase 2 [California Department of Water Resources 2014]) would be conducted

1 at all facilities to identify the types of soil avoidance or soil stabilization measures that should be  
 2 implemented to ensure that the facilities are constructed to withstand subsidence and settlement  
 3 and to conform to applicable state and federal standards (Appendix 3B, *Environmental*  
 4 *Commitments, AMMs, and CMs*). These investigations would build upon the geotechnical data reports  
 5 (California Department of Water Resources 2001a, 2010b, 2011) and the CERs (California  
 6 Department of Water Resources 2010a, 2010b, 2015), as well as the results of the investigations  
 7 that will be conducted under the Geotechnical Exploration Plan—Phase 2 (California Department of  
 8 Water Resources 2014). Conforming to state and federal design standards (described in detail under  
 9 Alternative 4), including site-specific geotechnical evaluations, would ensure that appropriate  
 10 design measures are incorporated into the project and any subsidence that takes place under the  
 11 project facilities would not jeopardize their integrity. Therefore, there would not be an adverse  
 12 effect.

13 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on unstable soils that are  
 14 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 15 to or failure of the facility. However, as stated in Appendix 3B, *Environmental Commitments, AMMs,*  
 16 *and CMs*, DWR would be required to design and construct the facilities according to state and federal  
 17 design standards and guidelines (e.g., California Building Code, American Society of Civil Engineers  
 18 Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 7-10, 2010). Conforming to  
 19 these codes would reduce the potential hazard of subsidence or settlement to acceptable levels by  
 20 avoiding construction directly on or otherwise stabilizing the soil material that is prone to  
 21 subsidence. Because these measures would reduce the potential hazard of subsidence or settlement  
 22 to meet design standards, the impact would be less than significant. No mitigation is required.

23 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**  
 24 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

25 Alternative 5A would include the same physical/structural components as Alternative 4, except it  
 26 would entail two fewer intakes. These differences would result in slightly fewer effects related to  
 27 expansive, corrosive, and compressible soils than under Alternative 4 because there would be two  
 28 fewer structures. The effects under Alternative 5A would, however, be the similar to those of  
 29 Alternative 4. See discussion of Impact SOILS-4 under Alternative 4.

30 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake  
 31 facilities, pumping plants, access roads and utilities, and other features could be adversely affected  
 32 because they would be located on expansive, corrosive, and compressible soils. However, all facility  
 33 design and construction would be executed in conformance with the CBC (described in detail under  
 34 Alternative 4) which specifies measures to mitigate effects of expansive soils, corrosive soils, and  
 35 soils subject to compression and subsidence. By conforming to the CBC and other applicable design  
 36 standards, potential effects associated with expansive and corrosive soils and soils subject to  
 37 compression and subsidence would be offset. There would be no adverse effect.

38 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to  
 39 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils  
 40 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils  
 41 could damage in-ground facilities or shorten their service life. Compression/settlement of soils after  
 42 a facility is constructed could result in damage to or failure of the facility. However, because DWR  
 43 would be required to design and construct the facilities in conformance with state and federal  
 44 design standards, guidelines, and building codes (e.g., CBC and USACE design standards).

1 Conforming to these codes and standards is an environmental commitment by DWR to ensure that  
 2 potential adverse effects associated with expansive and corrosive soils and soils subject to  
 3 compression and subsidence would be offset (see Appendix 3B, *Environmental Commitments, AMMs,*  
 4 *and CMs*). Therefore, this impact would be less than significant. No mitigation is required.

5 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**  
 6 **Operations**

7 Alternative 5A has different operations from those under Alternative 4, but of a lesser magnitude  
 8 with respect to potential effects on accelerated bank erosion because the flow from the north Delta  
 9 would be 3,000 cfs rather than 9,000 cfs. The effects under Alternative 5A would, however, be  
 10 similar to those under Alternative 4. See the discussion of Impact SOILS-5 under Alternative 4.

11 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be  
 12 adverse because, as described in Chapter 3, Section 3.6.2, *Conservation Components*, as part of the  
 13 Environmental Commitment 4, major channels could be dredged to create a larger cross-section that  
 14 would offset increased tidal velocities. The effect would not be adverse because there would be no  
 15 net increase in river flow rates and therefore no net increase in channel bank scour.

16 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 17 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 18 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 19 entail expansion of the channel cross-section to increase the tidal prism at these locations as  
 20 described in Chapter 3, Section 3.6.2, *Conservation Components*. For most of the existing channels  
 21 that would not be subject to tidal flow restoration, there would be no adverse effect to tidal flow  
 22 volumes and velocities. The tidal prism would increase by 5–10%, but the intertidal (i.e., MHHW to  
 23 MLLW) cross-sectional area also would be increased such that the channel flow rates would be  
 24 reduced by 10–20% compared to Existing Conditions. Consequently, no appreciable increase in  
 25 scour is anticipated because the overall net flow would be reduced. The impact would be less than  
 26 significant. No mitigation is required.

27 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**  
 28 **Disturbances Associated with Implementation of Proposed Environmental Commitments 3, 4,**  
 29 **6-11**

30 Effects on accelerated erosion from implementation of Environmental Commitments under  
 31 Alternative 5A, would be similar in mechanism and magnitude to those described for Alternative 4A.  
 32 Any differences would be due to differing acreages or locations, but would be slight. See the  
 33 discussion of Impact SOILS-6 under Alternative 4A.

34 **NEPA Effects:** Implementation of some of the Environmental Commitments under Alternative 5A  
 35 would involve ground disturbance and construction activities that could lead to accelerated soil  
 36 erosion rates and consequent loss of topsoil. However, as described in Appendix 3B, *Environmental*  
 37 *Commitments, AMMs, and CMs*, the project proponents would be required to obtain coverage under  
 38 the General Permit for Construction and Land Disturbance Activities, necessitating the preparation  
 39 of a SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP, site-specific  
 40 BMPs, and compliance with the General Permit would ensure that accelerated water and wind  
 41 erosion as a result of implementing Environmental Commitments would not be an adverse effect.

1 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of  
 2 restoration areas could cause accelerated water and wind erosion of soil. However, the project  
 3 proponents would seek coverage under the state General Permit for Construction and Land  
 4 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs and  
 5 compliance with water quality standards. As a result of implementation of permit conditions, the  
 6 impact would be less than significant. No mitigation is required.

7 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering and Inundation Associated**  
 8 **with Restoration Activities as a Result of Implementing the Proposed Environmental**  
 9 **Commitments 3, 4, 6-11**

10 Effects from implementation of Environmental Commitments under Alternative 5A on loss of topsoil  
 11 would be similar in mechanism to those described for Alternative 4A. Differences in Environmental  
 12 Commitments, would be slight. See the discussion of Impact SOILS-7 under Alternative 4A.

13 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., levee  
 14 foundations, water control structures); overcovering (e.g., levees, embankments, application of fill  
 15 material in subsided areas); and water inundation (e.g., aquatic habitat areas) over areas of the Plan  
 16 Area. Based on calculations using a geographic information system, implementation of habitat  
 17 restoration activities at the ROAs would result in excavation, overcovering, or inundation of  
 18 approximately 1,000 acres of topsoil. This effect would be adverse because it would result in a  
 19 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would reduce the severity of  
 20 this effect.

21 **CEQA Conclusion:** Significant impacts could occur if there is loss of topsoil from excavation,  
 22 overcovering, and inundation associated with restoration activities as a result of implementing the  
 23 proposed Environmental Commitments. Implementation of several Environmental Commitments  
 24 would involve excavation, overcovering, and inundation (to create aquatic habitat areas) of topsoil  
 25 over extensive areas, thereby resulting in a substantial loss of topsoil of over 1,000 acres. The  
 26 impact would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and  
 27 compensate for these impacts to a degree, but not to a less-than-significant level. Therefore, this  
 28 impact is considered significant and unavoidable.

29 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

30 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 4.

31 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 32 **Topsoil Storage and Handling Plan**

33 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 4.

34 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and**  
 35 **Damage from Construction on Soils Subject to Subsidence as a Result of Implementing the**  
 36 **Proposed Environmental Commitments 3, 4, and 6-11**

37 Effects from implementation of Environmental Commitments under Alternative 5A related to  
 38 subsidence would be similar in mechanism to those described for Alternative 4A. See the discussion  
 39 of Impact SOILS-8 under Alternative 4A.

1 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on  
 2 unstable soils that are subject to subsidence. However, as described in Appendix 3B, *Environmental*  
 3 *Commitments, AMMs, and CMs*, geotechnical studies would be conducted at all the ROAs to identify  
 4 the types of soil stabilization that should be implemented to ensure that levees, berms, and other  
 5 features are constructed to withstand subsidence and settlement and to conform to applicable state  
 6 and federal standards.

7 With construction of all levees, berms, and other conservation features designed and constructed to  
 8 withstand subsidence and settlement and through conformance with applicable state and federal  
 9 design standards, this effect would not be adverse.

10 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are  
 11 subject to subsidence. Subsidence occurring after the facility is constructed could result in damage  
 12 to or failure of the facility. However, as outlined in Appendix 3B, *Environmental Commitments, AMMs,*  
 13 *and CMs*, because the project proponents would be required to design and construct the facilities  
 14 according to state and federal design standards and guidelines (which may involve, for example,  
 15 replacement of the organic soil), the impact would be less than significant. No mitigation is required.

16 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**  
 17 **and Compressible Soils as a Result of Implementing the Proposed Environmental**  
 18 **Commitments 3, 4, and 6-11**

19 Effects from implementation of Environmental Commitments under Alternative 5A, resulting from  
 20 construction of Environmental Commitments in areas of expansive, corrosive, or compressible soils  
 21 would be similar in mechanism to those described for Alternative 4A. See the discussion of Impact  
 22 SOILS-9 under Alternative 4A.

23 **NEPA Effects:** The Environmental Commitments could be located on expansive, corrosive, and  
 24 compressible soils. ROA specific geotechnical studies and testing would be completed prior to  
 25 construction within the ROAs. The site-specific studies and tests would identify specific areas where  
 26 engineering soil properties, including soil compressibility, may require special consideration during  
 27 construction of specific features within ROAs (see Appendix 3B, *Environmental Commitments, AMMs,*  
 28 *and CMs*). Conformity with USACE, CBC, and other design standards for construction on expansive,  
 29 corrosive and/or compressible soils would prevent adverse effects of such soils.

30 **CEQA Conclusion:** Some of the restoration facilities could be constructed on soils that are subject to  
 31 expansion, corrosive to concrete and uncoated steel, and compression under load. Expansive soils  
 32 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils  
 33 could damage in-ground facilities or shorten their service life. Compression or settlement of soils  
 34 after a facility is constructed could result in damage to or failure of the facility. However, as outlined  
 35 in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, because the project proponents  
 36 would be required to design and construct the facilities according to state and federal design  
 37 standards, guidelines, and building codes (which may involve, for example, soil lime stabilization,  
 38 cathodic protection of steel, and soil replacement), this impact would be considered less than  
 39 significant. No mitigation is required.

40 **10.3.5 Cumulative Analysis**

41 The cumulative effects analysis for soils considers the effects of implementation of the alternatives  
 42 in combination with the potential effects of other past, present, and reasonably foreseeable future

1 projects and programs. Implementation of the alternatives and other local and regional projects as  
 2 presented in Table 10-9, could contribute to regional impacts and hazards associated with soils.

3 **Table 10-9. Effects on Soils from Plans, Policies, and Programs Considered for Cumulative Analysis**

| Agency  | Program/Project   | Status                       | Description of Program/Project   | Effects on Soils  |
|---|---|------------------------------|--|---|
| California Department of Water Resources                    | Mayberry Farms Subsidence Reversal and Carbon Sequestration Project | Completed October 2010       | Permanently flooded a 308-acre parcel of DWR owned land (Hunting Club leased) and restored 274 acres of palustrine emergent wetlands within Sherman Island to create permanent wetlands and to monitor waterfowl, water quality, and greenhouse gases. | Inundation of topsoil over approximately 274 acres.                                     |
| California Department of Water Resources                    | Dutch Slough Tidal Marsh Restoration Project                        | Planning phase               | Wetland and upland habitat restoration in area used for agriculture.   | Inundation and overcovering (by dredge spoils) of topsoil over much of 1,166-acre site. |
| Freeport Regional Water Authority and Bureau of Reclamation | Freeport Regional Water Project                                     | Completed late 2010          | Project included 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.  | Loss of approximately 50–70 acres of topsoil from excavation and overcovering.          |
| Reclamation District 2093                                   | Liberty Island Conservation Bank                                    | Completed 2011               | This project included restoration of inaccessible, flood prone land to wildlife habitat.   | Inundation of approximately 186 acres of topsoil.                                       |
| City of Stockton  | Delta Water Supply Project (Phase 1)                                | 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.                   | Loss of 106 acres of topsoil from excavation and overcovering.                          |
| California Department of Water Resources                    | Delta Levees Flood Protection Program                               | Ongoing                      | Levee rehabilitation projects in the Delta.  | Unknown but probably small acreage of overcovering of topsoil.                          |
| USACE   | Suisun Channel (Slough) Operations and Maintenance Project          | Ongoing                      | Maintenance dredging of an entrance channel in Suisun Bay, with turning basin.   | Unknown acreage of overcovering of topsoil from dredge material disposal.               |
| California Department of Water Resources                    | Central Valley Flood Management Planning Program                    | Planning phase               | Among other management actions, involves levee raising and construction of new levees for flood control purposes.  | Unknown acreage of overcovering of topsoil from levee earthwork.                        |

| Agency                                   | Program/Project   | Status   | Description of Program/Project   | Effects on Soils  |
|--|---|--|--|---|
| 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.   | Loss of approximately 2 acres of topsoil from excavation and overcovering.  |
| California Department of Water Resources | North Delta Flood Control and Ecosystem Restoration Project | Final EIR certified and Notice of Determination filed in 2010.                       | Project is intended to improve flood management and provide ecosystem benefits in the North Delta area through actions such as construction of setback levees and configuration of flood bypass areas to create quality habitat for species of concern. These actions are focused on McCormack-Williamson Tract and Staten Island. The purpose of the Project is to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes.  | Unknown but probably significant acreage of overcovering of topsoil from tidal inundation, excavation and overcovering. |
| 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: increase the availability of high-quality water in the Delta for export or outflow through the following: (1) diversion of water on to the Reservoir Islands during high-flow periods (i.e., December through March); (2) storage of water on the Reservoir Islands; (3) mitigation for wetland and wildlife effects of the water storage operations on the Reservoir Islands by implementing a habitat management plan on Bouldin Island and Holland Tract; (4) supplemental water storage in Semitropic Groundwater Storage Bank and the Antelope Valley Water Bank; (5) discharging water for export to designated south- of-Delta users when excess CVP or SWP pumping capacity is available (i.e., typically July through November); and (6) releasing water for water quality and outflow enhancement in the Bay-Delta Estuary typically from September through November. | Loss of approximately 10,000 acres of topsoil from inundation.  |

| Agency  | Program/Project                                       | Status                         | Description of Program/Project  | Effects on Soils  |
|---|---|--------------------------------|---|---|
| California Department of Water Resources                        | Cache Slough Area Restoration                         | Currently under study          | Restoration of lands within the Cache Slough Complex located in the Delta. Could include roughly 45,000 acres of existing and potential open water, marsh, floodplain and riparian habitat.   | This project is examined as part of the BDCP alternatives and effects further described in the Draft BDCP.  |
| Reclamation District 2093                                       | Staten Island Wildlife-Friendly Farming Demonstration | Ongoing program                | Habitat restoration project allowing longer flooding duration on agricultural lands.  | Longer inundation period over 2,500–5,000 acres of agricultural land. Construction of new internal levees could accelerate erosion or disturb soil. |
| California Department of Fish and Wildlife                      | Fremont Landing Conservation Bank                     | Construction completed in 2013 | 4,500 acres of farmland and floodplain operating as conservation bank for endangered and threatened salmon and steelhead.   | Unknown but probably significant acreage of topsoil loss from tidal inundation, excavation and overcovering.  |
| California 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. | Potential effects on soil resources from restoration and other actions.   |
| 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 effects on soil resources from restoration actions.   |
| California Department of Water Resources                        | Central Valley Flood Management Planning Program      | Planning phase                 | Among other management actions, involves levee raising and construction of new levees for flood control purposes.   | Potential beneficial effect on soil resources (topsoil) and adverse effects from earthwork, including accelerated erosion and sedimentation.        |
| SAFCA, Central Valley Flood Protection Board, USACE             | Flood Management Program                              | Ongoing                        | South Sacramento Streams Project component consists of levee, floodwall, and channel improvements.  | Potential beneficial effect on soil resources (topsoil) and adverse effects from earthwork, including accelerated erosion and sedimentation.        |
| Bureau of Reclamation, California Department of Water Resources | 2-Gates Fish Protection Demonstration Project         | Delayed                        | Temporary gates would be placed across Old River and Connection Slough in the central Delta and operated from December to March for fish protection purposes.   | No direct effect on soil resources.   |

| Agency  | Program/Project                             | Status   | Description of Program/Project  | Effects on Soils  |
|---|---|--|---|---|
| Bureau of Reclamation, California Department of Water Resources                                       | Franks Tract Project                        | Delayed  | State and federal agencies would evaluate and implement, if appropriate and authorized, a strategy to significantly reduce salinity levels in the south Delta and at the CCWD and SWP/CVP export facilities and improve water supply reliability by reconfiguring levees and/or Delta circulation patterns around Franks Tract while accommodating recreational interests.  | Potential beneficial effect on soil resources (topsoil) and adverse effect from earthwork, including accelerated erosion and sedimentation. |
| Bureau of Reclamation, California Department of Water Resources, Contra Costa Water District          | Los Vaqueros Expansion Investigation        | Final EIR certified by Contra Costa Water District in March 2010         | The existing Los Vaqueros Reservoir would be expanded up to a total of 275 thousand acre-feet to take full advantage of the existing state of the art fish screens currently in use in the Delta. New Delta intakes, pumps, and pipelines would be required to fill the additional reservoir capacity, and water deliveries would be made from the expanded reservoir to Bay Area beneficiaries through new conveyance facilities.  | Potential effects on soil resources from earthwork, including accelerated erosion and sedimentation and loss of topsoil.                    |
| State and Federal Contractors Water Agency, California Department of Water Resources and MOA Partners | Lower Yolo Restoration Project              | Draft Supplemental EIR released for public comment on December 14, 2015. | The goal of this project is to provide important new sources of food and shelter for a variety of native fish species at the appropriate scale in strategic locations in addition to ensuring continued or enhanced flood protection.   | Potential effects on soil resources from earthwork, including accelerated erosion and sedimentation and loss of topsoil.                    |
| State Water Resources Control Board   | Bay-Delta Water Quality Control Plan Update | Ongoing development.   | The State Water Board is updating the 2006 Bay-Delta Water Quality Control Plan (WQCP) in four phases:<br>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;<br>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 | No direct effect on soil resources.   |

| Agency                       | Program/Project                | Status | Description of Program/Project  | Effects on Soils  |
|------------------------------|--------------------------------|--------|---|---|
|                              |                                |        | amended include Delta outflow criteria;<br>Phase III: Requires changes to water rights and other measures to implement changes to the WQCP from Phases I and II;<br>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 | CALFED Levee Stability Program |        | The California Bay-Delta Program's (CALFED) levee stability program provides for long-term protection of resources in the Delta by maintaining and improving the integrity of the area's extensive levee system.  | Potential beneficial effect on soil resources (topsoil) and adverse effect from earthwork, including accelerated erosion and sedimentation and loss of topsoil. |
| San Joaquin County           | General Plan Update            |        | The general plan provides guidance for future growth in a manner that preserves the county's natural and rural assets. Most of the urban growth is directed to existing urban communities.  | Potential beneficial effect on soil resources (topsoil).  |

1  
2 The analysis focuses on projects and programs within the Plan Area that involve substantial grading,  
3 excavation, overcovering, or inundation. The principal programs and projects considered in the  
4 analysis are listed in Table 10-9. These programs and projects have been drawn from a more  
5 substantial compilation of past, present, and reasonably foreseeable programs and projects included  
6 in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and*  
7 *Cumulative Impact Conditions*. The projects listed in Table 10-9 are therefore a subset of projects  
8 included in Appendix 3D and consist only of those projects that could affect soils and, where  
9 relevant, in the same timeframe as the project, potentially resulting in a cumulative impact.

10 When the effects of the proposed project on soils are considered in connection with the potential  
11 effects of projects listed in Table 10-9, the potential cumulative effects on soils could range from  
12 beneficial to potentially adverse. The specific programs, projects and policies with the potential to  
13 combine with effects of the alternatives to create a cumulatively considerable impact are identified  
14 below for each impact category. The potential for cumulative impacts on soils is described for  
15 construction of the conveyance facilities and CM2–CM21 within the Plan Area.

### 16 **10.3.5.1 Cumulative Effects of the No Action Alternative**

17 The No Action Alternative in a cumulative condition would result in accelerated water and wind  
18 erosion as a result of implementation of numerous levee stabilization, dredge spoil disposal, and  
19 habitat restoration projects. However, federal, state, and local regulations, codes, and permitting  
20 programs would continue to require implementation of measures to prevent nonagricultural  
21 accelerated erosion and sediment transport associated with construction. The loss of topsoil as a  
22 result of excavation, overcovering, and inundation would continue in the Delta and statewide as a

1 result of numerous land development and habitat restoration projects. Such losses of topsoil are  
 2 effectively irreversible. In contrast, the loss of topsoil associated with habitat restoration projects  
 3 typically results from overcovering, such as placement of dredge spoils in subsided areas, and  
 4 inundation, such as the introduction of seasonal or perennial water into nonwetland environments  
 5 to establish seasonal wetlands or freshwater or tidal marshes. Land subsidence in the Delta and the  
 6 Suisun Marsh would continue. However, the rate of subsidence in the future may be slower than the  
 7 current rate as the organic soils become more consolidated over time. Several projects are now  
 8 underway that would have a beneficial effect on subsidence, some with the explicit goal of  
 9 controlling or reversing subsidence. These entail inundating areas underlain by peat soils to restore  
 10 or create tidal marsh habitat. The inundation would tend to reduce biological oxidation rates of the  
 11 soil organic matter. Depending on the vegetation type, soil organic matter would accumulate over  
 12 time in the restored marsh habitats, thereby raising the elevation of the area. Although these  
 13 projects would tend to control or reverse subsidence only on the islands at which they are  
 14 implemented, they would benefit the Delta as a whole by promoting the “blocking” effect of Delta  
 15 islands on sea water intrusion in the Delta. The subsidence control/reversal projects would  
 16 therefore help to maintain water quality and water supply in the Delta in the event of widespread  
 17 levee failure. Ongoing and reasonably foreseeable future projects in the Plan Area are likely to  
 18 encounter expansive, corrosive, and compressible soils. However, federal and state design  
 19 guidelines and building codes would continue to require that the facilities constructed as part of  
 20 these projects incorporate design measures to avoid the adverse effects of such soils.

21 In total, the plans and programs would result in the loss of at least 3,618 acres of topsoil from  
 22 overcovering or inundation. The cumulative effect of these plans, policies, and programs along with  
 23 the No Action Alternative would be deemed to have direct and adverse effects on topsoil loss in the  
 24 Delta. Subsidence would be controlled or reversed on approximately 308 acres, resulting in a  
 25 beneficial effect.

26 The Delta and vicinity is within a highly active seismic area, with a generally high potential for major  
 27 future earthquake events along nearby and/or regional faults, and with the probability for such  
 28 events increasing over time. Based on the location, extent and non-engineered nature of many  
 29 existing levee structures in the Delta area, the potential for significant damage to, or failure of, these  
 30 structures during a major local seismic event is generally moderate to high. In the instance of a large  
 31 seismic event, levees constructed on liquefiable foundations are expected to experience large  
 32 deformations (in excess of 10 feet) under a moderate to large earthquake in the region. The failure  
 33 of such levees could cause a temporary or permanent loss of topsoil from inundation. (See Appendix  
 34 3E, *Potential Seismic and Climate Change Risks to SWP/CVP Water Supplies* for more detailed  
 35 discussion). While similar risks would occur under implementation of the action alternatives, these  
 36 risks may be reduced by project-related levee improvements along with those projects identified in  
 37 Table 10-9.

### 38 **Impact SOILS-1: Cumulative Impact on Accelerated Erosion Caused by Vegetation Removal** 39 **and Other Soil Disturbances as a Result of Constructing the Proposed Water Conveyance** 40 **Facilities**

41 Construction activities associated with Alternatives 1A through 9 could result in accelerated erosion  
 42 due to vegetation removal and other activities which cause soil disturbance. Accelerated water and  
 43 wind erosion are expected to affect soils as a result of past, present, and reasonably foreseeable  
 44 future projects.

1 **NEPA Effects:** Although the action alternatives are not expected to result in adverse effects on soil  
 2 erosion, when combined with projects listed above that may generate a cumulative effect on soil  
 3 erosion. However, the projects listed above would be required to comply with state water quality  
 4 regulations (i.e., the storm water General Permit for Construction and Land Disturbance Activities)  
 5 to control accelerated erosion and movement of sediment to receiving waters. Though past, current,  
 6 and future projects may result in accelerated soil erosion, the various regulatory frameworks that  
 7 govern within the Plan Area are expected to mitigate any potential adverse effects on soil erosion.  
 8 The proposed project is also subject to the same regulations as the projects listed in Table 10-9 and  
 9 would have no adverse effect on soil erosion. Consequently, there would not be a significant  
 10 cumulative impact and the incremental contribution of the proposed project would not be  
 11 cumulatively considerable.

12 **CEQA Conclusion:** The soil erosion that could occur in association with construction of all project  
 13 alternatives would be mitigated through compliance with state water quality regulations. Other  
 14 past, present and probable future projects and programs in the Plan Area that are identified in Table  
 15 10-9 might also result in accelerated erosion, but would also have to comply with state water quality  
 16 regulations. Therefore, the impact of accelerated soil erosion associated with the project alternatives  
 17 would not combine with the soil erosion risks from other projects or programs to create a  
 18 substantial cumulative effect. This cumulative impact is considered less than significant. No  
 19 mitigation is required.

## 20 **Impact SOILS-2: Cumulative Impact on Topsoil from Construction Activities Occurring Within** 21 **the Plan Area**

22 For Alternatives 1A-9, the construction of conveyance facilities under CM1 could result in adverse  
 23 effects on soils involving the substantial loss of topsoil. These effects result from the following  
 24 actions.

- 25 • Excavation, such as for construction of canal foundations, pumping plant subgrades, and water  
 26 control structures.
- 27 • Overcovering, such as from paving and from application of dredge spoils onto native topsoil.
- 28 • Inundation, such as from introducing seasonal or perennial water to a non-wetland area for the  
 29 purpose of marsh restoration.

30 For Alternatives 1A-9, the construction of restored habitats associated with CM2-CM21 could also  
 31 result in similar construction-related effects.

32 Other projects that may involve construction and habitat restoration activities with similar effects  
 33 on the loss of topsoil are provided in Table 10-9.

34 **NEPA Effects:** Implementing the projects and programs listed in Table 10-9 in combination with any  
 35 of Alternatives 1A-9 would result in a substantial loss of topsoil. It is assumed that environmental  
 36 commitments and mitigation measures to reduce topsoil loss similar to those identified for the  
 37 alternatives analyzed in this document would also be implemented for at least some of these  
 38 projects. However, it is assumed that a net loss of topsoil would occur despite the use of mitigation  
 39 measures by the BDCP/California WaterFix or other projects. Consequently, these effects, in  
 40 combination with the BDCP/California WaterFix, could result in a cumulatively adverse effect on the  
 41 loss of topsoil. Due to the magnitude of the project footprint of Alternatives 1A-9, the amount of  
 42 topsoil lost from construction would be substantial in comparison to the other projects considered

1 in this cumulative analysis. Therefore, the incremental contribution of any one of the action  
2 alternatives would be cumulatively considerable.

3 **CEQA Conclusion.** Alternatives 1A–9 would result in adverse impacts on soils involving a significant  
4 loss of topsoil. Construction of the past, present, and reasonably foreseeable future projects listed in  
5 Table 10-9, taken in conjunction with Alternatives 1A–9, would result in a cumulative impact on  
6 topsoil loss. This cumulative impact is considered significant. Due to the magnitude of the project  
7 footprint for Alternatives 1A–9, the contribution from any of these action alternatives would be  
8 cumulatively considerable. The following mitigation measures could reduce this effect, but not to a  
9 less than significant level. Therefore this cumulative impact is considered significant and  
10 unavoidable.

11 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

12 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
13 1A.

14 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
15 **Topsoil Storage and Handling Plan**

16 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
17 1A.

18 **Impact SOILS-3: Cumulative Impact on Property Loss, Personal Injury, or Death from**  
19 **Instability, Failure, and Damage from Construction on or in Soils Subject to Subsidence as a**  
20 **Result of Constructing the Proposed Water Conveyance Facilities**

21 It is expected that past, present, and reasonably foreseeable future projects would be required to  
22 comply with design requirements (i.e., CBC) to offset potential adverse effects of subsidence.  
23 Moreover, this soil hazard existing at other project sites would be local to those sites and would not  
24 act in combination with those of the BDCP project. While the incremental contribution of the  
25 proposed project could be cumulatively considerable due to the scale of the alternatives, conforming  
26 to CBC and other BMPs would reduce the effects of the proposed project to acceptable levels and  
27 they would not be adverse. Accordingly, there would not be a significant cumulative impact.

28 **NEPA Effects:** Construction activities associated with Alternatives 1A through 9 could result in an  
29 adverse effect on life and property as a result of construction of project facilities on compressible  
30 soils that are subject to subsidence. However, the action alternatives are not expected to result in  
31 adverse effects on life and property as a result of constructing project facilities on compressible soils  
32 because the project proponents would conform to design requirements (i.e., CBC) to offset potential  
33 adverse effects of subsidence.

34 Given the extent of compressible soils in the Plan Area, past, present, and reasonably foreseeable  
35 future projects will likely have some project features located on these types of soils. However, these  
36 projects would not increase the risks to structures and people at the specific locations affected by  
37 action alternatives. Additionally, the projects listed in Table 10-9 would also be required to conform  
38 to the same design requirements under which the proposed project would be constructed.

39 Therefore, the risks of loss, injury, or death associated with the alternatives would not combine with  
40 the compressible soil risks from other projects or programs to create a cumulatively adverse effect  
41 at any one locality in the Plan Area. There would be no cumulative adverse effect.

1 **CEQA Conclusion:** The hazard from compressible soils that would exist and the potential adverse  
 2 effects that could occur in association with construction of all project alternatives would be  
 3 restricted to the locations of the construction activities of these alternatives. Other past, present and  
 4 probable future projects and programs in the Plan Area that are identified in Table 10-9 would not  
 5 increase the risks of loss, injury or death at the specific locations affected by project alternatives.  
 6 Therefore, the risks of loss, injury or death associated with the project alternatives would not  
 7 combine with the compressible soil risks from other projects or programs to create a substantial  
 8 cumulative effect at any one locality in the Plan Area. This cumulative impact is considered less than  
 9 significant. No mitigation is required.

10 **Impact SOILS-4: Cumulative Impact on Risk to Life and Property as a Result of Constructing**  
 11 **the Proposed Water Conveyance Facilities in Areas of Expansive, Corrosive, and**  
 12 **Compressible Soils**

13 It is expected that past, present, and reasonably foreseeable future projects would be required to  
 14 comply with design requirements (i.e., CBC) to offset potential adverse effects of subsidence and  
 15 compressible, expansive, and corrosive soils. Moreover, these soil hazards existing at other project  
 16 sites would be local to those sites and would not act in combination with those of the project. While  
 17 the incremental contribution of the proposed project could be cumulatively considerable due to the  
 18 scale of the alternatives, conforming to CBC and other BMPs would reduce the effects of the  
 19 proposed project to acceptable levels and they would not be adverse. Accordingly, there would not  
 20 be a significant cumulative impact.

21 **NEPA Effects:** Construction activities associated with Alternatives 1A through 9 could result in an  
 22 adverse effect on life and property as a result of construction of project facilities on expansive,  
 23 corrosive and/or compressible soils. However, the action alternatives are not expected to result in  
 24 adverse effects on life and property as a result of constructing project facilities on expansive,  
 25 corrosive and/or compressible soils because the project proponents would conform to design  
 26 requirements (i.e., CBC) to offset potential adverse effects of subsidence and compressible,  
 27 expansive, and corrosive soils.

28 Given the extent of expansive, corrosive and/or compressible soils in the Plan Area, past, present,  
 29 and reasonably foreseeable future projects will likely have some project features located on these  
 30 types of soils. However, these projects would not increase the risks to structures and people at the  
 31 specific locations affected by action alternatives. Additionally, the projects listed in Table 10-9  
 32 would also be required to conform to the same design requirements the proposed project would be  
 33 building under.

34 Therefore, the risks of loss, injury, or death associated with the alternatives would not combine with  
 35 the risks from other projects or programs to create a cumulatively adverse effect at any one locality  
 36 in the Plan Area. There would be no cumulative adverse effect.

37 **CEQA Conclusion:** The hazard from expansive, corrosive and/or compressible soils that would exist  
 38 and the potential adverse effects that could occur in association with construction of all project  
 39 alternatives would be restricted to the locations of the construction activities of these alternatives.  
 40 Other past, present and probable future projects and programs in the Plan Area that are identified in  
 41 Table 10-9 would not increase the risks of loss, injury or death at the specific locations affected by  
 42 project alternatives. Therefore, the risks of loss, injury or death associated with the project  
 43 alternatives would not combine with the soil risks from other projects or programs to create a

1 substantial cumulative effect at any one locality in the Plan Area. This cumulative impact is  
2 considered less than significant. No mitigation is required.

3 **Impact SOILS-5: Cumulative Impact on Accelerated Bank Erosion from Increased Channel**  
4 **Flow Rates as a Result of Operations**

5 As described in Alternative 1A, project operational components would cause changes in the tidal  
6 flows in some Delta channels, specifically those that lead into the major habitat restoration areas  
7 (Suisun Marsh, Cache Slough, Yolo Bypass, and South Delta ROAs). In major channels leading to the  
8 restoration areas (e.g., Lindsey, Montezuma, and Georgiana sloughs and Middle River), tidal flow  
9 velocities may increase by an unknown amount; any significant increases could cause some localized  
10 accelerated erosion/scour. However, detailed hydrodynamic (tidal) modeling would be conducted  
11 prior to any habitat restoration work in these ROA areas, and the changes in the tidal velocities in  
12 the major channels connecting to these restoration areas would be evaluated. If there is any  
13 indication that tidal velocities would be substantially increased, the restoration project design  
14 would be modified (such as by providing additional levee breaches or by requiring dredging in  
15 portions of the connecting channels) so that bed scour would not increase sufficiently to cause an  
16 erosion impact. Moreover, as presently occurs and as is typical with most naturally-functioning river  
17 channels, local erosion and deposition within the tidal habitats is expected as part of the restoration.

18 For most of the existing channels that would not be subject to tidal flow restoration, there would be  
19 no adverse effect to tidal flow volumes and velocities. The tidal prism would increase by 5–10%, but  
20 the intertidal (i.e., MHHW to MLLW) cross-sectional area also would be increased such that tidal  
21 flow velocities would be reduced by 10–20% compared to the existing condition. Consequently, no  
22 appreciable increase in scour is anticipated. The effect would not be adverse because there would be  
23 no net increase in river flow rates and, accordingly, no net increase in channel bank scour.

24 **NEPA Effects:** Very few, if any, of the past, present, and reasonably foreseeable future projects listed  
25 in Table 10-9 would involve increases in river channel flow rates. This, combined with the fact that  
26 the project would not cause a net increase in river flow rates, would not result in a substantial  
27 cumulative effect on bank erosion in the Plan Area.

28 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
29 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
30 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
31 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
32 effect would be to reduce the channel flow rates by 10–20% compared to Existing  
33 Conditions. Consequently, no appreciable increase in scour is anticipated. Because few, if any, of the  
34 past, present, and reasonably foreseeable future projects listed in Table 10-9 would involve  
35 increases in river channel flow rates, any cumulative effects would be less than significant. No  
36 mitigation is required.

37 **Impact SOILS-6: Cumulative Impact on Accelerated Erosion Caused by Clearing, Grubbing,**  
38 **Grading, and Other Disturbances Associated with Implementation of Proposed Conservation**  
39 **Measures CM2–CM11, CM18 and CM19**

40 Construction activities associated with Alternatives 1A through 9 could result in accelerated erosion  
41 due to vegetation removal and other activities which cause soil disturbance. Accelerated water and  
42 wind erosion are expected to affect soils as a result of past, present, and reasonably foreseeable  
43 future projects.

1 **NEPA Effects:** Although the alternatives are not expected to result in adverse effects on soil erosion,  
 2 when combined with projects listed above that may generate a cumulative effect on soil erosion.  
 3 However, the projects listed in Table 10-9 would be required to comply with state water quality  
 4 regulations (i.e., the storm water General Permit for Construction and Land Disturbance Activities)  
 5 to control accelerated erosion and movement of sediment to receiving waters. Though past, current,  
 6 and future projects may result in accelerated soil erosion, the various regulatory frameworks that  
 7 govern within the Plan Area are expected to mitigate any potential adverse effects on soil erosion.  
 8 The proposed project is also subject to the same regulations as the projects listed in Table 10-9 and  
 9 would have no adverse effect on soil erosion. Consequently, there would not be a significant  
 10 cumulative effect and the incremental contribution of the proposed project would not be  
 11 cumulatively substantial.

12 **CEQA Conclusion:** The soil erosion that could occur in association with construction of all project  
 13 alternatives would be mitigated through compliance with state water quality regulations. Other  
 14 past, present and probable future projects and programs in the Plan Area that are listed in Table 10-  
 15 9 might also result in accelerated erosion, but would also have to comply with state water quality  
 16 regulations. Therefore, the impact of accelerated soil erosion associated with the project alternatives  
 17 would not combine with the soil erosion risks from other projects or programs to create a  
 18 substantial cumulative impact. This cumulative impact is considered less than significant. No  
 19 mitigation is required.

20 **Impact SOILS-7: Cumulative Impact on Loss of Topsoil from Excavation, Overcovering, and**  
 21 **Inundation Associated with Restoration Activities as a Result of Implementing the Proposed**  
 22 **Conservation Measures CM2–CM11**

23 Construction activities associated with Alternatives 1A through 9 would result in the loss of topsoil  
 24 caused by excavation, overcovering, and inundation associated with implementing the restoration  
 25 activities.

26 **NEPA Effects:** Implementation of habitat restoration activities at the ROAs would result in  
 27 excavation, overcovering, or inundation of a minimum of 77,600 acres of topsoil (this total includes  
 28 areas of tidal habitat restoration, which will be periodically inundated). This effect would be adverse  
 29 because it would result in a substantial loss of topsoil. Combined with the loss of topsoil that would  
 30 occur from most or all of the past, present, and reasonably foreseeable future projects listed in Table  
 31 10-9, there would be a substantial cumulative adverse effect. Mitigation Measures SOILS-2a and  
 32 SOILS-2b would to reduce the severity of this effect, but the level of the effect would remain  
 33 substantial after mitigation because a large extent of topsoil would be temporarily or permanently  
 34 lost.

35 **CEQA Conclusion:** Implementation of CM2–CM11 would involve excavation, overcovering, and  
 36 inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby resulting in a  
 37 substantial loss of topsoil. Combined with the loss of topsoil that would occur from most or all of the  
 38 past, present, and reasonably foreseeable future projects listed in Table 10-9, there would be a  
 39 significant and unavoidable impact. Mitigation Measures SOILS-2a and SOILS-2b would to reduce  
 40 the severity of this effect, but the impact would remain significant after mitigation because a large  
 41 extent of topsoil would be temporarily or permanently lost. Mitigation Measures SOILS-2a and  
 42 SOILS-2b would minimize and compensate for these impacts to a degree, but not to a less-than-  
 43 significant level. Therefore, this impact is considered significant and unavoidable.

1           **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

2           Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative  
3           1A.

4           **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
5           **Topsoil Storage and Handling Plan**

6           Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative  
7           1A.

8           **Impact SOILS-8: Cumulative Impact on Property Loss, Personal Injury, or Death from**  
9           **Instability, Failure, and Damage from Construction on Soils Subject to Subsidence as a Result**  
10          **of Implementing the Proposed Conservation Measures CM2–CM11**

11          It is expected that past, present, and reasonably foreseeable future projects would be required to  
12          comply with design requirements (i.e., CBC) to offset potential adverse effects of subsidence.  
13          Moreover, where this soil hazard exists at the other project sites, the potential impact would be local  
14          to those sites and would not act in combination with that of the project.

15          **NEPA Effects:** The risks of loss, injury, or death associated with the alternatives would not combine  
16          with the risks from other projects or programs to create a cumulatively adverse effect at any one  
17          locality in the Plan Area. There would be no cumulative adverse effect.

18          **CEQA Conclusion:** The hazard from soils subject to subsidence that would exist and the potential  
19          adverse effects that could occur in association with construction of all project alternatives would be  
20          restricted to the locations of the construction activities of these alternatives. Other past, present and  
21          probable future projects and programs in the Plan Area that are identified in Table 10-9 would not  
22          increase the risks of loss, injury or death at the specific locations affected by project alternatives.  
23          Therefore, the risks of loss, injury or death associated with the project alternatives would not  
24          combine with the soil risks from other projects or programs to create a substantial cumulative effect  
25          at any one locality in the Plan Area. This cumulative impact is considered less than significant. No  
26          mitigation is required.

27          **Impact SOILS-9: Cumulative Impact on Risk to Life and Property from Construction in Areas**  
28          **of Expansive, Corrosive, and Compressible Soils as a Result of Implementing the Proposed**  
29          **Conservation Measures CM2–CM11**

30          It is expected that past, present, and reasonably foreseeable future projects would be required to  
31          comply with design requirements (i.e., CBC) to offset potential adverse effects of expansive,  
32          corrosive, and compressible soils. Moreover, where these soil hazards exist at the other project sites,  
33          the potential impact would be local to those sites and would not act in combination with that of the  
34          project.

35          **NEPA Effects:** The risks of loss, injury, or death associated with the alternatives would not combine  
36          with the risks from other projects or programs to create a cumulatively adverse effect at any one  
37          locality in the Plan Area. There would be no cumulative adverse effect.

38          **CEQA Conclusion:** Soils subject to expansion, corrosion, and compression that would exist and the  
39          potential adverse effects that could occur in association with construction of all project alternatives  
40          would be restricted to the locations of the construction activities of these alternatives. Other past,

1 present and probable future projects and programs in the Plan Area that are identified in Table 10-9  
 2 would not increase the risks of loss, injury or death at the specific locations affected by project  
 3 alternatives. Therefore, the risks of loss, injury or death associated with the project alternatives  
 4 would not combine with the soil risks from other projects or programs to create a substantial  
 5 cumulative effect at any one locality in the Plan Area. This cumulative impact is considered less than  
 6 significant. No mitigation is required.

### 7 **10.3.5.2 Concurrent Project Effects**

8 Vegetation removal and other soil disturbances associated with construction of water conveyance  
 9 facilities and habitat restoration activities could cause accelerated water and wind erosion of soil.  
 10 CM2–CM4 and CM6–CM21 have been identified as actions that will involve some element of  
 11 implementation and construction within the first five years. However, DWR would seek coverage  
 12 under the state General Permit for Construction and Land Disturbance Activities (as discussed in  
 13 Appendix 3B, *Environmental Commitments, AMMs, and CMs*) necessitating the preparation of a  
 14 SWPPP and an erosion control plan. Permit conditions would include erosion and sediment control  
 15 BMPs (such as revegetation, runoff control, and sediment barriers) and compliance with water  
 16 quality standards. Because implementation of the SWPPP and compliance with the General Permit  
 17 would control accelerated soil erosion, there would not be substantial soil erosion resulting in daily  
 18 site runoff turbidity in excess of 250 NTUs from combined conveyance facility and conservation  
 19 measure construction during the same time period. Therefore, there would be no increase in  
 20 concurrent effects on excessive soil erosion rates during construction.

21 Construction of the water conveyance facilities for all the action alternatives as well as proposed  
 22 habitat restoration activities would involve irreversible removal, overcovering, and inundation of  
 23 topsoil over extensive areas, thereby resulting in a substantial loss of topsoil. The concurrent effects  
 24 of conveyance facility and restoration conservation measure construction on loss of topsoil could be  
 25 greater than the effect of conveyance facility construction alone. As indicated above, this impact  
 26 would be significant. Mitigation Measures SOILS-2a and SOILS-2b would partially mitigate for these  
 27 impacts, but not to a less-than-significant level because topsoil would be permanently lost over  
 28 extensive areas. Therefore, this combined impact is considered significant and unavoidable.

29 Impacts related to constructing on corrosive soils, compressible soils, and on water and wind  
 30 erosion of soils assuming concurrent effects of constructing conveyance facilities and other  
 31 conservation measures would not be greater than described above because these conditions are site  
 32 specific and would be addressed by adhering to the California Building Code (CBC) requirements  
 33 and environmental commitments to reduce effects on soils. Concurrent soils effects under  
 34 Alternatives 4A, 2D, and 5A would be similar to, but less than, those described under other  
 35 alternatives.

### 36 **10.3.5.3 Cumulative Effects of the Action Alternatives**

#### 37 **Impact SOILS-1: Cumulative Impact on Accelerated Erosion Caused by Vegetation Removal** 38 **and Other Soil Disturbances as a Result of Constructing the Proposed Water Conveyance** 39 **Facilities**

40 Construction activities associated with the action alternatives 1A–9 could result in accelerated  
 41 erosion due to vegetation removal and other activities which cause soil disturbance. Accelerated

1 water and wind erosion are expected to affect soils as a result of past, present, and reasonably  
2 foreseeable future projects.

3 **NEPA Effects:** Although the action alternatives are not expected to result in adverse effects on soil  
4 erosion, when combined with projects listed above there may be a cumulative effect on soil erosion.  
5 However, the projects listed above would be required to comply with state water quality regulations  
6 (i.e., the storm water General Permit for Construction and Land Disturbance Activities) to control  
7 accelerated erosion and movement of sediment to receiving waters. Though past, current, and  
8 future projects may result in accelerated soil erosion, the various regulatory frameworks that  
9 govern within the Plan Area are expected to mitigate any potential adverse effects on soil erosion.  
10 Action alternatives are also subject to the same regulations as the projects listed in Table 10-9  
11 would have no adverse effect on soil erosion. Consequently, there would not be a significant  
12 cumulative impact and the incremental contribution of the action alternatives would not be  
13 cumulatively considerable.

14 **CEQA Conclusion:** The soil erosion that could occur in association with construction of all action  
15 alternatives would be mitigated through compliance with state water quality regulations. Other  
16 past, present and probable future projects and programs in the Plan Area that are identified in Table  
17 10-9 might also result in accelerated erosion, but would also have to comply with state water quality  
18 regulations. Therefore, the impact of accelerated soil erosion associated with the action alternatives  
19 would not combine with the soil erosion risks from other projects or programs to create a  
20 substantial cumulative effect. The incremental contribution of the action alternatives would not be  
21 cumulatively considerable. This cumulative impact is considered less than significant. No mitigation  
22 is required.

### 23 **Impact SOILS-2: Cumulative Impact on Topsoil from Construction Activities Occurring Within** 24 **the Plan Area**

25 For all action alternatives the construction of conveyance facilities under CM1 could result in  
26 adverse effects on soils involving the substantial loss of topsoil. The construction of restored  
27 habitats associated with CM2–CM21, or Environmental Commitments under the non-HCP  
28 alternatives, could also result in similar construction-related effects.

29 Other projects that may involve construction and habitat restoration activities with similar effects  
30 on the loss of topsoil are provided in Table 10-9.

31 **NEPA Effects:** Implementing the projects and programs listed in Table 10-9 in combination with any  
32 of the action alternatives would result in a substantial loss of topsoil. It is assumed that  
33 environmental commitments and mitigation measures to reduce topsoil loss similar to those  
34 identified for the alternatives analyzed in this document would also be implemented for at least  
35 some of these projects. However, it is assumed that a net loss of topsoil would occur despite the use  
36 of mitigation measures by the BDCP/California WaterFix or other projects. Consequently, these  
37 effects, in combination with the BDCP/California WaterFix, could result in a cumulatively adverse  
38 effect on the loss of topsoil. Due to the magnitude of the project footprints of all action alternatives,  
39 the amount of topsoil lost from construction would be substantial in comparison to the other  
40 projects considered in this cumulative analysis. The effect from Alternatives 4A, 2D, and 5A would  
41 be significantly less than under the BDCP alternatives, but would remain significant and  
42 considerable. Therefore, the incremental contribution of all action alternatives would be  
43 cumulatively considerable.

1 **CEQA Conclusion.** Implementation of action alternatives 1A–9 would result in adverse impacts on  
 2 soils involving a significant loss of topsoil. Construction of the past, present, and reasonably  
 3 foreseeable future projects listed in Table 10-9, taken in conjunction with all action alternatives,  
 4 would result in a cumulative impact on topsoil loss. The effect from Alternative 4A, 2D, and 5A  
 5 would be significantly less, but would remain significant and considerable. This cumulative impact is  
 6 considered significant. Due to the magnitude of the project footprint of all action alternatives, the  
 7 contribution from any of these alternatives would be cumulatively considerable. The following  
 8 mitigation measures could reduce this effect, but not to a less-than-significant level. Therefore this  
 9 cumulative impact is considered significant and unavoidable.

10 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

11 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 4.

12 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
 13 **Topsoil Storage and Handling Plan**

14 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 4.

15 **Impact SOILS-3: Cumulative Impact on Property Loss, Personal Injury, or Death from**  
 16 **Instability, Failure, and Damage from Construction on or in Soils Subject to Subsidence as a**  
 17 **Result of Constructing the Proposed Water Conveyance Facilities**

18 It is expected that past, present, and reasonably foreseeable future projects would be required to  
 19 comply with design requirements (i.e., CBC) to offset potential adverse effects of subsidence.  
 20 Moreover, this soil hazard existing at other project sites would be local to those sites and would not  
 21 act in combination with those of the project. While the incremental contribution of the action  
 22 alternatives could be cumulatively considerable due to the scale of the alternatives, conforming to  
 23 CBC and other BMPs would reduce the effects of the action alternatives to acceptable levels and they  
 24 would not be adverse. Accordingly, there would not be a significant cumulative impact.

25 **NEPA Effects:** Construction activities associated with action alternatives 1A through 9 could result  
 26 in an adverse effect on life and property as a result of construction of project facilities on soils that  
 27 are subject to subsidence. However, the action alternatives are not expected to result in adverse  
 28 effects on life and property as a result of constructing project facilities on soils subject to subsidence  
 29 because all action alternatives would conform to design requirements (i.e., CBC) to offset potential  
 30 adverse effects of subsidence.

31 Given the extent of soils subject to subsidence in the Plan Area, past, present, and reasonably  
 32 foreseeable future projects will likely have some project features located on this type of soils.  
 33 However, these projects would not increase the risks to structures and people at the specific  
 34 locations affected by the action alternatives. Additionally, the projects listed in Table 10-9 would  
 35 also be required to conform to the same design requirements under which the proposed project  
 36 would be constructed.

37 Therefore, the risks of loss, injury, or death associated with the alternatives would not combine with  
 38 the compressible soil risks from other projects or programs to create a cumulatively adverse effect  
 39 at any one locality in the Plan Area. There would be no cumulative adverse effect.

1 **CEQA Conclusion:** The hazard from soils subject to subsidence that would exist and the potential  
 2 adverse effects that could occur in association with construction of the action alternatives would be  
 3 restricted to the locations of the construction activities of these alternatives. Other past, present and  
 4 probable future projects and programs in the Plan Area that are identified in Table 10-9 would not  
 5 increase the risks of loss, injury or death at the specific locations affected by project alternatives.  
 6 Therefore, the risks of loss, injury or death associated with the project alternatives would not  
 7 combine with the subsidence risks from other projects or programs to create a substantial  
 8 cumulative effect at any one locality in the Plan Area. This cumulative impact is considered less than  
 9 significant. No mitigation is required.

10 **Impact SOILS-4: Cumulative Impact on Risk to Life and Property as a Result of Constructing**  
 11 **the Proposed Water Conveyance Facilities in Areas of Expansive, Corrosive, and**  
 12 **Compressible Soils**

13 It is expected that past, present, and reasonably foreseeable future projects would be required to  
 14 comply with design requirements (i.e., CBC) to offset potential adverse effects of compressible,  
 15 expansive, and corrosive soils. Moreover, these soil hazards existing at other project sites would be  
 16 local to those sites and would not act in combination with those of the action alternatives. While the  
 17 incremental contribution of the proposed project could be cumulatively considerable due to the  
 18 scale of all alternatives, conforming to CBC and other BMPs would reduce the effects of the proposed  
 19 project to acceptable levels and they would not be adverse. Accordingly, there would not be a  
 20 significant cumulative impact.

21 **NEPA Effects:** Construction activities associated with the action alternatives could result in an  
 22 adverse effect on life and property as a result of construction of project facilities on expansive,  
 23 corrosive and/or compressible soils. However, the action alternatives are not expected to result in  
 24 adverse effects on life and property as a result of constructing project facilities on expansive,  
 25 corrosive and/or compressible soils because the alternatives would conform to design requirements  
 26 (i.e., CBC) to offset potential adverse effects of compressible, expansive, and corrosive soils.

27 Given the extent of expansive, corrosive and/or compressible soils in the Plan Area, past, present,  
 28 and reasonably foreseeable future projects will likely have some project features located on these  
 29 types of soils. However, these projects would not increase the risks to structures and people at the  
 30 specific locations affected by the action alternatives. Additionally, the projects listed in Table 10-9  
 31 would also be required to conform to the same design requirements the proposed project would be  
 32 building under.

33 Therefore, the risks of loss, injury, or death associated with the alternatives would not combine with  
 34 the risks from other projects or programs to create a cumulatively adverse effect at any one locality  
 35 in the Plan Area. There would be no cumulative adverse effect.

36 **CEQA Conclusion:** The hazard from expansive, corrosive and/or compressible soils that would exist  
 37 and the potential adverse effects that could occur in association with construction of the action  
 38 alternatives would be restricted to the locations of the construction activities of these alternatives.  
 39 Other past, present and probable future projects and programs in the Plan Area that are identified in  
 40 Table 10-9 would not increase the risks of loss, injury or death at the specific locations affected by  
 41 all action alternatives. Therefore, the risks of loss, injury or death associated with the project  
 42 alternatives would not combine with the soil risks from other projects or programs to create a  
 43 substantial cumulative effect at any one locality in the Plan Area. This cumulative impact is  
 44 considered less than significant. No mitigation is required.

1 **Impact SOILS-5: Cumulative Impact on Accelerated Bank Erosion from Increased Channel**  
 2 **Flow Rates as a Result of Operations**

3 Project operational components would cause changes in the tidal flows in some Delta channels,  
 4 specifically those that lead into the major habitat restoration areas (Suisun Marsh, Cache Slough,  
 5 Yolo Bypass, and South Delta ROAs). In major channels leading to the restoration areas (e.g.,  
 6 Lindsey, Montezuma, and Georgiana sloughs and Middle River), tidal flow velocities may increase by  
 7 an unknown amount; any significant increases could cause some localized accelerated  
 8 erosion/scour. This effect would not be as significant in Alternative 4A, 2D, or 5A. Detailed  
 9 hydrodynamic (tidal) modeling would be conducted prior to any habitat restoration work in these  
 10 ROA areas, and the changes in the tidal velocities in the major channels connecting to these  
 11 restoration areas would be evaluated. If there is any indication that tidal velocities would be  
 12 substantially increased, the restoration project design would be modified so that bed scour would  
 13 not increase sufficiently to cause an erosion impact.

14 For most of the existing channels that would not be subject to tidal flow restoration, there would be  
 15 no adverse effect to tidal flow volumes and velocities. The tidal prism would increase by 5–10%, but  
 16 the intertidal (i.e., MHHW to MLLW) cross-sectional area also would be increased such that tidal  
 17 flow velocities would be reduced by 10–20% compared to the existing condition. Consequently, no  
 18 appreciable increase in scour is anticipated. The effect would not be adverse because there would be  
 19 no net increase in river flow rates and, accordingly, no net increase in channel bank scour.

20 **NEPA Effects:** Very few, if any, of the past, present, and reasonably foreseeable future projects listed  
 21 in Table 10-9 would involve increases in river channel flow rates. This, combined with the fact that  
 22 the project would not cause a net increase in river flow rates, it would not result in a substantial  
 23 cumulative effect on bank erosion in the Plan Area under any of the action alternatives.

24 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in  
 25 channels and sloughs, potentially leading to increases in channel bank scour. However, where such  
 26 changes are expected to occur (i.e., at the mouths of tidal marsh channels), the project would also  
 27 entail expansion of the channel cross-section to increase the tidal prism at these locations. The net  
 28 effect would be to reduce the channel flow rates by 10–20% compared to Existing Conditions.  
 29 Consequently, no appreciable increase in scour is anticipated. Because few, if any, of the past,  
 30 present, and reasonably foreseeable future projects listed in Table 10-9 would involve increases in  
 31 river channel flow rates, any cumulative effects would be less than significant. No mitigation is  
 32 required.

33 **Impact SOILS-6: Cumulative Impact on Accelerated Erosion Caused by Clearing, Grubbing,**  
 34 **Grading, and Other Disturbances Associated with Implementation of Environmental**  
 35 **Commitments 2–11, 18, and 19**

36 Construction activities associated with the BDCP alternatives could result in accelerated erosion due  
 37 to vegetation removal and other activities which cause soil disturbance. The effect from  
 38 Environmental Commitments under Alternatives 4A, 2D, and 5A would be significantly less.  
 39 Accelerated water and wind erosion is expected to affect soils as a result of past, present, and  
 40 reasonably foreseeable future projects.

41 **NEPA Effects:** Although the action alternatives are not expected to result in adverse effects on soil  
 42 erosion, when combined with projects listed above that may generate a cumulative effect on soil  
 43 erosion. However, the projects listed in Table 10-9 would be required to comply with state water

1 quality regulations (i.e., the storm water General Permit for Construction and Land Disturbance  
 2 Activities) to control accelerated erosion and movement of sediment to receiving waters. Though  
 3 past, current, and future projects may result in accelerated soil erosion, the various regulatory  
 4 frameworks that govern within the Plan Area are expected to mitigate any potential adverse effects  
 5 on soil erosion. BDCP is also subject to the same regulations as the projects listed in Table 10-9 and  
 6 would have no adverse effect on soil erosion. Consequently, there would not be a significant  
 7 cumulative effect and the incremental contribution of the proposed project would not be  
 8 cumulatively substantial.

9 **CEQA Conclusion:** The soil erosion that could occur in association with construction of all project  
 10 alternatives would be mitigated through compliance with state water quality regulations. Other  
 11 past, present and probable future projects and programs in the Plan Area that are listed in Table 10-  
 12 9 might also result in accelerated erosion, but would also have to comply with state water quality  
 13 regulations. Therefore, the impact of accelerated soil erosion associated with the project alternatives  
 14 would not combine with the soil erosion risks from other projects or programs to create a  
 15 substantial cumulative impact. This cumulative impact is considered less than significant. No  
 16 mitigation is required.

17 **Impact SOILS-7: Cumulative Impact on Loss of Topsoil from Excavation, Overcovering, and**  
 18 **Inundation Associated with Restoration Activities as a Result of Implementing the Proposed**  
 19 **Conservation Measures CM2–CM11**

20 Construction activities associated with the action alternatives would result in the loss of topsoil  
 21 caused by excavation, overcovering, and inundation associated with implementing the restoration  
 22 activities.

23 **NEPA Effects:** Implementation of habitat restoration activities under the BDCP alternatives at the  
 24 ROAs would result in excavation, overcovering, or inundation of a minimum of 77,600 acres of  
 25 topsoil (this total includes areas of tidal habitat restoration, which will be periodically inundated).  
 26 Alternatives 4A, 2D, and 5A would result in excavation, overcovering, or inundation of many fewer  
 27 acres. However, this effect for all actions alternatives would be adverse because it would result in a  
 28 substantial loss of topsoil. Combined with the loss of topsoil that would occur from most or all of the  
 29 past, present, and reasonably foreseeable future projects listed in Table 10-9, there would be a  
 30 substantial cumulative adverse effect. Mitigation Measures SOILS-2a and SOILS-2b would to reduce  
 31 the severity of this effect, but the level of the effect would remain substantial after mitigation  
 32 because a large extent of topsoil would be temporarily or permanently lost.

33 **CEQA Conclusion:** Implementation of CM2–CM11 under the BDCP alternatives or Environmental  
 34 Commitments under Alternatives 4A, 2D, and 5A would involve excavation, overcovering, and  
 35 inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby resulting in a  
 36 substantial loss of topsoil. Combined with the loss of topsoil that would occur from most or all of the  
 37 past, present, and reasonably foreseeable future projects listed in Table 10-9, there would be a  
 38 significant and unavoidable impact. Mitigation Measures SOILS-2a and SOILS-2b would to reduce  
 39 the severity of this effect, but the impact would remain significant after mitigation because a large  
 40 extent of topsoil would be temporarily or permanently lost. Mitigation Measures SOILS-2a and  
 41 SOILS-2b would minimize and compensate for these impacts to a degree, but not to a less-than-  
 42 significant level. Therefore, this impact is considered significant and unavoidable and the action  
 43 alternative contribution would be cumulatively considerable.

1           **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

2           Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 4.

3           **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a**  
4           **Topsoil Storage and Handling Plan**

5           Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 4.

6           **Impact SOILS-8: Cumulative Impact on Property Loss, Personal Injury, or Death from**  
7           **Instability, Failure, and Damage from Construction on Soils Subject to Subsidence as a Result**  
8           **of Implementing the Proposed Conservation Measures CM2–CM11**

9           It is expected that past, present, and reasonably foreseeable future projects would be required to  
10          comply with design requirements (i.e., CBC) to offset potential adverse effects of subsidence.  
11          Moreover, where this soil hazard exists at the other project sites, the potential impact would be local  
12          to those sites and would not act in combination with that of the action alternatives.

13          **NEPA Effects:** The risks of loss, injury, or death associated with implementation of CM2–CM11 under  
14          the BDCP alternatives or Environmental Commitments under Alternatives 4A, 2D, and 5A would not  
15          combine with the risks from other projects or programs to create a cumulatively adverse effect at  
16          any one locality in the Plan Area. There would be no cumulative adverse effect.

17          **CEQA Conclusion:** The hazard from soils subject to subsidence that would exist and the potential  
18          adverse effects that could occur in association with construction of all action alternatives would be  
19          restricted to the locations of the construction activities of these alternatives. Other past, present and  
20          probable future projects and programs in the Plan Area that are identified in Table 10-9 would not  
21          increase the risks of loss, injury or death at the specific locations affected by project alternatives.  
22          Therefore, the risks of loss, injury or death associated with the project alternatives would not  
23          combine with the soil risks from other projects or programs to create a substantial cumulative effect  
24          at any one locality in the Plan Area. This cumulative impact is considered less than significant. No  
25          mitigation is required.

26          **Impact SOILS-9: Cumulative Impact on Risk to Life and Property from Construction in Areas**  
27          **of Expansive, Corrosive, and Compressible Soils as a Result of Implementing the Proposed**  
28          **Conservation Measures CM2–CM11**

29          It is expected that past, present, and reasonably foreseeable future projects would be required to  
30          comply with design requirements (i.e., CBC) to offset potential adverse effects of expansive,  
31          corrosive, and compressible soils. Moreover, where these soil hazards exist at the other project sites,  
32          the potential impact would be local to those sites and would not act in combination with that of the  
33          proposed project.

34          **NEPA Effects:** The risks of loss, injury, or death associated with implementation of CM2–CM11 under  
35          the BDCP alternatives or Environmental Commitments under Alternatives 4A, 2D, and 5A would not  
36          combine with the risks from other projects or programs to create a cumulatively adverse effect at  
37          any one locality in the Plan Area. There would be no cumulative adverse effect.

38          **CEQA Conclusion:** Soils subject to expansion, corrosion, and compression that would exist and the  
39          potential adverse effects that could occur in association with construction of all project alternatives  
40          would be restricted to the locations of the construction activities of these alternatives. Other past,

1 present and probable future projects and programs in the Plan Area that are identified in Table 10-9  
 2 would not increase the risks of loss, injury or death at the specific locations affected by project  
 3 alternatives. Therefore, the risks of loss, injury or death associated with the project alternatives  
 4 would not combine with the soil risks from other projects or programs to create a substantial  
 5 cumulative effect at any one locality in the Plan Area. This cumulative impact is considered less than  
 6 significant. No mitigation is required.

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