10.3 Environmental Consequences

10.3.3 Effects and Mitigation Approaches

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

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 RTM storage, soil stockpiling, and other activities over ~~less than~~ ~~7,500~~ ~~3,633~~7,377 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 three intakes~~,~~; ~~associated~~ pumping plant~~s,~~; ~~the~~ intermediate forebay~~,~~; ~~the~~ expanded Clifton Court Forebay, canal and gates between the expanded Clifton Court Forebay~~,~~; twin tunnel shafts~~, and~~; offsite pre-cast tunnel segment plants and onsite storage yards; ~~the~~ approach canals to the Banks and Jones Pumping Plants;, onsite and offsite 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. (Borrow areas and pre-cast tunnel segment plants would be in areas already proposed for disturbance and therefore are evaluated by this EIR/EIS, or would be at new locations outside the Plan Area. Areas outside of the Plan Area would likely occur at existing permitted facilities. Any ~~Such~~ new locations ~~that~~ would undergo additional technical and environmental review, including that for Soils impacts.) Some of the work would be conducted in 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 expanded Clifton Court 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 4 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 a portion of the proposed borrow/spoil area west of Clifton Court Forebay generally has 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 make the soil much more subject to wind erosion. Removal of vegetation cover and grading increase exposure to wind at the surface and obliterate the binding effect of plant roots on soil aggregates. These effects make the soil particles much more subject to entrainment by wind. However, most of the areas that would be extensively disturbed by construction activities are already routinely disturbed by agricultural activities, such from disking and harrowing. These areas are the ~~pumping plants, the~~ intermediate forebay, most of the expanded Clifton Court Forebay, borrow areas, RTM and spoil storage areas, sedimentation basins, solids handling facilities, substations, access roads, concrete batch plants, and laydown areas. Consequently, with the exception of loading and transporting of soil material to storage areas, the disturbance that would result from constructing the conveyance facilities in many areas would not substantially depart from the existing condition, provided that the length of time that the soil is left exposed during the year does not change compared to that associated with agricultural operations. Because the SWPPPs prepared for the various components of the project will be required to prescribe ongoing best management practices to control wind erosion (such as temporary seeding), the amount of time that the soil would be exposed during construction should not significantly differ from the existing condition.

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

Some of the soil excavated at tunnel shafts, siphon foundations, certain borrow areas, the Clifton Court forebays, tunnel and safe haven work areas, ventilation access shafts, concrete batch plants, a launch/reception shaft, a fuel station, a substation and transmission line, and the Highway 12 interchange~~Excavation of soil from borrow areas~~ and transported ~~of soil material~~ to spoil storage areas would consist of organic soil.~~would potentially subject soils to wind erosion. It is likely that approximately 8 million cubic yards of peat soil material would be disposed of as spoils; t~~ This material would be especially susceptible to wind erosion while being loaded onto trucks, transported, unloaded, and distributed.

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

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

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

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

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

- Preservation of existing vegetation.
- Perimeter control.
- Fiber roll and/or silt fence sediment barriers.
- Watering to control dust entrainment.
- Tracking control and "housekeeping" measures for equipment refueling and maintenance.
- Solid waste management.

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

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

Accelerated water and wind erosion as a result of construction of the proposed water conveyance facility could occur under Alternative 4, but proper implementation of the requisite SWPPP and compliance with the General Permit (as discussed in Appendix 3B, *Environmental Commitments*~~, Commitment 3B.2~~) 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, DWR would seek coverage under the state General Permit for Construction and Land Disturbance Activities (as discussed in Appendix 3B, *Environmental Commitments*~~, Commitment 3B.2~~), necessitating preparation of a SWPPP and an erosion control plan. As a result of implementation of the requisite 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

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

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

Topsoil Loss Mechanism	Acreage Affected
Excavation (intakes, shafts, levee foundations, borrow~~/spoil~~ areas)	~~623453~~3,576
Overcovering (spoil storage, reusable tunnel material storage)	~~3,4992,207~~3,133
Inundation (forebays, sedimentation basins, solids lagoons)	~~9743~~668
Total	~~5,0963,633~~7,377

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).

DWR has made an ~~Environmental~~ environmental ~~Commitment~~ commitment (Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material) to address~~for~~ ~~Disposal~~ disposal ~~Site~~ site ~~Preparation~~ 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 a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would ~~also be available to~~ reduce the severity of this effect~~.~~, but not to a less-than-significant level because topsoil would be permanently lost over extensive areas.

CEQA Conclusion: Construction of the water conveyance facilities would involve irreversible removal, overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss of topsoil despite a commitment for Disposal and Reuse of Spoils, RTM, and Dredged Material that would address ~~D~~disposal ~~S~~site ~~p~~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 by reducing the amount of topsoil lost, 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

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

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

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

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

The Environmental Commitment Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material 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 to the commitment, this mitigation measure 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.

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

Topsoil excavated to install conveyance, natural gas, and sewer pipelines will be segregated from the subsoil excavated from open-cut trenches, stockpiled, and reapplied to the surface after the pipe has been installed.

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

A qualified soil scientist will also prepare topsoil stockpiling and handling plans for the individual conveyance and restoration components, establishing such guidelines as the maximum allowable thickness of soil stockpiles, temporary stockpile stabilization/revegetation

[1] 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.

measures, and procedures for topsoil handling during salvaging and reapplication. The maximum allowable stockpile thickness will depend on the amount of time that the stockpile needs to be in place and is expected to range from approximately three to 10 feet. The plans will also specify that, where practicable, the topsoil be salvaged, transported, and applied to its destination area in one operation (i.e., without stockpiling) to minimize degradation of soil structure and the increase in bulk density as a result of excessive handling. The stockpiling and handling plans will also specify maximum allowable stockpile sideslope gradients, seed mixes to control wind and water erosion, cover crop seed mixes to maintain soil organic matter and nutrient levels, and all other measures to avoid soil degradation and soil erosional losses caused by excavating, stockpiling, and transporting topsoil. The BDCP proponents will ensure that each plan is prepared by a qualified individual, that it adequately addresses all relevant activities and facilities, and that its specifications are properly executed during construction by the contractors.

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

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

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

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

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

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

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

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

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

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

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

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

This potential effect could be substantial because the facilities could be located on soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all facilities to identify the types of soil avoidance or soil stabilization that should be implemented to ensure that the facilities are constructed to withstand subsidence and settlement and to conform to applicable state and federal standards. These investigations would build upon the geotechnical data reports (California Department of Water Resources 2001a, 2010b, 2011) and the CERs (California Department of Water Resources 2010a, 2010b). Additionally, conforming with state and federal design codes and standards, including the California Building Code and resource agency and professional engineering specifications, such as the American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures, ASCE-7-05, 2005, would ensure that appropriate design measures are incorporated into the project and any subsidence that takes place under the project facilities would not jeopardize their integrity. Conforming ~~with~~to these codes and standards is an environmental commitment by DWR to ensure cut and fill slopes and embankments will be stable as the water conveyance features are operated (Appendix 3B, *Environmental Commitments*). Conforming ~~with~~ to the standards and guidelines may necessitate such measures as excavation and removal of weak soils and replacement with engineered fill using suitable, imported soil, construction on pilings driven into competent soil material, and construction of facilities on cast-in-place slabs. These measures would reduce the potential hazard of subsidence or settlement to acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that is prone to subsidence.

CEQA Conclusion: Significant impacts could occur if there is property loss, personal injury, or death from instability, failure, or damage from construction on or in soils subject to subsidence as a result of constructing the proposed water conveyance facilities. Some of the conveyance facilities would be constructed on soils that are subject to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of the facility. However, ~~because~~ DWR would be required to design and construct the facilities according to state and federal design standards and guidelines (e.g., California Building Code, American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures, ASCE-7-05, 2005). Conforming ~~with~~ to these codes would reduce the potential hazard of subsidence or settlement to acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that is prone to subsidence. Because these measures would reduce the potential hazard of subsidence or settlement to meet design standards, this impact is considered less than significant. No mitigation is required.

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

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

Expansive Soils

~~The Alternative 4 alignment is underlain by soils with low to high shrink-swell potential (note areas of high linear extensibility in Figure 10-4). The majority of the soils with high shrink-swell potential are where the intakes, pumping plants, pipelines, sedimentation basin, one of the tunnels, and the northern third of the canal alignment are proposed. Most of these areas are in Sacramento County (Dierssen and Egbert-Valpac association soils). The remaining conveyance facilities would generally be located where the soils have low or moderate shrink-swell potential. Soil expansion-contraction is not expected to be a concern at these types of facilities.~~

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

Soil expansion is a concern only at soil depths that are subject to seasonal changes in moisture content. The Alternative 4 alignment is underlain by soils with low to high shrink-swell potential, which is depicted ~~(note areas of high~~as soil linear extensibility in Figure 10-4~~)~~. The majority of the soils with high shrink-swell potential (i.e., expansive soils) are where the intakes, pumping plant~~s~~, pipelines, sedimentation basin, borrow areas, spoils storage areas~~borrow/spoils sites~~, certain RTM storage areas, and the northern third of the canal alignment are proposed. Most of these areas are in Sacramento County where ~~(~~Dierssen and Egbert-Valpac association soils~~)~~ occur. The remaining conveyance facilities are generally situated in areas of soils with low to moderate shrink-swell potential ~~(see Figure 10-4)~~. However, a borrow/spoils area, a temporary work area, three concrete batch plants and three fuel station locations along the Alternative 4 alignment~~,~~ may contain soils with high to very high shrink-swell potential.

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

Soils Corrosive to Concrete

The near-surface (i.e., upper 5 feet) soil corrosivity to concrete ranges from low to high along the Alternative 4 alignment, ~~although~~with approximately half of the alignment is in areas of low to moderate corrosivity. The near-surface soils at the three intake ~~and pumping plant~~ facilities generally have a moderate corrosivity to concrete. The near-surface soils at the tunnel shafts have a low to high corrosivity to concrete. Data on soil corrosivity to concrete below a depth of approximately 5 feet (i.e., where pipelines, tunnels, and the deeper part of the tunnel shafts would be constructed) are not available. However, given the variability in the composition of the soils and geologic units on and within which the conveyance facilities would be constructed, corrosivity hazards are likely to range from low to high. Because soil corrosivity to concrete is high among the near-surface peat soils in the Delta, a high corrosivity is also expected to be present among the peat soils at depth. Site-specific soil investigations would need to be conducted to determine the corrosivity hazard at depth at each element of the conveyance facility. However, as described in 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*), geotechnical studies (as described in the Geotechnical Exploration Plan—Phase 2 [California Department of Water Resources 2014] would be conducted at all facilities to identify site-specific soil corrosivity hazards. The resulting geotechnical report, prepared by a California registered civil engineer or a California certified engineering geologist, would describe these hazards and recommend the measures that should be implemented to ensure that the facilities are constructed to withstand corrosion and to conform with applicable state and federal standards, such as the CBC.

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

Soils Corrosive to Uncoated Steel

The near-surface soils along the Alternative 4 alignment generally are highly corrosive to uncoated steel. Sections of the southern end of the alignment are moderately corrosive to uncoated steel. Data on soil corrosivity to uncoated steel below a depth of approximately 5 feet (i.e., where pipelines, tunnels, and the deeper part of the tunnel shafts would be constructed) are not available. However, given the variability in the composition of the soils and geologic units on and within which the conveyance facilities would be constructed, corrosivity hazards are likely to range from low to high. Site-specific soil investigations would need to be conducted to determine the corrosivity hazard at depth at each element of the conveyance facility.

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

Compressible Soils

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

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

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

Embankments that have subsided would be subject to overtopping, leading to flooding on the landside of the embankments. The embankment that would be subject to this hazard is the expanded Clifton Court Forebay.

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

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

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

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

CEQA Conclusion: Significant impacts could occur if there is risk to life and property as a result of constructing the proposed water conveyance facilities in areas of expansive, corrosive, and compressible soils. Many of the Alternative 4 facilities would be constructed on soils that are subject to expansion and are~~,~~ moderately or highly corrosive to concrete and uncoated steel, as well as soils that are moderately or highly subject to compression under load. Corrosive soils could damage in-ground facilities or shorten their service life. Compression/settlement of soils after a facility is constructed could result in damage to or failure of the facility. Surface soils that are moderately to highly expansive exist throughout the Alternative 4 alignment except in the central part of the Delta between approximately Staten Island and Bacon Island. Expansive soils could cause foundations, underground utilities, and pavements to crack and fail. However, DWR would be required to design and construct the facilities according to state and federal design standards, guidelines, and building codes. The CBC requires measures such as soil replacement, lime treatment, and post-tensioned foundations to offset expansive soils. The CBC requires such measures as using protective linings and coatings, dielectric (i.e., use of an electrical insulator polarized by an applied electric field) isolation of dissimilar materials, and active cathodic protection systems to prevent corrosion of concrete and steel in conformance with CBC requirements. Potential adverse effects of compressible soils and soils subject to subsidence could be addressed by overexcavation and replacement with engineered fill or by installation of structural supports (e.g., pilings) to a depth below the peat where the soils have adequate load bearing strength, as required by the CBC and by USACE design standards. Conforming ~~with~~ to these codes and standards (Appendix 3B, *Environmental Commitments*) is an environmental commitment by DWR to ensure that potential adverse effects associated with expansive and corrosive soils and soils subject to compression and subsidence would be offset. Therefore, this impact would be less than significant. No mitigation is required.

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

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

In general, changes in river flow rates associated with BDCP operations would remain within the range that presently occurs. However, the operational components would cause changes in the tidal flows in some Delta channels, specifically those that lead into the major habitat restoration areas (Suisun Marsh, Cache Slough, Yolo Bypass, and South Delta ROAs). In major channels leading to the restoration areas, tidal flow velocities may increase; this may cause some localized accelerated erosion/scour. Alternative 4 would have effects of a lesser magnitude with respect to potential accelerated bank erosion because the flow from the north Delta would be 9~~3~~,000 cfs rather than 15,000 cfs, as it is under some of the other BDCP alternatives.

However, the increased flows would be offset as part of the conservation measures by the dredging of these major channels, which would create a larger channel cross-section. The larger cross section would allow river flow rates to be similar to that of other high tidal flows in the region. Moreover, as presently occurs and as is typical with most naturally-functioning river channels, local erosion and deposition within the tidal habitats is expected as part of the restoration.

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

NEPA Effects: The effect would not be adverse because there would be no net increase in river flow rates and therefore no net increase in channel bank scour.

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

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

Conservation measures would include breaching, lowering, or removing levees; constructing setback levees and cross levees or berms; raising the land elevation by excavating relatively high areas to provide fill for subsided areas or by importing fill material; surface grading; deepening and/or widening tidal channels; excavating new channels; modifying channel banks; and other activities. Moreover, excavation and grading to construct facilities, access roads, and other features would be necessary under the two conservation measures that are not associated with the ROAs (i.e., *CM18 Conservation Hatcheries* and *CM19 Urban Stormwater Treatment*). These activities could lead to accelerated soil erosion rates and consequent loss of topsoil.

Water Erosion

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

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

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

Wind Erosion

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

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

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

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

NEPA Effects: These effects could potentially cause substantial accelerated erosion. However, as described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the BDCP proponents 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. The General Permit requires that SWPPPs be prepared by a QSD and requires SWPPPs be implemented under the supervision of a QSP. The QSD would select erosion and sediment control BMPs such as preservation of existing vegetation, seeding, mulching, fiber roll and silt fence barriers, erosion control blankets, watering to control dust entrainment, and other measures to comply with the practices and turbidity level requirements defined by the General Permit. Partly because the potential effect on receiving waters depends on location of a work area relative to a waterway, the BMPs would be site-specific. The QSP would be responsible for day-to-day implementation of the SWPPP, including BMP inspections, maintenance, water quality sampling, and reporting to the State Water Board. Proper implementation of the requisite SWPPP, site-specific BMPs, and compliance with the General Permit would ensure that accelerated water and wind erosion as a result of implementing conservation measures would not be an adverse effect.

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

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

NEPA Effects: Topsoil effectively would be lost as a resource as a result of its excavation (e.g., levee foundations, water control structures); overcovering (e.g., levees, embankments, application of fill material in subsided areas); and water inundation (e.g., aquatic habitat areas) over extensive areas of the Plan Area. Based on ICF's calculations using a geographic information system, Iimplementation of habitat restoration activities at the ROAs would result in excavation, overcovering, or inundation of a minimum of 77,600 acres of topsoil. This effect would be adverse because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the severity of this effect.

CEQA Conclusion: Significant impacts could occur if there is loss of topsoil from excavation, overcovering, and inundation associated with restoration activities as a result of implementing the proposed conservation measures. Implementation of the conservation measuresCM2 through CM11 would involve excavation, overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby resulting in a substantial loss of topsoil. Therefore, the impact would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts to a degree by minimizing topsoil loss, but not to a less than significant level because topsoil would still 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.

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.

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

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

NEPA Effects: Damage to or failure of the habitat levees could occur where these are constructed in soils and sediments that are subject to subsidence and differential settlement. These soil conditions have the potential to exist in the Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the vicinity. This potential effect could be substantial because the facilities could be located on unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees, berms, and other features are constructed to withstand subsidence and settlement and to conform to applicable state and federal standards. Such standards include the USACE Design and Construction of Levee and DWR Interim Levee Design Criteria for Urban and Urbanizing Area State-Federal Project Levees.

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

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

CEQA Conclusion: Significant impacts could occur if there is property loss, personal injury, or death from instability, failure, and damage from construction on soils subject to subsidence as a result of implementing the proposed conservation measures. Some of the restoration area facilities would be constructed on soils that are subject to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of the facility. However, because the BDCP proponents would be required to design and construct the facilities according to state and federal design standards and guidelines (which may involve, for example, replacement of the organic soil), the impact would be less than significant. No mitigation is required.

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

Expansive Soils

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

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

Corrosive Soils

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

Compressible Soils

Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne, and South Delta ROAs. Areas of low to medium compressibility occur in the South Delta ROA. Silts and clays with a liquid limit less than 35% are considered to have low compressibility. Silts and clays with a liquid limit greater than 35% and less than 50% are considered to have medium compressibility and greater than 50% are considered highly compressible. Organic soils typically have high liquid limits (greater than 50%) and are therefore considered highly compressible.

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

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

10.4 References Cited

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