Chapter 3
Description of Alternatives

3.1 Introduction

The BDCP sets out a comprehensive conservation strategy for the Delta designed to restore and protect ecosystem health, water supply, and water quality within a stable regulatory framework. The BDCP reflects the outcome of a multiyear collaboration among California Department of Water Resources (DWR), the Bureau of Reclamation (Reclamation), state and federal fish and wildlife agencies, state and federal water contractors, nongovernmental organizations, agricultural interests, and the general public.

As described in detail in Chapter 2, *Project Objectives and Purpose and Need*, the proposed BDCP (also referred to as the Plan) is intended to address federal Endangered Species Act (ESA) and California Natural Community Conservation Planning Act (NCCPA) compliance for the operation of the existing State Water Project (SWP) Delta facilities and for the construction and operation of conveyance facilities for the movement of water entering the Delta from the Sacramento Valley watershed to the existing SWP and federal Central Valley Project (CVP) pumping plants in the southern Delta. The BDCP is also proposed to provide for the conservation and management of covered species[1] through *conservation measures*, including the construction and operation of north Delta water conveyance facilities, within the area covered by the BDCP, i.e., the BDCP Plan Area (Plan Area) and the Areas of Additional Analysis. These actions—designed to contribute to the recovery of the covered species—include protecting, restoring, creating, and/or enhancing aquatic and terrestrial species habitat, natural communities, and landscape, as well as reducing the adverse effects of water diversions on certain covered species while providing a more reliable water supply.

As described in Chapter 1, Section 1.6, *Intended Uses of this EIR/EIS and Agency Roles and Responsibilities*), the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) are considering whether to issue incidental take permits (ITPs) under ESA Section 10(a)(1)(B) for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other covered activities as described in the BDCP. The applicant's proposed duration of the ITPs is 50 years. USFWS and NMFS would issue separate ITPs covering species within their respective authority. A habitat conservation plan (HCP) will be submitted as part of the ITP applications. The HCP describes activities that would be covered by the ITPs, the species for which incidental take would be authorized, and measures that would, to the maximum extent practicable, minimize the adverse effects on the covered species resulting from implementation of the covered activities, and mitigate any remaining adverse effects through the protection, restoration, creation, and/or enhancement of habitat for the covered species. The California Department of Fish and Wildlife (CDFW) would be responsible for approving the BDCP as a Natural Community Conservation Plan (NCCP). Reclamation's action in relation to the BDCP would be to adjust CVP operations specific to the Delta to accommodate new conveyance facility operations and/or flow requirements under the BDCP, in coordination with SWP operations.

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[1] Covered species are species addressed in the BDCP. The BDCP covered species are listed in Chapter 1, *Introduction,* Table 1-1.

This chapter describes the 15 action alternatives and the No Action Alternative being considered for the Plan. The action alternatives for the EIR/EIS have been developed to meet all or most of the project objectives and purpose and need statement of the BDCP described in Chapter 2, *Project Objectives and Purpose and Need*. The 15 action alternatives are variations of conservation plans that differ primarily in the location, design, conveyance capacity, and rules that would determine the operation of conveyance facilities implemented under BDCP Conservation Measure (CM) 1. For instance, the alternatives range from the proposed construction of one 3,000-cfs intake to five such intake facilities, representing a range of north Delta conveyance capacities from 3,000 cfs to 15,000 cfs. The operational rules also include varying requirements for Delta outflow and river flows in the south Delta. The range of alternatives also includes different amounts and types of habitat restoration and enhancement proposed under CM2 through CM11. One alternative includes 40,000 fewer acres of tidal habitat restoration compared to the other alternatives. Another includes 10,000 more acres of seasonally inundated floodplain restoration and 20 more miles of channel margin enhancement compared to the other alternatives. Other proposed conservation measures (CM12–CM22) do not vary among alternatives, but they are similarly considered in a conservation package. Issuance of 50-year ITPs and an NCCP permit is common to all of the alternatives, with the exception of the No Action Alternative. In addition, Section 3.8, *SWP Long-Term Water Supply Contract Amendment*, describes options to implement SWP funding mechanisms for a BDCP (or an alternative) conveyance facility and any other activities, such as mitigation for construction impacts, that may be selected and funded by the SWP water agencies. Options for funding methods include charging the SWP water agencies under the existing terms of the SWP long-term water supply contracts, amending the SWP long-term water supply contracts, or entering into agreements with water agencies for funding. Under any action alternative for the Plan, one or a combination of these methods would be used to fund the costs allocated to the SWP water agencies for the alternative action. The potential that any of these funding methods would reallocate and redistribute SWP water, such as from agricultural to municipal uses, is discussed in Chapter 30, *Growth Inducement and Other Indirect Effects*.

The BDCP sets out a comprehensive conservation strategy for the Delta designed to restore and protect ecosystem health, water supply, and water quality within a stable regulatory framework. The proposed BDCP conservation strategy has been developed to meet a range of specific biological goals and objectives. The BDCP includes a description of each element of the conservation strategy and its associated rationale. However, only CM1 facilities and operations are described at a *project level* in this EIR/EIS. This EIR/EIS is intended to provide CEQA and NEPA support for approval of the proposed BDCP and to inform permit decisions for the issuance of the proposed ITPs/NCCP permit. The EIR/EIS is thus intended to provide complete project level analysis for actions by USFWS and NMFS permitting the BDCP under the ESA, and for action by CDFW approving the BDCP as an NCCP under the NCCPA. With respect to particular components of the BDCP that must be implemented separately through individual permit actions or other discretionary decisions, the EIR/EIS intends to provide a mixture of project- and program-level components. Specifically, the EIR/EIS is intended to provide project-level assessment of the potential effects of modified and/or new conveyance facilities (CM1), including project-specific mitigation. All other conservation measures are presented and analyzed at a *program level*, with the expectation that more detailed, site-specific analysis and associated site-specific environmental documents will be prepared later, prior to implementation of specific projects, as the BDCP (or an alternative) is implemented over time, as appropriate. (See Chapter 4, *Approach to the Environmental Analysis*, for more detail on agency decision making related to project- and program-level approvals using this EIR/EIS.) The operation and maintenance of the SWP and CVP related to implementation of the BDCP, after the proposed water facilities defined in CM1 become operational, are also considered in this EIR/EIS. These changes in operation of the SWP and CVP are presented and analyzed at a project level (using CALSIM and DSM2 modeling); maintenance of these facilities, which presumably would be similar to existing activities, is described and analyzed at a program level.

The alternatives development process is described in Section 3.2, *Alternatives Development Process*, and in Appendix 3A, *Identification of Water Conveyance Alternatives for Bay Delta Conservation Plan Environmental Impact Report/ Environmental Impact Statement (Screening Report) (Conservation Measure 1)*. This discussion discloses how the range of alternatives was developed for evaluation and describes those alternatives considered but rejected from further consideration, as well as how the alternatives described in this chapter were selected. Appendix 3A includes consideration of potential alternatives to the proposed BDCP as well as consideration of potential alternatives to the federal fish and wildlife agencies' action of issuing ITPs. Section 3.3, *Proposed Bay Delta Conservation Plan*, provides a brief summary of the overall conservation strategy and the conservation measures that are collectively intended to address the impacts of take on species covered by the Plan and to contribute to the recovery of the covered species. The reader is referred to the Plan[2] for a more detailed discussion of the proposed conservation strategy, conservation measures, and covered activities. Section 3.4, *Components of the Alternatives: Overview*, presents an overview of the facilities and other project components that constitute the conservation measures and, in turn, the alternatives. Section 3.5, *Alternatives*, describes the No Action Alternative and each action alternative in detail. Section 3.6, *Components of the Alternatives: Details*, provides a detailed description of each component of the action alternatives, common to some or all of the alternatives. Section 3.7 and Appendix 3B, *Environmental Commitments*, present the environmental commitments that are incorporated into the BDCP and all action alternatives.

As of this Draft EIR/EIS, the federal Lead Agencies have not identified a Preferred Alternative for the purposes of NEPA; however, the identification of a Preferred Alternative for the purposes of CEQA is described below.

3.1.1 Preferred Alternative Under CEQA

From the standpoint of DWR as CEQA Lead Agency and the project applicant for the BDCP, Alternative 4, as described later in this chapter, is the *Preferred Alternative* for purposes of CEQA and is consistent with the proposed BDCP published concurrently with the publication of this Draft EIR/EIS.[3] Although, from an organizational standpoint, it might seem more logical to make the Preferred Alternative the first one addressed in an EIR/EIS (i.e., Alternative 1), in this case Alternative 4 did not emerge as the Preferred Alternative until well after the overall organization of this Draft EIR/EIS (including the numbering and placement of Alternatives) was already in place. Alternative 4 as described herein, moreover, represents a refinement (and improvement) on an earlier version of Alternative 4 that was found in a previous publicly available administrative draft of this Draft EIR/EIS.[4] The present version of Alternative 4 represents substantial refinements and additional scientific work and analysis to identify a form of the proposed BDCP that is grounded in solid science and reaches what DWR considers to be an optimal balance between ecological and

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[2] http://baydeltaconservationplan.com/Home.aspx

[3] As described in Chapter 1, *Introduction*, Section 1.1, the full Draft EIR/EIS should be understood to include not only the EIR/EIS itself and its appendices but also the proposed BDCP documentation including all appendices.

[4] The February 28, 2012 administrative draft EIR/EIS was made available on the BDCP website: http://baydeltaconservationplan.com.

water supply objectives in the Plan Area. Notably, identification of Alternative 4 as the preferred CEQA alternative is tentative only, and is subject to change as DWR and the CEQA responsible agencies, as well as the NEPA Lead Agencies, receive and consider public and agency input on this EIR/EIS. It is therefore possible that the final version of the BDCP may differ from Alternative 4 as described herein, either because Alternative 4 itself was refined, because another alternative was determined to be preferable, or because the Lead Agencies, in response to input, developed a new alternative with some features from some existing alternatives and other features from other existing alternatives.[5]

3.2 Alternatives Development Process

CEQA and NEPA require that an EIR and EIS include a detailed analysis of a range of reasonable alternatives to a proposed project or action. CEQA requires that an EIR evaluate alternatives to the proposed project that are potentially feasible and would attain most of the basic project objectives while avoiding or substantially lessening project impacts. NEPA generally requires that a range of reasonable alternatives that meet the purpose and need statement of the action, to which the federal Lead Agencies are responding, be analyzed at an equivalent level of detail in the EIS. A range of reasonable alternatives is analyzed to define the issues and provide a clear basis for choice among the options. The CEQA/NEPA analysis must also include an analysis of the No Project (for CEQA) or No Action Alternative (for NEPA).

CEQA requires that the Lead Agency consider alternatives that would avoid or substantially lessen any of the significant impacts of the proposed project. Section 15126.6[a] of the State CEQA Guidelines provides that:

> [a]n EIR shall describe a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives. An EIR need not consider every conceivable alternative to a project. Rather it must consider a reasonable range of potentially feasible alternatives that will foster informed decision making and public participation. An EIR is not required to consider alternatives which are infeasible. The lead agency is responsible for selecting a range of project alternatives for examination and must publicly disclose its reasoning for selecting those alternatives. There is no ironclad rule governing the nature or scope of the alternatives to be discussed other than the rule of reason.

Under these principles, the EIR needs to describe and evaluate only those alternatives necessary to permit a reasonable choice and "to foster meaningful public participation and informed decision making" (State CEQA Guidelines Section 15126.6[f]). Consideration of alternatives focuses on those that can either eliminate significant adverse environmental impacts or substantially reduce them; alternatives considered in this context may include those that are more costly and those that could

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[5] Just as further public and agency input may result in a new preferred CEQA alternative or a modification of Alternative 4 in its current form, the same is true of the text of the proposed Bay Delta Conservation Plan (BDCP) published contemporaneously with this Draft EIR/EIS. In particular, Chapter 9 of the BDCP, entitled *Alternatives to Take*, may be revised in light of further input regarding the practicability of the alternatives tentatively rejected therein. In other words, the current analysis in BDCP Chapter 9 of the impracticability of various alternatives to take, though representing DWR's best thinking as of the date of its release, remains subject to change. It should be noted that the alternatives set out in Chapter 9 of the BDCP are not identical to the EIR/EIS alternatives; nor are they subject to the same analysis. Within Chapter 9 of the BDCP, the analysis of the alternatives is focused solely on the potential for each of these alternatives to reduce the take of federally listed species in relationship to the proposed action. The alternatives addressed in the EIR/EIS, in contrast, are subject to a far broader analysis.

impede to some degree the attainment of the project objectives (Section 15126.6[b]). CEQA does not require the alternatives to be evaluated at the same level of detail as the proposed project.

Even so, due to the complex nature of the BDCP and associated environmental issues, the Lead Agencies have included far more information about project alternatives than required by CEQA. For example, the environmental review process for the BDCP, beginning in 2007, involved input from a large group of stakeholders and an extensive evaluation of various options and ongoing effects analysis that goes beyond the normal scope of a CEQA review. This process has been helpful in informing the public and gathering input on a project that will affect a very complex estuary and a statewide water supply system. For more details regarding what was evaluated, see Appendix 3A, *Identification of Water Conveyance Alternatives for Bay Delta Conservation Plan Environmental Impact Report/Environmental Impact Statement (Screening Report) (Conservation Measure 1)*.

Under CEQA, as noted above, the inclusion of an alternative in an EIR requires only that the alternative be "potentially feasible." The ultimate determination of "actual feasibility" can only be made by final agency decision makers, who have the discretion under CEQA to reject as infeasible alternatives that embody what the decision makers believe to be unacceptable policy tradeoffs. After weighing "economic, environmental, social, and technological factors," such decision makers "may conclude that a mitigation measure or alternative is impractical or undesirable from a policy standpoint and reject it as infeasible on that ground." Similarly, "an alternative 'may be found infeasible on the ground it is inconsistent with the project objectives as long as the finding is supported by substantial evidence in the record.'"[6] As for the BDCP, DWR will be the CEQA decision maker in determining the final form of what it ultimately chooses to propose to CDFW as an NCCP. CDFW, in considering DWR's proposal in light of the NCCPA, will be a responsible agency under CEQA for purposes of approving the BDCP.

The Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 CFR 1502.14) require all reasonable alternatives to be objectively evaluated in an EIS, so that each alternative is evaluated at an equal level of detail (40 CFR 1502.14[b]). Although this standard differs from that under CEQA, alternatives in this document are evaluated to an equivalent level of detail as required by NEPA. An EIS must "[d]evote substantial treatment to each alternative considered in detail including the proposed action" and "should present the environmental impacts of the proposal and alternatives in comparative form." Alternatives that cannot reasonably meet the purpose and need do not require detailed analysis. An EIS must briefly describe alternatives to the proposed action where unresolved resource conflicts exist. NEPA does not necessarily require alternatives to offer some environmental benefit over the proposed action; however, neither does it discourage consideration of alternatives with lesser effects. Reclamation's action in relation to the BDCP would be to adjust CVP operations specific to the Delta to accommodate new conveyance facility operations and/or flow requirements under the BDCP, in coordination with SWP operations. USFWS and NMFS are considering whether to issue ITPs under ESA Section 10(a)(1)(B) for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other covered activities as described in the BDCP. Agency roles and responsibilities are discussed further in Chapter 1, Section 1.6, *Intended Uses of this EIR/EIS and Agency Roles and Responsibilities.*

The following sections describe, in a general way, the screening/development process and criteria used to develop the final range of alternatives to be considered for CM1. This process is described in

[6] *California Native Plant Society v. City of Santa Cruz* (2009) 177 Cal.App.4th 957, 1001.

detail in Appendix 3A, *Identification of Water Conveyance Alternatives for Bay Delta Conservation Plan Environmental Impact Report/Environmental Impact Statement (Screening Report) (Conservation Measure 1)*. The development process for CM2–CM22 is described in Appendix 3G, *Background on the Process of Developing the BDCP Conservation Measures*. A detailed description of the process and steps used in identifying and refining proposed intake locations is described in Appendix 3F, *Intake Location Analysis*.

3.2.1 Development of Alternatives

The process for developing the BDCP was initiated in 2006. A primary objective is to meet the purpose and need and to achieve long-term compliance with ESA and NCCPA with respect to the operation of existing SWP facilities in the Sacramento–San Joaquin Delta (Delta), and the construction and operation of new conveyance facilities for the movement of water entering the Delta from the Sacramento Valley watershed to the existing SWP and CVP pumping plants in the southern Delta. The primary component of the BDCP related to development of alternatives was CM1—the water conveyance facilities combined with the operational scenarios under which they would be managed.

3.2.1.1 Delta Water Conveyance Alternatives Identified in the BDCP Steering Committee Process

The BDCP Steering Committee (Steering Committee) was established in order to provide a public forum where key policies and strategy issues could be publicly discussed and met between 2006 and 2010.[7] The Steering Committee established several working groups and technical teams to develop and evaluate potential alternatives. The Steering Committee conducted a preliminary analysis of broadly defined conveyance alignment alternatives to consider benefits and constraints of different conveyance alignment approaches and completed a *Conservation Strategy Options Evaluation Report* in September 2007 (BDCP Steering Committee 2007). This preliminary analysis refined the range of conveyance alignment alternatives to four Conservation Strategy Options.

- Option 1—Existing through-Delta conveyance with opportunistic Delta operations and potential new storage.
- Option 2—Through-Delta conveyance with San Joaquin River isolation (separate corridors for water supply and fish passage).
- Option 3—Dual conveyance: isolated conveyance between the Sacramento River and SWP and CVP pumping plants *and* through-Delta conveyance with San Joaquin River isolation (as in Option 2).
- Option 4—Isolated conveyance between the Sacramento River and SWP and CVP pumping plants.

[7] The Steering Committee comprised the following agencies: Department of Water Resources, Bureau of Reclamation, Santa Clara Valley Water District, Kern County Water Agency, Metropolitan Water District of Southern California, San Luis & Delta-Mendota Water Authority, Mirant Energy, Westlands Water District, Zone 7 Water Agency, American Rivers, Defenders of Wildlife, Environmental Defense Fund, Natural Heritage Institute, The Bay Institute, The Nature Conservancy, Delta Stewardship Council, North Delta Water Agency, California Farm Bureau Federation, California Resources Agency, Contra Costa Water District, Friant Water Authority, U.S. Fish and Wildlife Service (ex officio), California Department of Fish and Wildlife (ex officio), and National Marine Fisheries Service (ex officio).

3.2.1.2 Water Conveyance Alternatives Identified in EIR/EIS Scoping Comments

The EIR/EIS process initiated scoping in early 2008 and re-opened the process in early 2009. During the scoping process, 2,950 comments were received. The majority of the comments related to BDCP water supply components referred to as conveyance alignment approaches. The results of the scoping process, along with the conveyance alignment alternatives identified in the Steering Committee process, and conveyance alignment alternatives identified in correspondence to the California Natural Resource Agency between 2006 and June 2012, were considered and resulted in the development of 15 water conveyance alternatives (Appendix 3A, *Identification of Water Conveyance Alternatives for Bay Delta Conservation Plan Environmental Impact Report/ Environmental Impact Statement [Screening Report] [Conservation Measure 1]*). These conveyance alternatives focused on alignment of the CM1 water conveyance since, at the time of the EIR/EIS scoping process, no operational scenarios had been either considered or developed.

3.2.1.3 First (Initial) Screening Analysis of Water Conveyance Alternatives

The water conveyance alternatives identified following the EIR/EIS scoping process were then subjected to a multi-level screening process based upon legal considerations under CEQA and NEPA. This initial or first screening was completed prior to consideration of a range of operations for each of the conveyance alignment alternatives.

First, Second, and Third Level Screening Criteria

Three levels of screening criteria were applied to the 15 water conveyance alternatives during the initial screening. The first and second level screening processes facilitated the identification of alternatives under CEQA and NEPA. The first level screening criteria were based on the purpose and need and focused on allowing for the conservation and management of covered species; protecting, restoring, and enhancing certain aquatic, riparian, and associated terrestrial natural communities/ecosystems; reducing adverse effects on certain covered species through modified use of existing SWP and CVP diversion facilities and use of new SWP intakes; and restoring and protecting SWP and CVP water reliability (Appendix 3A, *Identification of Water Conveyance Alternatives for Bay Delta Conservation Plan Environmental Impact Report/Environmental Impact Statement [Screening Report] [Conservation Measure 1]*). The second level screening criteria focused on avoiding or substantially lessening expected significant environmental effects of the proposed project, and addressing *significant issues* related to the proposed action.

The third level screening process entailed defining potentially feasible alternatives under CEQA and reasonable alternatives under NEPA. The third level screening criteria were focused on consideration of the technical and economic feasibility/practicality of alternatives; whether an alternative would violate federal or state statutes or regulations; and whether an alternative balanced relevant economic, environmental, social, and technological factors.

First (Initial) Screening Analysis Results

Eight of the 15 water conveyance alternatives were eliminated through the first screening process (for description of the alternatives that were eliminated, see Appendix 3A, *Identification of Water Conveyance Alternatives for Bay Delta Conservation Plan Environmental Impact*

Report/Environmental Impact Statement [Screening Report] [Conservation Measure 1]). The remaining seven alternatives are listed below.

- **Second Screening Dual Conveyance Alignment Alternative A.** Dual conveyance with a tunnel between north Delta intakes and the SWP and CVP pumping plants, and continued use of existing south Delta intakes.
- **Second Screening Dual Conveyance Alignment Alternative B.** Dual conveyance with a lined or unlined east canal between north Delta intakes and the SWP and CVP pumping plants, and continued use of existing south Delta intakes.
- **Second Screening Dual Conveyance Alignment Alternative C.** Dual conveyance with a lined or unlined west canal between north Delta intakes and the SWP and CVP pumping plants, and continued use of existing south Delta intakes.
- **Second Screening Isolated Conveyance Alignment Alternative A.** Isolated Conveyance with a tunnel between north Delta intakes and the SWP and CVP pumping plants, and abandonment of existing south Delta intakes.
- **Second Screening Isolated Conveyance Alignment Alternative B.** Isolated conveyance with a lined or unlined east canal between north Delta intakes and the SWP and CVP pumping plants, and abandonment of existing south Delta intakes.
- **Second Screening Isolated Conveyance Alignment Alternative C.** Isolated conveyance with a lined or unlined west canal between north Delta intakes and the SWP and CVP pumping plants, and abandonment of existing south Delta intakes.
- **Second Screening Through Delta Conveyance Alignment Alternative.** Separate corridors with new fish screens along the Sacramento River at the Delta Cross Channel and Georgiana Slough to convey water through the lower Mokelumne River system and across the San Joaquin River to Middle River and Victoria Canal; a siphon under Old River for continued conveyance to the existing SWP and CVP pumping plants; operable barriers on Snodgrass Slough, head of Old River, Threemile Slough or Sevenmile Slough, and between Old River and Middle River (at Woodward Canal, Railroad Cut, and Connection Slough); dredging and setback levees along portions of Middle River; and continued use of the existing SWP and CVP south Delta intakes during flood periods.

The general approaches to conveyance could be implemented with facilities of different diversion and conveyance capacities (i.e., 3,000, 6,000, 9,000, or 15,000 cubic feet/second [cfs]). The ultimate decisions regarding what capacities should be addressed in particular EIR/EIS alternatives would depend in large part on how differing capacities would affect overall SWP/CVP systems operations. Operational issues are discussed in the following sections.

3.2.1.4 Identification of Operations Alternatives

Steering Committee workgroups and technical teams developed screening evaluations considering operations and restoration activities in the context of the following topics (discussed in detail in Appendix 3A).

- Fluctuating Delta salinity.
- Flooded western island.
- Preferential diversion on the Sacramento River at Hood compared to south Delta diversions.

- Increased spring river flows.
- Increased spring Delta outflow.
- Increased Fall X2 Delta outflow.
- Preferred south Delta diversion.
- Fully isolated Hood diversion.

In 2008, the Steering Committee approved a draft set of elements of a conservation strategy, which was evaluated in a scientific evaluation process very similar to that created under the CALFED Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) to refine existing, and develop new, Delta-specific restoration actions, provide Delta-specific implementation guidance, program tracking, performance evaluation, and adaptive management feedback (Appendix 3A, Section 3A.8.2). Based on the results of this modified DRERIP analysis, the Steering Committee performed additional analyses to further evaluate water conveyance and operations, taking into account climate change; north Delta bypass flows and operations; tidal marsh and Delta simulations; daily operations; and Delta island consumptive use.

In 2011, state and federal agencies and environmental organizations identified a range of north Delta intake capacities and the following additional conveyance operations alternatives to be analyzed (See Appendix 3A, for detail on these operations alternatives).

- DWR, CDFW, Reclamation, USFWS, and NMFS developed *Scenario 6* for south Delta operations and retained operations similar to those in the *January 2010 BDCP Operations* for the north Delta, with the addition of Fall X2 as set forth in the USFWS 2008 Long-Term Operation Biological Opinion (USFWS BiOp), modifications of Old and Middle River (OMR) criteria, modifications of the Head of Old River Barrier operations, and implementation of south Delta temporary agricultural barriers as under Existing Conditions.
- CDFW, USFWS, and NMFS developed an *Enhanced Ecosystem Conveyance Operations* approach—similar to *January 2010 BDCP Operations* with Fall X2 as set forth in the USFWS 2008 BiOp, reduced ability to divert water at the north Delta intakes through more stringent north Delta intake bypass criteria and Sacramento River flow requirements at Rio Vista, changes to OMR criteria, and reduced ability to divert water at the south Delta intakes.
- The State Water Resources Control Board (State Water Board) provided additional information related to the scoping comments submitted in 2008 and 2009. The proposal—*Enhanced Spring Delta Outflow*—would provide additional spring Delta outflow in all water year types to promote abundance and productivity of longfin smelt and other estuarine species, and Delta inflows would be modified to promote a more natural hydrograph.
- Several environmental organizations proposed three alternatives.
    - An alternative to (1) achieve Fall X2 protections in the south Delta; (2) reestablishment of a more natural hydrograph during winter and spring months; and (3) conduct reservoir operations to prevent unintended drawdowns with a range of potential conveyance capacities. The operations would be similar to Scenario 6 with (1) Fall X2 as under the USFWS 2008 BiOp; (2) modifications to OMR flow criteria; (3) proportional inflow bypasses from Shasta Lake, Folsom Lake, and Oroville Reservoir into the Sacramento River; and (4) additional pulse flows in the late winter and through the spring to protect outmigrating fall-run and spring-run Chinook salmon.

  - Operations to provide Delta outflow as described in the State Water Board Flow Recommendations for the Sacramento–San Joaquin Delta Ecosystem, published in 2010.
  - Operations as described above under Scenario 6 with a conveyance capacity of 9,000 cfs.
- Contra Costa Water District (CCWD) and other commenters proposed a *Limited Dual Conveyance Facility* —similar to *January 2010 BDCP Operations* but with only 3,000 cfs capacity for the north Delta intakes, addition of Fall X2 as under the USFWS 2008 BiOp, and modifications to the San Joaquin River inflow/export ratio.
- The Water Advisory Committee of Orange County proposed an Isolated Conveyance facility previously described as Initial Screening Conveyance Alternative B6. This alternative included an isolated conveyance with a tunnel between the Sacramento River near Fremont Weir and the SWP and CVP Pumping Plants, isolated conveyance with a tunnel between the Sacramento River near Decker Island to Clifton Court Forebay and Bethany Reservoir, and continued use of the south Delta intakes. This alternative was similar to alternatives suggested during the scoping process, and was evaluated.

3.2.1.5 Second Screening Analysis

As previously described, the first or initial screening of conveyance alternatives focused on water conveyance alternative alignments. Once the operational concepts were identified, a second screening process was implemented. For the second screening process, the conveyance concepts developed through the first screening process were combined with the operational concepts identified in 2011. This synthesis generated the following list of possible alternatives.

- **Second Screening Dual Conveyance Alternative 1A.** Dual conveyance with a tunnel—January 2010 BDCP Operations—15,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 1B.** Dual conveyance with a lined or unlined east canal—January 2010 BDCP Operations—15,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 1C.** Dual conveyance with a lined or unlined west canal—January 2010 BDCP Operations—15,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 2A.** Dual conveyance with a tunnel—Scenario 6 Operations—15,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 2B.** Dual conveyance with a lined or unlined east canal—Scenario 6 Operations—15,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 2C.** Dual conveyance with a lined or unlined west canal—Scenario 6 Operations—15,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 3A.** Dual conveyance with a tunnel—January 2010 BDCP Operations—6,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 3B.** Dual conveyance with a lined or unlined east canal—January 2010 BDCP Operations—6,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 3C.** Dual conveyance with a lined or unlined west canal—January 2010 BDCP Operations—6,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 4A.** Dual conveyance with a tunnel—Scenario 6 Operations—9,000 cfs north Delta intake capacity.

- **Second Screening Dual Conveyance Alternative 4B.** Dual conveyance with a lined or unlined east canal—Scenario 6 Operations—9,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 4C.** Dual conveyance with a lined or unlined west canal—Scenario 6 Operations—9,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 5A.** Dual conveyance with a tunnel—Limited Conveyance Operations Alternative—January 2010 BDCP Operations and Fall X2—3,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 6A.** Dual conveyance with a tunnel—Enhanced Ecosystem Alternative —9,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 7A.** Dual conveyance with a tunnel—Enhanced Spring Delta Outflow Alternative—9,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 8A.** Dual conveyance with a tunnel—Proportional North Delta Inflow Bypass Alternative—9,000 cfs north Delta intake capacity.
- **Second Screening Dual Conveyance Alternative 9A.** Dual conveyance with a tunnel—State Water Board 2010 Flow Recommendations for Delta Ecosystem—9,000 cfs north Delta intake capacity.
- **Second Screening Isolated Conveyance Alternative 1A.** Isolated conveyance with a tunnel—January 2010 BDCP Operations—15,000 cfs north Delta intake capacity.
- **Second Screening Isolated Conveyance Alternative 1B.** Isolated conveyance with a lined or unlined east canal—January 2010 BDCP Operations—15,000 cfs north Delta intake capacity.
- **Second Screening Isolated Conveyance Alternative 1C.** Isolated conveyance with a lined or unlined west canal—January 2010 BDCP Operations—15,000 cfs north Delta intake capacity.
- **Second Screening Through Delta Conveyance Alternative 1D.** Separate Corridors Operations—15,000 cfs north Delta intake capacity.

These 21 potential EIR/EIS alternatives were then evaluated according to the first, second, and third level screening criteria and the requirements of the Sacramento–San Joaquin Delta Reform Act (Delta Reform Act). They were also evaluated for finding of consistency with scoping comments from responsible and cooperating agencies related to a range of alternatives, and relative to legal rights and entitlements of entities that are not BDCP participants. The relationship of the BDCP to the Delta Reform Act is described in Chapter 1, Section 1.4.3, *Relationship to the Delta Reform Act and Delta Plan,* and in Appendix 3I, *BDCP Compatibility with the Delta Reform Act*. Details and results of the second screening process are provided in Appendix 3A, *Identification of Water Conveyance Alternatives for Bay Delta Conservation Plan Environmental Impact Report/Environmental Impact Statement (Screening Report) (Conservation Measure 1).* Conveyance alternatives eliminated as a result of the second screening analysis are discussed in Section 3.2.2.

3.2.2 Alternatives Considered and Dismissed from Further Evaluation

Because, as set forth in NEPA regulations and CEQA case law, an analysis need not consider every possible alternative to a project, but rather a range of reasonable alternatives, the alternatives listed above were evaluated to narrow them to a more manageable field by eliminating similar or duplicative features (i.e., based on conveyance facilities or operations), or because the alternative would fail to meet the purpose and need for the BDCP or would likely violate federal and state statutes or regulations. Accordingly, the following conveyance alternatives were dismissed from further evaluation, as detailed in Appendix 3A.

- Second Screening Dual Conveyance Alternative 3B.
- Second Screening Dual Conveyance Alternative 3C.
- Second Screening Dual Conveyance Alternative 4B.
- Second Screening Dual Conveyance Alternative 4C.
- Second Screening Dual Conveyance Alternative 8A.
- Second Screening Dual Conveyance Alternative 9A.

The remaining alternatives were renumbered for clarity and carried forward for analysis in the EIR/EIS as BDCP action alternatives.

3.2.3 Development of DWR "Proposed Project" in 2012

On July 25, 2012, California Governor Edmund G. Brown Jr., Secretary of the Interior Ken Salazar, and National Oceanic and Atmospheric Administration (NOAA) Assistant Administrator for Fisheries Eric Schwaab outlined revisions to the proposed BDCP. As revised, the proposed conveyance alternative for CM1 includes the following: (1) the construction of water intake facilities with a total capacity of 9,000 cfs, down from an earlier proposal of 15,000 cfs; (2) operations that would be phased in over several years; and (3) a conveyance system designed to use gravity flow to maximize energy efficiency and to minimize environmental impact. Based on this information, the BDCP analyzed Intakes 2, 3, and 5; two tunnels to convey water by gravity; no intermediate pumping plant; and operations guided by Scenario H. The EIR/EIS analyzes the proposed BDCP as Alternative 4.[8]

This proposal is analyzed in the BDCP effects analysis and this EIR/EIS. The proposed project, as embodied in the draft BDCP document published together with the EIR/EIS, will form a major portion of the HCP and NCCP that support applications for take authorization and other permits needed to proceed with implementation of the BDCP.

DWR's goal in this last step in the process of formulating alternatives was to identify a proposed version of CM1 that would be part of an overall BDCP that met the standards of the ESA and NCCPA while achieving the project objectives and meeting the project purpose and need. In order to minimize impacts in the Delta, DWR decided to propose only three (rather than five) intake facilities, thereby greatly reducing the potential CM1 footprint within the Delta itself. In doing so, DWR willingly reduced the export capacity of the proposed new north Delta diversions and conveyance structures while providing enough export capacity in the north to permit dual operations that could minimize adverse effects associated with operation of south Delta water conveyance facilities.

DWR also sought to identify proposed operations that provide balance maintaining exports and addressing ecological issues in the Delta, such that flow changes, habitat restoration, and other

[8] In February 2012, Alternative 4 included Intakes 1, 2, and 3 and an intermediate pumping plant, along with a set of operational criteria including provisions for Fall X2. This alternative has been updated to reflect the elements introduced in the July 2012 announcement.

conservation measures may give all aquatic species what they need to reverse their declining population trends and contribute to their recovery. DWR and the fish and wildlife agencies used as their starting point the alternative described above as *Alternative 4A. Dual conveyance with a tunnel—Scenario 6 Operations—9,000 cfs north Delta intake capacity* because that option included only three new intakes with a total of 9,000 cfs capacity and included Scenario 6 operations developed with active input from USFWS, NMFS, and CDFW.

In reviewing the February 2012 effects analysis, including the evaluation of the preliminary BDCP proposal, the fish and wildlife agencies identified a number of concerns with the preliminary proposal. As a result of these concerns, a new set of operational criteria was developed and is presented in BDCP Section 3.4.1.4.3, *Flow Constraints*. These criteria are intended to meet the ESA requirement to minimize and mitigate incidental take to the maximum extent practicable, and the NCCPA requirement to conserve each of the covered species in the Plan Area.

To support the selection of a revised operational scenario, the fish and wildlife agencies conducted modeling to examine the recovery needs of the covered fish throughout their range in the absence of habitat restoration. This analysis was refined over multiple runs to explore the operational flexibility of the BDCP to help meet the rangewide recovery needs without adversely affecting upstream reservoir operations. The fish and wildlife agencies worked collaboratively with DWR to develop an operational scenario that contributed to the recovery of the covered fish and fit within the constraints of the BDCP. As a result, it has been agreed that the uncertainties about level of needed spring and fall outflow are to be addressed by adopting *decision trees* prescribing selection of criteria at the time the north Delta diversions become operational. The decision trees set criteria for spring outflow and fall outflow. Under the decision tree structure, one of four possible operational criteria will be implemented initially based on the results of targeted research and studies. Targeted research and studies will proceed until the north Delta intakes become operational, with the results of those studies forming the basis for determining the outcome of each decision tree. Operating criteria may also be modified after that time, based on concurrence by the permittees and the fish and wildlife agencies, by means of the adaptive management process specified in the Plan. The decision tree concept is discussed in detail in Appendix 3A, Section 3A.10.6, and the decision tree process and outcomes are described further in Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria,* for Scenario H.

3.3 Proposed Bay Delta Conservation Plan

As described in Section 3.2, *Alternatives Development Process*, and Appendix 3A, *Identification of Water Conveyance Alternatives for Bay Delta Conservation Plan Environmental Impact Report/Environmental Impact Statement (Screening Report) (Conservation Measure 1)*, a detailed process of considering alternatives has been ongoing as part of the development of the proposed BDCP. During summer 2011, the alternatives were reduced to five action alternatives (with subalternatives) and the No Action/No Project Alternative. As part of the preparation of this EIR/EIS, these alternatives and subalternatives were renumbered to better represent the alternatives related to the particular alignment and conveyance option. Table 3-1 presents an overview of the alternatives for presentation in the EIR/EIS.

1 **Table 3-1. Action Alternatives Evaluated in the BDCP EIR/EIS**

EIR/EIS Alternative Number	Conveyance	Conveyance Alignment	Intakes Selected for Analysis	North Delta Diversion Capacity (cfs)	Operations[e]	Conservation Components	Measures to Reduce Other Stressors	Associated NMFS and USFWS Action
1A	Dual[a]	Pipeline/ Tunnel	1, 2, 3, 4, 5	15,000	Scenario A	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species
1B	Dual[a]	East	1, 2, 3, 4, 5	15,000	Scenario A	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species
1C	Dual[a]	West	West side intakes 1, 2, 3, 4, 5[g]	15,000	Scenario A	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species
2A	Dual[a]	Pipeline/ Tunnel	1, 2, 3, 4, 5 (or 1,2, 3, 6, 7)[b]	15,000	Scenario B	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species
2B	Dual[a]	East	1, 2, 3, 4, 5 (or 1, 2, 3, 6, 7)[b]	15,000	Scenario B	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species
2C	Dual[a]	West	West side intakes 1, 2, 3, 4, 5[g]	15,000	Scenario B	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species
3	Dual[a]	Pipeline/ Tunnel	1, 2[i]	6,000	Scenario A	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species

EIR/EIS Alternative Number	Conveyance	Conveyance Alignment	Intakes Selected for Analysis	North Delta Diversion Capacity (cfs)	Operations[e]	Conservation Components	Measures to Reduce Other Stressors	Associated NMFS and USFWS Action
4 (CEQA Preferred Alternative)	Dual[a]	Modified Pipeline/ Tunnel	2, 3, 5	9,000	Scenario H	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species
5	Dual[a]	Pipeline/ Tunnel	1	3,000	Scenario C	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f]); tidal habitat restoration limited to 25,000 acres	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species
6A	Isolated[c]	Pipeline/ Tunnel	1, 2, 3, 4, 5	15,000	Scenario D	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species
6B	Isolated[c]	East	1, 2, 3, 4, 5	15,000	Scenario D	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species
6C	Isolated[c]	West	West side intakes 1, 2, 3, 4, 5[g]	15,000	Scenario D	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species
7	Dual[a]	Pipeline/ Tunnel	2, 3, 5 [i]	9,000	Scenario E	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f]); additional 20 linear miles of channel margin habitat enhancement and 10,000 acres of seasonally inundated floodplain	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species

EIR/EIS Alternative Number	Conveyance	Conveyance Alignment	Intakes Selected for Analysis	North Delta Diversion Capacity (cfs)	Operations[e]	Conservation Components	Measures to Reduce Other Stressors	Associated NMFS and USFWS Action
8	Dual[a]	Pipeline/ Tunnel	2, 3, 5 [i]	9,000	Scenario F	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species
9	Through Delta[d]	Through Delta/ Separate Corridors[d]	Screened intakes at Delta Cross Channel and Georgiana Slough	15,000[d]	Scenario G	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f]); changes in the south Delta[h]	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout[f])	Issuance of 50-year Incidental Take Permits for BDCP Covered Species

[a] The *Dual Conveyance* water delivery system would consist of the new north Delta diversion facilities and the existing SWP/CVP export facilities in the south Delta. The north Delta diversion would be the primary diversion point using specific operating criteria and would be operated in conjunction with the existing south Delta diversion. The existing south Delta diversion would only operate on its own when the north Delta diversion is nonoperational during infrequent periods for maintenance or repair.

[b] Under Alternatives 2A, 2B, and 2C a total of five intakes would be constructed and operated. Intake locations 1–5 or 1, 2, 3, 6, and 7 are analyzed for these alternatives.

[c] The *Isolated Conveyance* water delivery system would consist only of the new north Delta diversion facilities. The SWP/CVP south Delta diversion points would no longer be operated. For the SWP this means the gated intake on Old River, Clifton Court Forebay, and the Skinner Fish Facility would no longer be operated. For the CVP this means the diversion point on Old River and the Tracy Fish Collection Facility would no longer be operated.

[d] The *Through Delta/Separate Corridors* water delivery system would convey water from the Sacramento River through the Delta using existing Delta channels for diversion by the SWP and CVP pumping plants. While the north Delta diversion capacity associated with this alternative is up to 15,000 cfs, it differs from the other action alternatives in that this capacity would be provided by flows through existing channels.

[e] See Table 3-6 for a summary of the individual rules that comprise the operational scenarios and a comparison by scenario and alternative. An overview of operational scenarios is provided in Section 3.4.1.2, *Operational Components*, while a more detailed description appears in Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*.

[f] The BDCP Steering Committee Handout of 3/25/10 is available at: <http://baydeltaconservationplan.com/Library/ArchivedDocuments/SteeringCommittee/SteeringCommitteeAgendasAndHandouts.aspx>.

[g] The west side intakes would be located on the west bank of the Sacramento River.

[h] Under this alternative, lands acquired for restoration or enhancement in the south Delta would not be located alongside corridors designated for water supply.

[i] The intake locations listed represent those locations selected for the analysis of each BDCP alternative. Based on the results of an October 2011 workshop on the Phased Construction of North Delta Intake Facilities (see Appendix 3F, *Intake Location Analysis*), different combinations of intakes could be constructed under these alternatives. Once an alternative is selected as part of the final BDCP, a decision regarding intake locations would be made.

3.3.1 Covered Activities and Associated Federal Actions

The BDCP and its alternatives include *covered activities* and *associated federal actions*. Covered activities are those actions that are carried out by nonfederal entities, such as the DWR, and that are expected to be covered by regulatory authorizations under ESA Section 10 and the NCCPA (California Fish and Game Code Section 2835). The covered activities (Table 3-2) consist of activities in the Plan Area associated with the conveyance and export of water supplies from the SWP's Delta facilities and with implementation of the BDCP conservation strategy. Each of these activities falls into one of six categories: (1) new water conveyance facilities construction, operation, and maintenance; (2) operation and maintenance of SWP facilities; (3) nonproject diversions[9]; (4) habitat protection, restoration, creation, enhancement, and management; (5) monitoring activities; and (6) research.

Table 3-2. BDCP Covered Activities

Covered Activities	Description
New water facilities construction, operations, and maintenance	This includes construction and operations of a new north Delta water conveyance facility to bring water from the Sacramento River in the north Delta to the existing water export pumping plants in the south Delta. In addition, the proposed intake facilities will require routine maintenance and periodic adjustment and tuning to ensure that operations are managed in accordance with governing fish passage criteria. This covered activity would also include improvements and routine maintenance of the Fremont Weir and Yolo Bypass and operation (not construction) of the North Bay Aqueduct Alternative Intake Project. Water operations measures, through the management of flows, will support ecosystem functions associated with aquatic resources.
Operations and maintenance of SWP facilities[a]	This includes activities that would be carried out by DWR to operate and maintain SWP facilities in the Delta after the BDCP (or an alternative) is approved and implemented.
Nonproject diversions	This includes the ongoing operation of the existing nonproject diversions, consistent with implementation of *CM21 Nonproject Diversions.*
Habitat restoration, creation, enhancement, and management activities	These activities include all actions that may be undertaken to implement the physical habitat conservation measures.
Activities to reduce effects of methylmercury contamination	These activities include actions to minimize the methylation and mobilization of inorganic mercury in BDCP habitat restoration areas.
Activities to reduce predation and other sources of direct mortality	These activities include control of nonnative aquatic vegetation; predator control for covered fish species; and installation and operation of nonphysical fish barriers in the Delta.
Adaptive management and monitoring programs	Various types of monitoring activities would be conducted during BDCP implementation, including preconstruction surveys, construction monitoring, compliance monitoring, effectiveness monitoring, and system monitoring.
Other conservation actions	These actions may include (1) the continued operation and maintenance of an existing oxygen aeration facility in the Stockton Deep Water Ship Channel, which serves to increase dissolved oxygen concentrations and thereby minimize a potential fish passage barrier; and (2) the development of a delta and longfin smelt conservation hatchery by USFWS.

[a] ESA and California Endangered Species Act (CESA) coverage for existing operation and maintenance of the SWP and coordinated operations with the CVP prior to operation of new water conveyance facilities are addressed through separate compliance processes.

[9] This includes the ongoing operation of the existing nonproject diversions consistent with implementation of *CM21 Nonproject Diversions*. Under this conservation measure, some nonproject diversions would be removed, consolidated, or modified.

As noted in Chapter 1, Section 1.5, *BDCP EIR/EIS Project Area*, the Plan Area consists mainly of the statutory Delta, the Suisun Marsh, and the Yolo Bypass. The Areas of Additional Analysis are two areas outside the defined Plan Area that encompass power transmission corridors. One area lies west of the Plan Area and is considered in the analysis of proposed BDCP alternatives that include the western alignment for the water conveyance facility (Alternatives 1C, 2C, and 6C). The other area lies east of the Plan Area and represents the potential transmission line alignment analyzed for Alternative 4. Implementation of the BDCP (or an alternative) could also affect regions upstream of the Delta and throughout the SWP/CVP Export Service Areas. Consequently, the *project area* encompasses a larger geographic area than the Plan Area, comprising three defined regions: the Upstream of the Delta Region, the Delta Region (as defined in Chapter 1, Section 1.5, *BDCP EIR/EIS Project Area*—generally referred to as the Plan Area), and the SWP and CVP Export Service Areas (Figure 1-4).

BDCP-associated federal actions are those BDCP-related actions that are carried out, funded, or authorized by Reclamation within the Plan Area and that would receive appropriate ESA coverage through Section 7. These actions would be (1) operation of existing CVP Delta facilities to convey and export water in coordinated operations with the SWP after the BDCP (or an alternative) is approved and implemented; (2) associated maintenance activities; and (3) the creation of habitat.

Nonfederal actions are categorized as covered activities under ESA Section 10 and the NCCPA for DWR because of DWR's involvement in these actions. The federal actions by Reclamation would not be covered activities for the purposes of the ESA Section 10(a)(1)(B) permit. These federal actions are actions that occur within the Delta that would be coordinated with DWR to support DWR's compliance with the ESA Section 10 permit. Reclamation's activities are subject to ESA Section 7. The Section 7 consultation would also include other CVP operation and maintenance activities that are not within the Plan Area. Further discussion of the approval process and the process for implementation of the conservation measures appears in Chapter 1, Section 1.6, *Intended Uses of this EIR/EIS and Agency Roles and Responsibilities*.

BDCP covered activities are outlined in this section and presented in detail in Section 3.6, *Components of the Alternatives: Details*. Federal actions associated with the Plan are outlined in Section 3.6.4.1. Unless specifically identified otherwise, these activities would be the same under all the action alternatives.

3.3.2 Conservation Measures

The BDCP conservation measures comprise specific actions that would be implemented to achieve the biological goals and objectives of the proposed Plan, and are a component of the Plan's conservation strategy. The BDCP conservation strategy consists of multiple components that are designed to collectively achieve the overall BDCP planning goals of ecosystem conservation and water supply reliability. The conservation strategy includes biological goals and objectives; conservation measures; avoidance and minimization measures; and a monitoring, research, and adaptive management program. The covered activities outlined in Table 3-2 are included in the conservation measures (Table 3-3) and are discussed in detail in Section 3.6, *Components of the Alternatives: Details*. The conservation measures address stressors at the scale of ecosystems, natural communities, and species. CM1–CM3 are intended to manage the routing, timing, and flow through the Delta while establishing an interconnected system of conserved lands across the Plan Area. CM4–CM11 were developed to restore, create, enhance, and manage physical habitat to expand the extent and quality of intertidal, floodplain, and other habitats across defined conservation zones (CZs) and tidal Restoration Opportunity Areas (ROAs) (Figure 3-1). The Plan Area is subdivided into 11 CZs within which conservation targets for natural communities and covered species' habitats have been established. ROAs encompass those locations in the Plan Area considered most appropriate for the restoration of tidal habitats and within which restoration goals for tidal and associated upland natural communities will be achieved. The remaining conservation measures, CM12–CM21, may reduce the adverse effects of various stressors on covered species; these include toxic contaminants, nonnative predators, illegal harvest, and nonproject water diversions. CM22 includes activities intended to avoid or minimize direct take of covered species and minimize impacts on natural communities that provide habitat for covered species.

Table 3-3. Summary of Proposed BDCP Conservation Measures of All Action Alternatives

CM	Title/Description	Primary Focus
1	Water Facilities and Operation	Manage the routing, timing, and amount of flow through the Delta while establishing an interconnected system of conservation lands across the Plan Area.
2	Yolo Bypass Fisheries Enhancement	
3	Natural Communities Protection and Restoration	
4	Tidal Natural Communities Restoration	Restore, enhance, and manage physical habitat to expand the extent and quality of intertidal, floodplain, and other habitats across defined conservation zones (CZs) and Restoration Opportunity Areas (ROA).
5	Seasonally Inundated Floodplain Restoration	
6	Channel Margin Enhancement	
7	Riparian Natural Community Restoration	
8	Grassland Natural Community Restoration	
9	Vernal Pool and Alkali Seasonal Wetland Complex Restoration	
10	Nontidal Marsh Restoration	
11	Natural Communities Enhancement and Management	
12	Methylmercury Management	Reduce the adverse effects of various stressors on covered species, such as toxic contaminants, nonnative predators, illegal harvest, and nonproject water diversions.
13	Invasive Aquatic Vegetation Control	
14	Stockton Deep Water Ship Channel Dissolved Oxygen Levels	
15	Localized Reduction of Predatory Fishes (Predator Control)	
16	Nonphysical Fish Barriers	
17	Illegal Harvest Reduction	
18	Conservation Hatcheries	
19	Urban Stormwater Treatment	
20	Recreational Users Invasive Species Program	
21	Nonproject Diversions	
22	Avoidance and Minimization Measures	Avoid or minimize direct take of covered species and minimize impacts on natural communities that provide habitat for covered species.

3.3.2.1 Implementation Schedule

An example of possible schedules for implementation of the conservation measures within BDCP alternatives is provided in Chapter 6 of the BDCP, *Plan Implementation*. It is recognized that there would be some variation among alternatives. The schedule in Chapter 6 is for implementation of the proposed project (BDCP) and was developed to meet the following goals.

- Ensure that key implementation actions occur early in the permit term to offset expected effects of covered activities and meet the NCCPA requirement for rough proportionality of effects and conservation.
- Ensure that implementation actions occur by the implementation deadlines established in BDCP Chapter 3, *Conservation Strategy*.
- Ensure that implementation actions occur on a feasible schedule and allow adequate time for landowner negotiation for acquisition, project planning, permitting, funding, design, and construction.
- Group the related implementation actions or covered activities together or in the proper sequence (e.g., implementing riparian restoration and channel margin enhancement together).
- Require natural community protection and restoration to occur in almost every time period to ensure that progress is always being made toward the total conservation requirement in year 40.

The schedule for natural community protection and restoration establishes milestones for both restoration and protection to stay ahead of impacts. For restoration, these milestones are defined by when restoration construction is completed, not the time at which a restoration site must meet its performance criteria, because it will take years or even decades for restored natural communities to be fully functioning biologically.

The conservation strategy is divided into near-term (NT) and long-term (LT) implementation stages (see BDCP Chapter 6, *Plan Implementation*, for a detailed schedule of Plan implementation). The NT implementation would last until the north Delta diversions and the new water conveyance facilities are constructed and operational. LT implementation would last 40 years—that is, through the remainder of the proposed 50-year BDCP permit duration. The long-term (LT) implementation stage is further divided into two sub-phases: Early long-term (Year 11 through Year 15) and Late long-term (Year 16 through Year 50). This division of the implementation period was used because dual conveyance from north and south Delta intakes would bring significant flexibility and ecological changes to the system. As a result, many of the conservation measures are interrelated with operations of the new conveyance.

NT implementation of conservation measures would be intended to provide a response to currently degraded or absent ecological functions, while building the foundation to improve long-term ecological functions. The NT measures include early habitat creation or restoration actions, implementation of conservation measures that address other stressors on covered fish species, and acquisition of terrestrial and wetland habitat to facilitate conservation of covered wildlife and plant species.

The BDCP implementation schedule was informed by the data and analyses used to develop the conservation strategy, as summarized below.

- The near-term, early long-term, and late long-term restoration targets established for tidal, seasonally inundated floodplain, and channel margin habitats (BCDP Chapter 3, Section 3.4, *Conservation Measures*) and the extent of habitat restoration effects on natural communities and covered species habitats (BDCP Chapter 5, *Effects Analysis*).

- Vernal pool complex and grassland restoration targets (BCDP Chapter 3, Section 3.4, *Conservation Measures*) and the extent of habitat restoration effects on natural communities and covered species habitats (BDCP Chapter 5, *Effects Analysis*).
- Vernal pool complex, alkali seasonal wetland complex, grassland, and cultivated lands protection/preservation targets (BDCP Chapter 3, Section 3.4, *Conservation Measures*).
- The pipeline/tunnel construction schedule and the extent of construction effects on natural communities and covered species habitats (BDCP Chapter 5, *Effects Analysis*).

The duration and schedule for construction of the BDCP water conveyance facilities is provided in Appendix 3C, *Construction Assumptions for Water Conveyance Facilities*. Construction of the water conveyance facilities would begin approximately 2 years after permit issuance and continue for an estimated 9–10 years. Operations could begin as early as Year 11. The BDCP implementation schedule for CM3–CM10 (natural community restoration) and amount of acreage by conservation measure is provided in Table 3-4. The acreages shown in Table 3-4 would vary depending on the alternative selected. A total of 65,000 acres of tidal habitat would be restored under all action alternatives except Alternative 5 (25,000 acres). A total of 10,000 acres of seasonally inundated floodplain habitat would be restored under all action alternatives except Alternative 7 (20,000 acres). A total of 20 linear miles of channel margin habitat would be enhanced under all action alternatives except Alternative 7 (40 linear miles). The implementation schedule for CM2 and CM11–CM22 is provided in Section 3.6.2, *Conservation Components*.

1 **Table 3-4. Implementation Schedule for Natural Community Protection and Restoration Conservation Measures (acres)**

		Near-Term		Early Long-Term	Late Long-Term						
	Total	1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 35	36 to 40	41 to 45	46 to 50
BDCP Reserve System											
CM3: Natural Communities Protection and Restoration											
Valley/Foothill Riparian	750	400	350								
Vernal pool complex	600	200	200	200							
Alkali seasonal wetland complex	150		120	5	5	5	5	5	5		
Grassland	8,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000		
Managed wetland	1,500	500	1,000								
Managed wetland (natural community)	6,600	1,400	1,900	600	550	550	550	550	500		
Cultivated lands (non-rice)	48,125	7,700	7,700	6,700	5,200	5,200	5,200	5,200	5,225		
Cultivated lands (rice)	500	100	100	100	100	100					
Cultivated lands (rice or equivalent)	3,000	300	400	400	400	400	400	400	300		
Nontidal marsh	50	10	15	5	5	5	5	5			
Total Acquisition	**69,275**	**11,610**	**12,785**	**9,010**	**7,260**	**7,260**	**7,160**	**7,160**	**7,030**		
CM4: Tidal Natural Communities Restoration [1]											
Tidal brackish emergent wetland	6,000	1,000	1,000	2,050	350	400	400	400	400		
Tidal freshwater emergent wetland	24,000	4,425	4,425	4,450	2,150	2,150	2,150	2,150	2,100		
Tidal perennial aquatic (below MLLW)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Tidal wetland of any type and transitional uplands	35,000	4,150	4,150	4,150	4,150	4,600	4,600	4,600	4,600		
Subtotal: Tidal wetland restoration	**65,000**	**9,575**	**9,575**	**10,650**	**6,650**	**7,150**	**7,150**	**7,150**	**7,100**		
CM5: Seasonally Inundated Floodplain Restoration [2]	10,000			1,000	1,800	1,800	1,800	1,800	1,800		
CM6: Channel Margin Enhancement (miles) [3]	20	5	5		5		5				
CM7: Riparian Natural Community Restoration	5,000	400	400	300	750	750	750	800	850		
CM8: Grassland Natural Community Restoration	2,000	570	570	340	100	100	100	100	120		
CM9: Vernal Pool and Alkali Seasonal Wetland Complex Restoration											
Vernal Pool Complex	67	20	20	27							
Alkali Seasonal Wetland	72	29	29	5	5	4					
CM10: Nontidal Marsh Restoration											
Nontidal Marsh Restoration	1,200	200	200	100	100	150	150	150	150		
Managed wetland	500	250	250								
Total Restoration	**83,839**	**11,044**	**11,044**	**12,422**	**9,405**	**9,954**	**9,950**	**10,000**	**10,020**		
Total Acquisition and Restoration	**153,114**	**22,654**	**23,829**	**21,432**	**16,665**	**17,214**	**17,110**	**17,160**	**17,050**		

[1] Under Alternative 5, 25,000 acres of tidal habitat would be restored under CM4.
[2] Under Alternative 7, 20,000 acres of seasonally inundated floodplain would be restored under CM5.
[3] Under Alternative 7, 40 linear miles of channel margin habitat would be enhanced under CM6.

3.3.2.2 Adaptive Management and Monitoring Program

As described above, the BDCP conservation strategy under all the action alternatives consists of 22 conservation measures that are designed to achieve the biological goals and objectives described in Chapter 3 of the BDCP, Section 3.3, *Biological Goals and Objectives*. The conservation measures include actions to improve flow conditions, increase aquatic food production, restore habitat for the covered species, and reduce the adverse effects of many biological and physical stressors on those species. This strategy also recognizes the considerable uncertainty that exists regarding the understanding of the Delta ecosystem and the likely outcomes of implementing the conservation measures, in terms of both the nature and the magnitude of the response of covered species and of ecosystem processes that support the species.

As a component of the conservation strategy, the adaptive management and monitoring program has been designed to use new information and insight gained during the course of Plan implementation to develop and implement alternative strategies to achieve the biological goals and objectives. It is possible that some of the conservation measures will not achieve their expected outcomes, while others will produce better results than expected. The adaptive management process describes how changes to the conservation measures will be made to improve the effectiveness of the Plan over time.

Monitoring and research will be used to confirm Plan implementation and to measure the Plan's effectiveness, as well as to assess uncertainties and increase understanding of Delta ecosystems. Extensive monitoring and research are currently underway in the Delta. To address the specific requirements of the Plan, some of these monitoring activities will continue and, in some cases, be expanded. In other cases, existing monitoring activities will be modified to reflect specific implementation needs of the Plan. The BDCP will also require that new types of monitoring activities be conducted in the Delta to support Plan implementation. To guide these efforts, detailed monitoring and research plans will be developed that identify specific metrics and protocols.

Adaptive management and monitoring activities will be implemented through a single, comprehensive program. Information obtained from monitoring and research activities will be used by decision makers to improve the effectiveness of the conservation measures toward advancing the biological goals and objectives. The adaptive management and monitoring program is directly related to several key components of the BDCP, as fully described in Chapter 3 of the BDCP, *Conservation Strategy*, Section 3.6, and Chapter 7, *Implementation Structure*, of the BDCP.

3.4 Components of the Alternatives: Overview

As described in Chapter 1, Section 1.6.1, *Overview of BDCP Approval Process*, USFWS and NMFS are considering whether to issue ITPs under ESA Section 10(a)(1)(B) for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other covered activities as described in the BDCP. The applicant's proposed duration of the ITPs is 50 years. USFWS and NMFS would issue separate ITPs covering species within their respective authority (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage). Issuance of ITPs is common to all of the action alternatives. An HCP will be submitted as part of the ITP applications. The HCP describes activities that would be covered by the ITPs, the species for which incidental take would be authorized, and measures that would, to the maximum extent practicable, minimize the adverse effects on the covered species resulting from implementation of the covered activities, and mitigate any remaining adverse effects through the protection, restoration, creation, and/or enhancement of habitat for the covered species. CDFW would be responsible for approving the BDCP as an NCCP. Reclamation's action in relation to the BDCP would be to adjust CVP operations specific to the Delta to accommodate new conveyance facility operations and/or flow requirements under the BDCP, in coordination with SWP operations.

The proposed BDCP consists of water conveyance facility components combined with water conveyance operational components (collectively CM1); conservation components (CM2–CM11); components related to reducing other stressors (CM12–CM21); and avoidance and minimization measures (CM22). Depending on the alternative, the water conveyance facility components would create a new conveyance mechanism or use existing water corridors to divert water from the north Delta to existing SWP and CVP export facilities in the south Delta, within operational rules to achieve the biological goals and objectives of the BDCP. The water conveyance facility components, which are analyzed at a project level in this EIR/EIS, are described in greater detail in Section 3.6.1, *Water Conveyance Facility Components (CM1)*. Conservation components and components to address other stressors would support a number of the specific biological goals and objectives identified in the Plan. These sets of conservation components are described in greater detail in Sections 3.6.2 and 3.6.3, respectively. When making a decision on the alternatives under CEQA and NEPA, Lead Agencies may make modifications to alternatives based on information provided in the EIR/EIS, so long as the resultant impacts have been evaluated.

The scenario characterized as *no federal action* (the No Action Alternative) means that the federal ITPs related to the proposed BDCP would not be issued and that the applicant would remain subject to the take prohibition for listed species and other ESA requirements. Ongoing activities or future actions that may result in the incidental take of federally listed species would need to be permitted through ESA Section 7 or Section 10. Similarly, permits would not be issued by CDFW under Section 2835 of the Fish and Game Code.

3.4.1 Overview of Water Conveyance Facility Components

3.4.1.1 Physical Components

The following is a comprehensive list of possible water diversion and conveyance facilities that could be included in one or more of the action alternatives. Not all components listed below would be found in each alternative. A number of these components are identified in Table 3-5 by alternative, and all are described in detail in Section 3.6.1, *Water Conveyance Facility Components (CM1)*. Appendix 3C, *Construction Assumptions for Water Conveyance Facilities*, provides details about construction procedures and other related specifications. Assumptions regarding construction activity timing and duration are also provided in Appendix 3C. Detailed depictions of the physical components of the BDCP action alternatives are provided in Figures M3-1, M3-2, M3-3, M3-4, and M3-5 in the Mapbook Volume of this EIR/EIS.

Table 3-5. Water Conveyance Facilities Components of Each Alternative

	Alternative															
Component	No Action	1A	1B	1C	2A	2B	2C	3	4	5	6A	6B	6C	7	8	9
New north Delta fish-screened intakes		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
New intake pumping plants		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
New diversion pumping plants																X
New intermediate pumping plant		X	X	X	X	X	X	X		X	X	X	X	X	X	
Use of existing SWP and CVP south Delta intake facilities	X	X	X	X	X	X	X	X	X	X				X	X	X
Operations of North Bay Aqueduct Alternative Intake Project	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Byron Tract Forebay[a]		X	X	X	X	X	X	X		X	X	X	X	X	X	
Expanded Clifton Court Forebay[b]									X							
Intermediate forebay		X			X			X	X	X	X			X	X	
Primary Conveyance Facility																
Pipelines/tunnels		X		X	X		X	X	X	X	X		X	X	X	
Canals			X	X		X	X					X	X			
Channels	X															X
New operable barrier(s)					X	X	X		X							X
Fish movement and habitat corridor around Clifton Court Forebay																X

[a] *Byron Tract Forebay* currently refers to proposed forebays both north and south of Clifton Court Forebay.
[b] *Expanded Clifton Court Forebay* refers to modifications to Clifton Court Forebay and expansion on Byron Tract 2.

- Intakes
    - New on-bank intake facilities would be constructed on the Sacramento River between Clarksburg and Walnut Grove. Alternatives 1A through 8 would entail between one and five 3,000 cfs-diversion-capacity facilities in 12 possible locations—7 locations on the east bank of the river (for pipeline/tunnel, modified pipeline/tunnel, and east alignment alternatives) and 5 locations on the west bank (for west alignment alternatives). Any single action alternative would include the construction of between one and five intakes. These intakes would rise approximately 55 feet from river bottom to top of structure with a length of approximately 700–2,300 feet, depending on location; fish screen heights would vary with location. Construction of the on-bank intakes would require the installation of cofferdams. Each intake site would require a temporary cofferdam to create a dewatered construction area encompassing the entire intake site. A portion of the cofferdam would remain in place as an integral part of the intake structure within the existing water side levee. Under Alternative 9, two 2,800-foot-long intakes, each with a capacity of 7,500 cfs, would be placed at the entrances to the Delta Cross Channel and Georgiana Slough (described in more detail in Section 3.5.16.1). At the Delta Cross Channel location, there would potentially be a new replacement intake control structure with gates. At the Georgiana Slough location, a new gated intake control structure with a flood flow capacity of 20,600 cfs would be constructed. Construction of Alternative 9 intakes would also require the installation of temporary

cofferdams to create a dry work area within the subject waterway. All intakes would be equipped with self-cleaning, positive barrier fish screens designed to be protective of salmonids and delta smelt. Fish screens would comply with CDFW and National Marine Fisheries Service (NMFS) fish screening criteria (refer to the July 2011 BDCP Fish Facilities Technical Team Technical Memorandum for additional detail on fish screening criteria[10]).

- New intake facilities would necessitate the widening of existing levees on the landside to increase crest width, to facilitate intake construction and accommodate the realignment of State Route 160. Minor dredging and channel modification activities would also take place along the face of the intakes.
- New intake facilities would include gantry cranes, log boom and log boom piles, riprap, and electrical buildings.

- Pumping plants
  - Intake pumping plants with a capacity of 3,000 cfs each would be constructed to convey water from intake facilities into pipelines, eventually connecting to the rest of the conveyance structures. Each plant and its associated facilities would encompass approximately 20 to 60 acres adjacent to the intake facility. Pipeline/tunnel, modified pipeline/tunnel, east alignment, and west alignment alternatives would entail construction of between one and five intake pumping plants.
  - An intermediate pumping plant would convey the water collected from the intake facilities between intermediate conveyance structures such as tunnels, canals, and forebays, depending on the design of the particular alternative. One intermediate pumping plant would be constructed for the pipeline/tunnel, east alignment, and west alignment alternatives. Under the modified pipeline/tunnel alignment (Alternative 4), water would be fed by gravity from the intermediate forebay to the major tunnel segment. This approach could be applied to other alternatives as the Lead Agencies make their final decisions regarding the BDCP and associated permits.
  - Diversion pumping plants with a capacity of 250 cfs would provide dilution flow at the confluence of the San Joaquin River and the head of Old River and upstream of the confluence of Middle River and Victoria Canal. These plants would be constructed under the through Delta/separate corridors alternative.
  - Pumping plant facilities would include sedimentation basins, solids handling facilities, transition structures, surge towers, one or two substations, transformers, a mechanical room, access roads, and other associated facilities and utilities. Some or all of these facilities would be associated with pumping plants under each alternative.
- Pipelines
  - Intake gravity collector pipelines would carry water between intakes and intake pumping plants. Each intake facility would convey water through six 12-foot-diameter pipelines to the adjacent pumping plant. Each intake site associated with the pipeline/tunnel, modified pipeline/tunnel, east alignment, and west alignment alternatives would include these

[10] Available here: <http://baydeltaconservationplan.com/Libraries/Dynamic_Document_Library/Fish_Facilities_Team_Technical_Memo_Final_7_15_2011.sflb.ashx>

pipelines. The gravity collector pipelines would convey water into the sedimentation basin before reaching the intake pumping plant.

  - Conveyance pipelines would carry water between intake pumping plants and other conveyance facilities such as tunnels, canals, and forebays. Two or four 16-foot-diameter conduits (or one 20-foot-diameter conduit) would be used for conveyance pipelines. Each intake site associated with the pipeline/tunnel, east alignment, and west alignment alternatives would include these pipelines. Intakes 2 and 3 under Alternative 4 (the modified pipeline/tunnel alignment) would include short segments of these pipelines between pumping plants and tunnels.

- Tunnels
  - A single-bore 29-foot-inside-diameter tunnel would convey water approximately 3.8 miles from intake pumping plants to a new intermediate forebay immediately west of South Stone Lake. This tunnel would be constructed under each pipeline/tunnel alternative using Intakes 1 and/or 2.
  - A 29-foot-inside-diameter tunnel and a single-bore 20-foot-diameter tunnel would convey water nearly 9 miles from intake pumping plants to a new intermediate forebay on Glannvale Tract. These tunnels would be constructed under Alternative 4.
  - A dual-bore 33-foot-inside-diameter tunnel would convey water 34.5 miles from the new intermediate forebay to a new Byron Tract Forebay adjacent to Clifton Court Forebay. This feature would be constructed for all pipeline/tunnel alternatives except Alternative 5, which would use a single-bore tunnel. Alternatives 1A, 2A, 3, 6A, 7, and 8 would have dual 33-foot-inside-diameter tunnels and Alternative 5 would have a single 33-foot-diameter tunnel.
  - A dual-bore 40-foot-inside-diameter tunnel would convey water 30.2 miles from the new intermediate forebay on Glannvale Tract to an expanded Clifton Court Forebay. These tunnels would be constructed under Alternative 4 (modified pipeline/tunnel alignment) and would be wider than tunnels constructed for the alternatives under the pipeline/tunnel alignment to facilitate the gravity-fed system proposed under Alternative 4 (instead of being pressurized and pumped through an intermediate pumping plant).
  - One dual-bore 33-foot-inside-diameter tunnel would convey water between the intermediate pumping plant on Ryer Island and a proposed canal segment on Hotchkiss Tract under the west alignment alternatives.
  - Three tunnel segments would be used as siphons to carry water under Lost Slough/Mokelumne River, San Joaquin River, and Old River, connecting canal segments under the east alignment alternatives.
- Canals
  - Canals would be unlined (earthen) or lined with concrete.
  - An approximately 2,000-foot-long canal would carry water from the Byron Tract Forebay to the existing approach canal to the Harvey O. Banks Pumping Plant (Banks Pumping Plant). This canal would be constructed for pipeline/tunnel, east alignment, and west alignment alternatives. For west alignment alternatives, this canal would be extended to convey water into the existing approach canal for the C. W. "Bill" Jones Pumping Plant (Jones pumping plant).

- An approximately 4,000-foot-long canal would carry water from the north cell of the expanded Clifton Court Forebay, under the Byron Highway through a siphon, and to the existing approach canal to the Banks pumping plant. From this canal, another 6,000-foot-long canal would carry water to the existing approach canal for the Jones pumping plant. These canals would be constructed for the modified pipeline/tunnel alignment (Alternative 4).
- An approximately 44-mile canal would convey water between the intake pumping plants and the Byron Tract Forebay across the east Delta, generally between Interstate (I-) 5 and the South Mokelumne and Middle Rivers. Canal segments would generally have a maximum top width of 700 feet and a depth of 23.5 feet. This canal would be constructed for the east alignment alternatives.
- An approximately 17-mile canal would convey water between intake pumping plants and an intermediate pumping plant/tunnel entrance on Ryer Island. Canal segments would generally have a maximum top width of 700 feet and a depth of 23.5 feet. This canal would be constructed for the west alignment alternatives.
- An approximately 10-mile canal would convey water between the tunnel exit portal on the Hotchkiss Tract and Byron Tract Forebay. Canal segments would generally have a maximum top width of 700 feet and a depth of 23.5 feet. This canal would be constructed for the west alignment alternatives.
- A new 4,000-foot-long canal on Coney Island, adjacent to Victoria Canal, would connect the water supply corridor between siphons at Old River and West Canal across Coney Island. This canal would be constructed for the through Delta/separate corridors alternative.
- A 4,000-foot-long intertie canal would be constructed from Clifton Court Forebay to the Tracy Fish Collection Facility (Tracy Fish Facility) for the through Delta/separate corridors alternative.

- Forebays
  - A 760-acre intermediate forebay would store water between intake facilities and the tunnel conveyance segment between South Stone Lake and the Sacramento River, just south of Hood. An emergency spillway would prevent the intermediate forebay from overtopping by spilling to an approximately 350-acre inundation area adjacent to the forebay (to the south). This forebay would be constructed for pipeline/tunnel alternatives. Pierson Tract is another potential site for this forebay. See Appendix 3H, *Intermediate Forebay Location Analysis*, for more information on siting of the intermediate forebay.
  - A 40-acre intermediate forebay would store water between intake facilities and the main tunnel conveyance segment on Glannvale Tract, adjacent to Twin Cities Road. An emergency spillway would prevent the intermediate forebay from overtopping by spilling to an approximately 120-acre inundation area adjacent to and surrounding the forebay. This forebay would be constructed for Alternative 4 (modified pipeline/tunnel alignment).
  - Byron Tract Forebay, adjacent to Clifton Court Forebay, would store water between the new conveyance structures and existing SWP/CVP south Delta export facilities. For west alignment alternatives, this new forebay would be constructed northwest of Clifton Court Forebay. For pipeline/tunnel and east alignment alternatives, the new forebay would be constructed southeast of Clifton Court Forebay. The water surface area of Byron Tract

Forebay would be 600 acres for the pipeline/tunnel, east alignment, and west alignment alternatives (Alternatives 1A–1C, 2A–2C, 6A–6C, 7, and 8); under Alternative 5, the water surface area would be 200 acres (see descriptions of individual alternatives in Section 3.5, *Alternatives*).

- Clifton Court Forebay would be expanded to the south and would be dredged to provide additional storage capacity. New embankments would be constructed around the forebay and an embankment would be constructed across the forebay to create a north cell and a south cell. The north cell would receive water pumped from the north Delta through the proposed tunnels, while the south cell would receive water conveyed through the existing through Delta system. The north cell water surface area would be approximately 1,300 acres, while the south cell would have a water surface area larger than 1,400 acres. This represents an expansion of approximately 700 acres. An emergency spillway at the north cell of Clifton Court Forebay would prevent the forebay from overtopping by spilling to Old River. This forebay expansion would be constructed under Alternative 4 (the modified pipeline/tunnel alternative).

- Fixed and operable barriers utilizing a range of gate technologies would variously allow the passage of fish, water, and boats through existing Delta channels. Operable barriers would be constructed for the through Delta/separate corridors alternative and those alternatives using Operational Scenarios B and H.

- Vertical, structurally reinforced wedge wire screen panels of stainless steel with 1.75-millimeter (0.069-inch) openings (i.e., fish screens) would be sized to reduce effects on fish and aquatic resources. All intakes, including the North Bay Aqueduct alternative intake, under all alternatives would incorporate fish screens.

- Levees would protect new channel fill areas and serve modified channels and intake facility sites. Minor levee modifications would be necessary under all alternatives; the through Delta/separate corridors alternative would entail additional levee-related activities.

- Culvert siphons would convey water under existing channels and between sections of canals (e.g., through tunnels) or other conveyance facilities. These would be constructed for the modified pipeline/tunnel alignment, east alignment, west alignment, and through Delta/separate corridors alternatives.

- Gates and similar control structures would control the flow of water through conveyance facilities and facilitate maintenance of conveyance structures. Control structures would be constructed under all action alternatives.

- Concrete batch plants and fuel stations would be built to support construction. The volume of concrete needed for the conveyance options would require locating concrete batch plants at the work site rather than importing concrete from outside suppliers. A suitable source of clean water would be required for each batch plant. Batch plants and fuel stations would be located side by side and would range in size from approximately 2 acres to 40 acres. Depending on the alternative selected, concrete batch plants and fuel stations would be constructed at one or more of the following locations. While it is anticipated that precast tunnel segments would be purchased and transported from existing plants, it is possible that one or more temporary plants would be constructed. If it is necessary to construct precast segment yards, they would be located adjacent to concrete batch plants.

    - Pipeline/tunnel alignment (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8)

        - An approximately 2-acre concrete batch plant and 2-acre fuel station at Intake 2.
        - An approximately 2-acre concrete batch plant and 2-acre fuel station at Intake 4.
        - An approximately 40-acre concrete batch plant and 2-acre fuel station approximately 2.5 miles north of SR 12.
        - An approximately 40-acre concrete batch plant and 2-acre fuel station along the pipeline/tunnel alignment approximately 8.5 miles south of SR 12.
        - An approximately 2-acre concrete batch plant and 2-acre fuel station along the pipeline/tunnel alignment on Byron-Bethany Road.
    - Modified pipeline/tunnel alignment (Alternative 4)
        - An approximately 2-acre concrete batch plant and 2-acre fuel station at Intake 2 (within the work area identified for Intake 2).
        - An approximately 2-acre concrete batch plant and 2-acre fuel station at Intake 5 (within the work area identified for Intake 5).
        - An approximately 40-acre concrete batch plant and 2-acre fuel station near Twin Cities Road and Interstate 5 (within a designated reusable tunnel material storage site). (Reusable tunnel material [RTM] is the by-product of tunnel excavation using an earth pressure balance [EPB] tunnel boring machine [TBM]; for additional description of the potential reuse of this material, see Appendix 3B, *Environmental Commitments*).
        - An approximately 40-acre concrete batch plant and 2-acre fuel station between Byron Highway and Italian Slough (within a designated RTM storage site).
    - East Alignment (Alternatives 1B, 2B, and 6B)
        - An approximately 2-acre concrete plant and 2-acre fuel station at Intake 2.
        - An approximately 2-acre concrete plant and 2 acre fuel station at Intake 4.
        - An approximately 25-acre concrete plant and 2-acre fuel station along the canal alignment just south of Snodgrass Slough.
        - An approximately 40-acre concrete plant and 2-acre fuel station along the tunnel alignment approximately 8.5 miles south of SR 12.
    - West Alignment (Alternatives 1C, 2C, and 6C)
        - An approximately 2-acre concrete plant and 2-acre fuel station along the canal alignment adjacent to Willow Point Road.
        - An approximately 2-acre concrete plant and 2-acre fuel station between Intakes 3 and 4.
        - An approximately 40-acre concrete plant and 2-acre fuel station along the canal alignment approximately 1 mile south of the SR 84/SR 220 junction.
        - An approximately 40-acre concrete plant and 2-acre fuel station along the canal alignment just north of Franks Tract.
        - An approximately 2-acre concrete plant and 2-acre fuel station along the canal alignment approximately 1 mile north of the Byron Highway.
    - Through Delta/Separate Corridors (Alternative 9)

    - An approximately 2-acre concrete plant and 2-acre fuel station the east bank of the Sacramento River between The Meadows Slough and the community of Locke.
    - An approximately 2-acre concrete plant and 2-acre fuel station on eastern Webb Tract near the San Joaquin River, north of a proposed operable barrier.
    - An approximately 2-acre concrete plant and 2-acre fuel station adjacent to and north of Highway 4 on Victoria Island.
- Temporary barge unloading facilities would be constructed at locations adjacent to construction work areas along the conveyance alignments for the delivery of construction materials. These facilities would be sized to accommodate various deliveries (e.g., tunnel segments, batched concrete, major equipment). Access roads from these facilities to the construction work area would be necessary. The barge unloading facilities would be removed following construction.
- Other facilities to support the function of the conveyance may include new bridges to connect existing roads and highways, new access roads, improvements to existing roads or bridges, improvements to local drainage systems affected by the alternatives, and other utilities improvements. Some areas would be temporarily or permanently dedicated to borrow, spoil, dredged material, or RTM. Where specific locations for these facilities are known, such areas are identified in Mapbook Figures M3-1 through M3-5.

3.4.1.2 Operational Components

The BDCP would include modifying operations of CVP and SWP facilities in the Delta (covered activities and BDCP-associated federal actions). The modified operation of the existing CVP and SWP Delta facilities and the operation of the proposed new conveyance facilities are described in this section. These modifications are summarized in Table 3-6.

Each of the BDCP action alternatives would modify the existing operation of the CVP and SWP in the Delta to further protect fish populations and to accommodate new Delta facilities and proposed habitat restoration. The existing operation of the CVP and SWP in the Delta is determined by rules and objectives that guide daily Delta operational activities. Many of these rules are included in D-1641 (which implemented the 1995 Bay-Delta Water Quality Control Plan [WQCP] objectives). Several additional rules have been added by the 2008 USFWS BiOp and the 2009 NMFS BiOp for long-term operation of the CVP and SWP. The existing operation of the CVP and SWP in the Delta is briefly summarized here, so that the modifications to these existing (No Action) operations can be identified for the BDCP action alternatives.

Currently, several different operational criteria influence exports and Delta outflow. The proposed BDCP north Delta intake operations would include additional rules governing allowable north Delta diversions. Delta operations for each of the alternatives can be described and compared by the applicable rules under each category (see Table 3-6). The BDCP alternatives comprise a range of operational rules for the SWP/CVP in the Delta that would require additions to, modification of, or elimination of some of the existing Delta operational rules, as described in detail below.

While meeting biological goals and objectives of the Plan, the applicable Delta operational rules evaluated for BDCP alternatives are intended to address the following questions.

- How much of the Delta inflow can be exported at the south Delta CVP and SWP pumping plants?
- How much of the Delta inflow can be exported at the BDCP north Delta intakes?

- How much of the inflow is needed for Delta outflow?

Answering these questions requires determining the most limiting (lowest) objective for south Delta exports, the most limiting (lowest) objective for north Delta intakes, and the most limiting (highest) objective for outflow. Because each alternative has a slightly different set of applicable rules with varying north Delta intake capacities, each BDCP alternative would have different Delta operations in many months.

Operational Requirements Influencing Maximum Allowable Exports

The first two rules govern the maximum CVP and SWP pumping capacities. Each alternative includes the CVP capacity of 4,600 cfs and assumes the existing south Delta SWP pumping capacity, as constrained by the Clifton Court Forebay limits (Rivers and Harbors Section 10) with additional diversions dependent on the San Joaquin River. SWP pumping to the maximum Banks pumping plant physical capacity of 10,300 cfs was assumed for BDCP alternatives that include north Delta intakes.

The export/inflow (E/I) ratio represents the volume of water pumped out of the Delta relative to the level of water flowing into the Delta. The E/I ratio, introduced in the 1995 WQCP, limits the CVP and SWP combined pumping to between 35% and 65% of the Delta inflow, varying by month and runoff conditions. This ratio was assumed to apply only to south Delta exports; BDCP north Delta intake diversions were assumed to be exempt from this rule. This parameter is therefore referred to as the *south Delta E/I ratio* as it has been applied to modeling for BDCP alternatives. In calculating the south Delta E/I ratio, then, Sacramento River inflow is considered to be downstream of the north Delta intakes.[11]

An additional limit that was imposed by the 2009 NMFS BiOp was a San Joaquin River inflow/export ratio that effectively limits the combined exports based on the SJR inflows during April and May.

Pumping from the south Delta can create upstream flows on the Old and Middle Rivers (OMR flow). These are also referred to as reverse or negative flows. The USFWS and NMFS BiOps introduced new limits on the reverse OMR flow in the months of December–June of many years (adaptively managed based on fish monitoring). The north Delta diversions that are proposed for each BDCP action alternative would allow these OMR limits to be satisfied while diverting additional water from the Sacramento River. The OMR limits will vary each year with fish and turbidity conditions. In addition, the CALSIM modeling assumed less negative OMR monthly limits that vary with water year type for some of the BDCP alternatives, reducing the allowable south Delta exports for those alternatives.

While physically outside the Delta, a final set of constraints on Delta exports is related to the storage capacity of San Luis Reservoir and seasonal (monthly) water supply deliveries that are assumed for south of Delta CVP and SWP contractors. The San Luis Reservoir provides about 2 million acre-feet (MAF) of seasonal storage for meeting the peak summer water demands. The San Luis Reservoir storage allows exports to continue through the fall and winter period. The No Action (described below) and BDCP action alternatives have similar assumptions about the seasonal water demands;

[11] With the exception of Scenarios H2 and H4, under which Sacramento River inflow was assumed to be upstream of the proposed north Delta intakes.

SWP exports include Article 21[12] deliveries to contractors with local storage capacity (e.g., surface reservoirs or groundwater storage). BDCP alternatives that allow the highest exports and fill San Luis Reservoir earlier each year will have the greatest Article 21 deliveries.

Operational Requirements Influencing Minimum Required Delta Outflow

In addition to rules controlling exports from the Delta, there are also several sets of rules governing Delta outflow. These include the minimum monthly outflows specified in D-1641 for each month, which often depend on the water year type (i.e., runoff conditions). These flow objectives were set to protect beneficial uses of Delta water for fish habitat. All the BDCP alternatives include these same D-1641 rules.

Delta outflow is also controlled by the maximum salinity objectives specified in D-1641 for each month or period. For example, salinity objectives are specified at certain Delta locations to protect agricultural diversions and drinking water supplies. Because Delta outflow is the major factor determining salinity within the Delta channels, these salinity objectives are satisfied by increasing Delta outflow. The Delta outflow required to meet these salinity objectives is simulated by evaluating historical outflow records (i.e., DAYFLOW) and salinity (electrical conductivity [EC] monitoring) to establish the relationship between these two metrics for each compliance location. The D-1641 salinity objectives are assumed to apply to the Existing Conditions, the No Action Alternative, and the BDCP action alternatives.[13]

Another set of rules controlling Delta outflow are the spring X2 objectives introduced in the 1995 WQCP. *X2*, the location of the 2 parts per thousand (ppt) salinity isohaline (i.e., the upstream edge of the low salinity zone), is specified on the basis of the month and the (unimpaired) runoff in the previous month. This objective supports several estuarine species whose abundance has been correlated with X2. This was formulated as an adaptive objective; the required outflow increased with higher runoff conditions.

The 2008 USFWS BiOp included an outflow requirement for September, October, and November of wet and above normal water year types. The *Fall X2* rule requires X2 to be at or downstream of Collinsville in above normal years and downstream of Chipps Island in wet years. The Fall X2 rule applies to the No Action Alternative and some of the BDCP action alternatives.

In addition, the State Water Board has recently explored additional operational rules that would require Delta outflow to be a specified percentage of monthly unimpaired flow (California State Water Resources Control Board 2010). This rule would be similar to the E/I ratio, but would be less negative in months with moderate runoff that was stored in upstream reservoirs. Because this possible Delta outflow rule would limit the total water diverted to storage or exported, higher

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[12] Article 21 water is one of several types of SWP water supply made available to SWP contractors under the long-term water supply contracts between DWR and SWP contractors. Article 21 water is provided for under Article 21 of the contracts. Unlike Table A water, which is an allocated annual supply made available for scheduled delivery throughout the year, Article 21 of each contract provides for delivery of water in addition to the Table A amounts when excess water is available in the Delta. Excess water is water reaching the Delta in excess of that needed to (i) meet in-basin needs (including fishery requirements), (ii) fill storage in San Luis Reservoir, and (iii) meet SWP contractor requests for Table A amounts. Article 21 water becomes available during wetter months of the year, generally December through March.

[13] An exception to D-1641 objectives is the proposal to change the compliance point from Emmaton to Threemile Slough. For the purposes of modeling, this assumption has been incorporated into the No Action Alternative, as well as each action alternative.

outflows might be expected in many months. BDCP Alternative 8 includes a monthly outflow/unimpaired flow percentage of 55% from January through June.

New Operational Rules for North Delta Intake Diversions

Fish protection at the proposed BDCP north Delta intakes would be provided by operational parameters that are related to maintaining seaward flow in the river and to continue the variability in flow that accompanies flow pulses, especially in key migratory months. Fish protection at the proposed BDCP north Delta intakes would also be provided by operational parameters that are screen approach velocity and sweeping velocity requirements. General daily or monthly rules for maximum allowable north Delta diversions were incorporated into the CALSIM modeling of each BDCP alternative. These new operational rules are referred to as *bypass flow* rules for the north Delta intakes. The bypass flow rule for July–September is assumed to be 5,000 cfs in all years. During these months, Sacramento River flow above 5,000 cfs could be diverted at the north Delta intakes, subject to the other Delta rules requiring minimum required Delta outflow. The minimum bypass flow in October and November was assumed to be 7,000 cfs in all years unless or until a pulse flow occurs on the Sacramento River near Wilkins Slough.

The BDCP north Delta intake diversion rules in December–June allow bypass flows to increase with the river inflow. Low-level pumping of 6% of the river flow would be allowed most of the time, but major diversions could not begin until the Sacramento River flow was greater than a specified threshold. The same set of monthly bypass rules was assumed for BDCP operational Scenarios A, B, C, D, and H. A different set of bypass rules is shared by operational Scenarios E and F. These bypass rules control how much of the Delta exports are diverted from the north Delta intakes. While the physical facilities and capacities are specified for each BDCP alternative, these bypass rules could be modified in the future under the adaptive management program as the results of fish monitoring in the vicinity of the new intakes are evaluated. For the evaluation of BDCP alternatives in this EIR/EIS, the north Delta intake bypass rules are assumed to be identical for Alternatives 1A through 6C, with a different set of rules applying to Alternatives 7 and 8 (none are needed for Alternative 9 [Scenario G]).

Summary Comparison of BDCP Operational Scenarios for Alternatives

Table 3-6 provides a summary of the major Delta objectives (rules) for determining the maximum allowable exports and the minimum required outflow under each BDCP alternative. The existing rules are included in the No Action Alternative operations. Each BDCP operational scenario includes many of the No Action rules as well as several modified or new rules. The operational scenarios are described briefly below and in more detail in Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*.

- Operational elements common to all scenarios include physical limits of SWP and CVP south Delta pumping plants, available San Luis Reservoir storage, SWP Article 21 delivery, seasonal SWP and CVP delivery patterns, minimum monthly specified outflow, maximum salinity for Delta diversions, and maximum Spring X2 location.
- Scenario A would include most No Action objectives for south Delta exports and required Delta outflow; however, Scenario A does not include Fall X2 objectives nor the SJR inflow/export ratio. Scenario A includes new criteria for north Delta diversion bypass flows and assumed operations of the proposed Fremont Weir (notch) during high Sacramento River flows. The minimum bypass flow ranges from 5,000 to over 15,000 cfs, depending on time of year. Numerical bypass

rules are described in more detail later in this chapter. Scenario A was used in the CALSIM modeling for Alternatives 1A, 1B, 1C, and 3. Different north Delta diversion capacities would influence the volume of pumping from the south Delta, resulting in variation of Delta operations.

- Scenario B would include the Fall X2 criteria, but not the SJR inflow/export ratio. Scenario B would also include less negative OMR flow limits, and an operable barrier at the head of Old River. All other No Action rules were assumed to apply, and the north Delta intake bypass rules would be the same as those under Scenario A. Operational Scenario B was used in the CALSIM modeling for Alternatives 2A, 2B, and 2C.
- Scenario C would incorporate all the No Action rules. The north Delta intake bypass flow rules would be the same as those under Scenario A. Operational Scenario C was used in the CALSIM modeling for Alternative 5. The north Delta operations were limited because of the reduced conveyance capacity, entailing a single 3,000 cfs intake on the Sacramento River.
- Scenario D would eliminate use of the south Delta intakes (i.e., an isolated north Delta conveyance only) and would use the same north Delta intake bypass flow rules as those under Scenario A. None of the existing south Delta export rules would apply, including the E/I ratio. All the No Action outflow rules would apply. Operational Scenario D was used in the CALSIM modeling for Alternatives 6A, 6B, and 6C.

1 **Table 3-6. Comparison of Operational Rules under BDCP Operational Scenarios and Alternatives**

Operational Scenario Alternative	Applicable Months	No Action	Scenario A Alt 1	Scenario B Alt 2	Scenario A Alt 3	Scenario H Alt 4	Scenario C Alt 5	Scenario D Alt 6	Scenario E Alt 7	Scenario F Alt 8	Scenario G Alt 9
Delta Operational Rules Controlling Maximum Allowable CVP and SWP South Delta Exports											
Physical/Permitted Limit for CVP (4,600 cfs)	Jan–Dec	X	X	X	X	X	X	X	X	X	X
Physical Limit for SWP (10,300 cfs)	Jan–Dec	X	X	X	X	X	X	X	X	X	X
Permitted Limit for SWP (6,680 cfs plus 1/3 of San Joaquin River Dec 15–March 15)	Jan–Dec	X	O	O	O	O	X	O	O	O	X
Export/Inflow Ratio (65% Jul–Jan; 35% Feb–Jun)	Jan–Dec	X	X[a]	X[a]	X[a]	X[a]	X[a]	O	X[a]	X[a]	X
SJR Inflow/Export Ratio	Apr–May	X	O	O[b]	O	O[b]	X	O	X[c]	X[c]	O[d]
Reverse Old and Middle River Flows	Dec–Jun	X	X	X[e]	X	X[e]	X	O	X[f]	X[f]	X
Available San Luis Reservoir Storage	Jan–Dec	X	X	X	X	X	X	X	X	X	X
SWP Article 21 Delivery (when San Luis Reservoir is Full)	Jan–Dec	X	X	X	X	X	X	X	X	X	X
Seasonal CVP and SWP Delivery Pattern	Jan–Dec	X	X	X	X	X	X	X	X	X	X
Delta Operational Rules Controlling Minimum Required Delta Outflow											
Minimum Monthly Specified Outflow	Jan–Dec	X	X	X	X	X	X	X	X	X[g]	X
Maximum Salinity (EC) for Delta Diversions	Jan–Dec	X	X	X	X	X	X	X	X	X	X
Maximum Spring X2 Location	Feb–Jun	X	X	X	X	X[h]	X	X	X	X	X
Maximum Fall X2 Location	Sep–Oct	X	O	X	O	X[h]	X	X	X	X	X

Operational Scenario Alternative	Applicable Months	No Action	Scenario A Alt 1	Scenario B Alt 2	Scenario A Alt 3	Scenario H Alt 4	Scenario C Alt 5	Scenario D Alt 6	Scenario E Alt 7	Scenario F Alt 8	Scenario G Alt 9
New Operational Rules Controlling Maximum North Delta Intake Diversions											
Maximum Capacity of North Delta Intakes (cfs)	N/A	None	15,000	15,000	6,000	9,000	3,000	15,000	9,000	9,000	None
Bypass Flows (% of Sacramento River at Freeport)	Jan–Dec	O	X	X	X	X	X	X	X	X	O

Note:

"X" indicates that a BDCP alternative incorporates an operational rule.

"O" indicates that a BDCP alternative does not incorporate that operational rule.

[a] In computing the E/I ratio for these scenarios, the Sacramento River inflow is considered to be downstream of the north Delta intakes, with the exception of Scenarios H2 and H4, for which Sacramento River inflow was assumed to be upstream of the proposed north Delta intakes.

[b] Under these scenarios, a different strategy was applied to achieve similar objectives as the SJR I/E ratio.

[c] SJR I/E ratio is applicable December through June and therefore would apply for five months longer than under the No Action Alternative.

[d] SJR I/E ratio is applicable when the San Joaquin River flow at Vernalis is greater than 10,000 cfs.

[e] More restrictive/protective than Scenario A.

[f] More restrictive/protective than Scenario B.

[g] More restrictive/protective than in the No Action Alternative; the Delta outflow requirement is expressed as a percent of unimpaired flow.

[h] For Alternative 4, additional spring outflow will be determined based on the results of the decision tree process. Maximum Fall X2 Location will also be determined by the decision tree process under Alternative 4.

- Scenario E would use north Delta bypass rules modified from those under Scenario A. Scenario E assumed less negative OMR limits and more restrictive SJR inflow/export ratios (December–March and June) and would eliminate south Delta exports in April and May. Scenario E would include all of the No Action outflow rules, including Fall X2. Operational Scenario E was used in the CALSIM modeling for Alternative 7.
- Scenario F would use the same rules as Scenario E, but would be modified to include specific Delta outflow criteria and cold water pool management criteria for specific reservoirs. Operational Scenario F was used in the CALSIM modeling for Alternative 8.
- Scenario G would include all the No Action rules for south Delta exports and Delta outflow, including the Fall X2 criteria. There would not be any north Delta bypass flow rules; diversions at the proposed fish screens on Delta Cross Channel and Georgiana Slough would be controlled by tidal hydraulics and the Delta Cross Channel gate closure rules. Operational Scenario G was used in the CALSIM modeling for Alternative 9. All the south Delta export rules were applied for CALSIM modeling, although the SJR inflow/export ratio would not be required because the migrating SJR fish would be separated from the exports. The No Action OMR flow restrictions would apply.
- Scenario H would include less negative OMR flow limits and an operable barrier at the head of Old River. All other No Action rules were assumed to apply except the SJR inflow/export ratio, and the north Delta intake bypass rules would be the same as those under Scenario A. Delta Outflow under Scenario H would be determined by the outcome of the decision tree process needed to account for scientific uncertainties related to spring outflow and Fall X2 requirements for delta and longfin smelt, salmonids, and sturgeon. Thus, there are different potential outflow requirements that could be used for spring and fall. The decision tree process and outcomes are described further in Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*, for Scenario H. Operational Scenario H was used in the CALSIM modeling for Alternative 4.

Each of the BDCP operational scenarios can be compared with the assumed No Action Delta operational rules listed in Table 3-6. Chapter 5, *Water Supply*, and Chapter 6, *Surface Water,* provide a more detailed description and evaluation of the different Delta operations that resulted from the CALSIM modeling of each BDCP alternative. Delta operations are the combination of the Delta inflow, the assumed Delta operational rules, and the assumed capacity and bypass flow rules for the new BDCP facilities.

3.4.2 Overview of Conservation Components

A primary conservation goal of the BDCP is to protect, restore, enhance, and manage tidal, riparian, and seasonally inundated floodplain habitats for the benefit of fish, wildlife, plants, and ecosystem processes in the Plan Area. Habitat restoration, enhancement, and management activities are covered activities under the BDCP; they include all actions that may be undertaken to implement the physical habitat conservation measures. Each action alternative includes activities intended to address conservation needs across a variety of habitat types and locations. This EIR/EIS describes and analyzes these components at a program level. These activities are described in detail in Section 3.6.2, *Conservation Components*.

The BDCP physical habitat conservation program is organized geographically across the northern, eastern, southern, and western regions of the Plan Area. It is also organized by habitat type, as well as temporally into NT and LT implementation phases.

Each of the action alternatives would include implementation of protection, restoration, enhancement, and management activities, as summarized below.

- Restoration, protection, and enhancement of the following natural community/habitat types would be undertaken under all action alternatives: freshwater and brackish tidal, subtidal, and transition habitats; seasonally inundated floodplain; channel margin; riparian habitat; grassland communities; vernal pool complex; alkali seasonal wetland complex; managed seasonal wetland; nontidal perennial emergent wetland and nontidal perennial aquatic; inland dune scrub; and cultivated lands. Target acreages would vary for some alternatives; these are discussed in detail in Section 3.6.2.
- Management plans would be prepared and implemented for protected natural communities and covered species that occupy those communities. The following natural communities would receive protection, restoration, creation, and enhancement, and would be incorporated into a conservation reserve system: tidal perennial aquatic; tidal mudflat; tidal brackish and emergent wetland; tidal freshwater emergent wetland; valley/foothill riparian; grassland; nontidal freshwater perennial emergent wetland; nontidal perennial aquatic habitat; alkali seasonal wetland complex; vernal pool complex; managed wetland; and inland dune scrub. Although not considered a natural community, cultivated lands are nonetheless a part of the BDCP conservation strategy because, in certain instances, they provide value as habitat for covered species.

3.4.3 Overview of Conservation Components Related to Reducing Other Stressors

The BDCP has identified several issues, beyond water exports and habitat conditions, that affect the survival of covered fish species in the Delta. These *other stressors* include but are not limited to exposure to contaminants, competition, predation and other changes to the ecosystem caused by nonnative species, entrainment at water intake pumps not operated by SWP and CVP, and fish passage. BDCP will implement measures intended to address the effects of other stressors (CM12–CM21; Tables 3-3 and 3-4) under all alternatives except the No Action Alternative.[14] Section 3.6.3 provides a detailed description of these components.

- Control of methylmercury load in BDCP conservation sites.
- Control of nonnative submerged and floating aquatic vegetation in BDCP tidal habitat restoration.
- Improvement of dissolved oxygen levels in the Stockton Deep Water Ship Channel (DWSC) when covered species are present.
- Temporary reduction of local effects of predators on covered fish species.

[14] With the BiOps, specific species' recovery plans, and the federal and state regulatory agency actions that monitor some of the other stressors listed (e.g., invasive species control, stormwater runoff), the No Action Alternative could involve reduction of several of these other stressors; however, it would be speculative to assess which would be substantively addressed and to what extent.

- Installation of nonphysical barriers to improve survival of emigrating juvenile salmonids at channel junctions.
- Fund efforts to reduce illegal harvest of covered fish species.
- Establishment of new and expansion of existing conservation propagation programs for delta smelt and longfin smelt.
- Fund efforts to treat pollutant runoff from urban stormwater.
- Support current efforts to reduce the risk of introduction of invasive species by recreational vessels.
- Support installation of screens and alteration of nonproject diversions, as appropriate, to reduce the risk of entrainment of covered fish species.
- Implement avoidance and minimization measures to minimize effects on covered species and natural communities that could result from BDCP covered activities, rather than from other stressors.

3.5 Alternatives

As described in Chapter 1, Section 1.6.1, *Overview of BDCP Approval Process*, USFWS and NMFS are considering whether to issue ITPs under ESA Section 10(a)(1)(B) for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other covered activities as described in the BDCP (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage). An HCP will be submitted as part of the ITP applications. The HCP describes activities that would be covered by the ITPs, the species for which incidental take would be authorized, and measures that would, to the maximum extent practicable, minimize the adverse effects on the covered species resulting from implementation of the covered activities, and mitigate any remaining adverse effects through the protection, restoration, creation, and/or enhancement of habitat for the covered species. Reclamation's action in relation to the BDCP would be to adjust CVP operations specific to the Delta to accommodate new conveyance facility operations and/or flow requirements under the BDCP, in coordination with SWP operations. CDFW is considering whether to issue permits under Section 2835 of the Fish and Game Code.

The 15 action alternatives for BDCP differ in the location, design, and operation of conveyance facilities/improvements implemented under CM1. With the exception of the NEPA No Action Alternative, which also functions as the CEQA No Project Alternative, each alternative selected for detailed evaluation in this EIR/EIS would involve some level of construction of conveyance facilities/improvements to the system for diverting water to the existing SWP and CVP south Delta export facilities. Additionally, as noted above, each action alternative would include operational criteria for the water supply infrastructure, habitat conservation components, and measures to mitigate the impact of other stressors on covered species. Issuance of ITPs and an NCCP permit is also a common element of all of the action alternatives. Table 3-1 provides a summary of the alternatives evaluated in the EIR/EIS.

In general, the numbering of alternatives in this EIR/EIS reflects the fact that three sets of three alternatives share many common elements and only one or a handful of differences. Thus, Alternatives 1A, 1B, and 1C would all involve *dual conveyance* scenarios with a total of 15,000 cfs of capacity operated under *Operational Scenario A*, developed in early 2010. They differ only in that Alternative 1A would use a pipeline/tunnel, rather than a surface canal, as its major conveyance facility. Alternative 1B would entail an eastside canal, while Alternative 1C would entail a combination of a westside canal and pipeline/tunnel. Similarly, Alternatives 2A, 2B, and 2C would use the same three dual conveyance designs as 1A, 1B, and 1C with a total capacity of 15,000 cfs, but they would be operated under Operational Scenario B rather than Scenario A. Scenario B was developed in early 2011 and reflects a greater degree of input from USFWS, NMFS, and CDFW than does Scenario A. Alternatives 6A, 6B, and 6C represent a similar approach—that is, they use the same respective physical alignments as 1A, 1B, and 1C—but they would constitute an *isolated conveyance* facility with 15,000 cfs of capacity operated under Scenario D, which is a modification of Scenario A, eliminating the use of south Delta intakes. Most action alternatives share the same set of conservation components, with variations incorporated into Alternatives 5, 7, and 9. All action alternatives share the same measures to reduce other stressors.

As described in more detail in Appendix 3A, *Identification of Water Conveyance Alternatives for Bay Delta Conservation Plan Environmental Impact Report/Environmental Impact Statement (Screening Report) (Conservation Measure 1)*, these alternatives, with the exception of the No Action/No Project Alternative, which is required by CEQA and NEPA, have each been formulated to meet the purpose and need; achieve all or most of the BDCP objectives (which incorporate and add to the BDCP purpose statement; see Chapter 2, *Project Objectives and Purpose and Need,* for more detail); and have some potential to avoid or substantially lessen the adverse effects of the proposed BDCP. Accordingly, they were carried forward for detailed evaluation in this EIR/EIS. (For ease of reference, the No Action/No Project Alternative is hereinafter referred to simply as the No Action Alternative.)

The alternatives differ primarily in their physical conveyance facility infrastructure/improvements, the locations of facilities, and diversion capacities. Other differences are associated with operational criteria for water supply facilities and the acreage of habitats that would be restored or enhanced. The major physical/structural components of each alternative are summarized in Table 3-5. The alternatives are described in detail below.

3.5.1 No Action Alternative

CEQ regulations for implementing NEPA require an EIS to include evaluation of a No Action Alternative (40 CFR 1502.14). At the Lead Agencies' discretion under NEPA, the No Action Alternative may be described as the future circumstances without the proposed action and can also include predictable actions by persons or entities, other than the federal agencies involved in a project action, acting in accordance with current management direction or level of management intensity. When the proposed action involves updating an adopted management plan or program, the No Action Alternative includes the continuation of the existing management plan or program. The CEQ suggests that the No Action Alternative may provide a benchmark that allows decision makers to compare the magnitude of environmental effects of the action alternatives (46 Fed. Reg. 18026 [March 23, 1981]). Accordingly, this EIR/EIS uses the No Action Alternative as the point of comparison for determining impacts of the federal action under NEPA.

Under CEQA, an EIR is required to analyze the No Project Alternative. The No Project Alternative allows decision makers to use the EIR to compare the impacts of approving the proposed project with the future conditions of not approving the proposed project. Under CEQA, the No Project Alternative is not the baseline for assessing the significance of impacts of the proposed project. The

CEQA baseline for assessing significance of impacts of any proposed project is normally the environmental setting, or existing conditions, at the time a Notice of Preparation (NOP) is issued (State CEQA Guidelines Section 15125[a]). State CEQA Guidelines Section 15126.6, Subdivision (e)(2) indicates that No-Project conditions may include some reasonably foreseeable changes in existing conditions and changes that would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services.

Under the No Action Alternative, DWR and Reclamation would continue to operate the SWP and the CVP, respectively, to divert, store, and convey SWP and CVP water consistent with applicable laws and contractual obligations. The SWP and the CVP are major water storage and delivery systems that divert water from the southern portion of the Delta. The SWP and CVP both include major reservoirs upstream of the Delta and transport water via natural watercourses and canal systems to areas south and west of the Delta. The CVP also includes facilities and operations on the Stanislaus and San Joaquin Rivers.

Under the No Action Alternative, existing CVP facilities in the Delta, including Delta Cross Channel, the Jones Pumping Plant (formerly Tracy Pumping Plant), the Tracy Fish Collection Facility, and the Delta Mendota Canal (DMC) would continue to be operated consistent with applicable laws and contractual obligations. The Delta Cross Channel is a gated diversion channel in the Sacramento River near Walnut Grove and Snodgrass Slough. Flows into the Delta Cross Channel from the Sacramento River are controlled by two 60-foot by 30-foot radial gates. When the gates are open, water flows from the Sacramento River through the cross channel to channels of the lower Mokelumne and San Joaquin Rivers toward the interior Delta. The Delta Cross Channel operation improves water quality in the interior Delta by improving circulation patterns of good quality water from the Sacramento River towards Delta diversion facilities. The CVP uses the Sacramento River, San Joaquin River, and Delta channels to transport water to the export pumping plant located in the south Delta. The CVP's Jones Pumping Plant, about 5 miles north of Tracy, consists of six available pumps. The Jones Pumping Plant is located at the end of an earth-lined intake channel about 2.5 miles in length. At the head of the intake channel, louver screens intercept fish, which are then collected, held, and transported by tanker truck to release sites far away from the pumping plants. Jones Pumping Plant has a permitted diversion capacity of 4,600 cfs with historical maximum pumping rates typically ranging from 4,500 to 4,300 cfs during the peak of the irrigation season and approximately 4,200 cfs during the winter non-irrigation season. The winter-time constraints at the Jones Pumping Plant are the result of a DMC freeboard constriction between Jones Pumping Plant and O'Neill Forebay, O'Neill Pumping Plant capacity, and the current water demand in the upper sections of the DMC.

Similarly, under the No Action Alternative, SWP facilities in the Delta, including Clifton Court Forebay, John E. Skinner Fish Protective Facility, and the Banks Pumping Plant, would continue to be operated consistent with applicable laws and contractual obligations. Clifton Court Forebay is a 31,000 acre-foot reservoir located in the southwestern edge of the Delta, about 10 miles northwest of Tracy. Clifton Court Forebay provides storage for off-peak pumping, moderates the effect of the pumps on the fluctuation of flow and stage in adjacent Delta channels, and collects sediment before it enters the California Aqueduct. Diversions from Old River into Clifton Court Forebay are regulated by five radial gates. The Skinner Fish Facility is located west of the Clifton Court Forebay, 2 miles upstream of the Banks Pumping Plant. The Skinner Fish Facility screens fish away from the pumps that lift water into the California Aqueduct. Large fish and debris are directed away from the facility by a 388-foot long trash boom. Smaller fish are diverted from the intake channel into bypasses by a series of metal louvers, while the main flow of water continues through the louvers and towards the pumps. These fish pass through a secondary system of screens and pipes into seven holding tanks, where a subsample is counted and recorded. The salvaged fish are then returned to the Delta in oxygenated tank trucks. The Banks Pumping Plant is in the south Delta, about 8 miles northwest of Tracy, and marks the beginning of the California Aqueduct. By means of 11 pumps, including two rated at 375 cfs capacity, five at 1,130 cfs capacity, and four at 1,067 cfs capacity, the plant provides the initial lift of water 244 feet into the California Aqueduct. The nominal capacity of the Banks Pumping Plant is 10,300 cfs. Further description of CVP and SWP facilities and their operation is provided in Chapter 5, Section 5.1.2, *SWP and CVP Facilities and Operations*.

Under the No Action Alternative, the federal ITPs related to the proposed BDCP would not be issued and the applicant would remain subject to the take prohibition for listed species and other ESA requirements. Ongoing activities or future actions that may result in the incidental take of federally listed species would need to be permitted through ESA Section 7 or Section 10. Similarly, permits would not be issued by CDFW under Section 2835 of the Fish and Game Code. For this analysis, the No Action Alternative assumptions are limited to Existing Conditions, programs adopted during the early stages of development of the EIR/EIS, facilities that are permitted or under construction during the early stages of development of the EIR/EIS, projects that are permitted or are assumed to be constructed by 2060, and changes due to climate change and sea level rise that would occur with or without the proposed action or alternatives (Appendix 3D, *Defining Existing Conditions, the No Action/No Project Alternative, and Cumulative Impact Conditions*). These assumptions represent continuation of the existing plans, policies, and operations and conditions that represent continuation of trends in nature.

Because the BDCP No Action Alternative assumptions are consistent with the requirements and limitations prescribed by CEQA, from this point forward in this document, the No Action Alternative also represents the No Project Alternative. For ease of reference, the joint No Action/No Project Alternative is referred to as the No Action Alternative. The No Action Alternative assumptions include the basic description of the No Action Alternative, assumptions related to the SWP and CVP, ongoing programs and policies by governmental and nonprofit entities, projections related to climate change, and assumptions related to annual actions that vary every year. Among the ongoing programs by governmental entities which are included in the No Action Alternative are many of the actions required by the 2008 and 2009 USFWS and NMFS BiOps. The following summarizes which actions are reflected in the No Action Alternative.

- The anticipated effects of actions required by the 2008 and 2009 BiOps that have already occurred or are expected to be implemented prior to BDCP approval are assumed in the No Action Alternative.
- The anticipated effects of actions required by the 2008 and 2009 BiOps that change water operations in the Plan Area or upstream were assumed in the No Action Alternative if they were reasonably certain to occur and enough was known about the effects of the action in early 2010 (when the No Action Alternative for hydrodynamic modeling was established) to define modeling assumptions for the change in water operations.[15]
- The anticipated effects of some actions required by the 2008 and 2009 BiOps in the Plan Area are also included in the BDCP conservation strategy. In some cases, these actions are included in

[15] For a detailed explanation about these modeling assumptions, see EIR/EIS Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*.

the No Action Alternative and in other cases they are not. A key reason for these assumptions is that the 2008 and 2009 USFWS and NMFS BiOps will be superseded by the BDCP and associated BiOps. As described in Chapter 1, *Introduction*, the current operation of the CVP/SWP is governed by requirements that include the 2008 and 2009 BiOps. The requirements of these BiOps may be modified in response to a court ordered remand process, depending on the schedule approved by the court. The new operation of BDCP will occur once the new north Delta intakes are constructed. Once the new intakes are operational, the BDCP and any corresponding BiOps will replace the then-current BiOps for long-term operation of the CVP/SWP.

- Examples of effects assumed in the No Action Alternative, but that are also associated with BDCP conservation measures, include the effects of operations of the Delta Cross-Channel Gates (NMFS Action IV.12) and those related to measures to reduce entrainment at the south Delta export facilities (NMFS Action IV.3). An example of the effects of actions that are attributable to the BDCP and not assumed in the No Action Alternative include Yolo Bypass improvements and tidal marsh restoration (NMFS Actions I.6.1, I.6.2, and I.7; USFWS Action Reasonable and Prudent Alternative Component 4). More discussion of these assumptions is provided below.
- In some cases, RPA actions also included in BDCP were modified to take into account new scientific information available since the BiOps were issued, or additional planning done for BDCP beyond what was developed for the BiOps. Examples of this include *CM16 Non-physical Fish Barriers*, which is similar to, but much more defined and specific than, NMFS Action IV.1.3.
- Requirements of the 2008 and 2009 BiOps that call for conducting planning or feasibility studies with undefined outcomes were not assumed in the No Action Alternative. By themselves, these planning or feasibility studies would have no effect on environmental conditions. Their outcomes are unknown at this time and therefore too speculative to include in the No Action Alternative. Further environmental compliance, permitting, and ESA and California Endangered Species Act (CESA) compliance would be needed to implement any recommendations of these future studies. Examples include fish passage over SWP/CVP terminal dams such as Shasta (NMFS Actions NF4.4 and LF2).
- Requirements of the 2008 and 2009 BiOps that involve reporting, monitoring, or research actions are not assumed in the No Action Alternative because they are not expected to affect the environment or covered species (monitoring and research actions required by the BiOps are discussed in Section 3.6, *Adaptive Management and Monitoring Program* in Chapter 3 of the BDCP).

As mentioned above, the BiOp actions related to the Yolo Bypass improvements and floodplain restoration were not included in the No Action Alternative and have been assumed to occur under the BDCP in *CM2 Yolo Bypass Fisheries Enhancement*. This decision was made for the following reasons:

- At the time the 2009 BiOp was issued, the RPA actions (NMFS Actions I.6.1, I.6.2, and I.7) did not contain detail sufficient to include them in the hydrodynamic modeling or to determine the future effects of the actions. Action I.6.1 required Reclamation and DWR to submit to NMFS by December 31, 2011, a "plan to implement this action." The Action specified a range of options to consider and a list of potential constraints on those options (e.g., operations of Shasta). A similar plan was required in the related Actions I.6.2 and I.7. Reclamation and DWR submitted a plan in compliance with these RPA actions.

- As described above, portions of the 2008 and 2009 USFWS and NMFS BiOps would be superseded by the BDCP and its associated BiOp for operation of CVP/SWP in the Delta, including the operations of the Yolo Bypass. Therefore, the requirements in the 2008 and 2009 BiOps in the Plan Area that overlap with BDCP, including the Yolo Bypass Actions, will apply until the new north Delta intakes are operational.
- Early in the BDCP planning process, it was assumed that the BDCP may become the vehicle to implement actions in the Yolo Bypass. However, Reclamation and DWR continue to develop environmental documents consistent with the RPA in coordination with the BDCP process.
- The BDCP proposes actions in the Yolo Bypass that go beyond those in the NMFS 2009 BiOp actions. *CM2 Yolo Bypass Fisheries Enhancement* includes 20 *component projects* that are to be implemented in four phases (years 1 to 5, 6 to 10, 11 to 25, and 26 to 50). The NMFS BiOp Actions in the Yolo Bypass are subsumed within these component projects, but at a much greater level of detail and analysis than presented in the 2009 NMFS BiOp. CM2 also includes more actions in the Yolo Bypass than proposed in the 2009 NMFS BiOp. An example of the additional detail and analysis in BDCP is provided by CM2 Component Projects 6 (*Experimental Sturgeon Ramps at Fremont Weir*) and 7 (*Auxiliary Fish Ladders at Fremont Weir*). While these projects would be considered similar to NMFS Action I.7 (*Reduce Migratory Delays and Loss of Salmon, Steelhead, and Sturgeon at Fremont Weir and Other Structures in the Yolo Bypass*), BDCP includes more detail about how and where these structures would be built (e.g., location, conceptual designs) and what performance measures they would have (e.g., BDCP biological objectives specify maximum passage delay times for salmon and sturgeon at the Fremont Weir) than is found in the NMFS Action I.7. This additional detail was not known at the time of the NMFS 2009 BiOp and therefore could not be modeled in the No Action Alternative. Similarly, the 2008 USFWS Action RPA Component 4 related to the restoration of 8,000 acres of tidal habitat was not included in baseline modeling assumptions. Although tidal habitat restoration may occur prior to the implementation of the BDCP, generally, this restoration will be part of CM4 and is analyzed at a program level in this EIR/EIS.

The detailed elements of the No Action Alternative are presented in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact Conditions.*

As noted above, the assumptions for the No Action Alternative, as they relate to ongoing operation of the SWP/CVP, are limited to what is reasonably foreseeable under existing and adopted programs in light of predicted conditions reflecting ongoing climate change. The inherent challenge in envisioning No Action conditions nearly half a century away (2060) has required the Lead Agencies to make some informed judgments about what might happen outside the immediate SWP/CVP context during such an extended time period. It is likely that, over the course of nearly five decades, conditions influencing water supply throughout California will change in numerous ways. Since such changes could affect how the SWP and CVP under the BDCP would operate within a larger water supply framework, the analysis of the No Action Alternative in this EIR/EIS is intended to identify the predictable or foreseeable actions of California water suppliers other than DWR and Reclamation under a long-term scenario in which a BDCP is not approved or implemented. As is explained throughout this EIR/EIS, such conditions would likely entail continuing uncertainty of SWP/CVP south Delta exports, continuing vulnerability in the south Delta to long-term reductions in water quality due to sea level rise, and continuing vulnerability resulting from a major seismic event harming Delta facilities so as to temporarily halt export operations. Further discussion of these risks and their potential consequences is incorporated in Appendix 3E, *Potential Seismic and Climate Change Risks to SWP/CVP Water Supplies*.

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

3.5.2.1 Physical and Operational Components

Under Alternative 1A, water would primarily be conveyed from the north Delta to the south Delta through pipelines/tunnels. Water would be diverted from the Sacramento River through five fish-screened intakes on the east bank of the Sacramento River between Clarksburg and Walnut Grove. Water would travel in pipelines from the intakes to a sedimentation basin and solids lagoon before reaching the intake pumping plants. From the intake pumping plants water would be pumped into another set of pipelines to an intermediate forebay (via a transition structure) or to a tunnel (Tunnel 1) that would also carry water to the intermediate forebay. An emergency spillway would prevent the intermediate forebay from overtopping by spilling to an adjacent approximately 350-acre inundation area. From this forebay, water would be pumped by an intermediate pumping plant or conveyed by a gravity bypass system into a dual-bore tunnel (Tunnel 2) that would run south to a new forebay near Byron Tract, adjacent to Clifton Court Forebay. This arrangement would enhance water supply operational flexibility, using forebay storage capacity to regulate flows from north Delta intakes and flows to south Delta pumping plants. Byron Tract Forebay would be designed to provide water to Jones pumping plant 24 hours per day.

A map and a schematic diagram depicting the conveyance facilities associated with Alternative 1A are provided in Figures 3-2 and 3-3. Figure 3-2 shows the major construction features associated with this proposed water conveyance facility alignment; a detailed depiction is provided in Figure M3-1 in the Mapbook Volume. Note that not all these structures would be constructed under this alternative. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-7.

New connections would be constructed between the new Byron Tract Forebay and the Banks and Jones pumping plants, along with control structures to regulate the relative quantities of water flowing from the north Delta and the south Delta. Alternative 1A would entail the continued use of the SWP/CVP south Delta export facilities.

Alternative 1A would include the following new water conveyance facilities components, which are described in detail in Section 3.6.1, *Water Conveyance Facility Components (CM1)*.

- Five north Delta intakes with fish screens along the east bank of the Sacramento River (Intakes 1–5).
- Pipelines conveying water from intakes to intake pumping plants.
- Sedimentation basins and solids handling facilities.
- Intake pumping plants at each intake location; associated facilities include an access road, electrical substation, communication devices, and transformers.
- Discharge pipelines conveying water from intake pumping plants to an initial tunnel (Tunnel 1) or a transition structure.
- Two surge towers at pumping plants for Intakes 1 and 2.

- Transition structures, such as stop logs and vents, between discharge pipelines and larger conveyance pipelines.
- Conveyance pipelines between transition structures and intermediate forebay transition structures with radial gates and stop logs.
- An intermediate forebay.
- An intermediate forebay gravity bypass that would allow water in the intermediate forebay to be diverted by gravity to either bore of Tunnel 2.
- An approximately 350-acre designated inundation area to temporarily contain overflow, conveyed by an emergency spillway, from the intermediate forebay.
- An intermediate pumping plant that would pump water from the intermediate forebay into Tunnel 2; associated features would include an access road, electrical substations, and transformers.
- Two tunnels (Tunnel 2) between the intermediate pumping plant and Byron Tract Forebay.
- Byron Tract Forebay, adjacent to and south of Clifton Court Forebay, with large-diameter TBM launch/retrieval shafts and vent shafts at approximately 3-mile intervals.
- Connections and control structures to the Banks and Jones pumping plants.
    - A canal and set of gates between Byron Tract Forebay and the approach canal to the Banks pumping plant.
    - A set of gates in the approach canal to the Banks Pumping Plant upstream of the connection to Byron Tract Forebay.
    - A set of gates at the outlet between the embankment of the Byron Tract Forebay and the approach canal to the Jones pumping plant.
    - A set of gates in the approach canal to the Jones Pumping Plant upstream of the connection to Byron Tract Forebay.
- Transmission lines running from the existing electrical grid to project substations.
- Borrow, spoils, and RTM storage/disposal areas.

Table 3-7. Summary of Physical Characteristics under Alternatives 1A, 2A, and 6A

Feature Description/Surface Acreage[a]	Approximate Characteristics
Overall project	
Conveyance capacity (cfs)	15,000
Overall length (miles)	45
Intake facilities/approximately 60 acres average per site	
Number of on-bank fish-screened intakes	5
Maximum diversion capacity at each intake (cfs)	3,000
Intake pumping plants/(included with intake facilities)	
Six pumps per intake plus one spare, capacity per pump (cfs)	500
Total dynamic head (ft)	30–57
Tunnels/370 acres (permanent subsurface easement = 1,860 acres)	
Tunnel 1 connecting Intakes 1 and 2 to the intermediate forebay, maximum flow 6,000 cfs	
Tunnel length (ft)	20,000
Number of tunnel bores; number of shafts (total)	1; 2
Tunnel finished inside diameter (ft)	29
Tunnel 2 connecting intermediate pumping plant to Byron Tract Forebay, maximum flow 15,000 cfs	
Tunnel length (ft)	183,000
Number of tunnel bores; number of shaft sites (total)	2; 13
Tunnel finished inside diameter (ft)	33
Intermediate forebay/925 acres	
Water surface area (acres)	760
Active storage volume (af)	5,250
Emergency spillway inundation area (acres)	350
Intermediate pumping plant (at southern end of intermediate forebay)	
Number of pumps, capacity per pump (cfs)	10 at 1,500 (high head) 6 at 1,500 (low head)
Total dynamic head (ft)	0–90
Byron Tract Forebay/840 acres	
Water surface area (acres)	600
Active storage volume (af)	4,300
Power requirements	
Total conveyance electric load (MW)	182

af = acre-feet.
cfs = cubic feet per second.
ft = feet.
MW = megawatt.

[a] Acreage estimates represent the permanent surface footprints of selected facilities. Characteristics of other areas including temporary work areas and those designated for borrow, spoils, and resuable tunnel material storage are reported in Appendix 3C. Overall project acreage includes some facilities not listed, such as permanent access roads.

Facilities under Alternative 1A would be operated to provide diversions up to a total of 15,000 cfs from the new north Delta intakes. The total diversion capacity for the south Delta export facilities would remain constant at 15,000 cfs due to the limited capacity of downstream conveyance structures, but the north Delta facilities would provide flexibility in where water is being diverted from (north vs. south Delta). Operations of the existing SWP/CVP south Delta export facilities would continue as described in Section 3.5.1 for the No Action Alternative.

Alternative 1A water conveyance operations would follow the criteria described as Operational Scenario A and would include criteria for north Delta diversion bypass flows, south Delta OMR flows, south Delta E/I ratio[16], flows over Fremont Weir into Yolo Bypass via operable gates, Delta inflow and outflow, Delta Cross Channel gate operations (in addition to NMFS BiOp Action IV.1.2), additional Rio Vista minimum flow requirements, operations for Delta water quality and residence, and water quality for agricultural and municipal/industrial diversions. These criteria are discussed in detail in Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*.

3.5.2.2 Conservation Components

Alternative 1A includes activities intended to address conservation needs across a variety of habitat types and locations. Activities would be carried out in the habitat types and amounts listed below. These activities are described in detail in Section 3.6.2.

- 65,000 acres of restored tidal perennial aquatic, tidal mudflat, tidal freshwater emergent wetland, and tidal brackish emergent wetland natural communities within the BDCP ROAs (CM4).
- 10,000 acres of seasonally inundated floodplain habitat within the north, east, and/or south Delta ROAs (CM5).
- 20 linear miles of channel margin habitat enhancement in the Delta (CM6).
- 5,000 acres of restored native riparian forest and scrub habitat (CM7).
- 2,000 acres of restored grassland and 8,000 acres of protected or enhanced grassland within BDCP CZs 1, 8, and/or 11 (CM8 and CM3).
- Up to 67 acres of restored vernal pool complex and 72 acres of restored alkali seasonal wetland within CZs 1, 8, and/or 11 (CM9), 600 acres of protected vernal pool complex within CZs 1, 8, and/or 11 (CM3).
- 1,200 acres of restored nontidal marsh within CZs 2 and 4 and/or 5, and the creation of 500 acres of managed wetlands (CM10).
- 50 acres of protected nontidal marsh (CM3).
- 150 acres of protected alkali seasonal wetland complex in CZs 1, 8, and 11 (CM3 and CM11)
- 1,500 acres of protected managed wetlands (CM3 and CM11)
- 6,600 acres of protected managed wetland natural community (CM3)
- 48,125 acres of cultivated land (non-rice), up to 500 acres of cultivated land (rice), and 3,000 acres of cultivated land (rice or equivalent) protected (CM3 and CM11).

[16] In computing the E/I ratio for this alternative, the Sacramento River inflow is considered to be downstream of the north Delta intakes.

3.5.2.3 Measures to Reduce Other Stressors and Avoidance and Minimization Measures

Measures to Reduce Other Stressors

Alternative 1A includes the following conservation measures (CM12–CM21) related to reducing other stressors (exposure to contaminants, competition, predation and changes to the ecosystem caused by nonnative species, entrainment at intake pumps not operated by SWP and CVP, and fish passage). These conservation measures are described in detail in Section 3.6.3.

- Methylmercury Management (CM12) – Actions implemented under this conservation measure would minimize conditions that promote production of methylmercury in restored areas and the subsequent introduction of methylmercury to the foodweb and to covered species.
- Invasive Aquatic Vegetation Control (CM13) – Actions implemented under this conservation measure would control the introduction and spread of invasive aquatic vegetation in BDCP aquatic restoration areas.
- Stockton Deep Water Ship Channel Dissolved Oxygen Levels (CM14) – Through funding provisions, this conservation measure would ensure that the DWSC Aeration Facility continues operations to maintain dissolved oxygen (DO) concentrations in the Stockton DWSC in accordance with total maximum daily load (TMDL) objectives.
- Localized Reduction of Predatory Fishes (Predator Control) (CM15) – Actions implemented under this conservation measure would reduce populations of predatory fishes at specific locations and eliminate or modify holding habitat for predators at selected locations of high predation risk.
- Nonphysical Fish Barriers (CM16) – Implementation of this conservation measure would entail the installation of nonphysical barriers (structures combining sound, light and bubbles) at the head of Old River, the Delta Cross Channel, and Georgiana Slough, and potentially at Turner Cut and Columbia Cut, to direct outmigrating juvenile salmonids away from Delta channels in which survival is lower.
- Illegal Harvest Reduction (CM17) – Under this conservation measure, funding would be provided to CDFW to increase the enforcement of fishing regulations to reduce illegal harvest of Chinook salmon, Central Valley steelhead, green sturgeon, and white sturgeon in the Delta, bays, and upstream waterways.
- Conservation Hatcheries (CM18) – This conservation measure would establish new conservation propagation programs and expand the existing program for delta smelt and longfin smelt to ensure the existence of refugial captive populations of both delta smelt and longfin smelt, thereby helping to reduce risks of extinction for these species.
- Urban Stormwater Treatment (CM19) – Under this conservation measure, the BDCP Implementation Office would provide a mechanism, through funding, for implementing stormwater treatment measures in urban areas that would result in decreased discharge of contaminants to the Delta.
- Recreational Users Invasive Species Program (CM20) – Under this conservation measure, the BDCP Implementation Office would fund a Delta Recreational Users Invasive Species Program, which would implement actions to prevent the introduction of new aquatic species and reduce

the spread of existing aquatic invasive species via recreational watercraft, trailers, and other mobile recreational equipment used in aquatic environments in the Plan Area.

- Nonproject Diversions (CM21) – Under this conservation measure, the BDCP Implementation Office would fund actions that would minimize the potential for entrainment of covered fish species associated with operation of nonproject diversions (diversions other those related to the SWP and CVP).

Avoidance and Minimization Measures

The primary purpose of *CM22 Avoidance and Minimization Measures* is to incorporate measures into BDCP activities that will avoid or minimize direct take of covered species and minimize impacts on natural communities that provide habitat for covered species. This conservation measure would entail the implementation of avoidance and minimization measures (AMMs) (e.g., best management practices [BMPs] to avoid erosion, sedimentation, and contaminant spills) for each BDCP project, based on the comprehensive avoidance and minimization measures described in the BDCP Appendix 3.C, *Avoidance and Minimization Measures*.

3.5.2.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 1A (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.2.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 1A (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

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

3.5.3.1 Physical and Operational Components

Under Alternative 1B, five fish-screened intakes on the east bank of the Sacramento River between Clarksburg and Walnut Grove would divert water into pipelines leading to intake pumping plants. Water would travel through sedimentation basins and be pumped into another set of pipelines, eventually reaching a lined or unlined canal. Once in the canal, gravity would carry water south along the eastern side of the Delta to an intermediate pumping plant, where it would be raised to an elevation allowing gravity to carry it through a continuing canal to the new Byron Tract Forebay, adjacent to and south of Clifton Court Forebay. Along the way, diverted water would travel under existing watercourses through culvert siphons or tunnel siphons. This arrangement would enhance water supply operational flexibility, using forebay storage capacity to regulate flows from north Delta intakes to south Delta pumping plants. Byron Tract Forebay would be designed to provide water to Jones pumping plant 24 hours per day. A map and schematic depicting the conveyance facilities associated with Alternative 1B are provided in Figures 3-4 and 3-5; characteristics of this alternative are summarized in Table 3-1. Figure 3-4 shows the major construction features associated with this proposed water conveyance facility alignment. A detailed depiction is provided in Figure M3-2 in the Mapbook Volume. Note that not all these structures would be constructed under this alternative.

New connections would be created between the new Byron Tract Forebay and the Banks and Jones pumping plants, along with control structures to regulate the relative quantities of water flowing from the north Delta and the south Delta. Use of existing SWP/CVP south Delta export facilities would continue. This facility could convey up to 15,000 cfs from the north Delta. The total diversion capacity for the south Delta export facilities would remain constant at 15,000 cfs due to the limited capacity of downstream conveyance structures, but the north Delta facilities would provide flexibility in where water is being diverted from (north vs. south Delta). The water conveyance alignment would be approximately 49 miles long from the north Delta intakes to the Byron Tract Forebay.

Alternative 1B water conveyance operations would follow criteria described as Operational Scenario A and would include criteria for north Delta diversion bypass flows, south Delta OMR flows, south Delta E/I ratio,[17] flows over Fremont Weir into Yolo Bypass via operable gates, Delta inflow and outflow, Delta Cross Channel gate operations (in addition to NMFS BiOp Action IV.1.2), additional Rio Vista minimum flow requirements, operations for Delta water quality and residence, and water quality for agricultural and municipal/industrial diversions. Water conveyance operational criteria are discussed in detail in Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*.

As shown in Table 3-5, Alternative 1B would have the same water conveyance facility components as Alternative 1A between the intakes and the start of the primary conveyance, except that the primary conveyance would be a lined or unlined canal in the east Delta rather than pipelines/tunnels, and there would be no intermediate forebay. Additionally, Alternative 1B would include the following new water facility components.

- Conveyance pipelines between transition structures and canal transition structures with radial gates and stop logs.
- Lined or unlined canal between the intake pumping plants and an intermediate pumping plant.
- An intermediate pumping plant just north of the town of Holt would lift diverted water from the northern two-thirds of the canal to the southern one-third; the plant would include a small forebay or transition from the upstream canal to the pump bays, an electrical substation, and transformers.
- A transition structure and discharge pipelines connecting the intermediate pumping plant to the downstream canal.
- A lined or unlined canal between the intermediate pumping plant and Byron Tract Forebay.
- Eight inverted culvert siphons along the conveyance alignment to convey diverted water under existing shallow watercourses.

[17] In computing the E/I ratio for this alternative, the Sacramento River inflow is considered to be downstream of the north Delta intakes.

- Three tunnel siphons along the conveyance alignment to convey diverted water under existing deep watercourses.
- Nineteen bridge crossings (two state highway and seventeen local, county, or private road bridges) along the conveyance alignment.
- Other road, rail, and utility crossings, including drainage and irrigation facilities.

An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes,) is presented in Table 3-8. Detailed discussions of water conveyance facility components, including construction detail, are provided in Section 3.6.1, *Water Conveyance Facility Components (CM1)*.

Table 3-8. Summary of Physical Characteristics under Alternatives 1B, 2B, and 6B

Feature Description/Acreage[a]	Approximate Characteristics
Overall project	
Potential export capacity (cfs)	15,000
Overall length (miles)	49
Intake facilities/ approximately 60 acres average per site	
Number of on-bank fish-screened intakes	5
Maximum diversion capacity at each intake (cfs)	3,000
Intake pumping plants/(included with intake facilities)	
One pumping plant with sedimentation basin per intake (each)	5
Six pumps per intake plus one spare, capacity per pump (cfs)	500
Total dynamic head (ft)	21
Isolated conveyance canal/6,610 acres	
Type	Unlined or lined
Top width (approximate maximum, ft)	700 (location-specific)
Invert width (ft)	340
Depth (bottom to water surface, ft)	23.5
Side slopes (H:V)	3:1, 8:1
Average permanent ROW width (ft)	1,400
Culvert siphons (comprised of four box culverts, each 26 by 26 feet)/160 acres (surface)	
Stone Lakes Drain, length (ft)	1,740
Beaver Slough, length (ft)	1,930
Hog Slough, length (ft)	1,970
Sycamore Slough, length (ft)	2,010
White Slough, length (ft)	2,300
Disappointment Slough, length (ft)	2,410
BNSF Railroad, length (ft)	1,470
Middle River, length (ft)	2,410
Tunnel siphons/95 acres (subsurface)	
Lost Slough/Mokelumne River	
Tunnel siphon length (ft)	7,450
Number of tunnel siphon bores; number of shafts (total)	2; 4
Tunnel siphon finished inside diameter (ft)	33

Feature Description/Acreage[a]	Approximate Characteristics
San Joaquin River	
Tunnel siphon length (ft)	3,240
Number of tunnel siphon bores; number of shafts (total)	2; 4
Tunnel siphon finished inside diameter (ft)	33
Old River	
Tunnel siphon length (ft)	1,920
Number of tunnel siphon bores; number of shafts (total)	2; 4
Tunnel siphon finished inside diameter (ft)	33
Intermediate pumping plant/(within canal footprint on Lower Roberts Island)	
Number of pumps, capacity per pump (cfs)	15 at 1,000 2 at 500
Total dynamic head (ft)	31
Byron Tract Forebay/860 acres	
Type	Unlined
Water surface area (acres)	600
Active storage volume (af)	4,300
Power requirements	
Total conveyance electric load (MW)	82

af = acre-feet.
BNSF = Burlington Northern and Santa Fe Railroad.
cfs = cubic feet per second.
ft = feet/foot.
H:V = horizontal to vertical ratio.
MW = megawatt.
ROW = right-of-way.

[a] Acreage estimates represent the permanent footprints of selected facilities. Characteristics of other areas including temporary work areas and those designated for borrow, spoils, and reusable tunnel material storage are reported in Appendix 3C. Overall project acreage includes facilities not listed, such as bridge abutments.

3.5.3.2 Conservation Components

Conservation components under Alternative 1B would be identical to those under Alternative 1A.

3.5.3.3 Measures to Reduce Other Stressors and Avoidance and Minimization Measures

Measures to reduce other stressors and AMMs under Alternative 1B would be the same as those under Alternative 1A.

3.5.3.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 1B (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.3.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 1B (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

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

3.5.4.1 Physical and Operational Components

Under Alternative 1C, five fish-screened intakes on the west bank of the Sacramento River between Clarksburg and Walnut Grove would divert water into pipelines leading to intake pumping plants. Water would travel through sedimentation basins and be pumped into another set of pipelines to a lined or unlined canal. Water would be carried south along the western side of the Delta to an intermediate pumping plant and then pumped through a tunnel to a continuing canal to the proposed Byron Tract Forebay immediately northwest of Clifton Court Forebay. Along the conveyance route, diverted water would travel under existing watercourses and one rail crossing through culvert siphons. This arrangement would enhance water supply operational flexibility, using forebay storage capacity to regulate flows from north Delta intakes to south Delta pumping plants. As under Alternative 1B, Byron Tract Forebay would be designed to provide water to Jones pumping plant 24 hours per day. A map and schematic depicting the conveyance facilities associated with Alternative 1C are provided in Figures 3-6 and 3-7; characteristics of this alternative are summarized in Table 3-1. Figure 3-6 shows the major construction features associated with this proposed water conveyance facility alignment. A detailed depiction is provided in Figure M3-3 in the Mapbook Volume.

New connections would be created between Byron Tract Forebay and the Banks and Jones pumping plants, along with control structures to regulate the relative quantities of water flowing from the north Delta and the south Delta. Use of existing SWP/CVP south Delta export facilities would continue. This facility could convey up to 15,000 cfs from the north Delta. The total diversion capacity for the south Delta export facilities would remain constant at 15,000 cfs due to the limited capacity of downstream conveyance structures, but the north Delta facilities would provide flexibility in where water is being diverted from (north vs. south Delta). The west alignment would be approximately 52 miles long from the north Delta intakes to the Byron Tract Forebay.

Alternative 1C water conveyance operational criteria include north Delta diversion bypass flow criteria, south Delta OMR flow criteria, south Delta E/I ratio,[18] flows over Fremont Weir into Yolo Bypass via operable gates, Delta inflow and outflow criteria, Delta Cross Channel gate operations (in addition to NMFS BiOp Action IV.1.2), additional Rio Vista minimum flow requirements, operations for Delta water quality and residence criteria, and water quality criteria for agricultural and

[18] In computing the E/I ratio for this alternative, the Sacramento River inflow is considered to be downstream of the north Delta intakes.

municipal/industrial diversions. Water conveyance operational criteria are discussed in detail in Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*.

As shown in Table 3-5, Alternative 1C would have the same water conveyance facility components as Alternative 1A, except that the primary conveyance would be a combination of lined or unlined canal segments and pipelines/tunnels; the five intakes and associated intake facilities (e.g., sedimentation basins, solids handling facilities, intake pumping plants, and associated pipelines) would be located on the west bank of the Sacramento River; and there would be no intermediate forebay. Additionally, Alternative 1C would include the following new water facility components.

- Conveyance pipelines between transition structures and canal transition structures with radial gates and stop logs.
- A lined or unlined canal between the intake pumping plants and an intermediate pumping plant.
- An intermediate pumping plant at the entrance of a tunnel to convey diverted water through the tunnel.
- A dual-bore tunnel extending 17 miles between the intermediate pumping plant and a second canal segment.
- A lined or unlined canal between the tunnel exit portal and Byron Tract Forebay.
- Byron Tract Forebay immediately northwest of Clifton Court Forebay.
- Connections to the Banks and Jones pumping plants, comprising a canal between Byron Tract Forebay and the approach canals to the Banks and Jones Pumping Plants and sets of gates in the approach canals upstream of the connection to the canal from Byron Tract Forebay.
- Nine inverted culvert siphons along the conveyance alignment to convey diverted water under ten existing shallow watercourses and one rail line.
- Sixteen bridge crossings along the conveyance alignment.
- Other road and utility crossings, including drainage and irrigation facilities.

An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-9. Detailed discussions of water conveyance facilities components, including construction detail, are provided in Section 3.6.1, *Water Conveyance Facility Components (CM1)*, and a detailed depiction of the physical components is provided in Figure M3-3 in the Mapbook Volume.

Table 3-9. Summary of Physical Characteristics under Alternatives 1C, 2C, and 6C

Feature Description/Acreage[a]	Approximate Characteristics
Overall project	
Potential export capacity (cfs)	15,000
Overall length (miles)	52
Intake facilities/approximately 60 acres average per site	
Number of on-bank fish-screened intakes	5
Maximum diversion capacity at each intake (cfs)	3,000
Intake pumping plants/(included with intake facilities)	
One pumping plant with sedimentation basin per intake (each)	5
Six pumps per intake plus one spare, capacity per pump (cfs)	500

Feature Description/Acreage[a]	Approximate Characteristics
Total dynamic head (ft)	26–30
Isolated conveyance canals/4,490 acres	
Type	Unlined or lined
Top width (approximate maximum, ft)	700 (location-specific)
Invert width (ft)	340
Depth (bottom to water surface, ft)	23.5
Side slopes (H:V)	3:1, 8:1
Average permanent ROW width (ft)	1,400
Culvert siphons (comprised of four box culverts, each 26 by 26 feet)/170 acres (surface)	
Elk Slough, length (ft)	1,300
Duck Slough, length (ft)	1,300
Miner Slough, length (ft)	2,000
Rock Slough, length (ft)	2,000
BNSF Railroad, length (ft)	1,880
Main Canal, length (ft)	1,410
Kellogg Creek, length (ft)	1,380
Kendall Creek Overflow, length (ft)	1,740
Italian Slough, length (ft)	1,610
Intermediate pumping plant/(within canal footprint on Ryer Island)	
Number of pumps, capacity per pump (cfs)	15 at 1,000 2 at 500
Total dynamic head (ft)	55
Concrete-lined soft ground tunnel/75 acres (permanent subsurface easement = 780 acres)	
Tunnel length (ft)	89,650
Number of tunnel bores	2
Tunnel finished inside diameter (ft)	33
Byron Tract Forebay/780	
Type	Unlined
Water surface area (acres)	600
Active storage volume (af)	4,300
Power requirements	
Total conveyance electric load (MW)	138 MW

af = acre-feet
BNSF = Burlington Northern and Santa Fe Railroad
cfs = cubic feet per second
ft = feet/foot
H:V = horizontal to vertical ratio
MW = megawatt
ROW = right-of-way

[a] Acreage estimates represent the permanent footprints of selected facilities. Characteristics of other areas including temporary work areas and those designated for borrow, spoils, and reusable tunnel material storage are reported in Appendix 3C. Overall project acreage includes some facilities not listed, such as bridge abutments.

3.5.4.2 Conservation Components

Conservation components under Alternative 1C would be identical to those under Alternative 1A.

3.5.4.3 Measures to Reduce Other Stressors and Avoidance and Minimization Measures

Measures to reduce other stressors and AMMs under Alternative 1C would be the same as those under Alternative 1A.

3.5.4.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 1C (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.4.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 1C (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

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

3.5.5.1 Physical and Operational Components

Like Alternative 1A, Alternative 2A would consist of pipelines and tunnels generally located in the central Delta with an intermediate forebay; however, Alternative 2A could potentially entail two different intake and intake pumping plant locations. As an alternative to Intakes 1–5, intake locations 1, 2, 3, 6, and 7 are being considered. Unlike the other intakes, Intakes 6 and 7 would be downstream of Sutter and Steamboat Sloughs. This alternative would convey water from five fish-screened intakes between Clarksburg and Walnut Grove to a new Byron Tract Forebay adjacent to Clifton Court Forebay. Use of existing SWP and CVP south Delta export facilities would continue. A map and schematic depicting the conveyance facilities associated with Alternative 2A are provided in Figures 3-2 and 3-3; the alternative's characteristics are summarized in Table 3-1 (the draft map and original schematic for Alternative 2A is the same as that for Alternative 1A). Figure 3-2 shows the major construction features associated with this proposed water conveyance facility alignment. A detailed depiction of these features is provided in Figure M3-1 in the Mapbook Volume. Note that not all these structures would be constructed under this alternative.

This facility could convey up to 15,000 cfs from the north Delta. Alternative 2A water conveyance operational criteria would be modified from those described under Alternatives 1A, 1B, and 1C. The modifications, developed considering input from USFWS, NMFS, and CDFW, are summarized as Operational Scenario B and include incorporation of Fall X2 criteria and less negative south Delta

OMR flows, as described in Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*. Operational Scenario B also includes north Delta diversion bypass flow criteria, south Delta E/I ratio,[19] flows over Fremont Weir into Yolo Bypass via operable gates, Delta inflow and outflow criteria, Delta Cross Channel gate operations (in addition to NMFS BiOp Action IV.1.2), additional Rio Vista minimum flow requirements, operations for Delta water quality and residence criteria, and water quality criteria for agricultural and municipal/industrial diversions.

An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-7. Detailed discussions of water conveyance facilities components, including construction detail, are provided in Section 3.6.1, *Water Conveyance Facility Components (CM1)*.

3.5.5.2 Conservation Components

Conservation components under Alternative 2A would be the same as those under Alternative 1A.

3.5.5.3 Measures to Reduce Other Stressors and Avoidance and Minimization Measures

Measures to reduce other stressors and AMMs under Alternative 2A would be the same as those under Alternative 1A.

3.5.5.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 2A (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.5.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 2A (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

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

3.5.6.1 Physical and Operational Components

Alternative 2B would include the same physical/structural water conveyance components and eastern alignment as Alternative 1B, but, like Alternative 2A, could entail two different intake and intake pumping plant locations downstream of Steamboat and Sutter Sloughs. Currently, as an alternative to Intakes 1–5, intake locations 1, 2, 3, 6, and 7 are being considered. Proposed water

[19] In computing the E/I ratio for this alternative, the Sacramento River inflow is considered to be downstream of the north Delta intakes.

supply operations under Alternative 2B would follow Operational Scenario B, and could convey up to 15,000 cfs from the north Delta. Use of existing SWP/CVP south Delta export facilities would continue.

A map and schematic depicting the conveyance facilities associated with Alternative 2B are provided in Figures 3-4 and 3-5 (the draft map and original schematic for Alternative 2B is the same as that for Alternative 1B); characteristics of this alternative are summarized in Table 3-1. Figure 3-4 shows the major construction features (including work and borrow/spoil areas) associated with this proposed alignment. A detailed depiction of these features is provided in Figure M3-2 in the Mapbook Volume. Note that not all these structures would be constructed under this alternative. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-8. Detailed discussions of water conveyance facilities components, including construction detail, are provided in Section 3.6.1, *Water Conveyance Facility Components (CM1)*.

3.5.6.2 Conservation Components

Conservation components under Alternative 2B would be the same as those under Alternative 1A.

3.5.6.3 Measures to Reduce Other Stressors

Measures to reduce other stressors under Alternative 2B would be the same as those under Alternative 1A.

3.5.6.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 2B (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.6.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 2B (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

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

3.5.7.1 Physical and Operational Components

Alternative 2C would include the same physical/structural water conveyance components and western alignment as Alternative 1C. Proposed water supply operations under Alternative 2C would follow Operational Scenario B, and could convey up to 15,000 cfs from the north Delta. Use of existing SWP/CVP south Delta export facilities would continue.

A map and schematic depicting the conveyance facilities associated with Alternative 2C are provided in Figures 3-6 and 3-7 (the draft map and original schematic for Alternative 2C is the same as that for Alternative 1C); characteristics of this alternative are summarized in Table 3-1. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-9. Figure 3-6 shows the major construction features associated with this proposed water conveyance facility alignment. A detailed depiction of these features is provided in Figure M3-3 in the Mapbook Volume. Note that not all these structures would be constructed under this alternative. Detailed discussions of water conveyance facilities components, including construction detail, are provided in Section 3.6.1, *Water Conveyance Facility Components (CM1)*.

3.5.7.2 Conservation Components

Conservation components under Alternative 2C would be the same as those under Alternative 1A.

3.5.7.3 Measures to Reduce Other Stressors

Measures to reduce other stressors under Alternative 2C would be the same as those under Alternative 1A.

3.5.7.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 2C (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.7.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 2C (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

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

3.5.8.1 Physical and Operational Components

Alternative 3 would comprise physical/structural components similar to those under Alternative 1A, but would entail only two fish-screened intakes (Intakes 1 and 2; Figure 3-2) and intake pumping plants. These intake locations represent those locations selected for the analysis of this alternative. Based on the results of an October 2011 workshop on the Phased Construction of North Delta Intake Facilities (see Appendix 3F, *Intake Location Analysis*), different combinations of intakes could be constructed under this alternative.[20] Once an alternative is selected as part of the final

[20] For example, Intakes 2 and 3, Intakes 2 and 5, or Intakes 3 and 5 could be proposed when a final BDCP EIR/EIS is approved.

BDCP EIR/EIS, a decision regarding intake locations would be made. Conveyance pipelines and the initial tunnel between the intake pumping plants and the intermediate forebay would be adjusted to the intake locations. Water would be conveyed from two intakes between Clarksburg and Walnut Grove to a new Byron Tract Forebay adjacent to Clifton Court Forebay. Water supply operations would be guided by criteria under Operational Scenario A (Table 3-1), except that this alternative would convey up to 6,000 cfs rather than up to 15,000 cfs from the north Delta. Use of existing SWP/CVP south Delta export facilities would continue.

A map and schematic depicting the conveyance facilities associated with Alternative 3 are provided in Figures 3-2 and 3-8 (the draft map for Alternative 3 is identical to the map of Alternative 1A); characteristics of this alternative are summarized in Table 3-1. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-10. Detailed discussions of water conveyance facilities components, including construction detail, are provided in Section 3.6.1, *Water Conveyance Facility Components (CM1)*. Figure 3-2 shows the major construction features associated with this proposed water conveyance facility alignment. A detailed depiction of these features is provided in Figure M3-1 in the Mapbook Volume. Note that not all these structures would be constructed under this alternative.

Table 3-10. Summary of Physical Characteristics under Alternative 3

Feature Description/Surface Acreage[a]	Approximate Characteristics
Overall project	
Conveyance capacity (cfs)	6,000
Overall length (miles)	45
Intake facilities/approximately 60 acres average per site	
Number of on-bank fish-screened intakes	2
Maximum diversion capacity at each intake (cfs)	3,000
Intake pumping plants/(included with intake facilities)	
Six pumps per intake plus one spare, capacity per pump (cfs)	500
Total dynamic head (ft)	30–57
Tunnels/370 acres (permanent subsurface easement = 1,860 acres)	
Tunnel 1 connecting Intakes 1 and 2 to the intermediate forebay, maximum flow 6,000 cfs	
Tunnel length (ft)	20,000
Number of tunnel bores; number of shafts (total)	1; 2
Tunnel finished inside diameter (ft)	26
Tunnel 2 connecting intermediate pumping plant to Byron Tract Forebay, maximum flow 6,000 cfs	
Tunnel length (ft)	183,000
Number of tunnel bores; number of shaft sites (total)	2; 13
Tunnel finished inside diameter (ft)	23
Intermediate forebay/925 acres	
Water surface area (acres)	760
Active storage volume (af)	5,250
Emergency spillway inundation area (acres)	350
Intermediate pumping plant (at southern end of intermediate forebay)	
Number of pumps, capacity per pump (cfs)	6 at 1,000 cfs and 1 at 500 cfs
Total dynamic head (ft)	0–90

Feature Description/Surface Acreage[a]	Approximate Characteristics
Byron Tract Forebay/840 acres	
Water surface area (acres)	600
Active storage volume (af)	4,300
Power requirements	
Total conveyance electric load (MW)	33

af = acre-feet.
cfs = cubic feet per second.
ft = feet.
MW = megawatt.
[a] Acreage estimates represent the permanent surface footprints of selected facilities. Characteristics of other areas including temporary work areas and those designated for borrow, spoils, and resuable tunnel material storage are reported in Appendix 3C. Overall project acreage includes some facilities not listed, such as permanent access roads.

3.5.8.2 Conservation Components

Conservation components under Alternative 3 would be the same as those under Alternative 1A.

3.5.8.3 Measures to Reduce Other Stressors and Avoidance and Minimization Measures

Measures to reduce other stressors and AMMs under Alternative 3 would be the same as those under Alternative 1A.

3.5.8.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 3 (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.8.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 3 (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

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

3.5.9.1 Physical and Operational Components

Under Alternative 4, water would primarily be conveyed from the north Delta to the south Delta through pipelines/tunnels. Water would be diverted from the Sacramento River through three fish-screened intakes on the east bank of the Sacramento River between Clarksburg and Courtland. Water would travel in gravity collector pipelines from the intakes to a sedimentation basin before reaching the intake pumping plants. From the intake pumping plants water would be pumped into short segments of conveyance pipelines, and then through an initial single-bore tunnel, which would lead to an intermediate forebay on Glannvale Tract. From the southern end of this forebay, water would pass through an outlet structure into a dual-bore tunnel where it would flow by gravity to the south Delta. Water would then be conveyed through a siphon under Italian Slough, and then into the north cell of the expanded Clifton Court Forebay, which would be dredged and redesigned to provide an area isolating water flowing from the new north Delta facilities. The expanded Clifton Court Forebay would be designed to provide water to Jones pumping plant 24 hours per day.

A map and a schematic diagram depicting the conveyance facilities associated with Alternative 4 are provided in Figures 3-2, 3-9, and 3-10. Figure 3-2 shows the major construction features associated with this proposed water conveyance facility alignment; a detailed depiction is provided in Figure M3-4 in the Mapbook Volume. New siphon and canal connections would be constructed between the north cell of the expanded Clifton Court Forebay and the Banks and Jones pumping plants, along with control structures to regulate the relative quantities of water flowing from the north Delta and the south Delta. Alternative 4 would entail the continued use of the SWP/CVP south Delta export facilities.

Alternative 4 would include the following new water conveyance facilities components, which are described in detail in Section 3.6.1, *Water Conveyance Facility Components (CM1)*. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-11.

- Three north Delta intakes with fish screens along the east bank of the Sacramento River (Intakes 2, 3, and 5).
- Pipelines conveying water from intakes to intake pumping plants.
- Sedimentation basins and solids handling facilities.
- Intake pumping plants at each intake location; associated facilities include an access road, electrical substation with transformers, switching equipment, communication devices, and surge towers.
- Discharge pipelines conveying water from intake pumping plants to initial tunnels.
- One single-bore tunnel connecting Intake Pumping Plant 2 to Intake Pumping Plant 3, and the intermediate forebay (Tunnel 1a), with a launch, retrieval, and vent shaft. The segment of this tunnel between Intake Pumping Plants 2 and 3 would have an inside diameter of 20 feet and the segment between Intake Pumping Plant 3 and the intermediate forebay would have an inside diameter of 29 feet.

- One 20-foot-inside-diameter single-bore tunnel between Intake Pumping Plant 5 and the intermediate forebay (Tunnel 1b), with a launch, retrieval, and vent shaft.
- Valve vaults, flowmeter vaults, and discharge headers between discharge pipelines and larger conveyance tunnels, junction structures, or tunnel shafts.
- Transition structures, such as stop logs and vents, between tunnel shafts and the intermediate forebay.
- Inlet structures with roller gates, trashracks, gate hoist gantry, and stop logs.
- An intermediate forebay, a pass-through facility.
- An outlet structure to convey water from the intermediate forebay into each main tunnel bore (Tunnel 2) via a vertical shaft.
- Two 40-foot-inside-diameter tunnels (Tunnel 2) between the intermediate forebay and a culvert siphon leading to the expanded Clifton Court Forebay, with large-diameter TBM launch/retrieval shafts, safe haven work areas, and vent shafts at approximately 4-mile intervals.
- An expanded Clifton Court Forebay with new embankments and an embankment dividing the forebay into a north cell and a south cell.
- Connections and control structures to the Banks and Jones pumping plants.
    - A culvert siphon between the north cell of Clifton Court Forebay and a new canal segment.
    - A canal and set of gates between the siphon leading from the north cell and the approach canal to the Jones Pumping Plant.
    - A culvert siphon, two segments of canal, and a set of gates between the siphon leading from the north cell of Clifton Court Forebay and the approach canal to Banks Pumping Plant, downstream of Skinner Fish Facility.
    - A set of gates in the existing approach canal to the Banks Pumping Plant downstream of the connection to the north cell of Clifton Court Forebay.
    - A set of gates in the existing approach canal to the Jones Pumping Plant downstream of the connection to Old River.
- Transmission lines running from the existing electrical grid to project substations. Under Alternative 4, the method of delivering power to construct and operate the water conveyance facilities is assumed to be a “split” system that would connect to the existing grid in two different locations—one in the northern section of the alignment, and one in the southern section of the alignment.
- Borrow areas and areas identified for the storage and/or disposal of spoil, RTM, and dredged material.

Table 3-11. Summary of Physical Characteristics under Alternative 4

Feature Description/Surface Acreage[a]	Approximate Characteristics
Overall project/2,000 acres	
Conveyance capacity (cfs)	9,000
Overall length (miles)	45
Intake facilities/approximately 90 acres average per site	
Number of on-bank fish-screened intakes	3
Maximum diversion capacity at each intake (cfs)	3,000
Intake pumping plants/(included with intake facilities)	
Six pumps per intake plus one spare, capacity per pump (cfs)	500
Total dynamic head (ft)	59–73
Tunnels/170 acres (permanent subsurface easement = 1,720 acres)	
Tunnel 1a connecting Intakes 2 and 3 to the intermediate forebay	
Tunnel length (ft)	47,400
Number of tunnel bores; number of shafts (total)	1; 4
Tunnel finished inside diameter (ft)	20 (between Intakes 2 and 3); 29 (between Intake 3 and the intermediate forebay)
Tunnel 1b connecting Intake 5 to the intermediate forebay	
Tunnel length (ft)	24,900
Number of tunnel bores; number of shafts (total)	1; 3
Tunnel finished inside diameter (ft)	20
Tunnel 2 connecting intermediate forebay to Clifton Court Forebay	
Tunnel length (ft)	159,000
Number of tunnel bores; number of shaft sites (total)	2; 9
Tunnel finished inside diameter (ft)	40
Intermediate forebay/245 acres	
Water surface area (acres)	41
Active storage volume (af)	710
Emergency spillway inundation area (acres)	125
Expanded Clifton Court Forebay/2,950 acres (total finished area)	
Forebay dredging area (acres)	2,030
Expanded water surface area (acres)	690
Active storage volume (af)	9,260 (north cell) 8,110 (south cell)
Power requirements	
Total conveyance electric load (MW)	50–60

af = acre-feet.
cfs = cubic feet per second.
ft = feet.
MW = megawatt.
[a] Acreage estimates represent the permanent surface footprints of selected facilities. Characteristics of other areas including temporary work areas and those designated for borrow, spoils, and reusable tunnel material are reported in Appendix 3C. Overall project acreage includes some facilities not listed, such as permanent access roads.

Facilities under Alternative 4 would be operated to provide diversions up to a total of 9,000 cfs from the new north Delta intakes. The total diversion capacity for the south Delta export facilities would remain constant at 15,000 cfs due to the limited capacity of downstream conveyance structures, but the north Delta facilities would provide flexibility in where water is being diverted from (north vs. south Delta). Operations of the existing SWP/CVP south Delta export facilities would continue as described in Section 3.5.1 for the No Action Alternative.

Alternative 4 water conveyance operations would follow the criteria described as Operational Scenario H and would include criteria for north Delta diversion bypass flows, south Delta OMR flows, south Delta E/I ratio,[21] flows over Fremont Weir into Yolo Bypass via operable gates, Delta inflow and outflow, Delta Cross Channel gate operations (in addition to NMFS BiOp Action IV.1.2), additional Rio Vista minimum flow requirements, operations for Delta water quality and residence (per D-1641), and water quality for agricultural and municipal/industrial diversions (per D-1641). Delta outflow under Scenario H would be determined by the outcome of a decision tree process being used to account for potential uncertainties related to flow requirements. The decision tree process and outcomes are described further in Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*, for Scenario H.

3.5.9.2 Conservation Components

Alternative 4 includes activities intended to address conservation needs across a variety of habitat types and locations. Activities would be carried out in the habitat types and amounts listed below. These activities are described in detail in Section 3.6.2.

- 65,000 acres of restored tidal perennial aquatic, tidal mudflat, tidal freshwater emergent wetland, and tidal brackish emergent wetland natural communities within the BDCP ROAs (CM4).
- 10,000 acres of seasonally inundated floodplain habitat within the north, east, and/or south Delta ROAs (CM5).
- 20 linear miles of channel margin habitat enhancement in the Delta (CM6).
- 5,000 acres of restored native riparian forest and scrub habitat (CM7).
- 2,000 acres of restored grassland and 8,000 acres of protected or enhanced grassland within BDCP CZs 1, 8, and/or 11 (CM8 and CM3).
- Up to 67 acres of restored vernal pool complex and 72 acres of restored alkali seasonal wetland in CZs 1, 8, and/or 11 (CM9), and 600 acres of protected vernal pool complex within CZs 1, 8, and/or 11 (CM3).
- 1,200 acres of restored nontidal marsh within CZs 2 and 4 and/or 5, and the creation of 500 acres of managed wetlands (CM10).
- 50 acres of protected nontidal marsh (CM3).
- 150 acres of protected alkali seasonal wetland complex in CZs 1, 8, and 11 (CM3 and CM11).
- 1,500 acres of protected managed wetlands (CM3 and CM11).

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[21] In computing the E/I ratio for Scenarios H1 and H3, the Sacramento River inflow is considered to be downstream of the north Delta intakes. However, in computing the E/I ratio for Scenarios H2 and H4, the Sacramento River inflow was assumed to be upstream of the proposed north Delta intakes.

- 6,600 acres of protected managed wetland natural community (CM3)
- 48,125 acres of cultivated land (non-rice), up to 500 acres of cultivated land (rice), and 3,000 acres of cultivated land (rice or equivalent) protected (CM3 and CM11).

3.5.9.3 Measures to Reduce Other Stressors and Avoidance and Minimization Measures

Measures to Reduce Other Stressors

Alternative 4 includes the following conservation measures (CM12–CM21) related to reducing other stressors (exposure to contaminants, competition, predation and changes to the ecosystem caused by nonnative species, entrainment at intake pumps not operated by SWP and CVP, and fish passage). These conservation measures are described in detail in Section 3.6.3.

- Methylmercury Management (CM12) – Actions implemented under this conservation measure would minimize conditions that promote production of methylmercury in restored areas and the subsequent introduction of methylmercury to the foodweb and to covered species.
- Invasive Aquatic Vegetation Control (CM13) – Actions implemented under this conservation measure would control the introduction and spread of invasive aquatic vegetation in BDCP aquatic restoration areas.
- Stockton Deep Water Ship Channel Dissolved Oxygen Levels (CM14) – Through funding provisions, this conservation measure would ensure that the Stockton DWSC Aeration Facility continue operations to maintain DO concentrations in the DWSC in accordance with TMDL objectives.
- Localized Reduction of Predatory Fishes (Predator Control) (CM15) – Actions implemented under this conservation measure would reduce populations of predatory fishes at specific locations and eliminate or modify holding habitat for predators at selected locations of high predation risk.
- Nonphysical Fish Barriers (CM16) – Implementation of this conservation measure would entail the installation of nonphysical barriers (structures combining sound, light and bubbles) at the head of Old River, the Delta Cross Channel, and Georgiana Slough, and potentially at Turner Cut, Columbia Cut, the Delta-Mendota Canal intake, Clifton Court Forebay, and other locations, to direct outmigrating juvenile salmonids away from Delta channels in which survival is lower.
- Illegal Harvest Reduction (CM17) – Under this conservation measure, funding would be provided to CDFW to increase the enforcement of fishing regulations to reduce illegal harvest of Chinook salmon, Central Valley steelhead, green sturgeon, and white sturgeon in the Delta, bays, and upstream waterways.
- Conservation Hatcheries (CM18) – This conservation measure would establish new conservation propagation programs and expand the existing program for delta and longfin smelt to ensure the existence of refugial captive populations of both delta and longfin smelt, thereby helping to reduce risks of extinction for these species.
- Urban Stormwater Treatment (CM19) – Under this conservation measure, the BDCP Implementation Office would provide a mechanism, through funding, for implementing stormwater treatment measures in urban areas that would result in decreased discharge of contaminants to the Delta.

- Recreational Users Invasive Species Program (CM20) – Under this conservation measure, the BDCP Implementation Office would fund a Delta Recreational Users Invasive Species Program, which would implement actions to prevent the introduction of new aquatic species and reduce the spread of existing aquatic invasive species via recreational watercraft, trailers, and other mobile recreational equipment used in aquatic environments in the Plan Area.
- Nonproject Diversions (CM21) – Under this conservation measure, the BDCP Implementation Office would fund actions that would minimize the potential for entrainment of covered fish species associated with operation of nonproject diversions (diversions other those related to the SWP and CVP).

Avoidance and Minimization Measures

The primary purpose of *CM22 Avoidance and Minimization Measures*, is to incorporate measures into BDCP activities that will avoid or minimize direct take of covered species and minimize impacts on natural communities that provide habitat for covered species. This conservation measure would entail the implementation of AMMs (e.g., BMPs to avoid erosion, sedimentation, and contaminant spills) for each BDCP project, based on the comprehensive avoidance and minimization measures described in the BDCP Appendix 3.C, *Avoidance and Minimization Measures*.

3.5.9.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 4 (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.9.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 4 (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

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

3.5.10.1 Physical and Operational Components

Alternative 5 would comprise physical/structural components similar to those of Alternative 1A, but would entail a single 3,000 cfs fish-screened intake between Clarksburg and Walnut Grove. Water would be conveyed through a single-bore rather than a dual-bore tunnel from the intermediate pumping plant to a new Byron Tract Forebay adjacent to Clifton Court Forebay. The intermediate forebay and Byron Tract Forebay would have smaller capacities than those under Alternative 1A. Use of existing SWP/CVP south Delta export facilities would continue. A map and schematic depicting the conveyance facilities associated with Alternative 5 are provided in Figures 3-2 and 3-12 (the draft map for Alternative 5 is identical to the map of Alternative 1A); characteristics of this alternative are summarized in Table 3-1. Figure 3-2 shows the major construction features associated with this proposed alignment. A detailed depiction of these features is provided in Figure M3-1 in the Mapbook Volume. Note that not all these structures would be constructed under this alternative.

Table 3-12. Summary of Physical Characteristics under Alternative 5

Feature Description/Surface Acreage[a]	Approximate Characteristics
Overall project	
Conveyance capacity (cfs)	3,000
Overall length (miles)	45
Intake facilities/approximately 60 acres	
Number of on-bank fish-screened intakes	1
Maximum diversion capacity at each intake (cfs)	3,000
Intake pumping plants/(included with intake facilities)	
Six pumps per intake plus one spare, capacity per pump (cfs)	500
Total dynamic head (ft)	30–57
Tunnels/370 acres (permanent subsurface easement = 1,860 acres)	
Tunnel 1 connecting Intake 1 to the intermediate forebay, maximum flow 3,000 cfs	
Tunnel length (ft)	20,000
Number of tunnel bores; number of shafts (total)	1; 2
Tunnel finished inside diameter (ft)	23
Tunnel 2 connecting intermediate pumping plant to Byron Tract Forebay, maximum flow 3,000 cfs	
Tunnel length (ft)	183,000
Number of tunnel bores; number of shaft sites (total)	1; 13
Tunnel finished inside diameter (ft)	23
Intermediate forebay/480–925 acres	
Water surface area (acres)	300–760
Active storage volume (af)	2,100–5,250
Emergency spillway inundation area (acres)	350
Intermediate pumping plant (at southern end of intermediate forebay)	
Number of pumps, capacity per pump (cfs)	7 at 500
Total dynamic head (ft)	0–90
Byron Tract Forebay/300–840 acres	
Water surface area (acres)	200–600
Active storage volume (af)	1,433–4,300
Power requirements	
Total conveyance electric load (MW)	16

af = acre-feet.
cfs = cubic feet per second.
ft = feet.
MW = megawatt.

[a] Acreage estimates represent the permanent surface footprints of selected facilities. Characteristics of other areas including temporary work areas and those designated for borrow, spoils, and resuable tunnel material storage are reported in Appendix 3C. Overall project acreage includes some facilities not listed, such as permanent access roads.

Water supply operations could convey up to 3,000 cfs from the north Delta. Alternative 5 water conveyance operational criteria would be guided by criteria under Operational Scenario C. These operations include Fall X2, south Delta OMR flows, and San Joaquin I/E ratios consistent with the No Action Alternative.

Conveyance pipelines and the initial tunnel between the intake pumping plant and the intermediate forebay would be adjusted to the intake location. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-12. Detailed discussions of water conveyance facilities components, including construction detail, are provided in Section 3.6.1, *Water Conveyance Facility Components (CM1)*.

3.5.10.2 Conservation Components

Conservation components under Alternative 5 would be the same as those under Alternative 1A, except that 25,000 rather than 65,000 acres of tidal habitat would be restored.

3.5.10.3 Measures to Reduce Other Stressors and Avoidance and Minimization Measures

Measures to reduce other stressors and AMMs under Alternative 5 would be the same as those under Alternative 1A.

3.5.10.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 5 (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.10.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 5 (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

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

3.5.11.1 Physical and Operational Components

Like Alternative 1A, Alternative 6A would convey water from five fish-screened intakes in the Sacramento River between Clarksburg and Walnut Grove in the north Delta through tunnels to a new Byron Tract Forebay adjacent to Clifton Court Forebay in the south Delta. However, this would be an *isolated conveyance*, no longer involving operation of the existing SWP/CVP south Delta points of diversion at Clifton Court Forebay and the Tracy Fish Facility on Old River. A map and schematic depicting the conveyance facilities associated with Alternative 6A are provided in Figures 3-2 and 3-13 (the draft map for Alternative 6A is identical to the map of Alternative 1A); characteristics of this alternative are summarized in Table 3-1. Figure 3-2 shows the major construction features associated with this proposed water conveyance facility alignment. A detailed depiction of these features is provided in Figure M3-1 in the Mapbook Volume. Note that not all these structures would be constructed under this alternative.

The proposed water operations under Alternative 6A would discontinue use of the existing SWP/CVP south Delta points of diversion at Clifton Court Forebay and the Tracy Fish Facility on Old River and convey up to 15,000 cfs from the north Delta using proposed water operations described under Operational Scenario D. Scenario D would be modified from Scenario A to eliminate use of south Delta intakes and add criteria related to Fall X2 (described in detail in Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*).

Under Alternative 6A, physical and structural components would be similar to those under Alternative 1A. However, the existing hydraulic connections between the SWP/CVP south Delta points of diversions at Clifton Court Forebay and the Tracy Fish Facility on Old River would be closed. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-7. Detailed discussions of water conveyance facilities components, including construction detail, are provided in Section 3.6.1, *Water Conveyance Facility Components (CM1)*.

3.5.11.2 Conservation Components

Conservation components under Alternative 6A would be the same as those under Alternative 1A.

3.5.11.3 Measures to Reduce Other Stressors and Avoidance and Minimization Measures

Measures to reduce other stressors and AMMs under Alternative 6A would be the same as those under Alternative 1A.

3.5.11.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 6A (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.11.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 6A (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

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

3.5.12.1 Physical and Operational Components

Like Alternative 1B, Alternative 6B would convey water from five fish-screened intakes in the Sacramento River between Clarksburg and Walnut Grove in the north Delta through lined or unlined canals to a new Byron Tract Forebay adjacent to Clifton Court Forebay in the south Delta. However, like Alternatives 6A and 6C, this would be an isolated conveyance, no longer involving operation of the existing SWP/CVP south Delta points of diversion at Clifton Court Forebay and Tracy Fish Facility on Old River. A map and schematic depicting the conveyance facilities associated with Alternative 6B are provided in Figures 3-4 and 3-14 (the draft map for Alternative 6B is identical to the map of Alternative 1B); characteristics of this alternative are summarized in Table 3-1. Figure 3-4 shows the major construction features associated with this proposed water conveyance facility alignment. A detailed depiction of these features is provided in Figure M3-2 in the Mapbook Volume. Note that not all these structures would be constructed under this alternative.

The proposed water conveyance operations would be guided by criteria under Operational Scenario D. Water supply operations could convey up to 15,000 cfs from the north Delta.

Under Alternative 6B, physical and structural components would be similar to those under Alternative 1B. However, the existing hydraulic connections between the SWP/CVP south Delta points of diversion at Clifton Court Forebay and the Tracy Fish Facility on Old River would be closed. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-8. Detailed discussions of water conveyance facilities components, including construction detail, are provided in Section 3.6.1, *Water Conveyance Facility Components (CM1)*.

3.5.12.2 Conservation Components

Conservation components under Alternative 6B would be the same as those under Alternative 1A.

3.5.12.3 Measures to Reduce Other Stressors and Avoidance and Minimization Measures

Measures to reduce other stressors and AMMs under Alternative 6B would be the same as those under Alternative 1A.

3.5.12.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 6B (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.12.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 6B (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

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

3.5.13.1 Physical and Operational Components

Like Alternative 1C, Alternative 6C would convey water from five fish-screened intakes in the Sacramento River between Clarksburg and Walnut Grove in the north Delta through a tunnel and two canal segments to a new Byron Tract Forebay adjacent to Clifton Court Forebay in the south Delta. However, like Alternatives 6A and 6B, this would be an isolated conveyance, no longer involving operation of the existing SWP/CVP south Delta points of diversion at Clifton Court Forebay and Tracy Fish Facility on Old River. A map and schematic depicting the conveyance facilities associated with Alternative 6C are provided in Figures 3-6 and 3-15 (the draft map for Alternative 6C is identical to the map of Alternative 1C). Figure 3-6 shows the major construction features associated with this proposed water conveyance facility alignment. A detailed depiction of these features is provided in Figure M3-3 in the Mapbook Volume. Note that not all of these structures would be constructed under this alternative.

The proposed water operations under Alternative 6C would be guided by criteria under Operational Scenario D. Water supply operations could convey up to 15,000 cfs from the north Delta.

Under Alternative 6C, physical and structural components would be similar to those under Alternative 1C. However, the existing hydraulic connections between the SWP/CVP south Delta points of diversion at Clifton Court Forebay and the Tracy Fish Facility on Old River would be closed. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-9. Detailed discussions of water conveyance facilities components, including construction detail, are provided in Section 3.6.1, *Water Conveyance Facility Components (CM1)*.

3.5.13.2 Conservation Components

Conservation components under Alternative 6C would be the same as those under Alternative 1A.

3.5.13.3 Measures to Reduce Other Stressors

Measures to reduce other stressors and AMMs under Alternative 6C would be the same as those under Alternative 1A.

3.5.13.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 6C (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.13.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 6C (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

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

3.5.14.1 Physical and Operational Components

Alternative 7 would comprise physical/structural components similar to those under Alternative 1A, but would entail only three fish-screened intakes (Intakes 2, 3, and 5) between Clarksburg and Walnut Grove. Based on the results of a workshop on the Phased Construction of North Delta Intake Facilities, Intake 1 could be constructed instead of Intake 5 under this alternative. Once an alternative is selected as part of the final BDCP EIR/EIS, a decision regarding intake locations would be made. Water would be conveyed from the intakes to a new Byron Tract Forebay adjacent to Clifton Court Forebay. Use of existing SWP/CVP south Delta export facilities would continue.

A map and schematic depicting the conveyance facilities associated with Alternative 7 are provided in Figures 3-2 and 3-11 (the schematic for Alternative 7 is the same as that for Alternative 8 and the draft map for Alternative 7 is identical to the map of Alternative 1A); characteristics of this alternative are summarized in Table 3-1. Figure 3-2 shows the major construction features associated with this proposed water conveyance facility alignment. A detailed depiction of these features is provided in Figure M3-1 in the Mapbook Volume. Note that not all of these structures would be constructed under this alternative.

Table 3-13. Summary of Physical Characteristics under Alternatives 7 and 8

Feature Description/Surface Acreage[a]	Approximate Characteristics
Overall project	
Conveyance capacity (cfs)	9,000
Overall length (miles)	45
Intake facilities/approximately 60 acres average per site	
Number of on-bank fish-screened intakes	3
Maximum diversion capacity at each intake (cfs)	3,000
Intake pumping plants/(included with intake facilities)	
Six pumps per intake plus one spare, capacity per pump (cfs)	500
Total dynamic head (ft)	30–57
Tunnels/370 acres (permanent subsurface easement = 1,860 acres)	
Tunnel 1 connecting Intakes 1 and 2 to the intermediate forebay, maximum flow 6,000 cfs	
Tunnel length (ft)	20,000
Number of tunnel bores; number of shafts (total)	1; 2
Tunnel finished inside diameter (ft)	26
Tunnel 2 connecting intermediate pumping plant to Byron Tract Forebay, maximum flow 9,000 cfs	
Tunnel length (ft)	183,000
Number of tunnel bores; number of shaft sites (total)	2; 13
Tunnel finished inside diameter (ft)	26
Intermediate forebay/925 acres	
Water surface area (acres)	760
Active storage volume (af)	5,250
Emergency spillway inundation area (acres)	350
Intermediate pumping plant (at southern end of intermediate forebay)	
Number of pumps, capacity per pump (cfs)	9 at 1,000 cfs; 2 at 500 cfs
Total dynamic head (ft)	0–90
Byron Tract Forebay/840 acres	
Water surface area (acres)	600
Active storage volume (af)	4,300
Power requirements	
Total conveyance electric load (MW)	80

af = acre-feet.
cfs = cubic feet per second.
ft = feet.
MW = megawatt.

[a] Acreage estimates represent the permanent surface footprints of selected facilities. Characteristics of other areas including temporary work areas and those designated for borrow, spoils, and resuable tunnel material storage are reported in Appendix 3C. Overall project acreage includes some facilities not listed, such as permanent access roads.

The water supply operations could convey up to 9,000 cfs from the north Delta. Alternative 7 water conveyance operational criteria are modified from those outlined under Alternatives 1A, 1B, and 1C and are described by Operational Scenario E (Section 3.6.4.2, *North Delta and South Delta Water*

Conveyance Operational Criteria). Scenario E would use north Delta bypass rules modified from those under Scenario A. Scenario E assumed less negative OMR flow and a longer implementation period for SJR inflow/export ratios (December–March and June) and would eliminate south Delta exports in April and May. Scenario E would include all of the No Action outflow rules. The modifications under this enhanced aquatic alternative are intended to further improve fish and wildlife habitat, especially along the San Joaquin River.

Conveyance pipelines and the initial tunnel between the intake pumping plants and the intermediate forebay would be adjusted to the intake locations. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-13. Detailed discussions of water conveyance facilities components, including construction detail, are provided in Section 3.6.1, *Water Conveyance Facility Components (CM1)*.

3.5.14.2 Conservation Components

Conservation components under Alternative 7 would be similar to those under Alternative 1A, but 40 rather than 20 linear miles of channel margin habitat would be enhanced, and 20,000 rather than 10,000 acres of seasonally inundated floodplain would be restored to further improve fish and wildlife habitat, particularly along the San Joaquin River.

3.5.14.3 Measures to Reduce Other Stressors and Avoidance and Minimization Measures

Measures to reduce other stressors and AMMs under Alternative 7 would be the same as those under Alternative 1A.

3.5.14.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 7 (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.14.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 7 (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.15 Alternative 8—Dual Conveyance with Pipeline/Tunnel, Intakes 2, 3, and 5, and Increased Delta Outflow (9,000 cfs; Operational Scenario F)

3.5.15.1 Physical and Operational Components

Alternative 8 would comprise physical/structural components similar to those under Alternative 1A, but would entail only three fish-screened intakes (Intakes 2, 3, and 5) between Clarksburg and Walnut Grove. These intake locations represent those locations selected for the analysis of this alternative. Based on the results of an October 2011 workshop on the Phased Construction of North Delta Intake Facilities (see Appendix 3F, *Intake Location Analysis*), different combinations of intakes could be constructed under this alternative. Once an alternative is selected as part of the final BDCP EIR/EIS, a decision regarding intake locations would be made. Water would be conveyed from the intakes to a new Byron Tract Forebay adjacent to Clifton Court Forebay. Use of existing SWP/CVP south Delta export facilities would continue. The water operations could convey up to 9,000 cfs from the north Delta and would be designed to provide up to 1.5 MAF in increased Delta outflow.

A map and schematic depicting the conveyance facilities associated with Alternative 8 are provided in Figures 3-2 and 3-11 (the schematic for Alternative 8 would be the same as that for Alternative 7, and the draft map for Alternative 8 is identical to the map of Alternative 1A); characteristics of this alternative are summarized in Table 3-1. Figure 3-2 shows the major construction features associated with this proposed water conveyance facility alignment. A detailed depiction of these features is provided in Figure M3-1 in the Mapbook Volume. Note that not all these structures would be constructed under this alternative.

Alternative 8 water conveyance operational criteria are described by Operational Scenario F. The goal is to provide an increased Delta outflow of up to 1.5 MAF utilizing existing SWP and CVP water rights and not affect any other water rights holders.

Conveyance pipelines and the initial tunnel between the intake pumping plants and the intermediate forebay would be adjusted to the intake locations. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-7. Detailed discussions of water conveyance facilities components, including construction detail, are provided in Section 3.6.1, *Water Conveyance Facility Components (CM1)*.

3.5.15.2 Conservation Components

Conservation components under Alternative 8 would be the same as those under Alternative 1A.

3.5.15.3 Measures to Reduce Other Stressors and Avoidance and Minimization Measures

Measures to reduce other stressors and AMMs under Alternative 8 would be the same as those under Alternative 1A.

3.5.15.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 8 (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.15.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 8 (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.16 Alternative 9—Through Delta/Separate Corridors (15,000 cfs; Operational Scenario G)

3.5.16.1 Physical and Operational Components

Under Alternative 9, the through Delta/separate corridors alternative, there would be four basic corridors: (1) the north Delta separate water supply corridor that conveys water from the Sacramento River to Middle River; (2) the south Delta separate water supply corridor along Middle River and Victoria Canal that conveys water from San Joaquin River to Clifton Court Forebay; (3) the San Joaquin separate fish movement corridor that provides for fish migration from upper San Joaquin River to the lower San Joaquin River downstream of Franks Tract; and (4) the Mokelumne separate fish movement corridor that diverts from the Mokelumne River through Lost Slough and Meadows Slough to the Sacramento River.

Alternative 9 includes changes to SWP and CVP water conveyance infrastructure and operations; habitat conservation; measures related to reducing other stressors; monitoring; research; and an adaptive management program, as described in detail in Section 3.6.2.

Under Alternative 9, two fish-screened intakes would be constructed: one each at the Delta Cross Channel and Georgiana Slough. The intakes would be divided into bays to support consistent diversion capacity across the intake. Water would travel through a flow collection channel and radial gates, eventually reaching the existing channel. Once in the channel, water would flow south through the Mokelumne River and San Joaquin River to Middle River and Victoria Canal, which would be dredged to accommodate increased volumes of water. Along the way, diverted water would be guided by operable barriers. Water flowing through Victoria Canal would lead into two new canal segments and pass under two existing watercourses through culvert siphons, eventually reaching Clifton Court Forebay. From there, water would flow through existing SWP facilities, and a new intertie canal would be constructed to connect the forebay to CVP facilities. A map and schematics depicting the conveyance facilities associated with Alternative 9 are provided in Figures 3-16, 3-17, and 3-18; characteristics of this alternative are summarized in Table 3-1. A detailed depiction of the through Delta/separate corridors alternative is provided in Figure M3-5 in the Mapbook Volume.

The water supply operations of this conveyance facility could convey up to 15,000 cfs from the north Delta. The total diversion capacity for the south Delta export facilities would remain constant at 15,000 cfs due to the limited capacity of downstream conveyance structures. Water conveyance operational criteria under Alternative 9 would be guided by criteria under Operational Scenario G.

Alternative 9 includes the following water conveyance-related facilities.

- Operable barriers on the Mokelumne River near Lost Slough and on Snodgrass Slough near the Mokelumne River, extension of Meadows Slough to the Sacramento River, and installation of an operable barrier on Meadows Slough. These facilities would provide a path for fish migration from the Mokelumne and Cosumnes Rivers through Lost Slough and Meadows Slough to the Sacramento River, except during flood flows.
- On-bank diversions with fish screens at Delta Cross Channel and Georgiana Slough.
- A boat lock and channel at the diversion structure at Georgiana Slough.
- An operable barrier at Threemile Slough to reduce salinity in the San Joaquin River during low Delta outflow and potentially to reduce fish movement from the Sacramento River to the San Joaquin River.
- Operable barriers along Middle River at Connection Slough, Railroad Cut, Woodward Canal, and immediately downstream of Victoria Canal to isolate Middle River from Old River. Dredging would occur at each of these locations.
- Dredging along Middle River from Mildred Island to Victoria Canal and along Victoria Canal for a siphon to provide gravity flow into Clifton Court Forebay.
- Expansion and extension, through dredging, of Victoria Canal under West Canal, across Coney Island, and under Old River to Clifton Court Forebay.
- Intertie canal with a control gate between Clifton Court Forebay and the Tracy Fish Facility.
- Closure of the Clifton Court Forebay inlet gate from Old River except during flood flows.
- Closure of channel between Old River and the Tracy Fish Facility except during flood flows. Closure would include channel modification to allow continued access to River's End Marina from Old River.
- Operable barriers along the San Joaquin separate fish movement corridor at the upstream confluence of Old River and the San Joaquin River (head of Old River), Fisherman's Cut at False River, and Franks Tract to isolate Old River (San Joaquin separate fish movement corridor) from the San Joaquin River.
- A pumping plant on the San Joaquin River at the head of Old River to convey additional flows with organic material into Old River.
- A pumping plant on Middle River upstream of Victoria Canal to convey additional flows with lower salinity than Old River into Old River.

An overview of conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-14.

Table 3-14. Summary of Physical Characteristics under Alternative 9

Feature Description/Acreage[a]	Characteristics
Overall project/1,250	
Export capacity (cfs)	15,000
Water supply corridor from DCC to Clifton Court Forebay overall length (miles)	35
Intake facilities (Sacramento River)/90	
Number of on-bank fish-screened intakes	2
Maximum diversion capacity at each intake (cfs)	7,500
Screen length at each intake (ft)	2,800
Screen height (ft)	15
Operable barriers[b]/110	
Mokelumne River system	
Mokelumne River near Lost Slough	Type I
Meadows Slough near Sacramento River	Type II
Snodgrass Slough north of Delta Cross Channel	Type I
Sacramento River system	
Delta Cross Channel	Type II
Georgiana Slough	Type II
Threemile Slough	Type III
South of San Joaquin River	
San Joaquin River at head of Old River	Type I
Middle River south of Victoria Canal	Type I
Victoria Canal/North Canal	Type III
Woodward Canal/North Victoria Canal	Type III
Railroad Cut	Type III
Connection Slough	Type III
Franks Tract	Type III
Fisherman's Cut	Type III
Channel Enlargement	
Middle River, between Mildred Island and Railroad Cut (enlarged area, sq. feet)	4,777
Middle River, between Railroad Cut and Woodward Canal (enlarged area, sq. feet)	4,319
Middle River, between Woodward Canal and Victoria Canal (enlarged area, sq. feet)	3,201
Victoria Canal (enlarged area, sq. feet)	8,145
Culvert Siphons (comprised of four box culverts, each 26 by 26 feet)/(area included with canals)	
Old River, length (ft)	1,560
"West" Canal, length (ft)	1,260
Canal/440 (includes canal and siphon areas)	
Total length of new canal (miles), Coney Island Canal, and CCF Intertie Canal	2.1
Levees	
Total length of new levees constructed near River's End Marina (miles)	1.1
Old River and Middle River diversion pumping plants	
Number of diversion pumping plants	2
Total pumping capacity at each pumping plant (cfs)	250

Feature Description/Acreage[a]	Characteristics
Three pumps per pumping plant plus one spare, capacity per pump (cfs)	83
Drive type	CS
Total dynamic head at Old River diversion pumping plant (ft)	30
Total dynamic head at Middle River diversion pumping plant (ft)	20
Power requirements	
Total option electric load (MW)	2

CCF = Clifton Court Forebay.
cfs = cubic feet per second.
cy = cubic yard.
DCC = Delta Cross Channel.
ft = feet/foot.
H:V = horizontal to vertical ratio.
MW = megawatt.
MDC = Through-Delta facility.
CS = Constant speed.

[a] Acreage estimates represent the permanent footprints of selected facilities. Characteristics of other areas including temporary work areas and those designated for borrow and spoils are reported in Appendix 3C. Overall project acreage includes some facilities not listed, such as bridge abutments.

[b] Type I: Obermeyer gate, full waterway width.
Type II: Selected from radial, miter, or wicket gates, full waterway width.
Type III: Obermeyer gate boat lock with rock wall.

3.5.16.2 Conservation Components

Conservation components under Alternative 9 would be similar to those under Alternative 1A, but it is expected that different locations for restoration or enhancement activities could be chosen in the south Delta based on the creation of separate corridors with differing purposes. Under this alternative, lands acquired for restoration or enhancement in the south Delta would generally not be located adjacent to corridors designated for water supply because the increased biological productivity that could result from implementation of these measures would be exported instead of supporting other biological goals and objectives. However, the detailed locations of these modifications have not been delineated, and these components are analyzed on a program level consistent with Alternative 1A.

3.5.16.3 Measures to Reduce Other Stressors and Avoidance and Minimization Measures

Measures to reduce other stressors and AMMs under Alternative 9 would be the same as those under Alternative 1A.

3.5.16.4 Issuance of Federal Incidental Take Permits

USFWS and NMFS would issue 50-year ITPs under ESA Section 10(a)(1)(B) to DWR for the incidental take of federally listed species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the

BDCP and under Alternative 9 (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.5.16.5 Issuance of State Incidental Take Permits

CDFW would approve the BDCP as an NCCP and issue permits pursuant to Fish and Game Code Section 2835 to DWR for the incidental take of covered species from the construction, operation, and maintenance associated with water conveyance, ecosystem restoration, and other activities as described in the BDCP and under Alternative 9 (see Table 1-1 in Chapter 1, *Introduction*, for a list of the species for which BDCP proponents are seeking coverage).

3.6 Components of the Alternatives: Details

This section describes the components of all the action alternatives: the location, configuration, and construction of water conveyance facility components; the specific criteria for water conveyance operational components; the general location, character, and management of conservation activities; and the implementation strategies for components related to reducing other stressors.

3.6.1 Water Conveyance Facility Components (CM1)

The permanent and temporary physical/structural components related to water conveyance facilities would vary with alternative. During construction, temporary work areas and facilities throughout the Delta would be needed to construct the conveyance facilities. Temporary facilities would be removed following construction, and the work areas would be returned to their preconstruction condition to the extent possible. Demolition and/or removal of existing infrastructure (e.g., buildings and fences) would be required prior to the construction of some water conveyance facilities. Due to the relatively high groundwater level in some proposed work areas, dewatering would be necessary to provide a dry workspace. Dewatering and activities associated with tunneling were assumed to occur 7 days per week and 24 hours per day, while other construction activities would occur 5 days per week (Monday through Friday) up to 24 hours per day.

The major components of CM1, both permanent and temporary, are listed below; detailed descriptions follow. Additional construction detail is provided in Appendix 3C, *Construction Assumptions for Water Conveyance Facilities*.

- North Delta Intakes
  - Concrete intake structure
  - Fish screens
  - Sedimentation basin
  - Solids lagoon
  - Intake pumping plant
  - Intake pipelines
  - New access roads

- New perimeter berm/levee modifications
- Parking, lighting, fencing, and landscaping
- New utility corridors

- Conveyance Facilities
  - Pipelines/tunnels
    - Pipelines
    - Concrete-lined soft ground tunnel
    - Permanent right-of-way (ROW)/subsurface easements
    - Ventilation and tunnel access shafts
    - RTM conveyors and storage/disposal areas
  - Canals
    - Canal
    - Culvert siphons
    - Intermediate pumping plant
    - Tunnel siphons (concrete-lined soft ground tunnel)
    - New bridges
    - New access roads
- Operable barriers
- Forebays
  - Intermediate forebay, emergency spillway, embankment, and intermediate pumping plant
  - Byron Tract Forebay
  - Expanded Clifton Court Forebay
  - Gate control structures
- New utility corridors
- New bridges
- New access roads
- Connections to Banks and Jones pumping plants
- Power supply and grid connections
- Through Delta/separate corridors conveyance—levee construction and modification
  - Screened intakes (without pumping plants)
  - Diversion pumping plants
  - Operable barriers (some with boat locks)
  - Fixed barriers

    - New access roads
    - New utility corridors
    - New levee sections
- Temporary access and work areas for intake, canal, and pipeline/tunnel construction
    - Temporary barge unloading facilities
    - Road haul routes and temporary access roads
    - Concrete batch plants and fuel stations (and potentially precast segment plants)
    - General construction work areas, including field offices, warehouse, and maintenance shops.

Habitat restoration, protection, creation, and enhancement; stressor reduction conservation measures; and avoidance and minimization measures (CM2–CM22) could also include physical/structural components related to new roads for site access, levee work, and similar elements. These conservation measures are analyzed at the program level in this EIR/EIS.

3.6.1.1 North Delta Intakes

Depending on the alternative, CM1 would include construction of up to five new intakes on the east or west bank of the Sacramento River. A total of 17 potential intake locations were identified, based on discussions with the Lead Agencies regarding specific fishery considerations as described in the Fish Facility Technical Team (FFTT) Report.[22] These original 17 sites were narrowed to 12 sites, of which 7 are located along State Route (SR) 160/River Road on the east bank of the Sacramento River from south of Freeport to the historical community of Vorden, and 5 are located on the west bank from the Pocket Area south to near Randall Island. Along with the criteria previously identified in the FFTT report, sites were recommended based on the site's ability to minimize effects on aquatic and terrestrial species, maintain a diversion structure's functionality, provide adequate river depth, provide adequate sweeping flows, maintain flood neutrality, and minimize impacts on land use and local communities. A detailed description of the process and steps used in identifying and refining proposed intake locations is described in Appendix 3F, *Intake Location Analysis*. A maximum of five intake sites would be selected for any given alternative; each intake would divert a maximum of 3,000 cfs from the Sacramento River. Each intake site would comprise a concrete structure, a fish screen, a sedimentation basin, a solids lagoon, a pumping plant, conveyance pipelines to a point of discharge into the conveyance facility (pipelines/tunnels or canals, depending on the alternative), a 69-kilovolt (kV) substation, and new access roads. These construction activities would necessitate realignment of existing roadways, employee parking, lighting, fencing, control and communication devices, and landscaping. A new perimeter berm would be constructed, and the space enclosed by the existing levee and new perimeter berm would be backfilled up to the elevation of the top of the perimeter berm, creating a building pad for the intake structure and adjacent pumping plant.

A conceptual rendering of the intake design is provided in Figure 3-19. A schematic of a typical intake structure is shown in Figure 3-20.

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[22] BDCP Fish Facilities Technical Team. 2011. Bay Delta Conservation Plan Technical memorandum. July. Access date: October 16, 2013. Available: http://baydeltaconservationplan.com/Libraries/Dynamic_Document_Library/Fish_Facilities_Team_Technical_Memo_Final_7_15_2011.sflb.ashx

Two 7,500 cfs intake structures and two pumping plants would be constructed under Alternative 9. These intakes would be located where the Sacramento River meets the Delta Cross Channel and Georgiana Slough; the pumping plants, which include their own small intake structures, would be located on the San Joaquin River at the head of Old River and on Middle River upstream of Victoria Canal. However, these facilities differ substantially from those that would be incorporated into other alternatives. The differences are noted at the end of each subsection below.

Description

Intake Perimeter Berm

The intakes would be sited along the existing Sacramento River levee system, requiring levee modifications to facilitate intake construction and to provide continued flood management. At each intake pumping plant site, a new perimeter berm would be constructed on the landside (see Figure 3-20). The space enclosed by the perimeter berm would be filled up to the elevation of the top of the perimeter berm, creating a building pad for the adjacent pumping plant. The new perimeter berms would be designed to provide the same level of flood protection as the existing levee. Transition levees would be constructed to connect the existing levees to the new perimeter berms.

A typical new perimeter berm would have a broad-based, generally asymmetrical triangular cross section. The berm height, as measured from the adjacent ground surface on the landside vertically up to the elevation of the berm crest, would range from approximately 20 to 45 feet to provide adequate freeboard above anticipated water surface elevations. The width of the perimeter berm (toe of berm to toe of berm) would range from approximately 180 to 360 feet. The minimum crest width of the berm would be 20 feet; however, in some places it would be larger to accommodate roadways and other features. Cut-off walls would be constructed to avoid seepage, and the minimum slope of levee walls would be three units horizontal to one unit vertical. All levee reconstruction will comply with applicable state and federal flood management engineering and permitting requirements.

Construction of the Georgiana Slough intake for Alternative 9 would require the relocation of a levee and associated road to create space for a boat channel and lock to allow continued boat access between the Sacramento River and Georgiana Slough. Both diversion pumping plants, along with their associated facilities, would be constructed on engineered fill, with a final ground level of approximately 25 feet for the Old River plant and 15 feet for the Middle River plant.

Intake Structure

The intake structure would consist of a reinforced concrete structure subdivided into individual bays that can be isolated and individually managed. Water would be diverted from the river by gravity into the screened bays and routed from each bay through multiple parallel conveyance conduits to a receiving partitioned or channelized sedimentation basin. Each bay would be fitted at opposing faces with screen panels, flow control baffles, and provisions for bulkhead isolation. The bank of vertical stainless steel screen panels with stainless steel wire fabric would prevent impingement and entrainment of fry-sized salmonids and juvenile smelt. The series of self-contained flow control baffle assemblies would be located behind the screens and would uniformly distribute approach velocities at the screen face. Log booms and/or deflector equipment would protect the intakes from debris and other floating objects.

From the river bottom to the top of the structure, the intake structure would be approximately 55 feet tall, with the top deck elevation aligning with the top of the adjacent levee to maintain flood protection and provide access. Depending on the height of the river at the intake location, the intake would rise above the river's surface by 20–30 feet. At Intakes 1 and 2 for alternatives using the pipeline/tunnel alignment, the pumping plants would require a surge tower in lieu of an air vent; the elevation of the top rim of the surge tower would be approximately 65–70 feet (North American Vertical Datum of 1988 [NAVD 88]). For Alternative 4, surge towers would be required at all three intake pumping plant sites (Intakes 2, 3, and 5). The elevation of the top of the surge towers would range from approximately 70 to 105 feet.

The intakes would be sized to provide screen area, in accordance with federal and state standards, sufficient to prevent entrainment and impingement of salmonids and delta smelt. The intake sizes (length along the river at the face of the intake) would vary depending on intake location from approximately 700 to 2,500 feet for the pipeline/tunnel, modified pipeline/tunnel, and east alignments; and from 850 to 2,300 feet for the west alignment. Each intake, with the exception of the intakes proposed for Alternative 9, would have a maximum conveyance capacity of 3,000 cfs.

For the purposes of this EIR/EIS, it is assumed that the fish screens would be designed to meet delta smelt criteria, which require 5 square feet/cfs. The fish screen sizes, like the individual intake sizes, would vary depending on intake location and would range from 10 to 22 feet in height and from 915 to 1,935 feet in length. It is anticipated that the screen cleaning system would include several traveling brush cleaning systems installed on the waterside of the intake. As an alternative to the fixed screen panel and brushing system, a traveling screen system with a screen belt and stationary brush/water jet system could be used.

The two intake structures for Alternative 9 would not divert water toward a pumping plant but into existing channels. These structures would be 2,800 feet wide and 15 feet high. Each intake would divert up to 7,500 cfs. Radial gates downstream of the intakes would limit flow to this maximum, while slide gates on each bay would equalize approach velocity across the face of the fish screen. The intake at Georgiana Slough would entail construction of a boat lock to allow continued passage between the slough and the Sacramento River. Two smaller intake structures would not include fish screens; these would divert up to 250 cfs into the diversion pumping plants, redirecting flows of existing channels, and would include automatic self-cleaning trash racks, along with sluice gates between the intake and the pumps.

Sedimentation Basins and Solids Handling Facilities

Although the intake fish screens would remove debris and sediment from the intake inflow, a sedimentation basin would be constructed between the intake structure and the pumping plant to remove the suspended solids that pass through the screen. Settled sediment in the sedimentation basin would be collected by solids collection equipment in the sedimentation basin and conveyed by positive displacement/progressive cavity pumps to up to three solids lagoons for further settling and disposal. Water would be conveyed from the solids lagoons by gravity to the inlet structure of the sedimentation basin.

The sedimentation basin would be approximately 120 feet long by 40 feet wide by 55 feet deep, and would have interior concrete walls to create separate sedimentation channels. The channels would divide the flow, and each channel would be capable of being independently isolated for maintenance. Under the modified pipeline/tunnel alignment (Alternative 4), the sedimentation basin would be divided into three sedimentation channels. Each channel would be 500 feet long by

200 feet wide by 23 feet deep. The structural system for the basins would consist of reinforced concrete walls and mat slab foundation supported on piles. The walls would be designed to retain external soil loads and contain internal hydrostatic and dynamic loads. The bottom of the basin would be at an elevation between -28.0 and -20.9 feet (NAVD 88) and the top of the walls would be at the flood protection elevation.

The solids lagoons would be concrete lined to prevent seepage to the groundwater or adjacent riverbed, would be approximately 10 feet deep, and would have sloped sides with a top width of 86 feet and a top length of 165 feet. Under the modified pipeline/tunnel alignment (Alternative 4), the solids lagoons would be approximately 15 feet deep and would have a bottom width of 200 feet and a bottom length of 400 feet. Up to three solids lagoons would be used in a rotating cycle with one basin filling, one settling, and the third being emptied of settled and dewatered solids. The volume of solids generated on a daily basis would depend on the volume of water pumped through the intakes, as well as on the sediment load within the river. It is anticipated that during most periods when five intakes are operating at about 3,000 cfs each, approximately 137,000 dry pounds of solids per day would be pumped to the solids lagoons. During periods of high sediment load in the Sacramento River, the daily mass of solids would be expected to increase up to 253,000 dry pounds per day. The annual volume of solids is anticipated to be 486,000 cubic feet (dry solids basis).

Intake structures built as part of Alternative 9 would not require sedimentation basins or solids lagoons. However, typical maintenance activities associated with river intakes would be performed to ensure that sediment buildup is controlled. These activities may include those listed below.

- Suction dredging around the intake structures using raft- or barge-mounted equipment and pumping sediment to a landside spoils area.
- Mechanical excavation around intake structures using track-mounted equipment and a clamshell dragline from the top deck after installing a floating turbidity control curtain to isolate the work area.
- Dewatering the intake bays to remove sediment buildup using small front-end loading equipment and manual labor.

Intake Pumping Plant and Facilities

All pumping plants would include a cast-in-place- (CIP-) reinforced concrete structure and a superstructure, a 230 kV power substation and transformer to supply power, an access road, flood protection embankments, parking, outdoor lighting, security fencing, and communication equipment. In addition, intake pumping plants would have concrete sedimentation basins, associated solids handling facilities, and conveyance piping to a point of discharge into the proposed conveyance structure (i.e., pipelines/tunnels or canals). These structures/facilities would be located on the landside of the levee. To protect the structures from flood waters, the sedimentation basins, solids lagoons, and pumping plant would be constructed on engineered fill above design flood condition. All construction and modifications will comply with applicable state and federal flood management, engineering, and permitting requirements.

Each of the pumping plant sites would be approximately 1,000 by 1,000 feet (approximately 20 acres). The pumping plant would be approximately 262 feet long by 98 feet wide. Under the modified pipeline/tunnel alignment (Alternative 4), each of the pumping plant sites would be approximately 1,800 by 1,500 feet (approximately 60 acres). The pumping plant would be approximately 400 by 150 feet. Intake pumping plants would be constructed of reinforced concrete and have multiple floors to house mechanical and electrical equipment. The primary structural support systems used for the pumping plants would consist of reinforced concrete slabs and walls at and below grade, with steel framing and exterior metal wall and roof panels for the above-grade building. The pumping plant mechanical building system design criteria would conform to the requirements of Title 24, the California Mechanical Code, and other applicable codes, and would include heating, ventilation, air conditioning, plumbing, and fire protection systems.

The intake pumping plant would include seven 500-cfs pumps, including one standby pump. The intake pumps would be orientated vertically and would operate in parallel. Each pump would discharge into an individual 96-inch-diameter (8-foot) pipe. Pumping capacity could be varied by reducing the number of pumps on line and/or adjusting the pump operating speed. Variable frequency drives (VFDs) and flow meters would be required on all pumps to vary the pumping rate.

Conceptual engineering indicates that the intake pumping plants would require a deep foundation supporting a common concrete mat. Based on a preliminary pile foundation evaluation, using a 24-inch concrete-filled pipe pile, an estimated pile length of 40–45 feet below the founding level of the intake pumping plant would be necessary. Under the modified pipeline/tunnel alignment (Alternative 4), 42-inch diameter pipe piles filled with reinforced concrete would be driven to a length of 65–75 feet below the founding level of the pumping plant. Foundation types and dimensions will be refined further when site-specific subsurface geotechnical data becomes available. Ground improvements would also be needed to improve foundation materials that are susceptible to liquefaction.

A facility control system could provide local and remote automatic and manual control and monitoring of the facilities. It is anticipated that the control system would use a combination of buried fiber optic systems, microwave radio, and leased telecommunications lines. A global positioning satellite (GPS)-based time clock at each pumping plant would support the control system. This equipment would require that a small dish antenna be mounted on the roof of the pumping plant. Two additional antennae would be mounted on the pumping plant at Intake 1 to support a communications system.

A communications system would connect to the existing DWR Delta Field Division Operations and Maintenance Center near Banks Pumping Plant and the DWR communications headquarters in Sacramento. Buried fiber optic conduit would be installed from the southern end of the new conveyance facility at Byron Tract Forebay (or, under Alternative 4, Clifton Court Forebay) along the inlet canal to the Banks Pumping Plant and the Delta Field Division Operations and Maintenance Center. The conduit route would be adjacent to roads, highways, railroads, utilities, or other easements.

Pumping plants constructed for Alternative 9 would not pump water from intake facilities into other conveyance facilities. Rather, these pumping plants would provide diversion flow into existing channels. Each of the pumping plants would have three pumps plus one spare; each plant would have a 250 cfs capacity. The San Joaquin River plant would convey additional flows with organic material into Old River. The Middle River plant would convey additional flows with lower salinity levels into Old River. These plant sites would include a dewatering sump and discharge piping, flow meter vaults, outfall piping, an electrical and control building, an access road, and a transformer.

Intake Pumping Plant Substation

Each intake pumping plant would be served by a 69 kV substation with a footprint of about 150 by 150 feet. Here, transformers would convert power from 69 kV to the voltage needed for the pumps and auxiliary equipment at the adjacent structures. For Alternatives 1B, 2B, and 6B, one intake pumping plant would also house a 230 kV substation, which would be located in a 268- by 267-foot enclosure. This substation and its transformers would convert power from the conveyance facility's main 230 kV transmission line to 69 kV, for use by the pumping plants and other facilities.

The substations would be constructed adjacent to the pumping plants on concrete pads with sufficient ground preparation. The substation would be at the same elevation as the pumping plant operating floor and at the flood protection level; excavation is not anticipated.

To supply power during construction of the intake and pumping plant structures and power for the tunneling and excavating machines, substations would be constructed early in the overall construction schedule.

Intakes and pumping plants constructed for Alternative 9 would not necessitate substations but would incorporate transformers.

Fencing, Lighting, and Landscaping

Security fencing and lighting would be installed at all pumping plants. Outdoor lighting fixtures would be luminaries with individual photocells. Critical paths, entrances, and walkways would be illuminated. High bay lighting fixtures would be high-pressure sodium vapor, instant-on lamps.

The need for fencing will be determined in accordance with DWR's Water Resources Engineering Memorandum (WREM) No. 41a to protect the public from hazards associated with the conveyance facilities and ensure security of the facilities and operational personnel. Fencing would be placed within the ROWs of the facilities.

Vegetation and signage are to be determined in accordance with DWR's sensitivity to their impact on the Delta environment, guided by DWR's WREM No. 30a, *Architectural Motif, State Water Project*. All proposed vegetation and signage will be coordinated with local agencies through an architectural review process.

Intake Access

The intakes would all be sited on the existing Sacramento River levee and levee roads. The intake design includes parking for employees during operations and maintenance. Along with the levee modifications discussed above, the levee roads would need to be realigned. Temporary access roads would be needed to connect the existing road network to the intake site for delivery of materials and construction equipment and personnel. Temporary access roads around the building site would also be necessary during construction. The existing levee roads are public roads that carry traffic through the Delta, and include SR 160 and various county roads. Access for travelers through the Delta on these existing roadways would be maintained by use of temporary new road detours around the intake sites. The existing alignment of these roadways would be modified to accommodate the intake structure, and the roadways would be reopened to traffic following construction.

Operations and Maintenance

The proposed intake facilities (including intake pumping plants, sedimentation basins, and solids lagoons) would require scheduled routine or periodic adjustment and tuning to remain consistent with design intentions. Emergency maintenance is also anticipated. Routine facility maintenance would consist of activities such as painting, cleaning, repairs, and other tasks to operate facilities in accordance with design standards after construction and commissioning. It is anticipated that major equipment repairs and overhauls would be conducted at a centralized maintenance shop at one of the intake facilities sites or at the intermediate pumping plant site.

Routine visual inspection of the facilities would be conducted to monitor performance and prevent mechanical and structural failures of project elements. Maintenance activities associated with river intakes could include removal of sediments, debris, and biofouling materials. These maintenance actions could require suction dredging or mechanical excavation around intake structures; dewatering; or use of underwater diving crews, boom trucks or rubber wheel cranes, and raft- or barge-mounted equipment. Periodic mussel cleaning in the sedimentation basins and solids removal from solids lagoons for off-site disposal would be required. Sediment in channels would also be removed periodically.

Construction

Intake Construction

Depending on foundation material, foundation improvements would require excavation and replacement of soil below the new levee footprint and potential ground improvement. The levees would be armored with riprap—small to large angular boulders—on the waterside. All construction and modifications will comply with applicable state and federal flood management, engineering and permitting requirements.

Intake construction would begin during the first construction season. Each intake would require approximately 3.5–4.5 years to complete; construction of multiple intakes would overlap such that several intakes could undergo simultaneous construction, depending on the alternative. Intakes would be constructed using a sheetpile cofferdam in the river to create a dewatered construction area that would encompass the intake site. The cofferdam would lie approximately 10–35 feet from the footprint of the intake. The distance between the face of the intake and the face of the cofferdam would be dependent on the foundation design and overall dimensions. The length of each temporary cofferdam would vary by intake location, but would range from 740 to 2,440 feet. Cofferdams would be supported by steel sheet piles and/or king piles (heavy H-section steel piles). Installation of these piles would require both impact and vibratory pile drivers; piles would be driven using barge-mounted cranes and cranes mounted on temporary decks (see Chapter 1, *Introduction*, Table 1-3 for a summary of permits relevant to BDCP). Approximately 8–12 piles would be driven per day per intake site.

Some clearing and grubbing of levees would be required prior to installation of the sheet pile cofferdam, depending on site conditions. Additionally, if stone bank protection, riprap, or mature vegetation is present at intake construction site, it would be removed prior to sheet pile installation.

Once the cofferdam is completed, the enclosed area would be excavated to the level of design subgrade using clam shell or long-reach backhoe before ground improvements and installation of foundation piles. The anticipated ground improvement methods may include jet grouting and deep soil mixing. The foundation construction would either be carried out by in-the-wet construction or conventional construction using dewatering methods. Electric-powered dewatering wells would be installed throughout the site. Diesel-powered standby power generator(s) would be used to power the dewatering pumps during power outages. A backup pump would be provided at every dewatering location with pumps. Dewatering pumping may occur 24 hours per day, 7 days per week, and would continue throughout intake construction. Water would be pumped out of the cofferdam and stored in sedimentation tanks at landside work areas. Groundwater removed with the dewatering system would ultimately be treated as necessary and disposed of in surface waters under a National Pollutant Discharge Elimination System (NPDES) permit. Prior to dewatering, fish rescue and salvage plans (discussed in Appendix 3B, *Environmental Commitments*) would be implemented, as necessary, for dewatering operations. Velocity dissipation facilities, such as rock or grouted riprap, would be used to reduce velocity/energy and prevent scour where dewatering discharges reenter the river.

The area behind the cofferdam would be excavated to the necessary depth and cast-in-drilled-hole (CIDH) or concrete-filled steel pipe foundation piles would be installed to support the intake structures. CIDH piles are installed by drilling a shaft, installing rebar, and filling the shaft with concrete; no pile driving is necessary with CIDH methods. Use of concrete filled steel piles would involve vibratory or impact-driving hollow steel piles, and then filling them with concrete. The required number of piles would vary by intake length from 450 (for short intakes) to 800 (for long intakes). The number of intake piles driven in a day would range from approximately 8 to 12 per intake site. Minor channel work would be necessary to install the intake fish screens; the channel disturbance area would vary by intake location and would range from approximately 2.5 to 7.1 acres. Foundation type, dimensions, and construction methods will be revised further when additional site-specific subsurface geotechnical data becomes available.

To the extent possible, all in-water construction activities would take place between June 1 and October 31. No additional in-water work would be conducted for construction of the intakes until the cofferdam is removed and rock protection is installed during the in-water work window. In-water work would not occur every season over the duration of construction.

After intake structure construction is complete, the cofferdam would be flooded by removing the sheet pile walls in front of the intake structure. The removal of sheet pile walls would be performed by underwater divers using torches or plasma cutters to trim at the intake structure slab. Rock protection would be installed along the river banks upstream and downstream and along the front of the intakes to protect the intakes, prevent bank and channel erosion, and provide a transition from the river bottom to the intake structure. The length of bank protection required on either side of the intake would vary by intake location but would range from approximately 100 to 2,200 feet for the pipeline/tunnel, modified pipeline/tunnel, and east alignments, and from 500 to 1,800 feet for the west alignment. The intake structures and associated bank protection would permanently change existing substrates and local hydraulic conditions in the immediate vicinity of the intakes.

The Sacramento River would remain navigable during construction of the intakes. River channel width at several intake sites varies from about 400 to 600 feet. The anticipated protrusion of cofferdams into the river is about 40 to 60 feet. Cofferdams would be installed around intake construction sites. Warning signs and buoys would be posted upstream of, downstream of, and at the construction sites. Buoy lights would also be provided for nighttime navigation during construction. The completed intake structures would have proper lighting to prevent boat collisions with the structure at night.

Intake Gravity Collector Pipelines

To allow for the installation of pipe segments to connect the intake to the sedimentation basin, construction could involve trenchless methods or open-cut trenching. If trenchless methods is employed, conduits would be constructed from inside the cofferdam or shaft to the landside of the levee prior to construction of the intake. Trenchless construction would be done using pipe ramming or tunnel boring machines. RTM from tunneling would be removed using conveyors or pumps and transferred to a separation plant to remove the suspended solids from the soil cuttings of the RTM. The RTM would be treated, drained, and transported to stockpiles consistent with the NPDES permit requirements.

If open-cut trenching is used and the native materials are generally of good quality in the area of conduit construction, excavated material from the trench would be used as embedment and backfill materials. If the native soils are not suitable as foundation materials for the trench, suitable materials would be imported to the site.

Cut and cover construction would likely be used for landside pipe placement using long reach backhoes, scrapers, and excavators placed on levees or on the landside of the levees. Dewatering systems, if required to control groundwater and ensure a stable excavation trench, would be similar to those described for the intake structure foundations.

3.6.1.2 Conveyance Facilities

Tunnels

Design

The tunnel conveyance would consist of a single bore, 29-foot inside diameter (ID) tunnel on the northern end of the alignment (Tunnel 1) and a dual-bore, 33-foot ID tunnel on the longer, southern end of the alignment (Tunnel 2); Alternative 5 would convey water through a single-bore tunnel on the southern end. For Alternative 4, Tunnel 1a would be a single bore 20-foot ID tunnel between Intakes 2 and 3 and a 29-foot ID tunnel between Intake 3 and the intermediate forebay. Tunnel 1b would be a single bore 20-foot ID tunnel between Intake 5 and the intermediate forebay. Tunnel 2 for Alternative 4 would be constructed with a dual-bore 40-foot ID tunnel. An intermediate forebay would be constructed to provide a hydraulic break before the diverted water enters the common tunnel conveyance system downstream. This hydraulic break would provide water conveyance operational flexibility and allow independent operation of each intake facility.

The tunnel system would be operated under pressurized conditions at a constant volume with isolation facilities to allow reducing the number of tunnels in operation during periods of lower flow and to maintain velocity in active tunnels. Under Alternative 4, the tunnel would be operated with a gravity feed system rather than with an intermediate pumping plant with an optional gravity bypass system at the outlet of the intermediate forebay.

In alluvial soils with high groundwater pressures, the tunnel would be constructed at depths greater than 60 feet using mechanized closed-face pressurized tunneling machines. The tunnel invert elevation is preliminarily assumed to be at 100 feet below mean sea level (msl), primarily to avoid peat deposits. It would be lowered to 160 feet below msl under the San Joaquin River and Stockton DWSC to maintain sufficient cover between the tunnel and dredging operations in the shipping channel. The final depth and profile of the tunnel would be set in the preliminary design phase for

CM1, after detailed geotechnical investigations have been completed. A minimum horizontal separation of two outside tunnel diameters would be maintained in reaches with two tunnel bores. Because of the high groundwater level throughout the proposed tunnel alignment area, extensive dewatering (by means of dewatering wells along the tunnel alignment) and groundwater control in the tunneling operation and shaft construction would likely be necessary.

The main construction or launching shafts for each tunnel would be about 120 feet in diameter to accommodate construction and construction support operations. The TBM retrieval shaft would be approximately 90 feet in diameter, and 50-foot-diameter intermediate ventilation shafts would be located approximately every 3 miles. Tunnel ventilation would adhere to California Division of Occupational Health and Safety (Cal-OSHA) tunnel ventilation requirements. The tunnels would be lined with precast concrete bolted-and-gasketed segments. The tunnel concrete liner would serve as permanent ground support and would be installed immediately behind the tunnel-boring machine, thereby forming a continuous watertight vessel.

Upon completion of construction, launching, retrieval, and ventilation shafts would be converted to permanent access shafts so that personnel can gain access to the tunnel for inspections and maintenance. The large-diameter construction shafts would be modified to approximately 20-foot diameter access shafts that would rise approximately 20 feet above existing grade. The twin-bore tunnels would have two shafts, and would be surrounded by an earthen pad with approximate dimensions of 250 feet by 125 feet, and approximately 20 feet high. Road access to the top of the pad will be provided for maintenance vehicles.

Refer to Table 3-7 for a description of the physical characteristics of the tunnel conveyance facility under Alternatives 1A, 2A, and 6A; Tables 3-10 and 3-12 for Alternatives 3 and 5 respectively; and Table 3-13 for Alternatives 7 and 8. Details of the conveyance facility under Alternative 4 are shown in Table 3-11. A conceptual drawing of the configuration of a typical tunnel segment is shown in Figure 3-21.

Operation and Maintenance

Maintenance requirements for the tunnels have not yet been finalized. Some of the critical considerations include evaluating whether the tunnels need to be taken out of service for inspection and, if so, how frequently. Typically, new water conveyance tunnels are inspected at least every 10 years for the first 50 years and more frequently thereafter. In addition, the equipment that the facility owner must put into the tunnel for maintenance needs to be assessed so that the size of the tunnel access structures can be finalized. Equipment such as trolleys, boats, harnesses, camera equipment, and communication equipment would need to be described prior to finalizing shaft design, as would ventilation requirements. As described above, it is anticipated that, following construction, large-diameter construction shafts would be modified to approximately 20-foot diameter access shafts.

At the time of preparation of this EIR/EIS, the use of remotely operated vehicles or autonomous underwater vehicles is being considered for routine inspection, reducing the number of dewatering events and reserving such efforts for necessary repairs.

Construction

Construction staging areas would include space for offices, parking, shops, segment storage, fan line storage, daily spoils pile, power supply, water treatment, and other space requirements. Depending on the method selected to construct the walls for the shafts, the staging areas may also include space for the slurry ponds required for slurry wall construction. Work areas for RTM handling and spoils storage would also be necessary.

On occasion, access to the face of a TBM may be required for maintenance or emergency purposes. Such maintenance interventions for the TBM cutterhead would be performed in discrete areas—*safe havens*—within the tunnel alignments. The precise locations of the safe haven areas have not yet been determined because the locations would depend on site-specific mining conditions. At minimum, there would be one safe haven area between each tunnel shaft (launching and vent shafts). Intervention (or safe haven) zones could be situated at intervals of 2,000 feet along the tunnel alignment. These subsurface intervention sites would be constructed by injecting grout from the surface to a point in front of the TBM. The TBM would then bore into the grouted area. The purpose of grouting an intervention site is to allow pressures to be equalized between the face of the TBM and the tunnel, facilitating access and eliminating the need for working in hyperbaric conditions.

Surface disturbance activities at each of these intervention sites would be limited to an area no larger than 1 acre. Surface equipment would include a small drill rig and grout mixing and injection equipment. The surface drilling and grouting operation would typically be completed within 2 weeks. Once complete, all equipment would be removed and the surface features reestablished. Access to most intervention sites would be over established roadways. If access is not readily available over surface routes, surface sites would be accessed by helicopter.

Because the need for TBM maintenance or emergency access is dependent on the condition of the cutting face, the number and locations of intervention sites are not known. Impacts will be minimized or avoided by locating the intervention on disturbed sites either associated with construction of the tunnel or other activities or agricultural lands used to grow lower value crops. Discharge of drilling muds or other materials required for drilling and grouting would be confined to the work site and would be disposed of offsite at a permitted facility. Disturbed areas would be returned to preconstruction conditions by careful grading, reconstruction of features such as irrigation and drainage facilities, and replanting of crops and/or compensating farmers for crop losses.

To the greatest extent possible, intervention sites would be located to avoid sensitive terrestrial and aquatic habitats. In the event these areas cannot be avoided, DWR will ensure that impacts are minimized to the greatest extent possible. DWR would work with the appropriate permitting agencies to ensure that impacts are minimized and/or compensated and that permits allowing surface disturbance are secured. If needed, supplemental environmental compliance documentation will be completed.

The proposed tunnels are anticipated to be constructed in soft, alluvial soils with high groundwater pressures. Because of this, the tunnels would be constructed using mechanized soft ground tunneling machines. Each tunnel would require appropriately sized launching and TBM retrieval shafts to accommodate equipment. If dense gravels, cobbles, or boulders are encountered in the older alluvium at depth, other mining methods may be utilized, such as grouting, jet grouting, use of a slurry TBM, or freezing and hand mining. All shaft locations may also require dewatering activities, which would be implemented in a similar manner to dewatering for the construction of intake facilities, as described above. Dewatering systems would be designed and operated to control seepage pressures in the vicinity of the main bore and the vertical shafts to ensure that excavations remain stable. Discharge water would be conveyed to aboveground treatment facilities to comply with permit conditions before being discharged into the river. A diesel-powered train would transport construction workers through the tunnel during construction.

During construction, all shaft locations would be protected from flooding caused by failure of a levee. This protection would be achieved by constructing a raised earthen pad at each shaft site (or by use of another suitable method). The size of the pad would vary from site to site, depending on specific location conditions. It is anticipated that the height of the shaft protection pads will be at the 100-year design flood elevation for each island.

After construction of the tunnels, the launching and retrieval shafts would be backfilled around steel pipes or formed concrete pipes, or would be cast against reusable forms to the required finished diameter and geometry. The intermediate shafts would be excavated using conventional augers and would be supported using steel casings. The shafts would be drilled to below the tunnel invert elevation before the boring machine reaches the shaft stationing.

As previously indicated, RTM is the by-product of tunnel excavation using a TBM. The RTM would be a plastic mix consisting of soil cuttings, air, and water, and may also include soil conditioning agents. Soil conditioning agents such as foams, polymers, and bentonite may be used to make soils more suitable for excavation by a TBM. Before the RTM can be reused or disposed of, it must be managed and, at a minimum, go through a drying process. Additional RTM processing, beyond the conventional atmospheric drying process, would be implemented if deemed necessary to comply with regulatory requirements. For further discussion of this process, please see the description of "Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material," in Appendix 3B, *Environmental Commitments.*

The daily volume of RTM that would be withdrawn from the tunneling operations at any one shaft location would vary, with an average volume of approximately 6,000 cubic yards per day. It is assumed that the transport of the RTM out of the tunnels and to the RTM storage sites would be nearly continuous during mining or advancement of the TBM. The RTM would be carried on a conveyor belt from the TBM to the base of the launching shaft. The RTM would be withdrawn from the tunnel shaft with a vertical conveyor and placed directly into the RTM work area using another conveyor belt system. From the RTM handling area, the RTM would be rough segregated for transport to RTM storage and water treatment (if required) areas as appropriate. RTM would be transported and deposited via conveyor and/or truck to designated RTM storage areas, ranging in size from approximately 100 to 1,100 acres, depending on the action alternative. In total, approximately 1,595 acres may be needed for RTM storage for the pipeline/tunnel alignment. Under this alignment, it was assumed that RTM would be stacked to a height of 10 feet and that storage areas would be located adjacent to main tunnel shafts north of Scribner Road, east of the Sacramento River, on northern Brannan-Andrus Island, on southeastern Tyler Island, on eastern Bacon Island, and on northwestern Victoria Island, as shown in Mapbook Figure M3-1. Under the modified pipeline/tunnel alignment (Alternative 4), approximately 3,500 acres may be needed for storage of tunnel material and spoils from dredging Clifton Court Forebay. This area also includes land that would be required for access roads, staging and laydown areas, and other ancillary facilities required for the processing and storage of RTM. Therefore, the area required for storage of the material itself would be closer to 2,800 acres. Under this alignment, it was assumed that RTM and dredged material would be stacked to a height of 6 feet and that storage areas would be located adjacent to tunnel shafts, including sites just north of Intake 2, several parcels west of Interstate 5 near the intermediate forebay, on northern Staten Island, on southern Staten Island, on southwestern Bouldin Island, and on Byron Tract west of Clifton Court Forebay, as shown in Mapbook Figure M3-4. During future stages of engineering, it may be determined that it is preferable to store RTM at a height of 10 feet, as was assumed for alternatives under the pipeline/tunnel alignment. Using this assumption, approximately 1,800 acres would be required for the storage of RTM and dredged material under Alternative 4.

RTM Drying and Storage

Once the RTM is removed from the tunnel, it must be suitably dewatered prior to final long-term storage or reuse. Atmospheric drying by tilling and rotating the material, combined with subsurface collection of excess liquids is typically sufficient to render the material dry and suitable for long-term storage or reuse. Only for those areas where controlled and contained storage of material is deemed to be required, a retaining dike and underdrain liquid collection system (composed of a berm of compacted soil, gravel and collection piping, as described below), may be built at the RTM storage area(s). The purpose of this berm and collection system would be to contain any liquid runoff from the drying material. The berm geometry would conform to applicable design guidelines and standards. Based on the soil properties, the volume of material to be processed, and the size of the material storage area, the area may be subdivided into a system of dewatering or processing areas. The dewatering process would consist of surface evaporation and draining through a drainage blanket consisting of rock, gravel, or other porous drain material. The drainage system would be designed per applicable permit requirements. Treatment of liquids (primarily water) extracted from the material could be done in several ways, including conditioning, flocculation, settlement/sedimentation, and/or processing at a package treatment plant to ensure compliance with discharge requirements.

Once the material has been suitably dewatered, and depending on the constituents of the material, the RTM would be placed in either a lined or unlined storage area, suitable for long-term storage. These long-term storage areas may be the same area in which the material was previously dewatered or it may be a new site adjacent to the dewatering site. The storage areas would be created by excavating and stockpiling the native topsoil for future reuse. Once the area has been suitably excavated, and if a lined storage area is required, an impervious liner would be placed on the invert of the material storage area and along the interior slopes of the berms surrounding the pond. Due to the expected high groundwater tables, it is anticipated that there would be minimal excavation for construction of the long-term material storage areas. Additional features of the long-term material storage areas would include berms and erosion protection measures to contain storm runoff if necessary and provisions to allow for truck traffic during construction, as appropriate.

Depending on the type of soil removed through tunneling, the type of soil conditioners added, and the material management and water treatment processes required, RTM may be reused locally (e.g., for levee reinforcement or as fill material in support of restoration activities) or transported to another location for reuse. Dried material that is not reused may be graded, covered with previously-stockpiled topsoil, and seeded for vegetation. RTM would be tested per applicable standards and assessed for usability prior to reuse. Treated water from RTM could be reclaimed, discharged, or disposed according to NPDES and other applicable codes and regulations. Further discussion of the process for disposal and reuse of RTM is provided in Appendix 3B, *Environmental Commitments*.

Canals

Design

The canal conveyance would consist of a trapezoidal, open channel, earthen or concrete-lined canal formed by embankments constructed of compacted engineered fill. Details for a lined canal would be finalized in the preliminary design phase for CM1; however, in this EIR/EIS, impacts for lined and unlined canal are analyzed in resource chapters where applicable (e.g., Chapter 7, *Groundwater*).

A cross section of a typical canal segment is shown in Figure 3-22. The canal would require new access roads for maintenance, a drainage system to carry surface runoff and floodwater, and irrigation ditches to maintain existing agricultural ditches. Short segments of buried pipeline would also be utilized to convey water from the intake pumping plants to the canal. A new access toe road would be constructed on each side of the canal embankment to provide maintenance access to the drainage and irrigation ditches and to areas otherwise cut off by the canal. The toe road would be paved where existing paved roads have been disrupted by the canal. In other areas where existing roads are gravel or not surfaced, the toe road is assumed to be gravel. The toe road would connect to the embankment maintenance road at locations where the embankment maintenance road is interrupted at the ends of the embankments and at bridges. The toe roads would tie into existing public roads and may or may not be publicly accessible.

In areas where the existing ground slopes toward the canal on both sides, a drainage ditch would be constructed along both sides of the canal to collect water and direct it to collection points for removal by pumping. It is anticipated that these new ditches would be approximately 5 feet deep and would connect to the existing drainage system. In areas where the ground slopes away from the canal on both sides, or if surface runoff would be intercepted and conveyed around the canal by an existing drainage feature, no new drainage areas would be constructed.

Where the canal water surface elevation is generally above existing ground, the canal would be formed by earth embankments constructed of compacted engineered fill. The crests of the embankments would be wide enough to allow for two maintenance vehicles traveling in opposite directions to pass each other. The canal would be designed with 2 feet of concrete-lined freeboard[23] plus 2 feet of unlined freeboard for a total of 4 feet of freeboard on the waterside. Waterside embankments could include wind and wave erosion control, such as concrete lining, riprap, or lining with articulated concrete mat.

Seepage from the canal could occur where the normal water level in the canals is higher than the groundwater levels of the adjacent areas. Seepage could potentially raise the water table on the landside of the embankments through more permeable lenses of sand and/or gravel in the foundation. Control of seepage could include the following methods.

- Installation of a slurry cutoff wall through the canal embankments and foundation. A cutoff wall would be most effective in areas where a canal cuts through layers of permeable sands and gravels.
- Use of a drainage ditch parallel to the canal to control seepage and groundwater levels. Water in the drainage ditch would then be pumped into the sloughs or back into the canals.

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[23] Vertical distance between the design water surface elevation and the elevation of the bank or levee that contains the water.

- Installation of pressure relief wells along the drainage ditch to collect subsurface water and direct it into the parallel drainage ditch.

The risk to the canal from flooding in the adjacent islands may be reduced by providing a means for drainage water to pass from one side of the canal to the other. The water could be routed by any of the means listed below.

- Under the canal with a culvert to existing drainage systems.
- Over the canal with an overchute to existing drainage systems. Overchutes require piers similar to those supporting bridges to support the structure and span the width of the canals.
- Around the canal and through a gap between the existing levee and the ends of the canal embankments.
- To new storm drain pumps that would pump the water to sloughs or the canal.

Construction of irrigation ditches to supply water for agricultural use may be required in areas where irrigation water supply ditches are separate from drainage ditches. The irrigation ditches would likely need to be elevated above the existing ground to allow for gravity flow. New pumps or siphons may be required to supply the irrigation ditches.

Inverted culvert siphons would be used to convey diverted water from canals under major waterways and railroads. The 15,000 cfs culvert siphons would consist of reinforced concrete rectangular cells 26 by 26 feet each. Siphon length would vary from 595 to 2,400 feet, including concrete portions and upstream and downstream transition structures. The water velocity would be approximately 2 feet per second in the canal approaching the culvert siphon and 5–6 feet per second in the culvert. The culvert size and shape were selected as a compromise between head loss and potential sedimentation. The top of the culvert would be situated about 15 feet below the lowest elevation of the crossing to prevent exposure resulting from scour in the water body and to prevent uplift by the groundwater in the vicinity of the crossing. Culvert siphons would be installed using a cut and cover method, where one half of the water body to be crossed would be isolated with a cofferdam. Once the culvert(s) are placed and buried, the cofferdam would be removed and the same process would be repeated from the opposite bank. The installation of culvert siphons would require driving precast concrete foundation piles within a dewatered cofferdam using a combination of vibratory and/or impact driving. It is estimated that approximately 8–12 foundation piles would be driven per day.

Because the culvert siphons would need to be placed during low-flow periods (approximately August through November), it may be necessary to conduct this in-water work outside the June 1–October 31 in-water work window. Control structures would be provided at the inlet to the culvert siphon to allow for regulation of upstream water surface elevation. Control structures would also be provided at intermittent locations along the canal to provide for improved control of the water surface elevations where siphons are not required. For this analysis, it was assumed that radial gates with electric motors would be utilized to provide for control of the water surface elevation in the canal. A conceptual drawing of a typical culvert siphon is shown in Figure 3-23.

Where canals cross existing water bodies, tunnels would be used to convey water between canal segments. For the west alignment (Alternatives 1C, 2C, and 6C), a 17-mile-long tunnel segment would convey water from Ryer Island to Hotchkiss Tract. In the east alignment (Alternatives 1B, 2B, and 6B), shorter tunnel siphons would connect canal segments, crossing Lost Slough/Mokelumne River (5,400 feet), San Joaquin River (2,700 feet), and Old River (1,700 feet).

Tables 3-8 and 3-9 present a description of the physical characteristics of the canal conveyance features (Alternatives 1B, 2B, and 6B for the east alignment and Alternatives 1C, 2C, and 6C for the west alignment). A conceptual drawing of a typical canal segment is shown in Figure 3-24.

Three culvert siphons would be constructed under Alternative 4. One would serve as a transition between Tunnel 2 and the expanded Clifton Court Forebay under Italian Slough, one would connect the north cell of the expanded Clifton Court Forebay to a new approach canal to the Banks and Jones Pumping Plants under the south cell of the Forebay, and one would connect the new approach canal to the existing approach canal to Banks Pumping Plant under Byron Highway.

Two canal segments would be constructed for Alternative 9. One canal would be constructed on Coney Island to connect the south Delta separate water supply corridor from an enlarged and realigned Victoria Canal to Clifton Court Forebay, with culvert siphons conveying water under the existing West Canal and Old River. The Coney Island Canal would run approximately 4,000 feet, beginning at the downstream end of the siphon under Old River and ending at the upstream end of the siphon under West Canal. The second canal, with a control gate, would be constructed to connect Clifton Court Forebay to the Tracy Fish Facility. This canal, also approximately 4,000 feet long, would begin at the southeast corner of Clifton Court Forebay, cross Byron Tract, and connect to the Tracy Fish Facility utilizing a new levee (embankment) to close off the existing connection to Old River.

Operation and Maintenance

The flow rate and water level in the canal would be controlled by control structures such as radial gates to divide the canal into pools. Drawdown rates of water within the pools would be determined on the basis of the stability of the conveyance side embankment slopes.

Maintenance requirements for an unlined canal would include control of vegetation and rodents, embankment repairs in the event of flooding and wind wave action, and monitoring of seepage flows.

Sediment would be expected to build up on the bottom of the canal and require periodic removal by dredging. Sediment traps may be constructed to reduce the sediment that would collect in the siphons and tunnels.

Construction

Construction of the canal and pipeline segments connecting the intakes to the canal are assumed to be constructed at approximately 30 foot depths in open-trench excavations for the majority of the alignment, except where crossing a major waterway. As discussed above for tunnel construction, major waterways would be crossed using deep tunnel siphons at depths of approximately 120 feet msl. For the canal, excavation would proceed first with the excavated materials initially being hauled to storage areas or stockpiled nearby. Once a sufficient area has been excavated, the foundation for the embankments would be prepared and the embankments constructed. The canal and embankments would be constructed in independent segments. In addition to excavation for the canal, borrow areas, haul roads at the toe of the embankments, grading for drainage, and drainage pumping stations would be required to construct the canal.

Excavation of unsaturated soils could be performed using scrapers or excavators loading into large dump trucks. Excavations below the groundwater table using the same types of equipment would require extensive dewatering. Pipeline dewatering wells would be installed as part of construction

(1) to provide a dry, stable excavation bottom for placement of bedding, pipe material, and backfill; (2) to dewater the lenses of silts and sands encountered during excavation; and (3) to dewater highly permeable prolific sand layers below the excavation. In addition, due to the high level of the groundwater table, dewatering facilities may also be considered postconstruction for inspection, maintenance, or in the case of emergency.

Excavated materials that are suitable for embankment fill could be hauled and placed directly into areas ready for embankment construction or stockpiled for future use; unusable material would be hauled to spoils disposal areas. However it is unlikely that excavation of the canal would yield sufficient quantities of suitable material to build the embankments. Therefore, additional embankment material from borrow locations would be needed. The imported embankment materials would be placed and compacted on the dewatered foundation. Moisture conditioning of the embankment materials would generally be performed in the borrow areas prior to hauling and placement in the embankments.

The most likely method for construction of the shallower culvert siphon crossings is a cut-and-cover type excavation. Water in the slough would be diverted by use of a partial cofferdam across the slough (with continuous flow pumping of typical irrigation or flood flows) or by a temporary realignment of the slough during construction.

3.6.1.3 Operable Barriers

Design

An operable barrier at the head of Old River would be constructed to support operations of Alternatives 2A, 2B, 2C, and 4. This control structure is intended to prevent migrating and outmigrating salmon from entering Old River from the San Joaquin River, minimizing exposure to the SWP and CVP pumping facilities. It would be located at the divergence of the head of Old River and the San Joaquin River and would be approximately 210 feet long and 30 feet wide, with top elevation of 15 feet msl (NAVD 88). This structure would include seven bottom-hinged gates, totaling approximately 125 feet in length. Other components associated with this barrier are a fish passage structure, a boat lock, a control building, a boat lock operator’s building, and a communications antenna. Appurtenant components include floating and pile-supported warning signs, water level recorders, and navigation lights. The barrier would also have a permanent storage area (180 by 60 feet) for equipment and operator parking. Fencing and gates would control access to the structure. A communications antenna for telephone and telemetered data transmission would also be constructed, and a propane tank would supply emergency power backup.

The boat lock would be 20 feet wide and 70 feet long and would have floating boat docks for temporary mooring, navigation signs and lights, warning signs, and video surveillance capability. The fishway would be designed according to guidelines established by NOAA Fisheries and USFWS for several species including salmon, steelhead, and green sturgeon. The fishway would be approximately 40 feet long and 10 feet wide and would be constructed with reinforced concrete. Stoplogs would be used to close the fishway during the spring when not in use to protect it from damage.

When the gate is partially closed, flow would pass through the fishway traversing a series of baffles. The fishway is designed to maintain a 1-foot-maximum head differential across each set of baffles. The historical maximum head differential across the gate is 4 feet; therefore, four sets of baffles are required. The vertical slot fishway is entirely self-regulating and operates without mechanical adjustments to maintain an equal head drop through each set of baffles regardless of varying upstream and downstream water surface elevations.

Physical operable barriers would be primary structures to support water conveyance under Alternative 9. Under this alternative, operable barriers would serve to hydraulically isolate the corridors dedicated to fish movement and estuary habitat from those dedicated to diverting water from the Sacramento River and conveying it toward existing SWP and CVP facilities in the south Delta. The operable nature of the barriers would allow adjustments to channel flows to correct for changes in water quality and quantity in the Delta. Alternative 9 would use three types of barriers to accomplish different goals: inlet flow control, fish isolation, irrigation level control, flood control, and boat passage.

Depending on the characteristics of a specific barrier site and the intended function of the barrier, a variety of gate styles could be used. Depth of water, differences in water elevation between gate sides, whether the gates would be used to vary flow, and whether gates would permit boat passage are all factors that would determine the gate type(s) selected for any particular barrier. Similarly, the number of gate bays required at any given barrier would depend on the width and bottom profile of the channel.

Each barrier would tie into levees on both sides of the waterway. For those gates providing a flood protection function, the top elevation of the gates and barrier walls would be set to the same elevation as the existing levee crest adjacent to the barrier. Otherwise, gates would be slightly higher than normal waterway flow. All construction and modifications will comply with applicable state and federal flood management, engineering, and permitting requirements.

Type I barriers would use bottom-hinged navigable gates in locations where the majority of the waterway width requires gates and where depth is less than 20 feet. Type II barriers involve the use of nonnavigable radial gates for flow control and navigable wicket or miter gates for the operable portions; these would be used where waterway depth exceeds 20 feet. Type III barriers, like Type I barriers, would use bottom-hinged navigable gates for operable portions but would use rock walls for the fixed portions. This type of barrier would be used where gates are only required for recreational boat passage and where flood neutrality is not an issue.

Each barrier location would be accompanied by a 15-foot-wide by 53-foot-long control building. For those barriers requiring boat locks, the control building would also include an operations room on a second floor. Each site would also include a ground-mounted transformer and emergency generator.

Table 3-14 lists the operable barrier locations and types for Alternative 9.

Operation and Maintenance

For the operable barrier proposed under Alternative 4, periodic maintenance of the gates would occur every 5 to 10 years. Maintenance of the motors, compressors, and control systems would occur annually and require a service truck. Maintenance dredging around the gate would be necessary to clear out sediment deposits. Dredging around the gates would be conducted using a sealed clamshell dredge. Depending on the rate of sedimentation, maintenance would occur every 3 to 5 years, removing no more than 25% of the original dredged amount, using a sealed clamshell dredge. Because of constraints related to fish and other species of concern, the timing and duration of maintenance dredging would be limited. Spoils would be dried in the areas adjacent to the gate site. A formal dredging plan with further details on specific maintenance dredging activities will be developed prior to dredging activities. Guidelines related to dredging activities, including compliance with in-water work windows and turbidity standards are described further in Appendix 3B, *Environmental Commitments,* under *Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material*.

Gates constructed for Alternative 9 would also require routine annual inspection of gate facilities and systems, as well as associated equipment. Some gates may not be required to operate for extended periods and would be operated at least two times per year. Each gate bay would be inspected annually at the end of the wet season for sediment accumulation. Sediment would be removed during the summer. Each miter or radial gate bay would include stop log guides and pockets for stop log posts to facilitate the dewatering of individual bays for inspection and maintenance. Major maintenance could require a temporary cofferdam upstream and downstream for dewatering.

Construction

For construction of the barrier at the head of Old River under Alternatives 2A, 2B, 2C, and 4, one of two methods would be chosen: (1) cofferdam construction, which creates a dewatered construction area for ease of access and egress; and (2) in-the-wet construction, which allows the river to flow unimpeded and eliminates the time, material, and cost of constructing a cofferdam. To ensure the stability of the levee, a sheetpile retaining wall would be installed in the levee where the gate would be constructed.

The cofferdam construction method would enable the gates to be constructed in two phases and would allow in-water work to continue through the winter. The first phase would involve the placement of a cofferdam in half of the channel and then dewatering the area so the bottom of the channel could be used as a project construction site. The gates would be constructed within this area and on the adjacent levee. The cofferdam would remain in the water until the completion of half of the gate. It would then either be removed or cut off at the required invert depth and another cofferdam would be installed in the other half of the channel. In the second phase, the gate would be constructed using the same methods, with the cofferdam either removed or cut off, and incorporated into the final gate layout. Cofferdam construction would begin in August and last approximately 35 days. Construction activities within the cofferdam project area would last until approximately early November or could occur throughout the winter, depending upon weather and river flow conditions. The temporary barriers at this site would continue to be installed and removed as they are currently until the permanent gates are fully operable.

The in-the-wet method would involve working within the natural channel as it flows. No cofferdam or dewatering of the construction site would occur. Each gate would be constructed within the confines of the existing channel, and there would be no levee relocation. The channel invert would be excavated to grade using a sealed clamshell excavator working off the levee or from a barge. H-piles or other suitable deep foundation would be placed in the channel. Gravel and tremie concrete would be placed for the foundation within the confines of the H-piles. Reinforced concrete structures would then either be floated in or cast in place using prefabricated forms to be placed on top of the gravel, tremie concrete, and H-piles. Divers would complete the final connections between the concrete structures and the piles.

The boat lock for the Head of Old River Barrier would be constructed using sheetpiles and include two bottom-hinged gates on each end, measuring 20 feet wide and 10 feet high. Each gate would weigh approximately 8 tons and would be opened and closed using an air-inflated bladder. The invert of the lock would be at elevation –8.0 feet msl, and the top of the lock wall would be at elevation 15 feet. The boat lock would transport boats with the use of the bottom-hinged gates and a valve system for equalizing water levels, and would function by filling and emptying the lock chamber with a 36-inch valve. For boats traveling upstream, the lock chamber would be emptied to the downstream water level. The downstream gates would be opened and boats would enter the lock chamber. With the gates closed, the lock chamber would be filled to the upstream water level and the upstream gates would be opened to allow boat passage. For boats traveling downstream, the procedure would be reversed.

The construction of operable barriers under Alternative 9 would require dredging several hundred feet upstream and downstream of gate structures to transition the channel sides to fit the depth and width of the gates. Riprap would then be installed in these areas to control erosion. The majority of dredged material under Alternative 9 (including dredgings from channel expansion activities) would be stored in upland storage sites, and approximately 0.5% may be disposed of in an offsite landfill. Gates for Type I and III barriers could be constructed with existing waterways either wet or dry. Wet construction would require offsite prefabrication with attachment of concrete sills. The site would be dredged and sheet piles and H-piles installed. Then the sills and gates would be lifted into place using either barge-mounted cranes or catamarans made of sectional barges. Type II barriers would be constructed during summer low-flow periods. A closed steel sheet pile cofferdam would be constructed across part of the waterway. After dewatering, the structure would be constructed. Then the cofferdam would be removed and a new one installed for construction of the adjacent section. Construction through the winter high-flow periods is not anticipated. Additional temporary cofferdams may also be necessary upstream and downstream of deeper gate bays to allow dewatering and gate panel installation to take place. Barrier structures for Type II miter gates would include reinforced concrete walls, piers, and foundation mats. For the purposes of this analysis, it is assumed that a 60-ton bearing capacity would guide the depth of pile driving for foundation piles, anticipated to be between 60 and 80 feet below foundation level. A barge-mounted crane would install the rock walls for Type III barriers. The rocks may need a prepared foundation, depending on local site conditions.

A temporary work area of up to 15 acres would be required in the vicinity of each barrier for such uses as storage of materials, fabrication of concrete forms or gate panels, stockpiles, office trailers, shops, and construction equipment maintenance.

3.6.1.4 Forebays

Design

Intermediate Forebay and Intermediate Pumping Plant

Under the pipeline/tunnel alignment, an intermediate forebay near Hood would provide storage of approximately 5,250 af with a surface area of 760 acres and would provide a transition between the north Delta intakes and the intermediate pumping plant. Under Alternative 4 (the modified pipeline/tunnel alignment), the proposed intermediate forebay would be located on Glannvale Tract, would provide storage of 368 af with a surface area of 40 acres, and would feed into an outlet control structure to Tunnel 2. Under both alignments, this feature would also include a seepage cutoff wall to the depth of the impervious layer and a toe drain would surround the forebay embankment to capture water and pump it back into the forebay. The forebay would allow the intermediate pumping plant to operate efficiently over a wide range of flows and hydraulic heads in the pipelines/tunnels. Limitations on delivery of water from the intakes into the intermediate forebay and the need to operate the intermediate pumping plant efficiently would limit the ability to deliver flow from the pipelines/tunnels during portions of the day to the existing Banks and Jones pumping plants. For the Banks Pumping Plant, this would entail operating at low flows during hours with high electrical costs and at maximum capacity during "off-peak" periods to minimize electrical power costs. The Jones Pumping Plant must operate continuously (i.e., 24 hours per day, 7 days per week). The Byron Tract Forebay (see description below) would alleviate some of the impacts of these operational constraints and provide storage to balance inflow with outflow.

The intermediate pumping plant would include ten 1,500-cfs pumps to be used in higher hydraulic head condition, and six 1,500-cfs pumps for lower hydraulic head conditions. The pumping plant would include an approach channel from the forebay to the pump bays, the pumping plant structure, discharge pipes with flow measurement, transition manifold, and transition pipelines for discharge to the tunnel. The pipeline/tunnel alignment would require two 33-foot diameter (minimum) surge towers, the elevation of which would be approximately 105 feet (NAVD 88) at the rim. The intermediate pumping plant for the west alignment would also require two 33-foot diameter surge towers, the elevation of which would be as high as 70 to 80 feet (NAVD 88) at the rim, depending on the final pump selection and pipe arrangement. No surge towers would be required at the intermediate pumping plant for the east alignment.

The intermediate forebay allows for operation of a gravity bypass of the intermediate pumping plant by balancing the difference in water surface elevations between the intermediate forebay and the Byron Tract Forebay. Under Alternative 4, the passage of water from the intermediate forebay would rely exclusively on gravity flow. Under this alternative, therefore, the intermediate pumping plant, along with its associated surge towers and other facilities, would not be constructed. Instead, the intermediate forebay would be designed as a pass-through facility.

The intermediate pumping plant would be staffed 24 hours each day and would require similar maintenance activities to the intake pumping plants, as described in Section 3.6.1.2, *Conveyance Facilities*. It is assumed that the intermediate pumping plant would require periodic harvesting of pond weeds to maintain flows and forebay capacity. The harvesting would occur in the forebay and at the trashracks immediately upstream of the intermediate pumping plant.

The east and west alignments (Alternatives 1B, 2B, and 6B and 1C, 2C, and 6C, respectively) would incorporate a similar intermediate pumping plant. The east alignment plant would be approximately 3 miles south of the point where the alignment crosses the San Joaquin River. The west alignment plant would be at the entrance to the tunnel segment on Ryer Island, approximately 1.2 miles east of the Sacramento River DWSC. The intermediate pumping plant under these conveyance alignments would provide diverted water with the necessary head to flow into the Byron Tract Forebay.

Byron Tract Forebay

The Byron Tract Forebay (Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 5, 6A, 6B, 6C, 7, and 8) would be adjacent to Clifton Court Forebay and would provide storage of approximately 4,300 af with a surface area of 600 acres. The Byron Tract Forebay would be used to balance variations in pipeline/tunnel inflow with outflow on a daily basis. For the Banks pumping plant, this includes operating at low flows during hours with high electrical cost and at maximum capacity during off-peak periods to minimize electrical power costs. The Jones pumping plant would operate continuously. For Alternatives 1A, 1B, 2A, 2B, 3, 4, 5, 6A, 6B, 7, and 8, the Byron Tract Forebay would be constructed on the southeast side of Clifton Court Forebay. For Alternatives 1C, 2C, and 6C, the Byron Tract Forebay would be constructed on the northwest side of Clifton Court Forebay.

Expanded Clifton Court Forebay

Under the modified pipeline/tunnel alignment (Alternative 4), Clifton Court Forebay would be dredged and expanded by approximately 690 acres to the southeast of the existing forebay. Additionally, a new embankment would be constructed around the perimeter of the forebay, as well as an embankment dividing the forebay into a northern cell and a southern cell. The northern end would receive water from Tunnel 2 (from the north Delta intakes), which would pass under Italian Slough in a culvert siphon before entering Clifton Court Forebay (north). The northern cell would provide storage of approximately 6,070 af. The southern cell of the forebay would continue to provide functionality for the existing through-Delta conveyance system and would provide storage of approximately 26,000 af.

Operation and Maintenance

New forebays would be dredged to remove sediment and maintain design capacity. Maintenance requirements for the forebay embankments would include control of vegetation and rodents, embankment repairs in the event of island flooding and wind wave action, and monitoring of seepage flows. Maintenance of control structures could include roller gates, radial gates, and stop logs. Maintenance requirements for the spillway would include the removal and disposal of any debris blocking the outlet culverts. Dredging may be necessary to remove sediments in the forebays. As designed, both forebays are expected to have capacity to store sediment accumulated over a 50-year period. However, depending on the actual sedimentation rate, dredging may be necessary more or less often.

Construction

Under the pipeline/tunnel alignment, approximately 6 million cubic yards of earth would be excavated from portions of the intermediate forebay, and approximately 14 million cubic yards would be excavated from the Bryon Tract Forebay. Under the modified pipeline/tunnel alignment (Alternative 4), approximately 700,000 cubic yards of earth would be excavated from portions of the intermediate forebay, and approximately 4 million cubic yards of earth would be excavated for the expanded portion of the Clifton Court Forebay. These excavation amounts include the embankment foundation. Dewatering would be required for excavation operations. Much of the excavated material at both locations is expected to be high in organics and unsuitable for use in embankment construction. Some of the excavated material below the peat layers at both locations may be suitable for use in constructing the embankments. To the extent possible, spoils to be used for the embankments would be stored onsite. Under the modified pipeline/tunnel alignment, nearly 8 million cubic yards of material would be dredged from Clifton Court Forebay, equivalent to an average of about 2 feet throughout the forebay. Dredged material would be transported to and stored at an area also designated for storage of RTM to the west of Clifton Court Forebay. Guidelines for the disposal and reuse of dredged material are provided in Appendix 3B, *Environmental Commitments.*

3.6.1.5 Connections to Banks and Jones Pumping Plants

Design

For Alternatives 1A, 1B, 2A, 2B, 3, 5, 6A, 6B, 7, and 8, an approximately 2,000-foot-long canal would be constructed to connect the Byron Tract Forebay with the existing approach canal to the Banks pumping plant, with a series of radial gates to isolate the facilities. Under these alternatives, another series of radial gates constructed in an opening in the embankment of Byron Tract Forebay would allow for the control of water flow between the forebay and the approach canal to the Jones pumping plant. For Alternative 4, a culvert siphon (similar to those described above in relation to canals), would be constructed to connect the northern cell of the expanded Clifton Court Forebay to a new canal leading to the approach canal to the Jones Pumping Plant. An additional siphon would be constructed under the Byron Highway and into a short segment of canal before leading into the approach to the Banks Pumping Plant. For Alternatives 1C, 2C, and 6C, a canal would stretch from Byron Tract Forebay to approach canals for both existing pumping plants. The dual conveyance alternatives would also include the construction of gates in the existing approach canals upstream of the connections with the new facilities. These structures would allow operational flexibility between pumping from the north Delta and pumping from the south Delta.

Operations and Maintenance

Maintenance requirements for the canal would include erosion control, control of vegetation and rodents, embankment repairs in the event of island flooding and wind wave action, and monitoring of seepage flows. Sediment traps may be constructed by overexcavating portions of the channel upstream of the structures where the flow rate would be reduced to allow suspended sediment to settle at a controlled location. The sediment traps would be periodically dredged to remove the trapped sediment.

Construction

Canal construction would include use of scrapers, excavators, and/or draglines. The top layer of soil along some portions of the canal could consist of up to 25 feet of organic and peat soils deemed unsuitable for support of the canal embankments. In such areas, these soils would be removed and disposed of offsite; it is estimated that approximately 0.1% of spoil may need to be disposed of in a landfill. The removal of the full depth of the peat and organic soil could be limited to the area of the embankment foundations. In other areas, potentially liquefiable sands could be present below the organic soils. It would be necessary to remove or stabilize the liquefiable soils as part of the excavation for the canal embankments.

3.6.1.6 Power Supply and Grid Connections

Electric power would be required for intakes, pumping plants, operable barriers, boat locks, and gate control structures throughout the various proposed conveyance alignments. Temporary power would also be required during construction of water conveyance facilities.

New temporary power lines to power construction activities would likely be built prior to construction of permanent transmission lines to power conveyance facilities (see Mapbook Figures M3-1 through M3-5 to see the assumed alignment of both temporary and permanent lines under the various alternatives). These lines would extend existing power infrastructure (lines and substations) to construction areas, generally providing electrical capacity of 12 kV at work sites.

Main shafts for the construction of deep tunnel segments would require the construction of 69 kV temporary power lines. Under Alternatives 1A through 8, electrical power to operate the new north Delta pumping plant facilities would be delivered through 230 kV transmission lines that would interconnect with a local utility at a new or existing utility substation depending on the conveyance alignment. The alignment of this transmission line and its interconnection point would be based on the selection of a power provider for the BDCP following selection of a conveyance alignment. Possible alignments for the 230 kV transmission lines are shown in Figure 3-25. For the purposes of analysis, one sub-option has been selected for each of the four conveyance alignments that would require a 230 kV line. For the west alignment, this line would extend west from the intermediate pumping plant on Ryer Island. For the pipeline/tunnel alignment, the line would extend south from the intermediate pumping plant and would generally follow the tunnel connecting to existing utility facilities at the Banks pumping plant. The 230 kV line for the east alignment would also connect to the existing grid at this point, but would follow alongside the Byron Tract Forebay and canal ROW northeast to the intermediate pumping plant.

Under Alternative 4, the modified pipeline/tunnel alignment, the method of delivering power to construct and operate the water conveyance facilities is assumed to be a “split” system that would connect to the existing grid in two different locations. The northern point of interconnection would be located north of Lambert Road and west of Highway 99. From here, a 230 kV transmission line would run west, along Lambert Road, where one segment would run south to the intermediate forebay on Glannvale Tract, and then on to tunnel shaft locations on Staten Island; and one segment would run north to connect to a substation where 69 kV lines would connect to the intake pumping plants. At the southern end of the modified pipeline/tunnel alignment, the point of interconnection may be in one of two possible locations: southeast of Brentwood near Brentwood Boulevard or adjacent to the Jones pumping plant. While only one of these points of interconnection would be used, both are depicted in figures, and the effects of constructing transmission lines leading from both sites are combined and accounted for in resource-specific impact analysis. A 230 kV line would stretch from one of these locations to a tunnel shaft northwest of Clifton Court Forebay, and would then continue north, following tunnel shaft locations, to Bouldin Island, where a 34.5 kV line would continue to the southern end of Staten Island. Because the power required during operation of the water conveyance facilities would be much less than that required during construction, and because it would largely be limited to the intake pumping plants and intermediate forebay, the “split” system would enable all of the power lines extending from the southern point of interconnection to be temporary, limited to the construction schedule for the relevant tunnel reaches and features associated with Clifton Court Forebay. Additionally, those segments extending south of the intermediate forebay on McCormack-Williamson Tract and Staten Island would also be removed following construction of associated tunnel facilities.

It is assumed that a new substation would be constructed within or adjacent to the utility’s existing transmission ROW. Some utility grid reinforcement and upgrade may be needed to accommodate this large new pumping load. The 230 kV transmission line would terminate at the BDCP’s main 230 kV substation, which would be adjacent to one of the new pumping plants in a 268- by 267-foot enclosure. At the main 230 kV substation, the electrical power would be transformed from 230 kV to 69 kV and delivered to the adjacent main 69 kV substation to power the adjacent pumping plant. Additionally, the main 69 kV substation would deliver power on a new overhead 69 kV subtransmission line, looping into each of the other intake substations. Each 69 kV substation would have a footprint of approximately 150 by 150 feet. The subtransmission line would generally follow the alignment ROW. At the main 69 kV substation and at each of the intake substations, electrical power would be transformed from 69 kV to the voltage needed for the pumps and auxiliary equipment at the adjacent structures.

For Alternatives 1B, 1C, 2B, 2C, 6B, and 6C, a main 69 kV substation would be constructed at the intermediate pumping plant, and an overhead 69 kV subtransmission line would be constructed along a route parallel to the canal and within the project ROW. To supply power for communications, monitoring, and control of the gates at the tunnel and siphon entrances along the canal, 12 kV distribution lines would be extended along the canal from the 69 kV substations. Wherever possible, this 12 kV line would be constructed on the same poles as the 69 kV subtransmission line. A local utility distribution line would provide power for gate controls along the south canal of Alternatives 1C, 2C, and 6C. For Alternatives 1A, 2A, 3, 4, 5, 6A, 7, and 8, the main 69 kV substation would be built at the intermediate forebay with 69 kV subtransmission lines looping into each intake plant substation.

Three utility grids could supply power to the BDCP (or an alternative) conveyance facilities: Pacific Gas and Electric Company (PG&E) (under the control of the California Independent System Operator), the Western Area Power Administration (Western), and/or the Sacramento Municipal Utility District (SMUD). The electrical power needed for the conveyance facilities would be procured in time to support construction and operation of the facilities. As the operator of the SWP, DWR is an active participant in the activities of the California electric grid, from long-term planning to day-to-day operation. The power will be provided from the SWP power portfolio of existing physical generation facilities, long-term power contracts, and short-term power contracts—including Day-Ahead market purchases. Purchased energy may be supplied by existing generation, or by new generation constructed to support the overall energy portfolio requirements of the western electric grid. It is unlikely that any new generation will be constructed solely to provide power to the BDCP conveyance (or an alternative) facilities.

PG&E's distribution system would likely provide power for the through Delta/separate corridors alignment (Alternative 9) because the system currently reaches most of the proposed facilities. The pumping plants and intakes would receive 12 kV service from the local distribution system, while service to other facilities, including operable barriers, siphons, control gates, intakes, and boat locks would be at 480 volts. Operable barriers under this alignment would also have backup generation to ensure continued operational control during outages. Wood poles for the 12 kV service would be spaced 300 feet apart, on average, with a height of 40–45 feet, and would result in a disturbed area 2 feet in diameter. Facilities receiving 480 volt service require a three phase service drop (three or four wires) from a utility pole with a 12 kV/480 volt three phase transformer mounted on it. Alternatively, the utility may choose to site the transformer on a pad (ground level) at the point of service and bring 12 kV utility service to the transformer. For a pad-mounted transformer, there would be a disturbed area of 8 feet by 8 feet.

Towers for 230 kV transmission lines employed in other conveyance alignments would be spaced, on average, 750 feet apart. Their physical footprint would be approximately 30 feet square, with foundations at each leg measuring 3.5 to 5 feet in diameter. If a horizontal conductor configuration is chosen, the average tower height will be 95–100 feet, while towers configured for vertical conductors would be 130 feet high. Based on the potential utility providers' design practices, the 230 kV towers would most likely be monopoles (both utilities), with H-frame and lattice towers being options for a Western interconnection. The configuration may need to be a dual circuit design to accommodate future expansion for the utility. To discourage raptor perching, a dipped cross-arm configuration could be used in place of davit arms on monopole structures.

The 69 kV transmission lines would almost certainly be monopoles of either steel or wood depending on the utility. To meet the raptor-safe design guidelines, the 69 kV wood pole structure should be 60 inches minimum between the conductor (end of insulator) and pole face in areas of raptor concern. Poles for the 69 kV lines would be spaced 450 feet apart, on average. Wood poles would result in a disturbed area with a diameter of 2 feet while steel poles typically entail foundations 5–6 feet in diameter. Poles would typically be about 60 feet above ground (70-foot poles, embedded 10 feet). A shield wire (at the top of the structure) may be required by either utility for both 230 kV and 69 kV transmission. Analysis assumes that 34.5 kV power lines would be constructed to similar specifications.

For the electrical transmission facilities provided from the utility interconnection to and between the BDCP facilities, industry standard techniques will be incorporated into power line designs to minimize impacts on birds. For monopole and lattice structures, the material coating would be selected for color and reflectivity consistent with meeting visibility goals to mitigate bird strikes and collisions.

Construction

New transmission lines would generally follow the conveyance alignments and would be constructed within or adjacent to the alignment ROW. Temporary lines would be constructed from existing facilities to each worksite where power is necessary for construction. Construction of all transmission lines would require three phases: site preparation, tower or pole construction, and line stringing. For 12 kV and 69 kV lines, cranes would be used during the line stringing phase. For stringing transmission lines between 230 kV towers, cranes and helicopters would be used.

Construction of 230 kV and 69 kV transmission lines would require a corridor width of 100 feet and, at each tower or pole, 100 feet on one side and 50 feet on the other side for construction laydown, trailers, and trucks. Construction would also require about 350 feet along the corridor (measured from the base of the tower or pole) at conductor pulling locations, which includes any turns greater than 15 degrees and/or every 2 miles of line.

For construction of 12 kV lines (when not sharing a 69 kV line), a corridor width of 25–40 feet is necessary, with 25 feet in each direction along the corridor at each pole. Construction would also require 200 feet along the corridor (measured from the base of the pole) and a 50-foot-wide area at conductor pulling locations, which includes any turns greater than 15° and/or every 2 miles of line. For a pole-mounted 12 kV/480 volt transformer, the work area is only that normally used by a utility to service the pole (typically about 20 by 30 feet adjacent to pole). For pad-mounted transformers, the work area is approximately 20 by 30 feet adjacent to the pad (for construction vehicle access).

Consideration of underground transmission lines

As part of the transmission line planning process, DWR evaluated a number of locations and options for power transmission to CM1 conveyance intakes and other facilities. One option that has been considered and is the subject of ongoing discussion is the potential to underground all or portions of the temporary and permanent transmission lines that could pose bird strike risks. This option has not yet been incorporated into any of the alternatives assumptions for CM1 facilities but DWR is continuing to evaluate its feasibility at the request of wildlife agencies, and because AMM20 in the Plan accounts for potentially locating some existing transmission lines underground to reduce impacts on greater sandhill cranes. The following key feasibility factors would be evaluated to determine if underground transmission lines are a viable option for this project.

- Consequences for critical water infrastructure associated with the time and process to repair faults or breaks in overhead lines versus underground lines.
- Potential for additional construction and environmental impacts related to underground lines and associated facilities.
- Costs associated with construction, operation, and maintenance of aboveground lines versus underground lines.

The following is a brief summary of these feasibility issues.

Critical Infrastructure

The SWP and CVP are critical infrastructure for the state of California. Operation of the SWP and CVP relies on interconnection to the power grid, and any disruption to power requires coordination among operators, power grid operators, and grid controllers. This is necessary to plan for reliable return to service, including resuming or replenishing water deliveries, after either a planned or unplanned power outage. One of the primary concerns with underground lines is the additional time necessary to repair outages. Faults or breaks in overhead lines can usually be located almost immediately and repaired within hours or, at most, 1 or 2 days. The duration of underground outages can vary widely, from several days to several months, depending on the circumstances of the failure, type of underground line, and availability of skilled repair personnel.

Outages of a few days or less generally present fewer effects, require less stringent coordination protocols, and may allow a portion of the effect to be avoided or minimized through short-term operational adjustments. A prolonged disruption or outage generally requires greater coordination to ensure that grid operators and grid controllers can manage other grid infrastructure, resources, and loads reliably during the outage. The larger the load or aggregate load interrupted for a prolonged time, the more likely there would be a need to re-evaluate the expected electrical system behavior. Power is also needed to maintain communications and controls systems during both normal and emergency situations. While backup power may temporarily and partially provide power to these critical systems during an outage, return to normal power would be necessary to reliably support these systems and their security, especially information systems networked to the SWP and CVP.

Construction and Environmental Impacts

The design and construction of underground transmission lines differ from overhead lines because two significant technical challenges need to be overcome: (1) providing sufficient insulation so that cables can be within inches of grounded material, and (2) dissipating the heat produced during the operation of the electrical cables. Overhead lines are separated from each other and surrounded by air. Open air circulating between and around the conductors cools the wires and very effectively dissipates heat. Air is also an insulator that can recover if there is a flashover. In contrast, a number of different systems, materials, and construction methods have been used during the last century to achieve the necessary insulation and heat dissipation required for underground transmission lines.

Different types of cables require different ancillary facilities. When assessing the impacts of underground transmission line construction and operation, the impacts of the ancillary facilities must also be considered. Ancillary features may include vaults, transition structures, and pressurizing systems. Some of these facilities are constructed underground, while others are aboveground and may have a significant footprint. Installation of an underground transmission cable generally involves the following sequence of events: (1) ROW clearing, (2) trenching/blasting, (3) laying and/or welding pipe, (4) duct bank and vault installation, (5) backfilling, (6) cable installation, (7) adding fluids or gas, and (8) site restoration. Trenching for the construction of underground lines would create greater soil disturbance than constructing overhead lines. Overhead line construction disturbs the soil mostly at the site of each transmission pole, while underground lines require 6- to 8-foot deep trenching along the entire line. Trenching an underground line through farmlands, forests, wetlands, and other natural areas can cause significant land disturbances. Other construction impacts include dirt, dust, noise, and traffic disruption. In non-urban areas, soil compaction, erosion, and mixing may also be problematic. The special soils often placed around an underground line may slightly change the responsiveness of surface soils to farming practices. Post-construction, trees and large shrubs would not be allowed within the ROW due to potential problems with roots, although some herbaceous vegetation and agricultural crops may be allowed to return to the ROW. The ROW also must be kept safe from accidental contact by subsequent construction activities.

In addition to environmental impacts from construction, impacts may occur from fluid leaks. Fluid-filled lines must have a spill control plan. The estimate for potential line leakage is about one leak every 25 years. Soil contaminated with leaking dielectric oil is classified as a hazardous waste. This means that contaminated soils and water would have to be remediated. The types of dielectric fluid used in underground transmission lines include alkylbenzene and polybutene. These are not toxic, but are slow to degrade. The release and degradation of alkylbenzene could cause benzene compounds, a known carcinogen, to appear in plants or wildlife. In areas with a relatively high groundwater table, such as the Delta, the potential for groundwater contamination could be high. A nitrogen leak from a gas-filled line would not affect the environment, but would be a safety concern; workers would need to check oxygen levels in the vaults before entering.

Costs

Costs for construction and maintenance of underground lines are substantially higher than those associated with aboveground lines. Cost estimates for constructing underground transmission lines range from 4 to 14 times greater than those associated with overhead lines of the same voltage and same length, especially when traveling through challenging geographic regions containing certain soil and rock formations, mountains, urban areas, and protected wetland habitats. In a 2011 report prepared by the Public Service Commission of Wisconsin, the cost of a typical new 69 kV overhead single-circuit transmission line was approximately $285,000 per mile as opposed to $1.5 million per mile for a new 69 kV underground line (Public Service Commission of Wisconsin 2011). A new 138 kV overhead line cost approximately $390,000 per mile as opposed to $2 million per mile for underground. Many engineering factors significantly increase the cost of underground transmission facilities. As the voltage increases, engineering constraints and costs dramatically increase. This is one reason why underground distribution lines (12–24 kV) are not uncommon, while underground transmission lines are constructed far less frequently. Repair costs for underground lines also tend to be greater than costs for an equivalent segment of overhead line. Finally, underground cables tend to have a substantially shorter service life than those used for overhead lines.

3.6.1.7 Through Delta/Separate Corridors Levee Construction and Modification

Description

The through Delta/separate corridors alternative (Alternative 9) would rely on existing levees to contain and convey water to existing diversion facilities in the south Delta.

This alignment would entail construction of a 4,000-foot segment of new on-channel levee at Old River, isolating Old River from the Tracy Fish Collection Facility and connecting Clifton Court Forebay to the fish facility. Setback levees (approximately 2,000 feet total) on the south side of Victoria Canal would also be constructed to accommodate the dredged and expanded canal under this alternative. The majority of dredged material under Alternative 9 would be stored in upland storage sites, and approximately 0.5% may be disposed of in an offsite landfill. Spoils would be disposed of in designated spoils areas, and approximately 0.1% of spoils may be disposed of in offsite landfills.

New facilities protection levees would be constructed around pumping plants and equipment for the operable barriers. New levees or levee modifications constructed for the through Delta/separate corridors alternative would be designed to meet similar flood protection levels as the existing levees.

A typical new levee would share the shape, slope, and dimensions of those described above for intake facilities. A notable difference is that the height of the levees would be approximately 10–15 feet, matching the height of existing levees in the Delta. This corresponds to a base width of approximately 80–260 feet. All construction and modifications will comply with applicable state and federal flood management, engineering, and permitting requirements.

Refer to Table 3-14 for a description of the physical characteristics of the through Delta/separate corridors alternative.

Operation and Maintenance

Levee maintenance facilities would typically be composed of material stockpile areas, sized to accommodate materials, equipment, and sufficient area for staging and loading of materials. Such areas would typically be rectangular in plan and range from approximately 50 to 500 feet on a side, depending on the length of levee serviced by the maintenance facility.

Access roads would be used regularly for inspection of the levees. Inspection would be performed for both the waterside and landside slopes and features. Maintenance activities include periodic addition of waterside armoring material, which may necessitate access and work either from the levee crest (e.g., using an excavator to place riprap) or from the water (e.g., using a barge and crane to place rip-rap). Levee maintenance may also include operations designed to prevent and repair damage from animal burrowing within the levee. Vegetation control measures would be performed as part of levee maintenance.

Construction

To construct levees, compacted lean clayey and/or silty soils would be imported to the site. Excavation and foundation improvement activities would be similar to those described above, with the use of riprap for waterside armoring. Access roads would be maintained along the landside levee toe or along the levee crest, while a dedicated ROW would preclude encroachment from features that could compromise levee integrity. Where levees cross existing agricultural channels, new channels would need to be constructed.

Beneath the levee, a zone of native soils would typically be removed and replaced. The depth of replacement is estimated to range from approximately 5 to 15 feet, but is expected to be 5 feet typically. The width of replacement would be slightly greater than the width of the base of the levee. This zone would be replaced with compacted clayey or silty soils as described above. The typical configuration would include some type of *in situ* foundation improvement to strengthen and stiffen the relatively weak and compressible soils present underneath most of the levee alignments. A zone of improved foundation materials would extend from the waterside levee toe to the landside toe. The zone of improved foundation materials would extend down to depths ranging from approximately 20 to 60 feet. The zone of improved foundation materials would typically be composed of a combination of existing *in situ* materials and added materials, mixed together. Armoring material would be rip-rap, which generally is composed of small to large angular boulders. The on-channel levee would be subject to waterway flows and could be armored for the full slope length on the waterside.

An access road would be maintained either along the landside toe of the levee, along the levee crest, or along a combination of these locations. A dedicated ROW would extend along the landside levee to preclude encroachment of channels, ditches, trenches, or pits near the levee.

3.6.1.8 Temporary Access and Work Areas for Intake, Canal, and Pipeline/Tunnel Construction

Temporary Barge Unloading Facilities

Temporary barge unloading facilities would be constructed at locations adjacent to construction work areas along the conveyance alignments for the delivery of construction materials. These facilities would be sized to accommodate various deliveries (e.g., tunnel segments, batched concrete, major equipment). The docks would be approximately 50 by 300 feet and supported on approximately 32 two-foot-diameter steel piles. Piles would be driven within the allowable window for in-river construction.

Access roads from these facilities to the construction work area would be necessary. The barge unloading facilities would be removed following construction. Depending on the alternative selected, barge unloading facilities could be constructed at one or more of the following locations.

- SR 160 west of Walnut Grove (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8).
- Venice Island (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8).
- Bacon Island (Alternatives 1A, 2A, 3, 4, 5, 6A, 7, 8, and 9).
- Woodward Island (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8. Two barge facilities would be constructed at this location under Alternative 9).
- Victoria Island (Alternatives 1A, 2A, 3, 4, 5, 6A, 7, 8, and 9).
- Tyler Island (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8).
- Hog Island (Alternatives 1B, 2B, and 6B).

- Ryer Island (Alternatives 1C, 2C, and 6C).
- Brannan Island (Alternatives 1C, 2C, and 6C).
- Byron Tract on Italian Slough (Alternative 4).
- Bouldin Island on San Joaquin River (Alternative 4).
- Staten Island on South Mokelumne River (Alternative 4).
- Webb Tract (two barge facilities would be constructed on Webb Tract under Alternative 9—one at the northwest corner and one on the eastern side).
- Upper Jones Tract (Alternative 9).

In addition, there is an existing dock at Hood that would likely be used during construction for Alternatives 1A, 1B, 2A, 2B, 3, 4, 5, 6A, 6B, 7, and 8. The barge unloading facilities would be used for the delivery and removal of construction materials and equipment. A pier would be built within the worksite footprint of the intake or tunnel for these activities. The barge unloading facility at each location is assumed to be used for the duration of the construction of the intake or tunnel (for approximately 5–6 years). Piers would be disassembled and removed from the site at the end of construction. Under Alternative 4, it is assumed that barge activities would take place on levees using a ramp barge in conjunction with a crane/excavator barge or a crane or excavator positioned on or near the levee.

Road Haul Routes

It is assumed that the majority of haul routes would include interstates, state routes, and local arterial roadways, depending on the location of the work area and the origin/destination of the trip. Key roadways to be utilized as haul routes are assumed to be the federal and state facilities and their intersecting roadways listed below.

- I-5
- I-80
- I-580
- I-205
- SR 160
- SR 12
- SR 4

The reader is referred to Chapter 19, *Transportation*, for a more detailed discussion of potential existing public roads that may be used as haul routes.

In addition, haul routes could include all-weather access roads. All-weather roads would be required for year-round construction and for access to delivery areas and permanent spoils areas, including RTM areas. All-weather roads are typically surfaced with a minimum of 24 inches of gravel.

General Construction Work Areas

Work areas during construction would include areas for construction equipment and worker parking, field offices, a warehouse, maintenance shops, equipment and materials laydown and storage, RTM spoils areas, and stockpiles. Under Alternative 4, one of these areas would be located adjacent to Hood on the southern side of the community, and would serve as a staging area during the construction phase. It would consist of facilities such as parking areas, offices, and construction equipment storage. Materials to be stockpiled may include those listed below.

- Strippings from various excavations for possible reuse in landscaping.
- RTM that is slated for reuse after treatment for embankment or fill construction.
- Peat spoils for possible use on agricultural land, as safety berms on the landside of haul roads, or as toe berms on the landside of embankments (cannot be part of the structural section).
- Other materials being stockpiled on a temporary basis prior to hauling to permanent stockpile areas.

Such materials can be stockpiled in the construction areas of the project for later use. Some stockpiles may be used for material conditioning and potential reuse. Temporary stockpile areas may also allow for staging deliveries (offloading), for equipment/materials storage, and for temporary field offices for construction.

Site clearing and grubbing, work area limits, and site access to stockpile locations will be developed. Silt fencing and straw bale dikes will be installed, as needed, to address drainage issues. Dust abatement and other environmental concerns relating to stockpiles will be addressed by environmental commitments (Appendix 3B, *Environmental Commitments*) and mitigation measures introduced throughout the impact analysis. Stockpile areas may require security fences, gates, and/or cameras.

Depending on the selected RTM handling method, RTM areas may be permanent. Similarly, borrow or spoils areas that cannot be returned to previous uses may constitute permanent physical effects, subject to appropriate environmental permitting (see Table 1-3 in Chapter 1, *Introduction*, for a summary of permits relevant to the BDCP). While these areas are treated as "permanent surface impacts" throughout the assessment of impacts, it is anticipated that much of the RTM and spoil material could be reused, as described further in Appendix 3B, *Environmental Commitments.*

A potable water supply system would be necessary at main construction work areas. Accordingly, wells would be drilled to provide approximately 500 gallons per minute during construction activities. Geotechnical studies would be performed prior to drilling. If necessary, package water treatment plants would be brought to the site. These facilities would be anticipated to be located within the tunnel work areas.

3.6.1.9 SWP and CVP South Delta Export Facilities

Under most alternatives, existing SWP and CVP conveyance facilities would continue to be active physical components of the water conveyance system; as such, these facilities are described below. Operation and maintenance of these facilities and modifications proposed under the alternatives are detailed in Section 3.6.4. These facilities include the SWP Clifton Court Forebay, Skinner Fish Facility, Banks Pumping Plant, Tracy Fish Facility, Delta Cross Channel, Jones Pumping Plant, south Delta temporary barriers, Barker Slough Pumping Plant and North Bay Aqueduct, portions of the CCWD Diversion Facilities, and Suisun Marsh Facilities. Because CCWD's facilities are not operated or maintained by the CVP, the BDCP does not include modifications to them. Coverage under ESA and CESA for existing operation and maintenance of the SWP, coordinated operations of the SWP with the CVP, and operation and maintenance of CCWD's facilities are addressed through separate compliance processes and not addressed in the BDCP.

Clifton Court Forebay

Clifton Court Forebay is a 31,000-af regulatory reservoir for the SWP about 10 miles northwest of Tracy. Water flows through Grant Line Canal and Old River and into Clifton Court Forebay through radial gates near the confluence of Grant Line Canal and West Canal. The gates are operated on the tidal cycle to reduce approach velocities, prevent scour in adjacent channels, and minimize water elevation fluctuation in the south Delta by taking water in through the gates at times other than low tide. When a large head differential (difference in water surface elevation) exists between the outside and the inside of the gates, theoretical inflow can be as high as 15,000 cfs for a short time, though actual inflow would be constrained in accordance with the BDCP conservation strategy. The intake gates enable incoming flow into Clifton Court Forebay to be measured and conveyed to the Banks Pumping Plant. Water can be stored in Clifton Court Forebay to be conveyed at a later time to maximize pumping during off-peak hours. The off-peak hours are typically 10:00 p.m. to 7:00 a.m. Monday through Saturday, all day Sunday, and many holidays. The gates prevent reverse flow back into Old River.

The period of the tidal cycle in which the Clifton Court Forebay intake gates are opened is selected to minimize impacts on south Delta water users. DWR reports that the surface water elevation in Clifton Court Forebay varies throughout the day, typically between -2 feet and +0 to +2 feet depending on tidal conditions and predetermined gate opening priority for the forebay. Typical operation is targeted to restore the surface elevation to -1 foot each day at midnight. This water level creates the required hydraulic head differential between the available water in the Delta and Clifton Court Forebay to allow water to flow from the Delta into the forebay to provide sufficient water for SWP's Delta Export Allocation for the following day. The Clifton Court Forebay gates are closed once DWR's daily water allocation has been achieved. If tidal or other conditions prevent DWR's daily allocation from being achieved, the schedule for the following day's water conveyance operation is adjusted to minimize impacts on DWR deliveries.

The maximum design operating storage at Clifton Court Forebay is 28,653 af at the water surface elevation of +5 feet. The minimum design operating storage is 13,965 af at the minimum water surface elevation of -2 feet. DWR has indicated that unless engineering improvements are made to the perimeter embankment around Clifton Court Forebay, the maximum operating water surface elevation for future water operations should be limited to +4 feet. For the modified pipeline/tunnel alignment (Alternative 4), Clifton Court Forebay will be reconfigured by dividing it into two cells, a north cell and a south cell. The south cell will continue to function using existing operating rules for Clifton Court Forebay. The maximum design operating storage will be reduced to about 26,000 af. The perimeter embankment however will be completely rebuilt to current flood protection and seismic design standards, thereby improving its reliability.

Skinner Fish Facility and Banks Pumping Plant

Water from Clifton Court Forebay is conveyed through Skinner Fish Facility to the California Aqueduct Intake Channel, which extends to the Banks Pumping Plant. Large fish and debris are directed away from the Banks Pumping Plant by a 388-foot-long trash boom. Smaller fish are diverted from the intake channel into bypasses by a series of metal louvers into a secondary system of screens and pipes, and then into holding tanks. The salvaged fish are returned to the Delta in oxygenated tank trucks. For the modified pipeline/tunnel alignment (Alternative 4), only water from the south cell will be conveyed through the Skinner Fish Facility.

The 2009 NMFS BiOp requires DWR to initiate studies to develop predator controls in Clifton Court Forebay to reduce salmonid and steelhead losses in the forebay by March 31, 2014, such that losses do not exceed 40%, and to remove predators in the secondary channel at least once per week. The NMFS BiOp also requires modifications to operations of the Skinner Fish Facility to achieve at least 75% salvage efficiency for Central Valley salmonids, steelhead, and the southern Distinct Population Segment of North American green sturgeon.

Banks Pumping Plant has an installed pumping capacity of 10,670 cfs. It discharges into five pipelines that convey water into a roughly 1-mile-long canal, which in turn conveys water to Bethany Reservoir. Bethany Reservoir serves as a regulating reservoir for the downstream canals that deliver SWP water.

The maximum daily pumping rate at Banks Pumping Plant is controlled by a combination of the State Water Board's D-1641, an adaptive management process described in the 2008 USFWS and the 2009 NMFS BiOps, and permits issued by USACE that regulate the rate of diversion of water into Clifton Court Forebay. The diversion rate is normally restricted to 6,680 cfs as a 3-day average inflow and 6,993 cfs as a 1-day average inflow to Clifton Court Forebay. The diversions may be greater in the winter and spring, depending on San Joaquin River flows at Vernalis.

The Byron-Bethany Irrigation District diverts water from the California Aqueduct Intake Channel through a canal between the Skinner Fish Facility and Banks Pumping Plant. This diversion occurs under an agreement related to historical water rights to the waters near Clifton Court Forebay.

Tracy Fish Facility and Jones Pumping Plant

The Tracy Fish Facility, located at the Delta-Mendota Canal intake, and Jones Pumping Plant operate continuously because the CVP facilities do not include a regulating reservoir such as Clifton Court Forebay. Water is diverted from Old River upstream of its confluence with Grant Line Canal, through the Tracy Fish Facility into the 2.5-mile unlined upper reach of the Delta-Mendota Canal, which conveys water to the Jones Pumping Plant. The Tracy Fish Facility uses louver screens to divert fish into holding tanks, where they are then placed in tanker trucks and released into the Delta. The salvaged fish are returned to the Sacramento River near Horseshoe Bend and the San Joaquin River upstream of the Antioch Bridge.

The CVP facilities do not include storage capacity in the south Delta. Consequently, the facilities usually operate continuously when diversions are allowed. Water supply operations of the Jones Pumping Plant are constrained by tidal fluctuations and the capacity of the Delta-Mendota Canal between the Jones Pumping Plant and the San Luis Reservoir complex. This capacity, including pumping capacity at the O'Neill Pump-Generating Plant, is about 4,200 cfs. Accordingly, operations of the Jones Pumping Plant are limited to 4,200 cfs unless deliveries are required for CVP water service contractors that divert upstream of the O'Neill Pump-Generating Plant. In many months, operations criteria limit the Jones Pumping Plant to diversions of less than 4,200 cfs; however, in summer, fall, and winter months, there are opportunities to divert up to 4,600 cfs.

Delta-Mendota Canal/California Aqueduct Intertie

Construction of the Delta-Mendota Canal/California Aqueduct Intertie (Intertie) was completed in April 2012. The Intertie was designed to include a pipeline between the Delta-Mendota Canal and the California Aqueduct south of the Banks and Jones Pumping Plants, and a new pumping plant on the Delta-Mendota Canal that allows up to 467 cfs to be pumped from the Delta-Mendota Canal to the California Aqueduct. Prior to operation of this facility, the O'Neill Pump-Generating Plant, farther south along the Delta-Mendota Canal, created a bottleneck due to a design capacity of 4,200 cfs, causing Jones Pumping Plant to pump below capacity in fall and winter. Diverting an additional 400 cfs to the California Aqueduct allows the Jones Pumping Plant to pump at a maximum monthly average of about 4,600 cfs throughout the year. This operational modification is intended to be implemented primarily September through March. Conversely, up to 900 cfs can be conveyed from the California Aqueduct to the Delta-Mendota Canal along the same pipeline by gravity. Operations of the Intertie are subject to all applicable export pumping restrictions for water quality and fisheries protection.

South Delta Temporary Barriers Project

The existing South Delta Temporary Barriers Project consists of seasonal installation and removal of three temporary rock barriers in Middle River near Victoria Canal, Old River near Tracy, and Grant Line Canal near Tracy Boulevard Bridge. These rock barriers are designed to act as flow-control structures, trapping tidal waters behind them following high tide. These barriers improve water levels and circulation for local south Delta farmers. A fourth barrier, installed at the head of Old River at the divergence from the San Joaquin River, is designed to improve migration conditions for salmon originating in the San Joaquin River watershed during adult and juvenile migrations, which occur annually in the fall and spring, respectively. In the fall, the head of Old River barrier improves downstream dissolved oxygen conditions; during the spring, the barrier is intended to prevent downstream migrating salmon smolt in the San Joaquin River from entering Old River. In 2009 and 2010, DWR installed and operated a nonphysical barrier at the head of Old River as an alternative to the spring rock barrier at this location. The nonphysical barrier uses underwater bubbles, light, and sound as a behavioral deterrent and tests the effectiveness of excluding outmigrating smolts from entering the south Delta via Old River without having to physically block the flow of water into the channel with a rock structure. In the future, DWR may install and operate the nonphysical barrier at the head of Old River as an alternative to the spring rock barrier.

Joint Point of Diversion

Under State Water Board D-1641 (December 1999, revised March 2000), Reclamation and DWR are authorized to use/exchange diversion capacity between the SWP and CVP to enhance the beneficial uses of both projects. The sharing of the SWP and CVP export facilities is referred to as Joint Point of Diversion (JPOD). In general, JPOD capabilities are used to accomplish the following four objectives.

- When wintertime excess pumping capacity is available during Delta excess conditions, and total SWP and CVP San Luis Reservoir storage is not projected to fill before the spring pulse flow period, the project with the deficit in San Luis Reservoir storage may elect to use JPOD capabilities.
- When summertime pumping capacity is available at the Banks Pumping Plant and CVP reservoir conditions can support additional releases, the CVP may elect to use JPOD capabilities to enhance annual CVP releases for south of Delta water supplies.

- When summertime pumping capacity is available at the Banks or Jones Pumping Plant to facilitate water transfers, the JPOD may be used to further facilitate the water transfer.
- During certain coordinated SWP and CVP operation scenarios for fish entrainment management, the JPOD may be used to shift SWP and CVP exports to the facility with the least fish entrainment impact and minimize exports at the facility with the most fish entrainment impact.

Barker Slough Pumping Plant and North Bay Aqueduct

The Barker Slough Pumping Plant diverts water from Barker Slough into the North Bay Aqueduct for delivery in Napa and Solano Counties. The North Bay Aqueduct intake is approximately 10 miles from the mainstem Sacramento River at the end of Barker Slough in the Cache Slough area. The maximum pumping capacity is 175 cfs (pipeline capacity). During the last few years, daily pumping rates have ranged between 0 and 140 cfs.

Currently, DWR and the Solano County Water Agency are evaluating an alternative intake for the pumping plant because operations have been limited by water quality constraints and provisions in the USFWS and NMFS BiOps. Water conveyance operations of this potential new facility are incorporated in this analysis and discussed in Section 3.6.4.

Water Transfers

State and federal laws governing water use in California promote the use of water transfers to manage water resources, particularly water shortages, provided that certain conditions of the transfer are met to protect source areas and users. Transfers requiring export from the Delta are conducted at times when pumping and conveyance capacity at the SWP or CVP export facilities are available to move the water. Additionally, operations to accomplish these transfers must be carried out in coordination with SWP and CVP operational criteria, such that the capabilities of the projects to exercise their own water rights or to meet their legal and regulatory requirements are not diminished or limited in any way.

SWP and CVP contractors have independently acquired water and arranged for its pumping and conveyance through SWP facilities. State Water Code provisions grant other parties access to unused conveyance capacity, although SWP contractors have priority access to capacity not being used by DWR to meet SWP operational demands, including SWP water deliveries.

Conveyance of transfer water by Authorized Entities is a covered activity provided that the transfers are consistent with the operational criteria described in CM1 and the effects analysis described in BDCP Chapter 5, *Effects Analysis*. However, the withdrawal of transfer waters from source areas is outside the scope of the covered activity. Additional information regarding water transfers is provided in Appendix 1E, *Water in California: Types, Recent History, and General Regulatory Setting*; Appendix 5C, *Historical Background of Cross-Delta Water Transfers and Potential Source Regions*; and Appendix 5D, *Water Transfer Analysis Methodology and Results.*

Suisun Marsh Facilities

The existing Suisun Marsh facilities comprise the Suisun Marsh Salinity Control Gates, Morrow Island Distribution System, Roaring River Distribution System, Goodyear Slough Outfall, and various salinity monitoring and compliance stations throughout the marsh. Since the early 1970s, the California Legislature, State Water Board, Reclamation, CDFW, Suisun Resource Conservation District (SRCD), DWR, and other agencies have engaged in efforts to preserve beneficial uses of

Suisun Marsh to mitigate the potential impacts on salinity regimes associated with reduced freshwater flows to the marsh. Initially, salinity standards for Suisun Marsh were set by State Water Board D-1485 to protect production of alkali bulrush, a primary waterfowl plant food. Subsequent standards set under State Water Board D-1641 reflect the intention of the State Water Board to protect multiple beneficial uses. A contractual agreement between DWR, Reclamation, CDFW, and SRCD includes provision for measures to mitigate the effects of operation of the SWP and CVP and other upstream diversions on Suisun Marsh channel water salinity. The Suisun Marsh Preservation Agreement requires DWR and Reclamation to meet specified salinity standards, sets a timeline for implementing the Plan of Protection, and delineates monitoring and mitigation requirements. Maintenance activities for existing facilities include levee repairs, vegetation removal, fish screen cleaning and installation of new screens, mechanical repairs, structural repairs, removal or replacement of monitoring and compliance stations (including in-water work), and instrumentation installation on or near existing facilities.

3.6.2 Conservation Components

This section describes the proposed habitat conservation components associated with the action alternatives. The descriptions include the general locations proposed for implementation of each conservation measure, as well as the potential physical modifications and construction efforts necessary to implement habitat conservation–related activities. These descriptions include enough detail to support program-level impact analyses related to habitat and land use conversions. Any differences in conservation components among the action alternatives (e.g., different target acreages for restored habitat) are noted in the descriptions in the subsections below. A screening evaluation of alternatives for these conservation components is detailed in Appendix 3G, *Background on the Process of Developing the BDCP Conservation Measures*.

While general locations are provided, specific locations for these conservation actions have not been identified at this time. Therefore, the analyses consider typical construction, operation, and maintenance activities that would be undertaken for implementation of the habitat restoration and enhancement efforts. As appropriate, project-level implementation of the conservation actions would be subject to additional environmental review.

Activities associated with the implementation of the proposed habitat restoration and enhancement conservation measures are anticipated to include, but would not be limited to, the following.

- Grading, excavation, and placement of fill material.
- Breaching, modification, or removal of existing levees and construction of new levees.
- Modification, demolition, and removal of existing infrastructure (e.g., buildings, roads, fences, electric transmission and gas lines, irrigation infrastructure).
- Construction of new infrastructure (e.g., buildings, roads, fences, electric transmission and gas lines, irrigation infrastructure).
- Removal of existing vegetation and planting/seeding of vegetation.
- Controlling the establishment of nonnative vegetation to encourage the establishment of target native plant species.
- Control of nonnative predator and competitor species (e.g., feral cats, rats, nonnative foxes).

Habitat management actions include all activities undertaken to maintain the intended functions of protected, restored, and enhanced habitats over the term of the BDCP. Habitat management actions are anticipated to include, but are not limited to, the activities listed below.

- Minor grading, excavation, and filling to maintain infrastructure and habitat functions (e.g., levee maintenance; grading or placement of fill to eliminate fish stranding locations).
- Maintenance of infrastructure (e.g., buildings, roads, fences, electric transmission and gas lines, irrigation infrastructure, fences).
- Maintaining vegetation and vegetation structure (e.g., grazing, mowing, burning, trimming).
- Ongoing control of terrestrial and aquatic nonnative plant and wildlife species.

As part of the proposed BDCP, AMMs and BMPs would be implemented to avoid and minimize potential adverse effects of habitat restoration, enhancement, and management activities. These measures are described in Appendix 3B, *Environmental Commitments*.

3.6.2.1 Yolo Bypass Fisheries Enhancement (CM2)

Many covered species depend upon periodic inundation of floodplains to complete their life cycles, for rearing, or to support emigration or dispersal. Loss of floodplain habitat and river connectivity in recent decades has been linked with decreasing abundance of these species. Under CM2, the Fremont Weir and Yolo Bypass would be modified to increase the frequency, duration, and magnitude of floodplain inundation and improve fish passage in the Yolo Bypass. During periods when the bypass is inundated, a relatively high production of zooplankton and macroinvertebrates serves, in part, as the forage base for many of the covered fish species. CM2 is expected to advance the following benefits.

- Provide access to additional spawning habitat for Sacramento splittail. Because splittail are primarily floodplain spawners, successful spawning is predicted to increase with increased floodplain inundation.
- Provide additional juvenile rearing habitat for Chinook salmon, Sacramento splittail, and possibly steelhead. Growth and survival of larval and juvenile fish has been shown to be higher within the inundated floodplain compared to those rearing in the mainstem Sacramento River (Sommer et al. 2001).
- Improve downstream juvenile passage conditions for Chinook salmon, Sacramento splittail, river lamprey, and possibly steelhead and Pacific lamprey. An inundated Yolo Bypass is used as an alternative to the mainstem Sacramento River for downstream migration of juvenile salmonids, Sacramento splittail, river lamprey, and sturgeon; rearing conditions and protection from predators are believed to be better in this area. The expected increased habitat and productivity resulting from increased inundation of Yolo Bypass are likely to also provide some benefits to covered species, including steelhead and lamprey.
- Improve adult upstream passage conditions of migrating fish using the bypass such as Chinook salmon, steelhead, sturgeon, and lamprey. An inundated Yolo Bypass is used as an alternative route by upstream migrating adults of these species when Fremont Weir is spilling. Increasing the frequency and duration of inundations will provide these improved conditions for more covered species over longer portions of their migrations. A modified Fremont Weir can be operated to minimize stranding potential as flows are reduced. The overall benefits of providing additional flow in the bypass will be assessed through adaptive management. Monitoring for fish

stranding will also be implemented, and fish salvage and rescue operations will be carried out, as necessary, to avoid stranding and migration delays for covered fish species.

- Increase food for rearing salmonids, Sacramento splittail, and other covered species on the floodplain.
- Potential exists for exported organic material and phytoplankton, zooplankton, and other organisms produced from the flooded bypass to increase the availability and production of food in the Delta, Suisun Marsh, and bays downstream of the bypass.
- Increase the duration of floodplain inundation and the amount of associated rearing and migration habitat during periods that the Yolo Bypass is receiving water from both the Fremont Weir and the westside tributaries (e.g., Cache and Putah Creeks).
- Reduce losses of adult Chinook salmon, sturgeon, and other fish species to stranding and illegal harvest by improving upstream passage at the Fremont Weir (*CM17 Illegal Harvest Reduction*) and monitoring for fish stranding below Fremont Weir as flow into Yolo Bypass from the Sacramento River recedes. As necessary, implement fish salvage and rescue operations to avoid stranding and migration delays for covered fish species.
- Reduce the exposure and risk of juvenile fish migrating from the Sacramento River into the interior Delta through the Delta Cross Channel and Georgiana Slough, by decreasing the number of fish passing through these areas.
- Reduce the exposure of outmigrating juvenile fish to entrainment or other adverse effects associated with the proposed north Delta intakes and the proposed Barker Slough Pumping Plant facilities by passing juvenile fish into and through the Yolo Bypass upstream of the proposed intakes.
- Improve fish passage, and possibly increase and improve seasonal floodplain habitat availability, by retrofitting Los Rios Check Dam with a fish ladder, or creating another fish-passable route by which water from Putah Creek can reach the Toe Drain.

To achieve these benefits, CM2 includes modifications to the Yolo Bypass that, in balance with existing uses, would benefit covered fish by increasing the frequency, duration, and magnitude of floodplain inundation and improving fish passage. Any modification to the Yolo Bypass or other CM2 actions would be required to be designed and implemented to maintain flood conveyance capacity at the design flow level and to comply with other flood management standards and permitting processes. These activities would be coordinated, as appropriate, with USACE, DWR, Central Valley Flood Protection Board (CVFPB), and other flood management agencies.

Other planning actions are also proposed within the Yolo Bypass, including the Central Valley Flood Protection Plan (CVFPP) and the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan (HRFPIP), including an associated EIS/EIR, which is under development as of the publication of the BDCP EIR/EIS Public Draft. The integration of these separate, but overlapping processes will occur formally once BDCP has been approved. Until that time, coordination will occur through the Yolo Bypass Fishery Enhancement Working Group. This working group provides the forum to coordinate and discuss integration and the consideration of these and other planning efforts that are ongoing in the Yolo Bypass.

Yolo Bypass fisheries enhancement would be achieved with site-specific component projects to construct fish passage improvements and facilities to introduce and manage additional flows for seasonal floodplain habitat. Prior to construction for each project, necessary preparatory actions would include interagency coordination, feasibility evaluations, site or easement acquisition, coordination related to any required modifications to agricultural practices, development of site-specific plans, and regulatory compliance.

Actions to be implemented as part of CM2 fall into one of three categories. The component projects described in the pages below identify the category into which each action would fall.

- Category 1—Actions are generally small in scale, address a known problem and can be implemented relatively easily, or will provide an interim solution until a more permanent solution can be implemented. Category 1 actions would proceed immediately after BDCP permits are issued and before the Yolo Bypass Fisheries Enhancement Plan (YBFEP) is completed.
- Category 2—Actions are larger in scale and may require further evaluation, research, design, and coordination with the fish and wildlife agencies and stakeholders to refine the action to provide the greatest biological benefit while also addressing stakeholder concerns and accommodating stakeholder needs. Category 2 Actions will be further defined in the YBFEP, and will not proceed until the YBFEP is completed.
- Category 3—Actions may affect stakeholders or may be controversial and/or substantially change the existing conditions of the Yolo Bypass. Category 3 Actions would also be defined within the YBFEP, but would proceed only after an Environmental Impact Report /Environmental Impact Statement (EIR/EIS) for the YBFEP is completed and the Record of Decision/Notice of Determination (ROD/NOD) is signed (i.e., CEQA/NEPA compliance) and all permits have been received.

The YBFEP would propose a sustainable balance among important uses of the Yolo Bypass and consideration of existing conservation easements. Important uses of the Yolo Bypass include flood protection, agriculture, threatened and endangered terrestrial species habitat, fisheries habitat, the Yolo Natural Heritage Program, and managed wetlands habitat, as described in existing state and federal land management plans associated with the Yolo Bypass Wildlife Area and existing conservation easements on private land. With stakeholder and scientist input, the YBFEP would further refine CM2 and the component projects that would be evaluated. The YBFEP and an associated YBFEP EIR/EIS would be completed by year 4 of BDCP implementation. During their development, the component projects would be evaluated, individually or grouped as alternatives, to ensure the component projects would provide the greatest biological benefit to the covered fish species, consistent with the goals of this measure and the biological goals and objectives of the BDCP. Projects must also minimize impacts on other uses of the Yolo Bypass, such as flood control, agriculture, waterfowl use and hunting, and habitat for covered and non-covered species. Project design and environmental compliance documentation would also be completed, including the YBFEP EIR/EIS.

The BDCP identifies a number of anticipated component projects, which are summarized below. The component projects that are expected to achieve the desired biological outcomes of CM2 would be further developed and implemented. If the YBFEP evaluation does not support implementation of one or more of the component projects, they would not be implemented. Reasons that implementation may not be supported by the YBFEP include, but are not limited to, the following: the action would not be effective; the action is not needed because of the effectiveness of other actions; the action would have unacceptable negative effects on flood control; the action would have unacceptable negative effects on land use, species (both covered and non-covered native species), or habitat; or landowner agreement cannot be achieved with respect to implementing the action.

Many component projects will be evaluated in a parallel environmental compliance process because they are required by the RPA. Selected component projects that trigger EIR/EIS-level evaluation under CEQA/NEPA (Category 3 Actions) would be brought to a preliminary level of design for the YBFEP EIR/EIS. Permitting and the remainder of engineering design would begin after the YBFEP EIR/EIS is complete. Component projects requiring USACE Section 408 permissions may require that any real estate transactions have been completed, and Section 408 permissions may delay finalization of the ROD/NOD until USACE accepts final design.

Completion of the YBFEP and associated project-specific YBFEP EIR/EIS is anticipated to take 3 to 4 years. Full engineering design and permitting of multiple component projects are anticipated to take up to 3 additional years, depending upon the scope and scale of component projects. Preparing and letting construction contracts, and constructing the component projects within appropriate work windows are anticipated to span approximately 2 calendar years.

This conservation measure would be implemented under all action alternatives. CM2 actions are proposed for implementation in four phases: Phase 1—year 1 to year 5 of BDCP implementation; Phase 2—year 6 to year 10; Phase 3—year 11 to year 25; and Phase 4—year 26 to year 50. The discussion below identifies and summarizes the various conceptual component projects that would be implemented as part of CM2 and identifies which projects are currently considered Category 1, 2, or 3 actions. The Category 2 and 3 actions would be more fully defined and evaluated in the YBFEP and/or YBFEP EIR/EIS, as appropriate.

Phases 1 and 2 (Year 1 to Year 10)

Projects to be Implemented

- **Component Project 1: Fish Rescue.** Provide funding to accelerate fish rescue and improvements to fish stranding assessments (Phase 1, Category 1 Action).
- **Component Project 2: Monitoring and Research.** Perform compliance and effectiveness monitoring, research actions, and adaptive management (Phase 1, Category 1 or 2 Action).
- **Component Project 3: Fish-Rearing Pilot Project at Knaggs Ranch (not to exceed 10 acres).** Evaluate the use of water from Knights Landing Ridge Cut to solely provide or supplement flows, and evaluate the effectiveness of applying water pond by pond, rather than across a contiguously inundated, heterogeneous floodplain (Phase 1 or before, Category 1 Action).
- **Component Project 4: Expanded Fish Rearing at Knaggs Ranch.** Expand pilot project fish rearing via supplemental or sole flows from Knights Landing Ridge Cut to broader area over multiple years (Phase 1 or 2, Category 2 Action).
- **Component Project 5: Fish Ladder Operations Study at Fremont Weir.** Experiment with different approaches to operating the existing ladder (e.g., removing wooden baffles and monitoring fish passage) (Phase 1 or before, Category 1 or 2 Action).
- **Component Project 6: Experimental Sturgeon Ramps at Fremont Weir.** Construct and study up to four experimental ramps at the Fremont Weir to test whether they can provide effective passage for adult sturgeon and lamprey from the Yolo Bypass over the Fremont Weir to the

Sacramento River when the river overtops the weir by approximately 3 feet. The species-specific biological goals and objectives for both green and white sturgeon include the reduction of stranding at the Fremont Weir. Developing effective passage through experimental sturgeon ramps would contribute toward reducing stranding at Fremont Weir. Monitoring technologies would be used to collect information on fish passage to evaluate its efficacy at passing adult fishes (Phase 1, Category 3 Action).

- **Component Project 7: Auxiliary Fish Ladders at Fremont Weir.** Construct up to three sets of auxiliary fishways. At least one set would serve the western length of Fremont Weir. Because Fremont Weir is nearly 2 miles long and is constructed in two distinct lengths, these auxiliary fish ladders would help fish pass the weir regardless of the location from which they approach it. At least one of the fish ladders would replace, and possibly increase the width of, the existing Fremont Weir fish ladder. At least one multistage, multispecies fishway would be placed adjacent to the main gated seasonal floodplain inundation channel (in its ultimate location) to provide passage when velocities or partially opened gates would otherwise be impassable or provide poor fish passage. Fish ladder placement would result in positive drainage from the stilling basin, with very little, if any, additional work on the stilling basin (Phase 1 or 2, Category 3 Action).

- **Component Project 8: Fish Screens for Small Yolo Bypass Diversions.** If YBFEP determines screening small Yolo Bypass diversions to be an appropriate means to hold existing irrigation practices harmless, construct fish screens on small Yolo Bypass diversions. Such work would be applied toward the 100 cfs per year remediation target identified in *CM21 Nonproject Diversions* (Phase 2, Category 2 Action).

- **Component Project 9: New or Replacement Impoundment Structures and Agricultural Crossings at the Tule Canal and Toe Drain.** Replace agricultural crossings of the Tule Canal and Toe Drain with fish-passable structures such as flat car bridges or earthen crossings with large, open culverts. Construct new or replacement operable check-structures to facilitate continued agriculture in the Yolo Bypass while promoting fish passage in season (Phase 1, Category 3 Action).

- **Component Project 10: Lisbon Weir Improvements.** Replace the Lisbon Weir with a structure that improves fisheries management and improves the ability to impound water for irrigation, while reducing maintenance (Phase 1, Category 3 Action).

- **Component Project 11: Lower Putah Creek Improvements.** Lower Putah Creek would be realigned to improve upstream and downstream passage of Chinook salmon and steelhead. The action would also include floodplain habitat restoration to provide benefits for multiple species on existing public lands. This action would be designed so that it would not create stranding or migration barriers for juvenile salmon (Phase 1, Category 3 Action).[24] This action would be covered in the YBFEP, and may be covered in separate environmental analysis because it is a required action under the 2009 BiOp.

- **Component Project 12: Water Supply Improvement for the Yolo Bypass Wildlife Area.** Improve Yolo Bypass Wildlife Area water supply at Lisbon Weir to support wildlife management

[24] Improvements to Upper Putah Creek, outside the Plan Area, will be included as part of the YBFEP. Improvements to Upper Putah Creek will support fish passage, water quality, and spawning habitat improvements in Putah Creek upstream of the Yolo Bypass Wildlife Area and downstream of Solano Diversion Dam (Phase 1).

in the Yolo Bypass Wildlife Area (by reducing reverse flows in the Toe Drain) and potentially benefit the aquatic foodweb and downstream fish. Other actions not yet fully defined or developed would be considered. These may include a subsidy of Yolo Bypass Wildlife Area pumping costs or procurement of additional water from western tributary sources. This project incorporates goals of the Westside Concept (Phase 1 or 2, Category 3 Action).

- **Component Project 13: Use of Supplemental Flow through Knights Landing Ridge Cut.** Evaluate the desirability of using supplemental flows through Knights Landing Ridge Cut, introduced by means of redesigning Colusa Basin Drain Outfall Gates, increased operation of upstream unscreened pumps, or other means. If currently unscreened pumps were to be used for more than a pilot period, the pumps would need to be screened or replaced with fish-friendly pumps. This project incorporates goals of the Westside Concept (Phases 1 and 2, Category 3 Action).

- **Component Project 14: Flood-Neutral Fish Barriers.** Construct and test flood-neutral fish barriers to prevent fish from straying into Knights Landing Ridge Cut and the Colusa Basin Drain. These barriers would be most effective when employed in association with attraction flows to a location, such as at Fremont Weir, that is fish-passable and leads to the mainstem Sacramento River. This project incorporates goals of the Westside Concept (Phase 2, Category 3 Action).

- **Component Project 15: Gated Seasonal Floodplain Inundation Channel Past Fremont Weir.** Modify a section of the Fremont Weir to enable introducing managed flows to the Yolo Bypass at times when Fremont Weir is not overtopping. The Fremont Weir would continue to passively overtop when the Sacramento River stage exceeds the height of the weir. In the BDCP effects analysis, it is assumed that a section of the Fremont Weir would be lowered to 17.5 feet (NAVD 88). Lower elevations may be considered if necessary to satisfy inundation targets or fish passage needs. For operational modeling purposes, an additional opening at 11.5 feet was assumed. Because the Fremont Weir is perched on the natural levee that bounds the Yolo Basin, including the northern edge of the Yolo Bypass, it would be necessary to excavate through that area of higher ground to hydraulically connect the Sacramento River to the Yolo Bypass at these lower flow stages. Thus, the new section of gates would replace the former section of Fremont Weir and also extend below it, to govern flows in the excavated channel. The new section of operable gates would allow for controlled flow into the Yolo Bypass when the Sacramento River stage at the weir exceeds approximately 17.5 feet NAVD88, leaving the remaining portion of Fremont Weir to overtop passively when the Sacramento River stage is higher than the top of the weir (32.8 feet NAVD 88). The seasonal floodplain inundation flows will attract fish migrating upstream. Therefore, the gates and the fishways immediately adjacent to them would be designed so that when they are operated to provide seasonal floodplain inundation flows, they also allow the efficient upstream and downstream passage of sturgeon and salmonids between the Yolo Bypass and the Sacramento River. If additional work to ensure positive drainage of the entire length of Fremont Weir is required, it would be completed as part of this project (Phase 2, Category 3 Action).

- **Component Project 16: Nonphysical or Physical Barriers to Attract Juvenile Salmon into the Yolo Bypass.** If deemed necessary to enhance capture of juveniles into Yolo Bypass through the gated seasonal floodplain inundation channel (described in Component Project 15), construct and operate nonphysical or physical barriers in the Sacramento River. Examples of such barriers include bubble curtains or log booms (Phase 2 or 3, Category 3 Action).

- **Component Project 17: Support Facilities.** Construct associated support facilities (e.g. operations buildings, parking lots, access facilities such as roads and bridges) throughout the Yolo Bypass necessary to provide safe access for maintenance, monitoring, and fish rescue (Phase 2, Category 3 Action).
- **Component Project 18: Levee Improvements.** Improve levees adjacent to the Fremont Weir Wildlife Area, as necessary, to maintain existing level of flood protection, or to beneficially reuse excavated earth (Phase 2, Category 3 Action).
- **Component Project 19: Yolo Bypass Modifications to Direct or Restrain Flow.** Through modeling and further concept development, determine which of the following actions are necessary to improve the distribution (e.g., wetted area) and hydrodynamic characteristics (e.g., residence times, flow ramping, and recession) of water moving through the Yolo Bypass: grading, removal of existing berms, levees, and water control structures (including inflatable dams); construction of berms or levees; reworking of agricultural delivery channels; and earthwork or construction of structures to reduce Tule Canal and Toe Drain channel capacities. The project would include modifications that would allow water to inundate certain areas of the bypass to maximize biological benefits and reduce stranding of covered fish species in isolated ponds, minimize effects on terrestrial covered species, including giant garter snake, and accommodate other existing land uses (e.g., wildlife, public, recreation and agricultural use areas). Necessary lands would be acquired in fee-title or through conservation or flood easement (Phase 2, Category 3 Action).

Phase 3 (Year 11 to Year 25)

Final permissions/permits from the permitting agencies for construction of the component projects directly affecting flood control structures (Fremont Weir, Sacramento Weir, and Colusa Basin Drain Outfall Gates, if affected, as well as project levees) not obtained in Phase 1 or 2 would be received by Phase 3 at the latest. Those component projects that are not able to obtain permits and be constructed during Phases 1 and 2 would do so in Phase 3. Full buildout is estimated to be completed in years 10, 11 or 12, at which time operations of these component projects would begin.

The following project would be designed, permitted, and if feasible, constructed in Phase 3.

- **Component Project 20: Sacramento Weir Improvements.** At a minimum, modifications would be made to reduce leakage at the Sacramento Weir and thereby reduce attraction of fish from the Yolo Bypass to the weir, where they cannot access the Sacramento River and could become stranded. The YBFEP would review the benefits and necessity of constructing fish passage facilities at the Sacramento Weir to improve upstream adult fish passage and positive drainage to reduce juvenile fish stranding. This action may require excavation of a channel to convey water from the Sacramento River to the Sacramento Weir and from the Sacramento Weir to the Toe Drain; construction of new gates at all or a portion of the weir; and modifications to the stilling basin (Phase 3, Category 3 Action).

Phase 4 (Year 26 to Year 50)

Phase 4 would encompass project operation, monitoring, and continued adaptive management. A matrix of criteria would be developed and tested prior to Phase 4, and operations would be adjusted accordingly. For example, if results of monitoring and studies indicate that shorter or earlier gate operations within the adaptive management range yield equivalent or better fish benefits, operation of the gated channel at Fremont Weir would be modified accordingly and additional environmental analysis completed, as appropriate. If scientific results indicate that the wetter, later end of the adaptive management range is more effective biologically, operations would shift accordingly.

3.6.2.2 Natural Communities Protection and Restoration (CM3)

CM3 provides the mechanism and guidance to establish a system of conservation lands in the Plan Area—a *reserve system*—by acquiring lands for protection and restoration. Such a system is needed to meet natural community and species habitat protection objectives described in Section 3.3, *Biological Goals and Objectives*, of the BDCP document. The reserve system would be assembled over the BDCP permit term to accomplish the following aims (see BDCP Chapter 3, Section 3.4.3).

- Protect and enhance areas of existing natural communities and covered species habitat.
- Protect and maintain occurrences of selected covered plant species with limited distributions.
- Provide sites suitable for restoration of natural communities and covered species habitat (some restoration would occur on lands already publicly owned).
- Provide habitat connectivity among the lands in the reserve system and connectivity to existing conservation lands inside and outside the Plan Area.

A variety of mechanisms through which lands could be acquired are listed below; however, this is not an exhaustive list.

- Purchase in fee title.
- Purchase or application of permanent conservation easements (on public or private lands).
- Change of state- or federally-owned lands to more protective land use designation.
- Permanent agreements with state, federal, and local agencies (e.g., flood control agencies) that commit the parties to the restoration, enhancement, and management of public lands in the reserve system in a manner supporting BDCP biological objectives.
- Purchase of suitable mitigation credits from approved private mitigation banks.

The BDCP alternatives' commitments of habitat conservation acreage targets for the various natural communities are listed below. These targets represent the minimum extent of land that would be acquired; the actual extent acquired would likely be greater because acquired parcels may not consist wholly of habitat types that contribute to achieving conservation targets. Restoration under Alternative 5 would result in 40,000 fewer acres of restored tidal habitat than the other action alternatives; total tidal habitat restoration under Alternative 5 would be 25,000 acres. The general amounts of natural community protection and restoration provided for in CM4–CM10 are listed below. A detailed description of CM3 is provided in Chapter 3, *Conservation Strategy* (Section 3.4.3), of the BDCP document.

- 65,000 acres of tidal habitat restored (CM4).
- 5,000 acres of valley/foothill riparian habitat restored (CM7) and 750 acres protected.
- 2,000 acres of grassland habitat restored (CM8), and 8,000 acres of grassland habitat protected.
- Up to 67 acres of vernal pool complex restored and 72 acres of restored alkali seasonal wetland (CM9); at least 600 acres vernal pool complex protected and 150 acres alkali seasonal wetland complex protected.

- 8,100 acres of managed wetland protected.
- 50 acres of nontidal marsh protected.
- 48,125 acres of cultivated land (non-rice), up to 500 acres of cultivated land (rice), and 3,000 acres of cultivated land (rice or equivalent) protected (CM3 and CM11).

The implementation schedule for actions to preserve natural communities assumes that acquisition, protection/preservation, enhancement, and management of existing vernal pool complex, alkali seasonal wetland complex, grassland habitat, and agricultural habitats would be initiated prior to BDCP authorization. CM3 will be implemented according to the schedule in Table 3-4. This schedule was designed to ensure that mitigation and conservation occurs in rough proportion to impacts on natural communities and habitat for covered species.

It is anticipated that lands used for habitat restoration actions would primarily be those that are currently in public ownership or those that are acquired in fee title because restoration activities have a high potential to preclude other land uses. Lands acquired for the protection and maintenance of existing habitat functions may be acquired through conservation easements that specify permitted land uses and practices in sufficient detail to maintain the intended habitat functions of the acquired lands, although enhancements may also be implemented on conservation easement lands as opportunities arise.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, and adaptive management, as described in Chapter 3 (Section 3.4.3) of the BDCP.

3.6.2.3 Tidal Natural Communities Restoration (CM4)

CM4 would provide for the restoration of 65,000 acres of tidal natural communities and transitional uplands. Some or all of the transitional uplands may become tidal during the 50-year permit term and beyond. The tidal natural communities restoration will be focused within the ROAs. However, tidal restoration projects may be implemented outside of the ROAs, as needed, to meet the biological goals and objectives, provided that take limits resulting from such restoration do not exceed those established for the BDCP. The transitional upland areas, which are included in the 65,000-acre total, may accommodate sea level rise by evolving into tidal marsh plain if sea level rises as expected in the future.

The 65,000 acres of restored tidal natural communities and protected transitional uplands must include 6,000 acres of tidal brackish emergent wetland and 24,000 acres of tidal freshwater emergent wetland. The remainder of the 65,000 acres would consist of a combination of any of the restored tidal natural communities (tidal brackish emergent wetland, tidal freshwater emergent wetland, and tidal perennial aquatic) and protected transitional uplands to accommodate sea level rise during and after the 50-year permit term. The intent of this conservation measure is to gain tidal wetlands and accommodate sea level rise, and while a portion of the 65,000 acres will consist of subtidal aquatic areas (tidal perennial aquatic natural community), these areas are expected to be a byproduct of the tidal restoration and not the primary restoration goal. Therefore, restoration will be designed to maximize tidal emergent wetlands and minimize deep subtidal areas. Under Alternative 5, 25,000 acres of tidal habitat would be restored.

Of the 65,000-acre target for restored tidal natural communities, 20,600 acres must occur in particular ROAs, consistent with the following minimum restoration targets. The rationale for the tidal natural community targets is provided in Appendix 3G, *Background on the Process of Developing the BDCP Conservation Measures*.

- Restore 7,000 acres of brackish tidal natural communities, of which at least 6,000 acres are tidal brackish emergent wetland and the remainder can be any combination of tidal brackish emergent wetland, tidal perennial aquatic, and tidal mudflat, in Suisun Marsh ROA.
- Restore 5,000 acres of freshwater tidal natural communities (tidal freshwater emergent wetland, tidal perennial aquatic, tidal mudflat) in the Cache Slough ROA.
- Restore 1,500 acres of freshwater tidal natural communities (tidal freshwater emergent wetland, tidal perennial aquatic, and tidal mudflat) in the Cosumnes/Mokelumne ROA.
- Restore 2,100 acres of freshwater tidal natural communities (tidal freshwater emergent wetland, tidal perennial aquatic, and tidal mudflat) in the West Delta ROA.
- Restore 5,000 acres of freshwater tidal natural communities (tidal freshwater emergent wetland, tidal perennial aquatic, and tidal mudflat) in the South Delta ROA.

The remaining 44,400 acres of restored tidal natural communities and protected transitional uplands will be distributed among the ROAs, or may occur outside the ROAs in order to meet the biological goals and objectives, provided the restoration does not result in effects on terrestrial covered species habitats that exceed the incidental take limits established for terrestrial covered species described in the BDCP, Chapter 5, *Effects Analysis*.

Although specific locations have not been confirmed, the conceptual locations listed below have been identified for all the action alternatives except Alternative 9. A brief discussion of each ROA follows the summary of the conservation measure. The complete details of the conservation measure are available in Chapter 3, *Conservation Strategy* (Section 3.4.4), of the BDCP document.

The following restoration variables would be considered in the design of restored freshwater tidal natural communities.

- Distribution, extent, location, and configuration of existing and proposed restored tidal natural communities.
- Potential for improving habitat linkages that allow covered and other native species to move among protected habitats in and adjacent to the Plan Area.
- For tidal brackish restoration, distribution of restored tidal natural communities along salinity gradients to optimize the range and habitat conditions for covered species and food production.
- For tidal brackish restoration, elevation and location along the existing Suisun Marsh fringe to maximize opportunities for restoring middle and high marsh (as opposed to subtidal and low marsh), with a minimum of 1,500 acres, but more as feasible.
- Predicted tidal range at tidal natural communities restoration sites following reintroduction of tidal exchange.
- Size and location of levee breaches necessary to restore tidal action.
- Cross-sectional profile of tidal natural communities restoration sites (elevation of marsh plain, topographic diversity, depth, and slope).
- Density and size of restored tidal channels appropriate to each restoration site.
- Potential hydrodynamic and water quality effects on other areas of the Delta.

- Ability to accommodate sea level rise.
- Cost of the restoration project relative to benefits

The following general methods and techniques may be used to achieve the purposes of CM4.

- Restore natural remnant meandering tidal channels.
- Excavate channels to encourage the development of sinuous, high-density dendritic channel networks within restored marsh plain.
- Modify ditches, cuts, and levees to encourage more natural tidal circulation and better flood conveyance based on local hydrology.
- Prior to levee breaching, recontour the ground surface to maximize the extent of surface elevation suitable for establishment of tidal marsh vegetation (marsh plain) by scalping higher-elevation land to provide fill for placement on subsided lands to raise surface elevations (taking into consideration that the surface sediment in higher elevation land that is seasonally inundated can be a significant source for zooplankton and aquatic invertebrates, and scalping may temporarily remove that resource).
- Prior to breaching, import dredge or fill and place it in shallowly subsided areas to raise ground surface elevations to a level suitable for establishment of tidal marsh vegetation (marsh plain).
- Prior to breaching, cultivate stands of tules through flood irrigation for sufficiently long periods to raise subsided ground surface to elevations suitable to support marsh plain; breach levees when target elevations are achieved.

Additional methods specific to freshwater and brackish tidal natural communities are discussed in Chapter 3, *Conservation Strategy* (Section 3.4.4), of the BDCP.

Suisun Marsh Restoration Opportunity Area

Suisun Marsh ROA encompasses the Suisun Marsh and is located at the western end of the Plan Area, in Conservation Zone 11. Brackish tidal natural communities will be restored in Suisun Marsh ROA in coordination with the *Suisun Marsh Habitat Restoration and Management Plan*. Those areas suitable for tidal natural communities restoration in Suisun Marsh ROA consist of diked wetlands that are managed for waterfowl and experience little natural tidal action. These managed areas are separated from tidal sloughs by gated culverts and other gated structures that control water exchange and salinity. Waterfowl club managers control the timing and duration of flooding to promote growth of food plants for waterfowl. Some of these are managed as perennial wetlands, others are dry-managed during the summer and early fall months then prepared for waterfowl habitat and hunting with a series of flood-drain-flood cycles. The periodic flooding and discharge of managed wetlands can lead to periods of severely low DO events in adjoining water bodies, which cause acute mortality in at-risk fish species and impair valuable fish nursery habitat (Siegel 2007). Co-occurring with these low DO levels are elevated levels of methylmercury, a toxin prevalent in the Delta that bioaccumulates in the foodweb and adversely affects fish and wildlife.

Cache Slough Restoration Opportunity Area

The Cache Slough ROA includes the southern end of the Yolo Bypass in Conservation Zone 1 and lands to the west in Conservation Zone 2 supporting a complex of sloughs and channels. This ROA supports multiple covered fish species and may currently be the only area where delta smelt spawn and rear successfully. The Cache Slough ROA has been recognized as possibly containing the best functioning tidal natural communities in the Delta. The complex includes Liberty Island, which is likely the best existing model for freshwater tidal natural communities restoration in the Delta for native fishes. Additionally, this ROA encompasses a substantial area of land with elevations suitable for freshwater tidal natural communities restoration that would involve few impacts on existing infrastructure or permanent crops relative to other areas of the north Delta. The Cache Slough ROA provides an excellent opportunity to expand the natural communities supporting multiple aquatic and terrestrial covered species. Based on existing land elevations, approximately 21,000 acres of public and private lands in the area are potentially suitable for restoration of tidal natural communities. Areas suitable for restoration in this ROA include, but are not limited to, Haas Slough, Hastings Cut, Lindsey Slough, Barker Slough, Calhoun Cut, Little Holland, Yolo Ranch, Shag Slough, Little Egbert Tract, and Prospect Island.

Cosumnes/Mokelumne Restoration Opportunity Area

The Cosumnes/Mokelumne ROA is located in the eastern portion of the Plan Area, in Conservation Zone 4. This ROA consists primarily of cultivated lands and a complex of sloughs and channels at the confluence of the Cosumnes and Mokelumne Rivers, providing an opportunity to create extensive gradients of tidal and nontidal wetlands. Suitable restoration sites in this ROA include McCormack-Williamson, New Hope, Canal Ranch, Bract, and Terminous Tracts north of State Highway 12, and lands adjoining Snodgrass Slough, South Stone Lake, and Lost Slough.

West Delta Restoration Opportunity Area

The West Delta ROA consists of multiple small areas where tidal natural communities can be restored in the western Delta, in Conservation Zones 5 and 6. It primarily supports cultivated lands and grasslands in areas that were historically tidal wetlands but have been diked and hydrologically altered, isolating tidal natural communities in the Cache Slough ROA from Suisun Marsh. Areas suitable for restoration include Dutch Slough, Decker Island, portions of Sherman Island, Jersey Island, Bradford Island, Twitchell Island, Brannon Island, Grand Island, and along portions of the north bank of the Sacramento River where elevations and substrates are suitable.

South Delta Restoration Opportunity Area

The South Delta ROA, located in Conservation Zone 7, consists primarily of cultivated lands and a riverine system including the San Joaquin River and its tributaries. Potential sites for restoring freshwater tidal natural communities include Fabian Tract, Union Island, Middle Roberts Island, and Lower Roberts Island.

Site Preparation, Earthwork, and Other Site Activities

Construction site preparation could require clearing and grubbing, demolition of existing structures, surface water quality protection, dust control, establishment of storage areas and stockpile areas, temporary utilities and fuel storage, and erosion control.

Earthwork activities for development of the restoration habitat areas could include the construction activities described below on the landside and waterside of existing levees in areas that would be selected for tidal habitat restoration.

Modification of Landforms

Existing land elevations could be modified through grading and filling or subsidence reversal. These activities could be completed prior to breaching of levees and associated inundation of the site, as well as in the water.

Grading activities performed as part of restoration actions could include excavation and filling of material, shaping disturbed soils to smoothly transition into existing elevations at boundaries of construction areas, and smoothing and contouring of the disturbed ground surfaces to provide shallow elevation gradients from marsh plain to upland transition habitat. The specific landform plans would be developed for each location and evaluated in future environmental documentation.

Soil could be moved from higher elevations in the area to provide fill for placement on subsided lands for establishment of tidal marsh. Fill could also be imported to fill the subsided areas. In some areas, tules could be planted and farmed for several years to raise the elevation of subsided lands.

In adjacent areas that would not be inundated, grading could occur to ensure positive drainage and provide more diverse geomorphic surfaces for habitat.

As described in Appendix 3B, *Environmental Commitments*, erosion and dust control measures would be implemented during construction, and a Stormwater Pollution Prevention Plan (SWPPP) would be developed for each site.

Breaching and Modification of Levees

Levee modifications, including levee breaching or lowering, could be performed to reintroduce tidal exchange, reconnect remnant sloughs, restore natural remnant meandering tidal channels, encourage development of dendritic channel networks, and improve floodwater conveyance. Levee modifications could involve the removal of vegetation and excavation of levee materials. Excess earthen materials could be temporarily stockpiled, then respread on the surface of the new levee slopes where applicable or disposed of offsite. Any breaching or other modifications would be required to be designed and implemented to maintain the integrity of the levee system and to comply with flood management standards and permitting processes. This would be coordinated with the appropriate flood management agencies. Those agencies may include USACE, DWR, CVFPB, and other flood management agencies.

During detailed analyses of each location, levee breach sizes necessary to provide full tidal exchange between sloughs, open water, and restored tidal marsh areas would be identified. Breach lengths would be developed for each site depending on channel hydraulic geometry. In larger inundated areas (e.g., more than 200 acres), the breaches could be more than 100 feet long and extend below the water elevations during high or low tides. The edges of the breaches would be protected from erosion and related failure of the adjacent levee. Erosion protection could include geotextile fabrics, rock revetments, riprap, or other material selected during future evaluations for each location. Aggregate rock could be placed on the remaining levees to provide an access road to the breach location.

Levee lowering could involve removal of material in the upper sections of an existing levee, re-contouring of the levee slopes to provide stability for the shorter levee, placement of erosion protection on the slopes and specifically on the top of the levee that was previously subject to tidal action. Lowering levees provides opportunities for seasonal or periodic inundation of lands during high flows or high tides. This technique could be used to improve habitat or to reduce velocities and elevations of floodwaters. To reduce erosion potential on the new levee crest, a paved or gravel access road could be constructed with short (approximately 1 foot) retaining walls on each edge of the crest to reduce undercutting of the roadway by high tides. Levee modifications could also include excavation of watersides of the slopes to allow placement of slope protection, such as riprap or geotextile fabric, and to modify slopes to provide levee stability. Erosion and scour protection could be placed on the landside of the levee and continued for several feet onto the land area away from the levee toe.

Exit channels would be excavated on lands to be inundated to allow fish to leave the inundated area as waters recede.

Neighboring levees could require modification to accommodate increased flows or to reduce effects of changes in water elevation or velocities along channels following inundation of tidal marshes. Hydraulic modeling would be used during subsequent analyses to determine the need for such measures.

New Levees

New levees would be constructed to separate lands to be inundated for tidal marsh from non-inundated lands, including lands with substantial subsidence. Levees could be constructed as described for the new levees at intake locations. Any new levees would be required to be designed and implemented to comply with applicable flood management standards and permitting processes. This would be coordinated with the appropriate flood management agencies, which may include USACE, DWR, CVFPB, and local flood management agencies.

Dredging

Restoration actions may include channel dredging, drying dredged spoils before hauling or placement, placement of dredged material on lands or levees, and disposal in spoils areas. Depending on the locations and restrictions related to habitat and channel configuration, dredging operations may be staged from a barge floating in the channel or from the top of the levee. Dredging could be required periodically to maintain tidal circulation. Dredging methods can generally be classified in two categories: hydraulic dredging and mechanical dredging.

Hydraulic Dredging

Hydraulic dredging utilizes barge-mounted pumps equipped with hydraulic cutter jets to mobilize sediments and a siphon with a pump to move the water and dredge spoils, referred to as slurry, to settling ponds for dewatering. The size of the dewatering areas depends on slurry flow rate, amount of total dredge spoils, and settling rate of the material. This type of dredging results in the lowest developed sediment plumes in waterways; however, it requires management of large volumes of water. Hydraulic dredging is used in situations where there are large areas to be dredged, the concern for induced turbidity and harm to benthic vegetation is great, and there is ample area available for drying basins, as this method entrains more water in the sediment and requires greater drying capacity.

Mechanical Dredging

Mechanical dredging utilizes barge-mounted clamshell-type buckets or land-based drag line buckets to excavate the dredge spoils. Typically, the spoils are placed in holding areas on the barge for dewatering and transferred to a land disposal area for disposal. This dredging method results in more sediment in the waterway than does hydraulic dredging. However, the amount of water to be removed from the sediment prior to transport and disposal is less.

The clamshell dredging method excavates a water-sediment mix from the channel bottom with a clamshell bucket and deposits it to a drying basin or onto a barge to be transported to a drying basin. The operation may be staged from a barge floating in the channel or from the top of the levee, depending on restrictions in habitat and channel width. This method would likely be used in situations where there is limited space for drying basins, the likelihood of major disruption to vegetation and other organisms in the channel bottom is minimal, the area to be dredged is small, there are channel islands, or there is limited concern regarding temporary turbidity and sedimentation in the water.

The dragline dredging method excavates a water-sediment mix from the channel bottom with a bucket and deposits it either into a drying basin or onto a barge to be transported to a drying basin. The use of the dragline method requires sufficient height and swing clearance for the crane. The dragline method is effective in shaping the channel bottom with relative control.

Drying Operations

Dredged material may be placed into drying basins to be dried for beneficial reuse. Drying basins may be constructed on the landside of the levees, typically adjacent to the channel or suitable interior low areas. The basins would be constructed of onsite soil and compacted to reduce embankment erosion.

Three basins—primary, secondary, and return—are generally used for slurry from hydraulic dredging due to the amount of water in the slurry. The basins are typically connected by flashboard riser structures that control the overflow of water into the next basin and the waterway to ensure proper settling of sediments. The primary and secondary basins settle sediments over a period of 4–5 weeks in each basin. Water in the return basin is then returned to the waterway. Each unlined basin could be up to 100 acres in surface area and up to 6 feet deep with 2 feet of freeboard.

For mechanical dredging, a single basin could be used. The sediments settle over a period of 2–6 weeks. Dredged material would be tested to determine the presence of toxic materials prior to reuse. Clean dredge spoils could be hauled and placed on agricultural land or on low areas identified for subsidence reversal.

Construction Detour/Access Roads and Utilities Relocation

Relocation of existing roads and utilities could be required to support construction and postconstruction activities at the restoration project site or services to adjacent lands protected by levees. Roads and utilities on the levees to be breached or lands to be inundated that required modification would be constructed to a condition equal to or better than the preconstruction conditions.

Revegetation

Restored freshwater tidal marsh plains would be vegetated primarily with tules and other native freshwater emergent vegetation to reflect the historical composition and densities of Delta tidal marshes. Restored brackish tidal marsh plains, such as Suisun Marsh, would be dominated by native brackish marsh vegetation (e.g., pickleweed, saltgrass) appropriate to marsh plain elevations, mimicking the composition and densities of historical Suisun Bay brackish tidal marshes.

To facilitate revegetation of disturbed areas, weed eradication could be used followed by a combination of passive and active revegetation approaches. Passive revegetation techniques could include altering the hydrologic regime to promote the establishment of desirable native vegetation. Active revegetation techniques may include direct seeding and planting of seedlings or containerized stock. Prior to revegetation, undesirable vegetation species could be treated or removed from the restoration site. Disking and ripping could be required to allow for water filtration and deeper penetration and faster growth of plant roots. Direct seeding could be done by broadcasting, hydroseeding, or drill seeding. Soil amendments could be applied to the revegetated area.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, and adaptive management, as described in Chapter 3, *Conservation Strategy* (Section 3.4.4), of the BDCP.

3.6.2.4 Seasonally Inundated Floodplain Restoration (CM5)

Under CM5, the BDCP Implementation Office would modify flood conveyance levees and infrastructure to restore 10,000 acres of seasonally inundated floodplain along river channels throughout the Plan Area. The floodplain restoration is separate from fisheries enhancement in Yolo Bypass; CM2 augments existing flood flows in the Yolo Bypass, whereas CM5 restores floodplains that historically existed elsewhere in the Plan Area but have been lost as a result of flood management and channelization activities. These restored floodplains would intentionally be allowed to flood to provide the benefits described in Chapter 3, *Conservation Strategy* (Section 3.4.5.1), of the BDCP document. Restored floodplains would support valley/foothill riparian, nontidal freshwater perennial emergent and nontidal perennial aquatic natural communities. Restored floodplains can remain in agricultural production as long as such activities meet the requirements for agricultural use described in Chapter 3 (Section 3.4.5.3.2) of the BDCP. CM5 actions would be phased, with 1,000 acres restored by year 15 and 10,000 acres (cumulative) by year 40 of Plan implementation. Under Alternative 7, CM5 would provide for the restoration of an additional 10,000 acres of seasonally inundated floodplain habitat.

Although seasonally inundated floodplains may be restored along channels in the north, east, and south Delta, the most promising opportunities for large-scale floodplain restoration are in the south Delta.

Channel margin enhancement (CM6) and riparian natural community restoration (CM7) would be combined with floodplain restoration to provide a broad mosaic of natural communities and ecological functions. Floodplain restoration (CM5), channel margin enhancement (CM6), and riparian restoration (CM7) are interrelated. The implementation of CM7 depends partly on CM5, because 3,000 acres of riparian natural community would be implemented in restored floodplains. Seasonally inundated floodplain restoration (CM5) differs from channel margin enhancement (CM6) in that seasonally inundated floodplain restoration involves actions such as substantial levee setbacks (setbacks on the order of hundreds or thousands of feet) to allow for lateral channel migration and natural fluvial disturbances. While channel margin enhancement may involve levee setbacks in some cases, these setbacks would be relatively minor (setbacks on the order of a hundred feet or less) to provide for restoration of natural vegetation on the banks. Generally, these channel margin enhancement actions would do little to restore natural channel migration and the accompanying ecological benefits that accrue from eroding banks and altered channel morphology.

Channel straightening and levee construction have disconnected river channels from their historic floodplains over much of the Plan Area, resulting in the reduction, degradation, and fragmentation of seasonally inundated floodplain and its associated natural communities. The result has been a decrease in rearing and juvenile foraging habitat for salmonids, a decrease in primary productivity and thus food resources available to planktivorous fishes, and a decline in the abundance and distribution of floodplain-associated species, including Sacramento splittail, Chinook salmon, and slough thistle.

Because restoration may require modification of levees that serve flood management functions, floodplain habitats would be required to be designed and implemented to maintain flood conveyance capacity at the design flow level and to comply with other flood management standards and permitting processes. This would be coordinated with USACE, DWR, CVFPB, and other flood management agencies.

Actions to restore seasonally inundated floodplain habitats may include but are not limited to the following.

- Set levees back along selected river corridors and remove or breach levees thereby rendered nonfunctional.
- Create and expand new floodway bypasses to expand floodplain habitat and redirect flood flows along distributary channel networks into the estuary.
- Remove existing riprap or other bank protection to allow for channel migration between the set-back levees through the natural processes of erosion and sedimentation. This would reestablish floodplain processes and support creation and maintenance of spawning and rearing habitat.
- Modify channel geometry in unconfined channel reaches or along channels where levees are set back in order to create backwater salmonid and Sacramento splittail rearing habitat.
- Secure lands, in fee-title or through conservation easements, suitable for restoration of seasonally inundated floodplain.
- Selectively grade restored floodplain surfaces to provide for drainage of overbank flood waters such that the potential for fish stranding is minimized.
- Lower the elevation of restored floodplain surfaces or modify river channel morphology to increase inundation frequency and duration and to establish elevations suitable for the establishment of riparian vegetation by either active planting or allowing natural establishment.
- Continue to farm in the floodplain consistent with achieving biological objectives, engaging in farming practices and crop types that provide high benefits for covered fish species.
- In cases where farming is no longer feasible or compatible with floodplain habitat goals, discontinue farming within the setback levees and allow native riparian vegetation to naturally establish on the floodplain or actively plant native riparian vegetation.

Site Preparation, Earthwork, and Other Site Activities

Site preparation could require clearing and grubbing, demolition of existing structures, surface water quality protection, dust control, establishment of storage areas and stockpile areas, temporary utilities and fuel storage, and erosion control.

Earthwork activities for development of the seasonally inundated floodplains could include setting back levees, removal of existing levees, removal of riprap to allow for channel meander between the setback levees, grading to restore drainage patterns and increase inundation frequency and duration, and establishment of riparian habitat.

Seasonally inundated floodplain modifications would be required to be designed, implemented and maintained to allow the passage of flood flows at the required flood system design flow and to comply with other flood management standards and permitting processes. This would be coordinated with USACE, DWR, CVFPB, and other flood management agencies to assess the desirability and feasibility of channel modifications. To the extent consistent with floodplain land uses and flood management requirements, if applicable, woody riparian vegetation would be allowed to naturally establish, or plant stock would be derived from adjacent riparian vegetation.

During design, the need for grading to reduce risk of fish stranding as water recedes would be determined. Grading could also be required to convey water from the floodplain into tidal marsh restoration areas.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, and adaptive management, as described in Chapter 3, *Conservation Strategy* (Section 3.4.5)*,* of the BDCP.

3.6.2.5 Channel Margin Enhancement (CM6)

CM6 would entail restoration of 20 linear miles of channel margin by improving channel geometry and restoring riparian, marsh, and mudflat habitats on the waterside of levees along channels that provide rearing and outmigration habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Under Alternative 7, CM6 would provide for the enhancement of an additional 20 linear miles of channel margin.

Most channels in the Delta are flanked by levees. In these areas, channel margins lack the diversity and complexity of habitat conditions associated with unmodified channels. Because of the riprap armoring on many levees, adjacent channel margins are devoid of vegetation or have only low-quality vegetation that provides very limited benefits for covered species. Without vegetation along channel margins to provide shade and nutrient inputs, habitat value for covered fishes in these channels has declined. Both the quality and quantity of riparian, emergent wetland, and tidal mudflat habitat for covered terrestrial species have declined as a result of channel-margin levees.

Channel margin enhancement, as appropriate to site-specific conditions, includes the following actions.

- Modify the waterward side of levees or set back levees landward to create low floodplain benches. Construct the floodplain benches with variable surface elevations and water depths (laterally and longitudinally) to create hydrodynamic complexity, support emergent vegetation, and provide an ecological gradient of environmental conditions.
- Install large woody debris (e.g., tree trunks, logs, and stumps) into constructed benches to provide physical complexity. Use finely branched material to minimize refuge for aquatic

predators. Large woody debris would be installed to replace debris lost during enhancement; woody debris is expected to increase or be replaced over time through recruitment from adjacent riparian vegetation.

- Plant native riparian and/or emergent wetland vegetation on created benches; open mudflat habitat may be appropriate too, depending on elevation and location.

These actions would be implemented along channels protected by levees in the Plan Area. Channel margin enhancements associated with federal project levees would not be implemented on the levee, but rather on benches to the waterward side of such levees, and flood conveyance would be maintained as designed.

Channel margin enhancement would be performed only along channels that provide rearing and outmigration habitat for juvenile salmonids. These include channels that are protected by federal project levees—including the Sacramento River between Freeport and Walnut Grove, the San Joaquin River between Vernalis and Mossdale, and Steamboat and Sutter Sloughs—and channels in the interior Delta that are protected by nonfederal levees—including the North and South Fork Mokelumne River.

The approximate total lengths of channel margin of the main water bodies in the Plan Area where channel margin habitat enhancement could occur are as follows.

- Sacramento River (top of North Delta subregion to Sacramento–San Joaquin confluence in the West Delta subregion): 116 miles
- Sutter Slough: 13 miles
- Steamboat Slough: 23 miles
- Miner Slough: 15 miles
- Georgiana Slough: 24 miles
- Mokelumne River (North and South Forks within the Plan Area): 77 miles
- San Joaquin River (Vernalis to Sacramento–San Joaquin confluence in the West Delta subregion): 240 miles

These water bodies represent around 500 linear miles of channel margin habitat, and therefore CM6 has the potential to enhance around 4–8% of this total.

Site Preparation, Earthwork, and Other Site Activities

Site preparation could require clearing and grubbing, demolition of existing structures, surface water quality protection, dust control, establishment of storage areas and stockpile areas, temporary utilities and fuel storage, and erosion control.

Earthwork activities for development of the channel margin habitat areas could include modification of levees or setting back levees to create low benches designed with variable surface elevations that would support emergent vegetation to provide an ecological gradient of habitat conditions, and higher elevation benches that would support riparian vegetation. Riprap would be removed where levees are set back to restore seasonally inundated floodplain habitat. Channel geometry would be modified in unconfined channel reaches or along channels where levees are set back to restore seasonally inundated floodplain habitat and create backwater salmonid and splittail rearing and splittail spawning habitat.

These activities would be completed in a manner similar to that discussed in Section 3.6.2.3, *Tidal Natural Communities Restoration* (CM4). Channel margin modifications would be required to be designed, implemented and maintained to allow the passage of flood flows at the required flood system design flow and to comply with other flood management standards and permitting processes. These activities would be coordinated with USACE, DWR, CVFPB, and other flood management agencies.

Riparian and emergent vegetation would be planted on the benches of setback levees. Large woody material, such as tree trunks and stumps, could be anchored into constructed low benches or into existing riprapped levees to provide similar habitat functions.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, and adaptive management, as described in Chapter 3, *Conservation Strategy* (Section 3.4.6), of the BDCP. Because actions under CM6 have the potential to provide habitat for nonnative predatory fish, two monitoring actions are proposed to evaluate the use of enhanced channel margin sites and associated woody debris by predators.

3.6.2.6 Riparian Natural Community Restoration (CM7)

CM7 would entail restoration of 5,000 acres of native riparian forest and scrub in association with restoration of tidal and floodplain areas (CM4 and CM5, respectively) and channel margin enhancements (CM6). Riparian forest and scrub would be restored to include the range of conditions necessary to support habitat for each of the riparian-associated covered species. CM7 actions would be phased, with 1,100 acres restored by year 15 and 5,000 (cumulative) acres restored by year 40 of Plan implementation.

The substantial reduction in the extent, distribution, and diversity of valley/foothill riparian communities that historically occurred along the upper elevational margins of the Delta and along natural levees along Delta and Suisun Marsh channels and Delta islands has greatly reduced the availability of this natural community as habitat for associated covered and other native species. Design features of flood control levees such as steep slopes and the use of riprap generally preclude natural establishment or survival of native, woody riparian vegetation. These steep, riprapped surfaces provide little cover for covered fish species, and may contribute to increased predation losses. A lack of riparian habitat associated with existing and restored tidal aquatic and marsh habitats limits potential ecological benefits to fish and wildlife by limiting important ecological gradients and ecosystem functions that such ecotones would provide. Restoration of valley/foothill riparian habitats would increase the abundance and distribution of associated covered and other native species, improve connectivity among habitat areas within and adjacent to the Plan Area, improve genetic interchange among native riparian-associated species' populations, and contribute to the long-term conservation of riparian-associated covered species.

Riparian restoration sites would be prioritized in areas where they would improve linkages to allow terrestrial covered and other native species to move between protected habitats within and adjacent to the Plan Area. Some of this connectivity would be accomplished through planting native riparian vegetation along channel margins as described in *CM6 Channel Margin Enhancement*. However, channel margin enhancement would consist mostly of narrow riparian bands that would likely be flanked by agriculture and highways, with limited value for wildlife movement. Therefore, projects that involve restoration of large riparian areas would focus on connecting existing wildlife habitat along riparian corridors to meet the riparian habitat connectivity objective.

The 5,000 acres of restored riparian natural community must meet numerous requirements for mid- and late-successional stage vegetation structure, and for species habitat, as summarized in Chapter 3, *Conservation Strategy,* Section 3.4.7 of the BDCP. The location of riparian restoration would be determined during implementation in order to meet these specific geographic and species requirements. Site selection would also be guided, in part, by the needs of three other conservation measures, which have overlapping goals with riparian restoration: *CM4 Tidal Natural Communities Restoration*, *CM5 Seasonally Inundated Floodplain Restoration*, and *CM6 Channel Margin Enhancement*. Some riparian restoration would be accomplished in locations that can meet these dual requirements.

Riparian Restoration in Restored Floodplains

Three-thousand acres of the riparian restoration will take place in restored floodplains, consistent with CM5. The valley/foothill riparian natural community will actively be restored in some floodplains, and in other floodplains it will be allowed to naturally establish and grow where soils and hydrology are appropriate. Large patches of native riparian vegetation are expected to be established in floodplains in contrast to the existing narrow stringers of riparian vegetation that typically occur along channels and agricultural water conveyance features in much of the Plan Area.

Riparian Restoration in Restored Tidal Natural Communities

Native woody riparian vegetation would be allowed to naturally reestablish along the upper elevation margins of restored tidal natural communities in ROAs where soils and hydrology are suitable, including segments of stream channels that drain into restored marshes. Suitable soils for restoration are expected to be most extensive in the Cosumnes/Mokelumne and South Delta ROAs. In these ROAs, native riparian vegetation is expected to generally form as a band of variable width depending on site-specific soil and hydrologic conditions between high-marsh vegetation and herbaceous uplands.

Riparian Restoration on Enhanced Channel Margins

Where compatible with site-specific objectives for channel margin enhancement, native woody riparian vegetation would be planted along channel margins on benches on the waterward side of existing levees to enhance covered fish and wildlife species habitat. Native riparian vegetation restored in these locations is expected to form narrow stringers of riparian forest and scrub along enhanced channel margins. Riparian vegetation planted for channel margin enhancement (CM6) will also count toward the 5,000-acre requirement for CM7.

Due to these overlaps with CM4, CM5, and CM6, the area of land that would count only toward CM7 (and not toward another conservation measure) is 971 acres.

Site Preparation, Earthwork, and Other Site Activities

Site preparation could require clearing and grubbing, demolition of existing structures, surface water quality protection, dust control, establishment of storage areas and stockpile areas, temporary utilities and fuel storage, and erosion control.

Earthwork activities for development of the riparian habitat areas would be minimal, focusing on removal of riprap and minor landform modifications to restore water circulation. The primary activities would entail either natural establishment or planting of riparian vegetation, irrigation and maintenance of plantings, and control of nonnative species.

Native riparian vegetation would be planted if site-specific restored floodplain conditions indicate that such plantings would substantially increase the establishment of valley/foothill riparian habitat. Elderberry shrubs would be a component of such plantings to provide habitat for valley elderberry longhorn beetle.

Irrigation systems and water supplies could be necessary to establish native vegetation. The type of irrigation and the water source would be site dependent. Irrigation system construction could include placement of aboveground or belowground irrigation piping. Erosion and dust control measures would be implemented during construction as described in Appendix 3B, *Environmental Commitments*.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, and adaptive management, as described in Chapter 3, *Conservation Strategy,* (Section 3.4.7) of the BDCP.

3.6.2.7 Grassland Natural Community Restoration (CM8)

CM8 would entail restoration of 2,000 acres of grassland in CZs 1, 8, and/or 11, and other zones as needed to achieve the biological goals and objectives for covered species. Actions under CM8 would be phased, with 1,140 acres restored by year 10 and 2,000 acres (cumulative) restored by year 40 of Plan implementation.

Grassland habitat is distributed around the upland margin of the Sacramento–San Joaquin Delta and Suisun Bay system, and much has been lost to development and conversion to agriculture. Some covered activities would further remove the grassland natural community. Grassland restoration offers a way to offset these losses while improving habitat connectivity and increasing the diversity of grassland species.

Grassland restoration would include converting nongrassland areas (e.g., ruderal or cultivated lands) into grassland. Grasslands restored as a component of vernal pool complexes would also count toward the 2,000-acre restoration target for CM8.

Grassland restoration would focus on creating a mosaic of different grassland vegetation alliances, reflecting localized water availability, soil chemistry, soil texture, topography, and disturbance regimes, with consideration of historic site conditions. Grassland restoration sites would be selected that support soils suitable for grassland restoration and are adjacent to existing high-value grassland natural community (i.e., supporting covered species or high biodiversity) (Keeley 1993).

Sites that have been highly disturbed may require pretreatment before grassland restoration techniques are applied. For example, invasive weeds may need to be removed using a variety of techniques such as livestock grazing, herbicide treatment, tilling, soil removal and treatment (to remove the weed seed bank), or a combination of these or other treatments. Restoration may also require the recontouring of graded land as appropriate.

Seed sown on grassland restoration sites would be collected from the nearest practicable natural site with similar ecological conditions. Seed nurseries may be established in some of the restored grasslands to produce seed for subsequent restoration projects.

Seeding would be done in fall or early winter after the first rains. Seed may be broadcast using a tractor-mounted or handheld broadcast seeder, or a seed drill may be used. Plugs may be used rather than seeding in some areas, especially on steep hillsides. Once seedlings are established, the restored grasslands would be managed consistent with long-term, site-specific management plans.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, and adaptive management, as described in Chapter 3, *Conservation Strategy,* (Section 3.4.8) of the BDCP.

3.6.2.8 Vernal Pool and Alkali Seasonal Wetland Complex Restoration (CM9)

CM9 would entail restoration of vernal pool complex and alkali seasonal wetland complex in CZs 1, 8, or 11 (Figure 3-1) to achieve no net loss of vernal pool and alkali seasonal wetland acreage from BDCP covered activities (as shown in Table 3-4, it is assumed that 67 acres of restored vernal pool complex and 72 acres of restored alkali seasonal wetland would be restored under this measure). The restored vernal pool complexes would consist of vernal pools and swales within a larger matrix of grasslands. Similarly, the alkali seasonal wetland complex will consist of alkali seasonal wetlands within a larger matrix of grasslands. Specific restoration sites would be selected on the basis of their availability, suitability for restoration, biological value, and practicability considerations. Restored vernal pool complex and alkali seasonal wetland complex will complement other restoration and protection in the reserve system as well as existing conservation lands. In conjunction with protection of 600 acres of existing vernal pool complex and 150 acres of alkali seasonal wetland complex (under *CM3 Natural Communities Protection*), restoration actions will contribute to the establishment of a large, interconnected vernal pool complex and alkali seasonal wetland complex reserve in the Plan Area. The amount of vernal pool complex restoration would be determined during implementation based on the following criteria.

- If restoration is completed (i.e., restored natural community meets all success criteria) prior to impacts, then 1.0 wetted acre of vernal pools would be restored for each wetted acre directly affected (1:1 ratio).
- If restoration takes place concurrent with impacts (i.e., restoration construction is completed, but restored habitat has not met all success criteria, prior to impacts occurring), then 1.5 wetted acres of vernal pools would be restored for each wetted acre directly affected (1.5:1 ratio).

Restoration must offset loss of any wetland features exhibiting the hydrologic and vegetative characteristics of vernal pools whether or not they are occupied by covered species. Vernal pool complex restoration must also offset loss of wetland features that do not exhibit typical vernal pool hydrology and vegetation, but only if they are occupied by covered vernal pool crustaceans.

The restored vernal pools and surrounding upland natural community would be protected and managed in perpetuity. The surrounding upland natural community would consist of existing or restored grasslands.[25] The protected lands would include sufficient watershed surrounding the

[25] The surrounding grasslands will be a component of restored vernal pool complex and will not count toward the target acreages for grassland protection or restoration.

restored vernal pools to sustain the hydrology characteristic of this natural community, at a density representative of intact vernal pool complexes in the vicinity of the restoration site. In lieu of restoration, an equivalent amount of vernal pool restoration credit may be purchased at a USFWS- and CDFW-approved mitigation bank if the bank occurs in the Plan Area and meets the site selection criteria described below.

- The site is in CZs 1, 8, or 11.
- The site has evidence of historical vernal pools based on soils, remnant topography, remnant vegetation, historical aerial photos, or other historical or site-specific data.
- The site supports suitable soils and landforms for vernal pool restoration.
- The adjacent land use is compatible with restoration and long-term management to maintain natural community functions (e.g., not adjacent to urban or rural residential areas).
- Sufficient land is available for protection to provide the necessary vernal pool complex restoration and surrounding grasslands to provide the local watershed for sustaining vernal pool hydrology, with a vernal pool density representative of intact vernal pool complex in the vicinity of the restoration site.

Acquisition of vernal pool restoration sites would be prioritized based on the following criteria.

- The site will contribute to establishment of a large, interconnected vernal pool and alkali seasonal wetland complex reserve system (e.g., adjacent to existing protected vernal pool complex or alkali seasonal wetland complex).
- The site is close to known populations of covered vernal pool species.

Alkali seasonal wetland complex restoration sites will meet the following site selection criteria.

- The site is in CZs 1, 8, or 11.
- The site has evidence of historical alkali seasonal wetlands based on soils, remnant topography, remnant vegetation, historical aerial photos, or other historical or site-specific data.
- The site supports suitable soils and landforms for alkali seasonal wetland restoration.
- The adjacent land use is compatible with restoration and long-term management to maintain natural community functions (e.g., not adjacent to urban or rural residential areas).
- Sufficient land is available for protection to provide the necessary alkali seasonal wetland complex restoration and surrounding grasslands to provide the local watershed for sustaining alkali seasonal wetland hydrology, with an alkali seasonal wetland density representative of intact alkali seasonal wetland complex in the vicinity of the restoration site.

Acquisition of alkali seasonal wetland restoration sites will be prioritized based on the following criteria.

- The site will contribute to establishment of a large, interconnected vernal pool complex and alkali seasonal wetland complex reserve system (e.g., adjacent to existing protected vernal pool complex or alkali seasonal wetland complex).
- The site is close to known populations of covered alkali seasonal wetland species.

Site Preparation, Earthwork, and Other Site Activities

The following restoration techniques would be implemented for vernal pool restoration.

- Remnant natural vernal and swale topography would be restored by excavating or recontouring historical vernal pools and swales to natural bathymetry based on their characteristic visual signatures on historical aerial photographs, other historical data, and the arrangement and bathymetry of vernal pools and swales at a reference site.
- The reference site would consist of existing nearby, natural (i.e., unmodified by human activities) vernal pool complex supporting covered vernal pool species.
- To provide for high-functioning habitat, restored vernal pool complex would be vegetated with hand-collected seed from appropriate areas in the same conservation zone. Soil inocula would not be used to establish vernal pool plants and animals in these conservation zones unless the source vernal pools are free of undesirable nonnative plant species such as perennial pepperweed, waxy mannagrass, swamp timothy, and Italian ryegrass. These nonnative species establish more rapidly than native species, and create dense populations that are likely to reduce the establishment success of the native plants and also create thatch problems in the vernal pools.
- Vernal pool invertebrates are expected to be passively introduced into the restored vernal pools through the movement of other animals from pool to pool. If monitoring shows that passive introduction is insufficient for meeting restoration success criteria, active propagule (cyst) introduction may be implemented. Any introduction of propagules of covered vernal pool invertebrate species would be sourced from vernal pool soils that are free of undesirable nonnative species such as perennial pepperweed, swamp timothy, and Italian ryegrass.

The following restoration techniques will be implemented for alkali seasonal wetland complex restoration.

- Remnant natural vernal and swale topography will be restored by excavating or recontouring historical alkali seasonal wetlands and swales to natural bathymetry based on their characteristic visual signatures on historical aerial photographs, other historical data, and the arrangement and bathymetry of alkali seasonal wetlands and swales at a reference site.
- The reference site will consist of existing nearby, natural (i.e., unmodified by human activities) alkali seasonal wetland complex supporting covered species.
- To provide for high-functioning habitat, restored alkali seasonal wetland complex will be vegetated with hand-collected seed from appropriate areas in the same conservation zone. Soil inocula will not be used to establish alkali seasonal wetland plants and animals in these conservation zones unless the source wetlands are free of undesirable nonnative plant species such as perennial pepperweed, waxy mannagrass, swamp timothy, and Italian ryegrass. These nonnative species establish more rapidly than native species, and create dense populations that are likely to reduce the establishment success of the native plants and also create thatch problems in the alkali seasonal wetlands.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, and adaptive management, as described in Chapter 3, *Conservation Strategy,* (Section 3.4.9) of the BDCP.

3.6.2.9 Nontidal Marsh Restoration (CM10)

CM10 would entail restoration of 1,200 acres of nontidal marsh in CZs 2, 4 and/or 5 (Figure 3-1). CM10 actions would be phased, with 400 acres restored by year 10; 600 acres by year 20; and 1,200 (cumulative) acres restored by year 40 of Plan implementation. This CM also provides for creation of 500 acres of managed wetlands consisting of greater sandhill crane roosting habitat in the greater sandhill crane Winter Use Area in CZs 3, 4, 5, or 6 by year 10 (250 acres during years 1 through 5 and 250 acres during years 6 through 10).

Nontidal Marsh

Restored nontidal marsh (also referred to as *nontidal freshwater emergent wetland*) would be designed and managed primarily to support giant garter snake, but also to support other native wildlife functions including waterfowl foraging, resting, and brood habitat and shorebird foraging and roosting habitat, to the extent that management for these species does not reduce habitat value for the giant garter snake. Design measures will also be incorporated for western pond turtle. Although the restored nontidal marsh may provide nesting habitat value for tricolored blackbird, it will not be designed specifically for this species (which prefers large, dense patches of emergent vegetation). Instead, restoration sites will provide a mosaic of open water and relatively open emergent vegetation for the primary benefit of giant garter snake. Upland habitat consisting of grasslands would be restored or protected adjacent to restored freshwater emergent wetland, to provide upland habitat for giant garter snake and western pond turtle, and nesting habitat for waterfowl: this would be credited toward the 8,000 acres of grassland to be protected or the 2,000 acres of grassland to be restored.

Actions to restore nontidal freshwater emergent wetland natural community, as appropriate to site-specific conditions, would include, but would not be limited to, those listed below.

- Secure sufficient annual water to sustain habitat function.
- Establish connectivity with the existing irrigation and drainage conveyance system (i.e., agricultural ditches and canals) and habitats occupied by giant garter snakes.
- Prepare site, plant native marsh vegetation, and maintain plantings.
- Control nonnative invasive plants that impair achievement of reserve system objectives.

Nontidal marsh restoration sites will be designed to support the range of habitat conditions necessary for giant garter snake. By designing the restoration specifically for giant garter snake and ensuring adequate open basking opportunities, the restored nontidal marsh is also is expected to provide suitable habitat for western pond turtle. Existing cultivated lands will be converted to nontidal marsh in areas where hydrology and soils are suitable.

Restoration may include creating wetland topography by site grading or creation of depressions to hold water. Grading will establish an elevation gradient to support both open water, perennial aquatic habitat intermixed with shallower marsh habitat. Additional issues that will be addressed in each site-specific restoration plan include preventing fish from becoming stranded in the ponds (e.g., by the use of fish screens or other appropriate devices), if the hydrology source is a perennial water body that supports fish. Coarse woody debris or anchored basking platforms will be installed in open-water areas to improve habitat for western pond turtles. This will increase habitat value in locations with existing western pond turtles and in newly created ponds where it is hoped that new pond turtle populations will establish.

Grassland natural community will be protected (pursuant to CM3) or restored adjacent to restored nontidal freshwater emergent wetland natural community to provide upland habitat for giant garter snakes and other native wildlife. The restored tidal marsh will consist of a combination of emergent, tule-dominated vegetation and open water, with variable bank slopes.

Nontidal freshwater emergent wetland natural community will be allowed to naturally reestablish along the edges of nontidal perennial aquatic natural community but will also be planted as needed to facilitate marsh development and to manage species composition. Approximately two-thirds of the restored nontidal marsh is expected to consist of nontidal perennial aquatic natural community, and approximately one-third is expected to consist of nontidal freshwater emergent wetland, although this proportion may shift as needed based on site conditions and as necessary to optimize habitat value for giant garter snake. The choice of plant species for the nontidal freshwater emergent wetland natural community restoration sites will be based on a palette of native wetland plants including freshwater emergent and aquatic species. The palette will be specified in each site restoration plan. The plants will preferentially be grown from soil, seed, or plant stock from local wetland sites. In addition, vegetation is expected to change after the original planting such that other native species may colonize the wetland over time. Colonization by undesirable nonnative invasive plants is also likely, so restoration plans will address management of nonnative invasives.

Managed Wetlands

The 500 acres of managed wetlands will be created for greater sandhill crane. The restored wetlands will be protected in association with other protected natural community types (excluding nonhabitat cultivated lands) at a 2:1 upland-to-wetland ratio to provide buffers around the wetlands. The protected uplands will count toward protection requirements for other natural communities. Sites that are not expected to be affected by sea level rise will be selected for restoration. Sites will also be selected to avoid areas that experience local seasonal flood events that may be incompatible with the habitat management needs for greater sandhill crane.

At least 320 of the 500 acres of managed wetlands will consist of roosting habitat in minimum patch sizes of 40 acres within the greater sandhill crane Winter Use Area (BDCP Appendix 2.A) in CZs 3, 4, 5, or 6.

At least 180 of the 500 acres of managed wetlands will consist of two 90-acre wetland complexes within the Stone Lakes National Wildlife Refuge project boundary.[26] The complexes will be no more than 2 miles apart and will help provide connectivity between the Stone Lakes and Cosumnes greater sandhill crane populations. Each complex will consist of at least three wetlands totaling at least 90 acres of greater sandhill crane roosting habitat. One of the 90-acre wetland complexes may be replaced by 180 acres of cultivated lands (e.g., cornfields) that are flooded following harvest to support roosting cranes and provide highest-value foraging habitat, provided such substitution is consistent with the long-term conservation goals of Stone Lakes National Wildlife Refuge for greater sandhill crane.

- Greater sandhill crane roost sites will be created as managed seasonal wetlands using the following specifications. A site-specific management plan will be prepared for each roost site, which will include details on water management, plant composition, timing of flood-up and drawdown, vegetation management and control, access, and spring-summer management.

[26] The project boundary delineates the area surrounding the existing refuge for which the refuge has authority to acquire land or easements.

- Roost sites will be developed as a series of shallow, open ponds separated by a system of checks and levees. Small upland islands can also be created within the ponds. Cranes often congregate to roost or loaf on the checks and other areas of higher ground and forage in the shallow water contained within the ponds.
- The checks, levees, and other upland sites will be designed with sloping banks, which allow cranes to walk from the flooded pond to the adjacent uplands.
- In addition to the presence of water, food availability, and loafing opportunities, greater sandhill cranes select roosting sites based in part on predator avoidance. Therefore, the development of the ponds and checks will consider the ability of predators to access roosting cranes along checks and levees.
- Selected roost sites will have direct access to sufficient irrigation water to maintain required water depths.
- The wetlands will be maintained as described in *CM11 Natural Communities Enhancement and Management.*

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, and adaptive management, as described in Chapter 3, *Conservation Strategy,* (Section 3.4.10) of the BDCP.

3.6.2.10 Natural Communities Enhancement and Management (CM11)

CM11 would apply to all BDCP-protected and -restored habitats and would be implemented on permit issuance for certain conservation lands. The conservation measure would extend over time to cover new conservation lands as they are acquired. All lands in the reserve system (all natural communities protected and restored) would be managed or enhanced consistent with this conservation measure.

Natural communities and covered species habitat in the Plan Area have been degraded as a result of many human-related activities such as flood control and hydrologic alteration, urban and agricultural runoff, and introduction of invasive plant and wildlife species. Enhancement of natural communities and covered species habitat is necessary to reverse historical trends, and management is necessary to prevent further degradation in the reserve system.

Implementation of this conservation measure would include the following.

- Prepare and implement reserve unit management plans, in collaboration with fish and wildlife agencies, for protected natural communities and covered species habitats found within those communities.
- General enhancement and management actions, which would include the following.
  - Implement fire management plans as a component of each reserve unit management plan, which would include measures to avoid and minimize effects on covered species and their habitats during fire management activities on reserves.
  - Implement recreation plans as a component of each reserve unit management plan, which would identify sites where recreational use is compatible with the biological goals and objectives, along with acceptable forms of recreation and guidelines for management of recreational areas.

- Implement invasive nonnative plant control (terrestrial invasive plants) to benefit covered species and enhance native biodiversity.
- Implement nonnative animal control in aquatic and emergent wetland communities, riparian natural communities, and in managed wetlands.
- Minimize mosquito production to protect human health.
- Use pesticides only to achieve biological goals and objectives (e.g., invasive plant or invasive animal control), in accordance with label instructions, and in compliance with state and local laws.
- Maintain levees within the reserve system in a manner that balances wildlife and habitat needs with the need to maintain the structural integrity of the levees.
- Design and maintain infrastructure (e.g. fences, culverts, roads) to allow wildlife movement throughout the reserve system.
- Control access to lands in the reserve system in areas that are vulnerable to disturbance by humans and pets. Human and pet access will be restricted in vernal pool and alkali seasonal wetland complexes, nontidal marsh restored for giant garter snake, greater sandhill crane roost sites, and locations that support rare plant populations. Signs will be posted to inform the public of the access restrictions. Access to areas that support nesting covered bird species will be restricted during the nesting season.

- Manage and enhance the aquatic and emergent wetland natural communities in the reserve system, including tidal brackish emergent wetland, tidal freshwater emergent wetland, nontidal freshwater perennial emergent wetland, tidal perennial aquatic, and nontidal perennial aquatic. The following actions would be included in each reserve unit management plan addressing aquatic and emergent wetland natural communities in the reserve system.
    - Control nonnative plants and supplement, through plantings, native vegetation in tidal freshwater emergent wetlands.
    - Maintain grasslands within 200 feet of tidal marshes, as refugia for salt marsh harvest mouse, Suisun shrew, and other covered species.
    - Control nonnative wildlife that threatens covered species in emergent wetland natural communities.
    - Enhance and maintain vegetation composition and structure in Suisun Marsh to support appropriate habitat conditions for covered species.
    - Enhance topographic heterogeneity to provide variation in inundation characteristics and vegetative composition.
    - Manage and enhance habitat for California black rail.
    - Implement seed banking for soft bird’s-beak and Suisun thistle.
    - Manage and enhance habitat in Suisun Marsh for salt marsh harvest mouse.
    - Manage and enhance giant garter snake habitat.
    - Manage and enhance tricolored blackbird nesting habitat.
    - Manage roosting habitat for greater sandhill crane.

- Manage and enhance riparian natural communities in the reserve system.
  - Manage and enhance structure and composition of restored riparian areas.
  - Reduce or eliminate riparian invasive species that threaten habitat value.
  - Manage and enhance habitat for riparian woodrat (San Joaquin Valley).
  - Manage and enhance habitat for riparian brush rabbit.
  - Control riparian nonnative animals.
  - Maintain rare plant alliances through nonnative plant control and supplemental plantings.
  - Manage and enhance stream channels and channel banks associated with the riparian natural community.
  - Create, enhance, and manage self-sustaining occurrences of delta button celery and slough thistle.
- Manage and enhance grasslands and associated natural communities, including vernal pool complex, alkali seasonal wetland complex, and other seasonal wetlands.
  - Enhance and manage vegetation to reduce fuel loads for wildfires, reduce thatch, minimize nonnative competition with native plant species, increase biodiversity and provide suitable habitat conditions for covered species.
  - Increase the availability of overwintering and nesting burrows for western burrowing owl, California red-legged frog, and California tiger salamander; and to increase prey availability for San Joaquin kit fox, Swainson's hawk, white-tailed kite, and other native wildlife predators.
  - Install artificial nesting burrows and structures, where appropriate, for western burrowing owl, Swainson's hawk, and white-tailed kite to facilitate use of unoccupied areas.
  - Install woody debris in stock ponds to provide cover and basking opportunities for western pond turtle.
  - Manage and enhance the hydrology of vernal pool complex, alkali seasonal wetland complex, and stock ponds.
  - Control invasive nonnative predatory wildlife that limit the abundance of covered amphibians in vernal pools, alkali seasonal wetlands, and ponds.
  - Enhance and manage vernal pool complexes to sustain suitable conditions for vernal pool pollinators.
- Manage and enhance cultivated landscapes.
  - Maintain crops to provide the required habitat acreages and values for covered species that use cultivated lands.
  - Maintain uncultivated seasonal or permanent buffers on cultivated lands in the reserve system that are adjacent to riparian and wetland habitats.
  - Maintain water in canals and ditches during the activity period (early spring through mid-fall) for the giant garter snake, western pond turtle, and other covered species using waterways.

  - Minimize or discontinue pesticide use, as needed, to reduce negative effects on wildlife.
  - Retain patches of natural communities and habitat features in the cultivated lands matrix to benefit Swainson's hawk and white-tailed kite.
- Manage and enhance managed wetlands.
  - Manage and enhance habitat for salt marsh harvest mouse in the Grizzly Island Marsh Complex.
  - Manage wetlands for biodiversity of native species, including waterfowl and shorebirds.
  - Manage 5,000 acres as seasonal wetlands (wetlands that are dry during summer and fall months) to increase food value and density for overwintering waterfowl.
  - Manage 1,600 acres as permanent wetlands (wetlands that maintain some ponded water all year) to benefit breeding waterfowl and shorebirds.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, and adaptive management, as described in Chapter 3, *Conservation Strategy,* (Section 3.4.11) of the BDCP.

3.6.3 Conservation Measures to Reduce Other Stressors

The BDCP has identified several issues, beyond water exports and habitat conditions, that affect the survival of covered species in the Delta. These other stressors include exposure to contaminants, competition, predation and changes to the ecosystem caused by nonnative species, entrainment at water intake pumps not operated by SWP and CVP, and fish passage. The proposed BDCP components related to reducing other stressors are described below. These components would be implemented under all action alternatives.

3.6.3.1 Methylmercury Management (CM12)

This measure would minimize conditions that promote production of methylmercury in restored areas and its subsequent introduction to the foodweb, and to covered species in particular. Implementation of this conservation measure would require the following actions.

- Define design elements that minimize conditions conducive to generation of methylmercury in restored areas.
- Define adaptive management strategies that can be implemented to monitor and minimize actual post-restoration creation and mobilization of methylmercury.
- Implement appropriate measures to monitor and minimize methylmercury in site-specific restoration designs.

The design elements would be integrated into site-specific BDCP restoration designs based on site conditions, community type (tidal marsh, nontidal marsh, floodplain), and potential concentrations of mercury in prerestoration sediments. The adaptive management strategies could be applied where site conditions indicate a high probability of methylmercury generation and effects on covered species. For each BDCP restoration project under CM4 *Tidal Habitat Restoration*, a project-specific methylmercury management plan would be developed and would incorporate all of the methylmercury management measures discussed below or would include an explanation of why a particular measure should not or cannot be incorporated. Each project-specific plan would include the following components.

- A brief review of available information on levels of mercury expected in site sediments/soils based on proximity to sources and existing analytical data.
- A determination if sampling for characterization of mercury concentrations and/or post-restoration monitoring is warranted.
- A plan for conducting the sampling, if characterization sampling is recommended.

The BDCP Implementation Office, in conjunction with the Central Valley Water Board Methylmercury TMDL program, would provide for a programmatic quality assurance/quality control (QA/QC) program specifying sampling procedures, analytical methods, data review requirements, a QA/QC manager, and data management and reporting procedures. Each project-specific plan would be required to comply with these procedures to ensure consistency and a high level of data quality.

Because methylmercury is an area of active research in the Delta, each new project-specific methylmercury management plan would be updated based on the latest information about the role of mercury in Delta ecosystems or methods for its characterization or management. Results from monitoring of methylmercury in previous restoration projects would also be incorporated into subsequent project-specific methylmercury management plans. This program would be developed and implemented within the context of Methylmercury TMDL and Mercury Basin Plan Amendment requirements. In each of the BDCP project-specific methylmercury management plans developed under CM12, relevant findings and mercury control measures identified as part of TMDL Phase I Control Studies will be considered and integrated into restoration design and management plans. CM12 would also be implemented to meet any requirements of the U.S. Environmental Protection Agency (EPA) or the California Department of Toxic Substances Control actions.

The timing and phasing of implementing CM12 would be contingent upon the timing and phasing of individual restoration projects developed under BDCP.

The purpose of CM12, the Methylmercury TMDL, and the Mercury Basin Plan Amendment is to coordinate research and inform future actions concerning mercury methylation and measures to reduce methylation. In particular, the control studies conducted as part of the Methylmercury TMDL will include a description of mercury management practices identified in Phase I, and an evaluation of the effectiveness, costs, potential environmental effects, and overall feasibility of the control actions. At this time, there is no proven method to reduce methylation and mobilization of mercury into the aquatic system resulting from inundation of restoration areas. The measures listed below are meant to provide a list of current research that has indicated potential to mitigate mercury methylation. This list would be updated as additional information is produced by the Phase I Methylmercury TMDL control studies and other related research.

- Characterize mercury concentrations in soil to inform restoration design, postrestoration monitoring, and adaptive management strategies.
- Sequester methylmercury using low-intensity chemical dosing.
- Minimize microbial methylation through restoration design or management.
- Design restoration sites to maximize photodegradation, which removes methylmercury by converting it to the biologically unavailable, inorganic form of mercury.

- Remediate sulfur-rich sediments with iron to reduce the activity of sulfide and the methylation of mercury.
- Cap mercury-laden sediments to limit methylmercury flux into the water column and exposure to biota.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, research actions, and adaptive management, as described in Chapter 3, *Conservation Strategy,* (Section 3.4.12) of the BDCP. Key uncertainties associated with CM12 include the effectiveness of the measure in minimizing production and mobilization of methylmercury from lands in the reserve system and the foodweb and whether actions under CM12 interfere with the potential of a restoration project to meet its intended purpose. Compliance monitoring will document completion and implementation of site-specific methylmercury management plans for restoration sites. Effectiveness monitoring will assess how well CM12 minimizes production and mobilization of methylmercury from BDCP activities into the aquatic system and the foodweb.

3.6.3.2 Invasive Aquatic Vegetation Control (CM13)

CM13 would entail actions to prevent the introduction and control the spread of invasive aquatic vegetation (IAV) in BDCP aquatic restoration areas. IAV includes both submerged aquatic vegetation (SAV) and floating aquatic vegetation (FAV). Invasive SAV and FAV impair covered fish habitat through several mechanisms.

- Alter habitat by reducing water flow, thereby decreasing turbidity.
- Provide suitable habitat for predatory fish that prey on covered fish.
- In conjunction with predatory centrarchid fishes, physically impair access and displace native fish from shallow-water habitats.
- Alter physical and chemical habitat attributes such as light penetration, DO, pH, and nutrient concentrations.
- Displace native plants that would otherwise create physical structure and a biological environment that supports native and nonnative fish species (e.g., aquatic habitat dominated native plants instead of IAV would enhance the diversity of native invertebrates that provide a forage base for native and nonnative fish).

CM13 would provide for the control of Egeria, water hyacinth, and other IAV throughout the Plan Area. Implementation of CM13 would focus first on areas where IAV has the greatest potential to impair habitat for covered species, including in ROAs. To implement CM13, the BDCP would apply existing methods developed and used in the Delta by the California Department of Boating and Waterways (CDBW), primarily applying herbicide treatments, but potentially also including mechanical removal, or using other methods of removal as dictated by site-specific conditions, current research, intended outcome, and techniques to minimize incidental harm to protected biological resources. The BDCP Implementation Office would fund treatment of between approximately 1,700 acres per year (low estimate) and 3,300 acres per year (high estimate). Egeria, or Brazilian waterweed (*Egeria densa*), is now the most extensive and problematic IAV species in the Delta, but the historical record shows a substantial risk that other IAV species may be introduced or that existing IAV species may become more prominent; thus the BDCP would implement an early detection and rapid response program to detect, evaluate, and eradicate or control early invasions of other IAV species. In addition, ongoing research would investigate potential biological control methods for these two species. This could minimize or avoid the need for use of herbicides. Recognizing the potential threat of other IAV species, the Implementation Office would implement an early detection and rapid response program to detect, evaluate, and treat early invasions of other IAV species.

The BDCP Implementation Office would partner with existing programs operating in the Delta (including CDBW, U.S. Department of Agriculture-Agricultural Research Service, University of California Cooperative Extension Weed Research and Information Center, California Department of Food and Agriculture, local Weed Management Areas, Resource Conservation Districts, and the California Invasive Plant Council) to perform risk assessment and subsequent prioritization of treatment areas to strategically and effectively reduce expansion of the multiple species of IAV in the Delta. This risk assessment would dictate where initial control efforts would occur to maximize the effectiveness of the conservation measure. Additionally, avoidance and minimization measures would be adopted and would likely be similar to those conditions identified in the existing CDBW program (including the associated biological opinion and EIR), which restrict where and when herbicide treatment may occur, establish allowable chemical concentrations in treated areas and adjacent water, and require extensive water quality monitoring. These are further described in Chapter 3, *Conservation Strategy,* (Section 3.4.13.2.3) of the BDCP.

It is expected that initial implementation actions would begin in year 2 of Plan implementation.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, research actions, and adaptive management, as described in Chapter 3 (Section 3.4.13) of the BDCP. Uncertainties associated with this measure include questions regarding the most effective designs for tidal restoration sites that preclude invasive plants, effects of IAV on restored natural communities, and the feasibility of creating conditions that favor growth of native pondweeds rather than IAV.

3.6.3.3 Stockton Deep Water Ship Channel Dissolved Oxygen Levels (CM14)

CM14 would ensure that the Stockton DWSC Aeration Facility would operate as needed during the BDCP permit term in order to maintain the concentrations of DO above target levels during the entire BDCP permit term. The Implementation Office would develop annual work plans in coordination with fish and wildlife agencies, the Central Valley Water Board, and the current Aeration Facility operating entities that specify the extent of DO improvements to be implemented, and would monitor the effectiveness of measures intended to improve DO levels. Increasing DO concentrations in the Stockton DWSC in accordance with DO TMDL objectives would achieve the benefits listed below.

- Reduced delay and inhibition of upstream and downstream migration of fall-run Chinook salmon.
- Reduced physiological stress and mortality of fall-run Chinook salmon, steelhead, white sturgeon, other aquatic organisms and, once they are reestablished in the San Joaquin River, spring-run Chinook salmon.

As much as 60% of the natural historical inflow to Central Valley watersheds and the Delta has been diverted for human uses. This flow reduction has had varied effects, including contributing to higher water temperatures, lower DO levels, and decreased recruitment of gravel and large woody debris.

Other factors have also contributed to low DO, including dredging to deepen and widen shipping channels and excessive algal and nutrient loading resulting from land use upstream. Periods of low DO concentrations have historically been observed in the San Joaquin River's Stockton DWSC, which is located downstream from Stockton, California.

The Aeration Facility would be operated to ensure that the Stockton DWSC would not present a passage delay for covered fish species due to low DO levels. The BDCP Implementation Office would work with the fish and wildlife agencies and the Central Valley Water Board to develop an annual work plan for the Aeration Facility that would define the thresholds for when the Aeration Facility would operate and the duration of operation. The BDCP Implementation Office would also coordinate with the Central Valley Water Board to ensure that the requirements of both BDCP biological goals and objectives and the DO TMDL are compatible and effectively met.

Under this conservation measure, the BDCP Implementation Office would ensure continued funding for and operation of the Aeration Facility, and the continued implementation of measures to improve the facility's effectiveness in meeting BDCP biological goals and objectives, as well as the objectives of the DO TMDL. The Implementation Office would make funding available for the continued long-term operation and maintenance of the Aeration Facility within 1 year of implementation of the BDCP (or an alternative). The methods for determining responsibility for the DO deficit within the DWSC and assigning proportional responsibilities for funding the operation of the Aeration Facility (or other implementation measures) that could increase the DWSC DO concentrations to meet the objectives of the DO TMDL have not been adopted; thus the long-term funding for operations and maintenance beyond testing has not been secured and currently the Central Valley Water Board has not mandated such funding. Under CM14, the BDCP Implementation Office would share in funding the long-term operation and maintenance costs associated with the operation of the Aeration Facility. The Implementation Office also would consider funding for modifications to the Aeration Facility and/or construction of additional aeration facilities to increase DO levels in the Stockton DWSC and would potentially implement additional recommendations, which could improve the effectiveness of CM14 beyond the test results and thus provide greater benefit to covered fish species.

Implementation of CM14 would be informed through effectiveness monitoring that would be conducted as described in BDCP Section 3.6, *Adaptive Management and Monitoring Program*. Results from monitoring DO levels at various distances from the diffuser(s) would be used to assess the performance of aeration facility operations at achieving the water quality objective. The Implementation Office would use effectiveness monitoring results to determine whether aeration facility operations result in measurable benefits to covered fish species.

Based on a review of performance and effectiveness monitoring results, the Implementation Office or Adaptive Management Team may recommend adjustments to funding levels, Aeration Facility operations, or other related aspects to improve the performance and/or biological effectiveness of the Aeration Facility through the adaptive management process. Such changes, if approved by the Authorized Entities Group and the Permit Oversight Group, would be addressed in annual work plans. The BDCP Implementation Office would also coordinate with the TMDL stakeholder effort, whose ongoing efforts would direct what elements the BDCP may want to contribute to (i.e., what is not required under the TMDL but is required to achieve the BDCP biological goals and objectives). For example, the Central Valley Water Board is currently discussing whether the current TMDL standard of 6 mg/L from September 1 through November 30 each year is appropriate, or whether a water quality objective of 5 mg/L year round is more appropriate. Because these decisions would affect the BDCP, the Implementation Office would participate in these conversations. Additionally, the BDCP Implementation Office would also coordinate with the Central Valley Water Board to discuss operations and triggers for initiating and halting operations the Aeration Facility to meet water quality objectives.

Implementation of CM14 will be informed through compliance and effectiveness monitoring, research actions, and adaptive management, as described in Chapter 3, *Conservation Strategy,* (Section 3.4.14) of the BDCP.

3.6.3.4 Localized Reduction of Predatory Fishes (Predator Control) (CM15)

CM15 would reduce populations of predatory fishes at specific locations and eliminate or modify holding habitat for predators at selected locations of high predation risk (i.e., predation *hotspots*). This conservation measure seeks to benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem. Therefore, this conservation measure is not intended to entirely remove predators at any location, or substantially alter the abundance of predators at the scale of the Delta system. This conservation measure would also not remove piscivorous birds. Because of uncertainties regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot projects and research actions coupled with an adaptive management and monitoring program to evaluate effectiveness. Effects would be temporary, as new individuals would be expected to occupy vacated areas; therefore, removal activities would need to be continuous during periods of concern.

There are a number of sites throughout the Delta that are currently considered hotspots of predator aggregation or activity:

- Clifton Court Forebay
- CVP intakes
- Head of Old River
- Georgiana Slough
- Old and Middle Rivers
- Franks Tract
- Paintersville Bridge
- Human-made submerged structures (e.g., abandoned boats)
- Salvage release sites

In addition to these existing predation hotspots, the proposed BDCP is expected to create new hotspots:

- North Delta water diversion facilities – Large intake structures have been associated with increased predation by creating predator ambush opportunities and flow fields that disorient juvenile fish.
- Nonphysical fish barriers – Nonphysical fish barriers may attract predators such as striped bass.

There are likely other hotspots in the Delta beyond those listed here. The actions in this conservation measure would be applied to other hotspots in the Plan Area if those actions would help to fulfill the purpose of this conservation measure and help to meet the applicable biological goals and objectives.

The proposed program for a BDCP predator control measure includes two elements.

- Hotspot Pilot Program – Implement experimental treatment at priority hotspots, monitor effectiveness, assess outcomes, and revise operations with guidance from the BDCP Adaptive Management Team.
- Research Actions – With the adaptive management program, support focused studies to quantify the population-level efficacy of the pilot program and any program expansion(s) intended to increase salmonid smolt survival through the Delta.

Under the Hotspot Pilot Program, physical reduction techniques, such as boat electrofishing, hook-and-line fishing, predator lottery fishing tournaments, and passive and active capture, would be employed. The pilot program would also evaluate the effectiveness of modifying or eliminating habitat features that provide holding habitat for predatory fish and/or increase capture efficiency by predators (e.g., abandoned boats and derelict structures). Because of the high degree of uncertainty regarding predation/competition dynamics for covered fish species and the feasibility and effectiveness of safely removing large fractions of existing predator populations, the proposed predator reduction program is envisioned as an experimental pilot program within an adaptive management framework. The pilot program would be carefully monitored and refined to determine which practices are effective. If the pilot program shows that the main issues are resolvable, a defined predator reduction program may be implemented (i.e., defined in terms of predator reduction techniques and the sites and/or areas of the Plan Area where techniques will be employed). Research and monitoring would continue throughout the duration of the program to address remaining uncertainties and ensure the measures are effective (i.e., that they reduce numbers and densities of predators and increase survival of covered salmonids).

The progress of the Hotspot Pilot Program and research activities would be documented annually in the Adaptive Management and Monitoring Report. During year 1, the Implementation Office would evaluate the strategies for logistical issues, relative effectiveness, incidental impacts on covered fish, and cost-effectiveness. After year 1 of pilot program implementation, the Implementation Office would refine the scope and methodology of the pilot program—based on review and coordination with the resource agencies—and continue with implementation for an additional 5 to 7 years. At the end of this pilot implementation period, program assessment would involve independent science review and publication of findings. After the reviews are considered, the Adaptive Management Team, in collaboration with the resource agencies, would refine operations and decide whether and in what form predator reduction and further adaptive management would continue. Key uncertainties associated with this measure include determining where predation is likely to occur in vicinity of new north Delta intakes, determining the best predator reduction techniques, determining predator density and distribution in vicinity of the north Delta intakes, prioritizing hotspots for localized predator reduction, and assessing the effects of localized predator reduction measures on covered fish species.

3.6.3.5 Nonphysical Fish Barriers (CM16)

CM16 would be implemented to improve the survival of outmigrating juvenile salmonids by using nonphysical barriers to redirect the fish away from channels and river reaches in which survival is lower than in alternate routes. The BDCP Implementation Office may install nonphysical barriers that use a combination of sound, light, and bubbles at head of Old River, Delta Cross Channel, Georgiana Slough, and possibly Turner Cut and Columbia Cut. Barriers at these locations have a high potential to deter juvenile salmonids from using specific channels/migration routes that may contribute to decreased survival resulting from increased predation and/or entrainment, or to direct juvenile salmonids to areas that may increase their survival such as Yolo Bypass. Other locations may be considered in the future if, for example, future research demonstrates differential rates of survival in Sutter and Steamboat Sloughs or in Yolo Bypass relative to the mainstem Sacramento River. Nonphysical barrier placement may also be accompanied by methods to reduce local predator abundance, if monitoring results indicate that barriers attract predators or direct covered fish species away from potential entrainment hazards but toward predator hotspots. Nonphysical fish barriers have not been shown to be effective for other covered fish species; thus, this conservation measure is only expected to yield beneficial outcomes for salmonids.

Site-specific conditions will drive the design of nonphysical barrier in terms of techniques to anchor and secure the structure, measures to indicate the location of the structure for the safety of waterway users (i.e., recreational boaters), and preferences for fish migration routes. As described in the BDCP, Chapter 8, *Implementation Costs and Funding Sources,* (Section 8.4.16), the capital and operational costs of nonphysical barriers increase dramatically in deep and wide sections of channels. Therefore, the expected and measured benefits of the barrier at a particular location will be evaluated against its biological benefits.

Nonphysical barriers would be installed and operated from October to June or when monitoring determines that salmonid smolts are present in the target areas. Barriers would be removed and stored offsite while not in operation.

Implementation of this conservation measure by the BDCP Implementation Office would be informed through effectiveness monitoring that would be conducted as described in the BDCP Section 3.6, *Adaptive Management and Monitoring Program*. Monitoring would include studies to evaluate the effectiveness of nonphysical barriers using tagged juvenile salmonids. The studies would document the interaction of tagged fish with nonphysical barriers and the effectiveness of nonphysical barriers at directing fish toward preferred migration routes/channels and away from channels or migration routes that have higher mortality associated with either predation and/or entrainment.

Uncertainty regarding the potential attraction of predators to nonphysical barriers and the effectiveness of barriers under certain conditions (i.e., in high flow areas, areas with complex bathymetry or cover, or other areas that may have physical conditions that may limit their effectiveness) will be resolved as this conservation measure is implemented on an individual project level. Thus evaluating the potential attraction of predators and the effectiveness of nonphysical barriers under various conditions would also be part of the monitoring to be completed as part of this conservation measure. Changes, should any be warranted based upon the results of monitoring and evaluating the effectiveness of nonphysical barriers, would be approved through the adaptive management decision making process, and implemented through subsequent annual work plans.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, research actions, and adaptive management, as described in Chapter 3, *Conservation Strategy,* (Section 3.4.16) of the BDCP. Monitoring elements may be modified, as necessary, to best assess the effectiveness of CM16 based on the best available information at the time of implementation.

3.6.3.6 Illegal Harvest Reduction (CM17)

Implementation of CM17 would reduce illegal harvest of Chinook salmon, Central Valley steelhead, and sturgeon in the Delta, bays, and upstream waterways by providing funding to increase the enforcement of fishing regulations in the Delta and bays with the goal of reducing illegal harvest of covered salmonids and sturgeon. The BDCP Implementation Office would provide funds to CDFW to hire and equip 24 additional staff (17 game wardens and 7 supervisory and administrative staff) in support of the existing field wardens assigned to the Delta-Bay Enhanced Enforcement Program (DBEEP) over the term of the BDCP. These staff increases would be supported for the duration of the BDCP permit term. The additional game wardens would conduct patrols throughout the Delta wherever deemed necessary to reduce illegal harvest of adult salmonids and sturgeon. Increased enforcement as part of CM17 would be focused on the Bay-Delta area and its waterways; however, increased enforcement outside of the Plan Area may occur as part of CM17. Any reduction in illegal harvest of covered fish species, whether inside or outside the Plan Area, is expected to contribute to the achievement of the biological goals and objectives for the covered fish species. One location where increased patrols are expected to occur is the Fremont Weir, both before and following improvement to the structure planned as part of *CM2 Yolo Bypass Fisheries Enhancement*. There is increased risk of illegal harvest of adult salmonids and sturgeon when the fish become concentrated in the pool immediately downstream of the Fremont Weir. Increased enforcement would deter illegal fishing and contribute to a decrease in illegal harvest.

It is expected that it would take 2 to 3 years to achieve the staff increases, with the full increase in enforcement efforts associated with CM17 beginning in year 3 of BDCP implementation.

Implementation of CM17 would be monitored primarily by tracking program achievements recorded in the DBEEP annual reports, which summarize actions and accomplishments over the previous year, including the number of warnings and citations issued, reason for citations (e.g., the species associated with each of the violations), the number of arrests by violation, and compliance and effectiveness monitoring. The Implementation Office would coordinate with CDFW to adjust enforcement strategies and funding levels through the BDCP adaptive management process, based on review of DBEEP annual reports. DWR would coordinate with CDFW to ensure that information that could be important to the BDCP is included and summarized in the DBEEP annual reports upon BDCP permit authorization.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring and adaptive management, as described Chapter 3, *Conservation Strategy,* (Section 3.4.17) of the BDCP. Key uncertainties include whether increased enforcement reduces illegal harvest and whether increased enforcement has beneficial effects on anadromous fish stocks. Monitoring data would be used to answer these uncertainties by evaluating the incidence of illegal take of covered species (especially Chinook salmon, steelhead, and sturgeon) and whether changes in abundance and population dynamics can be attributed to reductions in illegal harvest.

3.6.3.7 Conservation Hatcheries (CM18)

This conservation measure would establish new conservation propagation programs and expand the existing programs for delta and longfin smelt. The BDCP Implementation Office would support two programs.

- The development of a delta and longfin smelt conservation hatchery by USFWS to house a delta smelt refugial population and provide a continuing source of delta and longfin smelt for experimentation.
- The expansion of the refugial population of delta smelt and establishment of a refugial population of longfin smelt at the University of California (UC) Davis Fish Conservation and Culture Laboratory (FCCL) in Byron.

- The principal purpose of this measure is to ensure the existence of refugial captive populations of both delta and longfin smelt, thereby helping to reduce risks of extinction for these species. The use of two refugial facilities will decrease the likelihood of catastrophic loss of captive fish to disease. The refugial populations would also constitute a source of animals for experimentation, as needed, to address key uncertainties about delta and longfin smelt biology. This approach minimizes the need to harvest wild stock for research purposes. The refugial populations established and maintained by USFWS with funding from the BDCP could also function as a source of animals for reintroduction or supplementation of wild populations. Reintroduction or supplementation is not proposed by the BDCP. However, if deemed necessary by the fish and wildlife agencies, and if technically feasible, the hatcheries could be used for this purpose independent of the BDCP.
- Bay-Delta populations of both delta smelt and longfin smelt have experienced dramatic declines over the past five decades of monitoring, including further declines over the past decade or so due to a combination of factors (Sommer et al. 2007; Baxter et al. 2008, 2010). Delta smelt continue to decline. It is possible that very low population size could result in an Allee effect,[27] causing an even more rapid decline of the species due to factors unique to small populations (Baxter et al. 2008). Allee effects occur because, below a certain threshold, the individuals in a population can no longer reproduce rapidly enough to replace themselves, and the population spirals toward extirpation. Thus, if Allee effects are acting on the delta smelt population now, or do so in the future, then the risk of extirpation of delta smelt would increase. Longfin smelt abundance has followed a trend similar to delta smelt, culminating in record low abundance indices several times in the past decade (Sommer et al. 2007; Baxter et al. 2008, 2010), so there may also be a potential for Allee effects in the longfin smelt population.

The new facility proposed by USFWS would house genetically managed refugial populations of delta and longfin smelt. State-of-the-art genetic management practices would be implemented to maintain close genetic variability and similarity between hatchery-produced and natural-origin fish. The facility would be designed to provide captive propagation of other species, if necessary, in the future. The specifications and operations of this facility have not been developed, nor has the facility location been determined, though it is expected to be located within the Plan Area in the vicinity of Rio Vista. Additional permitting and environmental documentation would be needed to implement this conservation measure once facility designs and funding are available. Because of these challenges, it is expected that design, permitting, and construction of the facility would take approximately 6 years, with the facility becoming operational by year 7.

[27] Examples of Allee effects are when reproductive output per fish declines at low population levels and/or increases at high population levels (Allee 1931).

The BDCP Implementation Office would enter into binding Memoranda of Agreement or similar instruments with USFWS and UC Davis. If and when populations of these species are considered recovered by USFWS, the Implementation Office would terminate funding for the propagation of the species and either fund propagation of other BDCP covered fish species, if necessary and feasible, or discontinue funds to this conservation measure and reallocate them to augment funding of other conservation measures identified in coordination with the fish and wildlife agencies through the BDCP adaptive management process.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring that will be conducted by the BDCP Implementation Office, as described in Chapter 3, *Conservation Strategy,* (Section 3.4.18) of the BDCP. There is one key uncertainty associated with CM18: Can refugial populations of both delta and longfin smelt be maintained with little or no supplementation from wild stocks? Answering this question will require the development of techniques for ensuring successful breeding and survivorship, so that refugial populations can be shown to increase without further supplementation from wild stocks.

3.6.3.8 Urban Stormwater Treatment (CM19)

Under CM19, the BDCP Implementation Office would provide a mechanism for implementing stormwater treatment measures that would result in decreased discharge of contaminants to the Delta. These measures would be focused on urban areas.

Reducing the amount of pollution in stormwater runoff entering Delta waterways would benefit covered fishes through the following mechanisms.

- Increasing aquatic productivity, which would support food abundance for splittail, delta and longfin smelt, green and white sturgeon, steelhead, and Chinook salmon (all races).
- Reducing loads of pesticides and herbicides, which can be toxic to the invertebrates and phytoplankton that form the base of the food web or are important prey species for covered fish species.
- Reducing sublethal effects (behavior, tissue and organ damage, reproduction, growth, and immune) of toxic contaminants (including metals and pesticides), which would improve the health of splittail, delta and longfin smelt, green and white sturgeon, steelhead, and Chinook salmon (all races).
- Reducing pyrethroids and other chemicals from urban areas and stormwater, which would improve the health of covered fish species.

The BDCP Implementation Office would oversee a program to provide funding grants to entities such as the Sacramento Stormwater Quality Partnership and/or counties and cities whose stormwater contributes to Delta waterways under NPDES Municipal Separate Storm Sewer System (MS4) stormwater permits, to implement actions from and in addition to their respective stormwater management plans. Projects would be funded if the Implementation Office determines that they are expected to benefit covered species. Interagency agreements and program development are expected to take 2 years, with the program becoming operational in year 3 of Plan implementation. Individual actions under the program are expected to take approximately 5 years each to fund, design, permit, and construct. This conservation measure would be in effect over the 50-year BDCP period. The BDCP Implementation Office would advertise and promote this grant program to ensure that the first awards are made within 2 years of Plan implementation, assuming qualified projects are considered. Some of the types of actions that could be funded under this conservation measure include, but are not limited to those listed below.

- Constructing retention or irrigation holding ponds for the capture and irrigation use of stormwater.
- Designing and establishing vegetated buffer strips to slow runoff velocities and capture sediments and other pollutants.
- Designing and constructing bioretention systems (grass buffer strips, sand bed, ponding area, mulch layer, planting soil, and plants) to slow runoff velocities and for removal of pollutants from stormwater.
- Constructing stormwater curb extensions adjacent to existing commercial businesses that are likely to contribute oil and grease runoff.
- Establishing stormwater media filters to remove particulates and pollutants, such as that located at the American Legion Park Pump Station in Stockton.
- Providing funds for moisture monitors to be installed during construction of sprinkler systems at commercial sites, that would eliminate watering when unnecessary.
- Providing support for establishment of onsite infiltration systems in lieu of new storm drain connections for new construction, such as pervious pavement in place of asphalt and concrete in parking lots and along roadways, and downspout disconnections to redirect roof water to beds of vegetation or cisterns on existing developed properties, including residential.

The BDCP Implementation Office would enter into binding memoranda of agreement or similar instruments with stormwater entities receiving grants under this conservation measure to ensure that their project is implemented. Individual stormwater entities would be responsible for conducting the monitoring necessary to assess the effectiveness of BDCP-supported elements of their stormwater management plans. Normally, such monitoring would be limited to that required by the applicable NPDES MS4 stormwater permit, which is intended to verify that discharges support applicable beneficial uses of the receiving waters. The BDCP Implementation Office may require further monitoring (e.g., to test effectiveness of experimental treatment measures), if such monitoring is determined appropriate during review of the project proposal.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring and adaptive management, as described in Chapter 3, *Conservation Strategy,* (Section 3.4.19) of the BDCP. The BDCP Implementation Office, in coordination with the fish and wildlife agencies, may discontinue effectiveness monitoring for this measure in future years if monitoring results indicate a strong correlation between reduction in stormwater pollution loads entering the Delta and responses of covered fish species.

3.6.3.9 Recreational Users Invasive Species Program (CM20)

Under CM20, the BDCP Implementation Office would fund a Delta Recreational Users Invasive Species Program designed to implement actions to prevent the introduction of new aquatic invasive species and reduce the spread of existing aquatic invasive species via recreational watercraft, trailers, and other mobile recreational equipment used in aquatic environments in the Plan Area. The BDCP Implementation Office would also implement such actions. The program would consist of two primary elements, described in more detail below: education and outreach, and watercraft inspection.

Program actions are likely to be implemented on the ground by multiple agencies, including the BDCP Implementation Office, CDFW, Reclamation, local water districts, counties, and others. Implementing agencies would be determined by the BDCP Implementation Office based on a variety of factors including likely effectiveness, enforcement ability, and cost effectiveness.

Education and Outreach

The BDCP Implementation Office would provide information to recreational boaters in the Plan Area regarding the potential threat of introductions of new aquatic invasive species, the presence and range of existing aquatic invasive species, the various vectors of aquatic invasive species, and the potential threat of the spread of existing aquatic invasive species within the Plan Area. The BDCP Implementation Office would implement education and outreach following the actions listed in the Education and Outreach section of the *California Aquatic Invasive Species Management Plan* (Objective 6; CAISMP) (California Department of Fish and Game 2008). The first and most important of these actions is to inventory existing education and outreach efforts in the Plan Area, and then to use this information to prioritize new efforts and partner with existing efforts.

Watercraft Inspection

The BDCP Implementation Office would develop and implement protocols to screen, inspect, decontaminate, and if necessary, quarantine recreational watercraft, trailers, and other equipment prior to entering waters of the Plan Area to meet the goals of this conservation measure. The BDCP Implementation Office would design these actions for the Plan Area in accordance with the specifications for a Level 3 screening and inspection program, as set forth in the *Uniform Minimum Protocols and Standards for Watercraft Interception Programs for Dreissenid Mussels in the Western United States* (UMPS II) (Zook and Phillips 2012). UMPS II provides uniform minimum standards and protocols for developing and implementing aquatic invasive species watercraft inspection programs using the best available science, technology, and understanding. A Level 3 (Comprehensive) inspection program is recommended for all high-risk waters and large water bodies. This type of program involves screening interviews at the point of entry; a comprehensive inspection, performed by trained inspectors, of all high-risk watercraft, trailers, and equipment identified as high-risk during the screening interview; decontamination and/or quarantine or exclusion of watercraft, trailers, and equipment that are not clean, drained, and dry; and optional vessel certification. For an area the size of the Plan Area, seven inspection and decontamination stations are appropriate.

To design appropriate actions, the BDCP Implementation Office would conduct an inventory of existing aquatic invasive species within the Plan Area, including their general location, range, and population sizes; and determine the risk of aquatic invasive species invasion and spread within the Plan Area. The BDCP Implementation Office would then design watercraft inspection actions using the protocols and standards outlined in UMPS II. Concurrently, the BDCP Implementation Office would consult with operators of existing watercraft inspection programs in California and the western United States to gain an understanding of the benefits and challenges and resulting successes and failures of watercraft inspection programs, to help design BDCP actions. Throughout the permit term, the BDCP Implementation Office would continue to track other comparable programs in California and the western United States to ensure that the program continues to meet a “best available science” standard for inventory and implementation.

Compliance monitoring would be required to document the implementation of CM20. Annual budgets, reports, and work plans would be required in order to demonstrate appropriate use of available funds and actions accomplished.

Implementation of this conservation measure would begin in year 1; full program development would likely take approximately 3 years.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, research actions, and adaptive management, as described Chapter 3, *Conservation Strategy,* (Section 3.4.20) of the BDCP.

3.6.3.10 Nonproject Diversions (CM21)

Under CM21, the BDCP (or an alternative) would provide for the funding of actions that would reduce potential entrainment of covered fish that may result from the operation of nonproject diversions. Nonproject diversions consist of infrastructure used to divert surface waters within the Plan Area and that is not associated with operation of the SWP or the CVP. Most of these nonproject diversions are used to support agriculture or to provide water for waterfowl rearing areas. The purpose of this conservation measure is to avoid or minimize incidental take of BDCP covered fish species associated with nonproject diversions whose owners voluntarily participate in this conservation measure. Nonproject diversions could result in incidental take of covered fish species by entrainment or impingement. Remediation of these nonproject diversions could eliminate or reduce this entrainment or impingement, and improve Delta ecosystem health by reducing the diversion of plankton and other nutritional resources, thereby benefiting all covered fishes.

This conservation measure is intended to avoid or minimize the effect of those nonproject diversions that have the greatest potential to result in incidental take of covered fishes. This would be achieved by consolidating, relocating, screening, removing, or otherwise remediating the harmful diversions. Remediation would be achieved by the methods described below, and also through the removal of some diversions in areas where cultivated lands or managed wetlands are converted into natural community types that do not require consumptive use of surface waters. The number and size of the diversions that will be eliminated as a result of restoration of natural community types are not precisely known because the affected parcels have not yet been identified and, moreover, some existing diversions may be remediated before restoration actions occur. Diversions that are removed as a result of those restoration activities are included in the overall diversion remediation commitment.

This conservation measure has the potential to result in the remediation of an average estimated 100 cfs of diversion capacity per year, beginning in year 6 and continuing throughout the term of the Plan. The level and extent of remediation that occurs through this process will depend on the number participating diverters and the diversion capacity of those participants' diversion facilities. The estimate of an average of 100 cfs diversion capacity per year remediated is based on an evaluation of the level of landowner participation to date in the existing CDFW and Reclamation fish screen programs, and the expected increase in participation with the availability of new funds and the opportunity to obtain take authorization through BDCP.

Remediation is defined to include application of any of the following methods for treatment of unscreened diversions.

- Installation of screens.
- Consolidation of multiple unscreened diversions into a single or fewer screened diversions placed in lower-value habitat.

- Relocation of diversions with substantial effects on covered species from high-value to lower-value habitat, in conjunction with screening.
- Reconfiguration and screening of individual diversions in high-value habitat to take advantage of small-scale distribution patterns and behavior of covered fish species relative to the location of individual diversions in the channel.
- Voluntary alteration of the daily and seasonal timing of diversion operation.
- Removal of individual diversions that have relatively large effects on covered fish species or as a consequence of transfer of cultivated lands or managed wetlands into the reserve system.

Additional methods may be implemented if the Program Manager determines those methods to be appropriate.

Under this conservation measure, the following actions will be implemented over the term of the BDCP.

- The BDCP Implementation Office will form a technical team to inventory potential projects and rank those potential projects in order of priority. The technical team will include BDCP staff designated by the Science Manager, USFWS and Reclamation representatives from the Anadromous Fish Screen Program, and a representative of CDFW's Fish Screen and Passage Program. Although the existing Reclamation and CDFW programs focus on achieving benefits to anadromous salmonids, the technical team will be charged to develop and apply criteria that consider potential effects on *all* covered fish species and that assign highest priority to cost-effective projects that maximize expected entrainment reductions.
- The Implementation Office will develop and publish criteria by which it will evaluate requests from landowners, on whose property nonproject diversions are located, for participation in this conservation measure. In its consideration of landowner requests, the Implementation Office will, at a minimum, take into account the following factors.
    - Demonstration by the landowner of a valid water right.
    - Use by the landowner of reasonable methods of diversion and water measurement.
    - Efforts by the landowner, or by the entity that receives water diverted through the landowner's diversion facility, to implement appropriate irrigation efficiency programs.
    - Demonstration by the landowner that the diverted water is being put to reasonable and beneficial use and not being wasted.
    - Demonstration by the landowner that subsurface drain water and/or surface return flow discharged into a Delta water way does not have an unreasonable impact on Delta water quality.
- Landowners who operate diversions identified by the technical team as a high priority for remediation, and whose diversions have been evaluated favorably by the Implementation Office pursuant to the aforementioned criteria, would be invited to participate in CM21. Operators who choose to be part of the program will sign a certificate of compliance committing them to the process and terms of this conservation measure. Operators who have signed a certificate of compliance will receive authorization for incidental take associated with diversion operation or remediation and will be referred to as Other Authorized Entities (see Chapter 7, *Implementation*

Structure, of the BDCP). Participating landowners will be covered for take associated with the operation of these diversions.

- Remediation actions will be fully funded through the BDCP. These actions will be completed within 5 years of the execution of a certificate of compliance by the Implementation Office and the participating landowner.
- With regard to diversions selected for remediation, the BDCP Implementation Office will implement the remediation program consistent with all Anadromous Fish Screen Program and Fish Screen and Passage Program objectives.
- The BDCP Implementation Office will prepare, either internally or in conjunction with the Anadromous Fish Screen Program and Fish Screen and Passage Program, annual summary reports describing prior year achievements of supported programs. The remediation program, including the execution of associated interagency agreements, creation of a technical team, development of selection criteria, and establishment of priorities, is expected to be in effect within 2 years and fully operational in year 3. Individual actions under the program are expected to take approximately 3 to 5 years to design, permit, and construct. Based on performance of the Anadromous Fish Screen Program and Fish Screen and Passage Program during the past 20 years, the highest priority projects, at least initially, may address the larger nonproject diversions (more than 100 cfs) located along major channels in the Delta. It is also likely that priority may be given to some smaller diversions occurring in locations that support relatively large concentrations of covered fish, and that other diversions would be given higher priority because their timing of operations is conducive to high risk of take of covered species.

Implementation of this conservation measure would commence in year 1 and would continue throughout the term of the Plan. Budgeting for this program will be coordinated between the BDCP Implementation Office and the managers of the Reclamation and CDFW programs. See BDCP Chapter 6, *Plan Implementation*, (Section 6.1), for details on the timing and phasing of CM21.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring, research actions, and adaptive management, as described in Chapter 3, *Conservation Strategy,* (Section 3.4.21) of the BDCP.

The BDCP Implementation Office may adjust its approach to the selection of diversions to be relocated or consolidated, design of intakes, or the means by which the effects of these diversions on covered species will be minimized. If the results of monitoring indicate that remediation of nonproject diversions does not substantially and cost-effectively benefit covered fish species, the BDCP Implementation Office, in coordination with the fish and wildlife agencies, may recommend termination of this conservation measure to the Authorized Entity Group.

3.6.3.11 Avoidance and Minimization Measures (CM22)

Under CM22, the BDCP Implementation Office would implement measures to avoid and minimize effects on covered species and natural communities that could result from BDCP covered activities. The AMMs that would be implemented through this framework are detailed in the BDCP Appendix 3.C, *Avoidance and Minimization Measures*, and summarized in Table 3-15. These measures would be implemented for covered activities throughout the BDCP permit term.

Specific AMMs would be developed for each BDCP project, based on the comprehensive avoidance and minimization measures described in Appendix 3.C, *Avoidance and Minimization Measures* of the

BDCP, and summarized in Table 3-15. Identification and implementation of the appropriate AMMs for each project would occur in four phases.

- **Planning-level surveys and project planning.** Site-specific surveys would be conducted during the project planning phase to identify natural communities, covered species habitat, and covered species to which AMMs apply. Projects would be designed to avoid and minimize impacts as described in Appendix 3.C, *Avoidance and Minimization Measures*, of the BDCP.
- **Preconstruction surveys.** Biological surveys may be necessary during the months or weeks prior to project construction, depending on the results of the planning surveys, as specified in Appendix 3.C, *Avoidance and Minimization Measures*, of the BDCP. Results of the planning surveys will be used to determine whether additional measures would be applied just prior to or during construction (e.g., establishing buffers around kit fox dens or covered bird species nests). Preconstruction surveys may also involve site preparation actions such as collapsing unoccupied burrows.
- **Project construction.** BMPs and other AMMs would be implemented during project construction as described in Appendix 3.C of the BDCP, *Avoidance and Minimization Measures*. For some activities, as specified in Appendix 3.C, a biological monitor will be present to ensure that the measures are effectively implemented. For some species (e.g., California red-legged frog), the biological monitor would relocate individuals from the construction area to specified nearby safe locations.
- **Operation and maintenance.** Some of the AMMs apply to long-term operation and maintenance activities, such as operation and maintenance of the water conveyance facilities and ongoing covered species' habitat enhancement and management. Appropriate measures would be identified during the project planning phase and implemented throughout the life of the project. AMMs applicable to long-term enhancement and management would be incorporated into site-specific management plans.

Table 3-15. Summary of the Avoidance and Minimization Measures

Number	Title	Summary
Benefit All Natural Communities and Covered Species		
1	Worker Awareness Training	Includes procedures to educate construction personnel on the types of sensitive resources in the project area, including sensitive timing windows for covered species, the applicable environmental rules and regulations, and specific training on the measures required to avoid and minimize effects on these resources.
2	Construction Best Management Practices and Monitoring	Standard practices and measures that will be implemented prior, during, and postconstruction to avoid or minimize effects of construction activities on sensitive resources (e.g., species, habitat), and monitoring protocols for verifying the protection provided by the implemented measures.
Primarily Benefit Covered Fishes		
3	Stormwater Pollution Prevention Plan	Includes measures that will be implemented to minimize pollutants in stormwater discharges during and after construction related to covered activities, and that will be incorporated into a Stormwater Pollution Prevention Plan to prevent water quality degradation related to pollutant delivery from project-area runoff to receiving waters.

Number	Title	Summary
4	Erosion and Sediment Control Plan	Includes measures that will be implemented for ground-disturbing activities, to control short-term and long-term erosion and sedimentation effects and to restore soils and vegetation in areas affected by construction activities, and that will be incorporated into plans developed and implemented as part of the National Pollutant Discharge Elimination System permitting process for covered activities. It is anticipated that multiple erosion and sediment control plans will be prepared and implemented for BDCP construction activities, each taking into account site-specific conditions such as proximity to surface water, erosion potential, drainage, etc.
5	Spill Prevention, Containment, and Countermeasure Plan	Includes measures to prevent and respond to spills of hazardous material that could affect navigable waters, including actions used to prevent spills, in addition to specifying actions that will be taken should any spills occur, and emergency notification procedures. Measures in AMM5 will be included in site-specific plans.
6	Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material	Includes measures for handling, storing, beneficial reuse, and disposing of excavation or dredge spoils and RTM, including procedures for the chemical characterization of this material or the decant water to comply with permit requirements, and reducing potential effects on aquatic habitat, as well as specific measures to avoid and minimize effects on species in the areas where RTM would be used or disposed.
7	Barge Operations Plan	Includes measures to avoid or minimize effects on aquatic species and habitat related to barge operations, by establishing specific protocols for the operation of all project-related vessels at the construction and/or barge landing sites. AMM7 also includes monitoring protocols to verify compliance with the plan and procedures for contingency plans. Measures in AMM7 will be included in a Barge Operations Plan.
8	Fish Rescue and Salvage Plan	Includes measures that detail procedures for fish rescue and salvage to avoid or minimize the number of Chinook salmon, steelhead, green sturgeon, and other covered fish stranded during construction activities, especially during placement and removal of cofferdams at intake construction sites. Measures in AMM8 include appropriate procedures for excluding fish from the construction zones and procedures for removing and handling fish should they become trapped, and will be included in a Fish Rescue and Salvage Plan.
9	Underwater Sound Control and Abatement Plan	Includes measures to minimize the effects of underwater construction noise on fish, particularly from impact-pile-driving activities. Potential effects of pile driving will be minimized by restricting work to the least sensitive period of the year and by controlling or abating underwater noise generated during pile driving.
Primarily Benefit Covered Plants, Wildlife, or Natural Communities		
10	Restoration of Temporarily Affected Natural Communities	Restore and monitor natural communities in the Plan Area that are temporarily affected by covered activities. Measures in AMM10, including methods for stockpiling and storing topsoil, restoring soil conditions, and revegetating disturbed areas; schedules for monitoring and maintenance; strategies for adaptive management; reporting requirements; and success criteria, will be incorporated into restoration and monitoring plans.
11	Covered Plant Species	Conduct botanical surveys during the project planning phase and implement protective measures, as necessary. Redesign to avoid indirect effects on modeled habitat and effects on core recovery areas.

Number	Title	Summary
12	Vernal Pool Crustaceans	Design projects to minimize indirect effects on modeled habitat and avoid effects on core recovery areas. Where practicable, the project will be planned and designed to ensure no ground-disturbing activities or alterations to hydrology will occur within 250 feet of vernal pool crustacean habitat; over the 50-year permit term no more than 20 wetted acres will be indirectly affected by covered activities within 250 feet of vernal pools. If conservancy or longhorn fairy shrimps are detected in core recovery areas, conduct protocol-level surveys, and redesign projects to ensure that no suitable habitat within these areas is adversely affected, due to the rarity of these species.
13	California Tiger Salamander	During the project planning phase, identify suitable habitat in and within 1.3 miles of the project footprint and implement protective measures in those areas. During the planning phase, aquatic habitats in potential work areas will be surveyed (nonprotocol) for California tiger salamander larvae and eggs. If California tiger salamander larvae or eggs are found, the project will be designed to avoid and minimize impacts on the aquatic habitat. If the aquatic habitat cannot be avoided, measures will be developed to relocate larvae or eggs to the nearest suitable aquatic habitat, as determined by the USFWS- and CDFW-approved biologist.
14	California Red-Legged Frog	During the project planning phase, identify suitable habitat in and within 1 mile of the project footprint, conduct one preconstruction survey within 1 week of construction, and implement protective measures for areas where species presence is known or assumed. During the planning phase, appropriate buffer distances will be established around aquatic habitat to minimize direct and indirect effects on California red-legged frog. If aquatic habitat cannot be avoided, aquatic habitats in potential work areas will be surveyed (nonprotocol) for tadpoles and egg masses. If California red-legged frog tadpoles or egg masses are found, and the aquatic habitat cannot be avoided, measures will be developed to relocate tadpoles and eggs to the nearest suitable aquatic habitat, as determined by the USFWS- and CDFW-approved biologist.
15	Valley Elderberry Longhorn Beetle	During the project planning phase, conduct surveys for elderberry shrubs within 100 feet of covered activities involving ground disturbance, and design project to avoid effects within 100 feet of shrubs, if feasible. Implement additional protective measures, as stipulated in AMM2. Elderberry shrubs identified within project footprints that cannot be avoided will be transplanted to previously approved conservation areas in the Plan Area.
16	Giant Garter Snake	During the project planning phase, identify suitable aquatic habitat (wetlands, ditches, canals) in the project footprint. Conduct preconstruction surveys during active period (May 1 to September 30) of suitable habitat using survey protocols approved by USFWS and CDFW, and implement protective measures. To the extent practicable, construction activities will be avoided within 200 feet of the banks of giant garter snake aquatic habitat, particularly in areas with a moderate to high likelihood of giant garter snake presence.
17	Western Pond Turtle	Identify suitable aquatic habitat and upland nesting and overwintering habitat in and within the project footprint. Conduct preconstruction surveys in suitable habitat twice, including 1 week before and within 48 hours of construction. Implement protective measures as described.

Number	Title	Summary
18	Swainson's Hawk and White-Tailed Kite	Conduct preconstruction surveys of potentially occupied breeding habitat in and within 0.25 mile of the project footprint to locate active nest sites. Surveys will be conducted to ensure nesting activity is documented prior to the onset of construction activity. Swainson's hawks nest in the Plan Area between approximately March 15 and September 15. Construction activity that is planned after March 15 of any year will require surveys during the year of the construction. If construction is planned before March 15 of any year, surveys will be conducted the year immediately prior to the year of construction. If construction is planned before March 15 of any year and subject to prior-year surveys, but is later postponed to after March 15, surveys will also be conducted during the year of construction.
19	California Clapper Rail and California Black Rail	Identify suitable habitat in and within 500 feet of the project footprint. Surveys will be initiated sometime between January 15 and February 1. A minimum of four surveys will be conducted. The survey dates will be spaced at least 2 to 3 weeks apart and will cover the time period from the date of the first survey through the end of March and mid-April. Surveys can be avoided if presence is assumed and protective measures are implemented as if the species is present. Implement protective measures in areas where species is present or assumed to be present. Activities within or adjacent to tidal marsh areas (and managed wetlands for California black rails) will be avoided during the rail breeding season (February 1 through August 31), unless surveys are conducted to determine rail locations and territories can be avoided.
20	Greater Sandhill Crane	Conduct preconstruction surveys within the identified greater sandhill crane winter use area to determine the presence of occupied winter roost sites in and within 0.5 mile of the project footprint during mid-September through March 7 of each construction year. Implement protective measures in occupied areas. Minimize indirect effects of conveyance facility construction through temporary (during construction) establishment of 700 acres of roosting/foraging habitat. The established habitat will consist of active cornfields that are sequentially flooded following harvest to support roosting cranes and provide highest-value foraging habitat. Individual fields will be at least 140 acres in 40-acre rotating blocks. These fields can shift locations throughout the Greater Sandhill Crane Winter Use Area, but will be located within 0.25 mile of the indirectly affected habitat.
21	Tricolored Blackbird	Conduct preconstruction surveys in breeding habitat in and within 1,300 feet of the project footprint if the project is to occur during the breeding season. Three surveys will be conducted within 15 days of ground disturbance during the breeding season (approximately mid-March through late August) prior to project activity, and during the construction year. Implement protective measures in occupied areas. Projects will be designed to avoid construction activity to the maximum extent practicable up to 1,300 feet, but not less than a minimum of 250 feet, from an active tricolored blackbird nesting colony.
22	Suisun Song Sparrow, Yellow-Breasted Chat, Least Bell's Vireo, Western Yellow-Billed Cuckoo	Conduct preconstruction surveys of potential breeding habitat in and within 500 feet of project activities. At least five surveys will be conducted in suitable habitats within 30 days prior to construction, with the last within 3 days prior to ground disturbance. It may be necessary to conduct the breeding bird surveys during the preceding year depending on when construction is scheduled to start. Implement protective measures in occupied areas.

Number	Title	Summary
23	Western Burrowing Owl	Western burrowing owl habitat surveys will be required where burrowing owl habitat (or sign) is encountered within and adjacent to (within 150 meters [492 feet]) a proposed project area. Species surveys in suitable habitat are required in both breeding and nonbreeding seasons. If burrowing owls or suitable burrowing owl burrows are identified during the habitat survey, and if the project does not fully avoid direct and indirect impacts on the suitable habitat, preconstruction surveys will be required. Preconstruction surveys may be conducted up to 14 days before construction. Suitable habitat is fully avoided if the project footprint does not impinge on a designated nondisturbance buffer around the suitable burrow. For occupied burrowing owl nest burrows, this nondisturbance buffer could range from 50 to 500 meters (164 to 1,640 feet).
24	San Joaquin Kit Fox	Conduct habitat assessment in and within 250 feet of project footprint. If suitable habitat is present, implement USFWS guidelines. Within 14 to 30 days prior to ground disturbance conduct a preconstruction survey in areas identified by the habitat assessment as being suitable breeding or denning habitat. Surveys will be conducted within the project footprint and the area within 250 feet beyond the footprint to identify known or potential San Joaquin kit fox dens. Implement protective measures in occupied areas.
25	Riparian Woodrat and Riparian Brush Rabbit	Surveys will be conducted for projects occurring within suitable habitat as identified from habitat modeling and by additional assessments conducted during the planning phase of construction or restoration projects following USFWS *Draft Habitat Assessment Guidelines and Survey Protocol for the Riparian Brush Rabbit and the Riparian Woodrat*. Implement protective measures in suitable habitat.
26	Salt Marsh Harvest Mouse and Suisun Shrew	Identify suitable habitat in and within 100 feet of the project footprint for projects in the species range. Ground disturbance will be limited to the period between May 1 and November 30, to avoid destroying nests with young. Prior to ground-disturbing activities, vegetation will first be removed with nonmechanized hand tools (e.g., goat or sheep grazing, or in limited cases where the biological monitor can confirm that there is no risk of harming salt marsh harvest mouse or Suisun shrew). Implement protective measures in suitable habitat.
27	Selenium Management	Develop a plan to evaluate site-specific restoration conditions and include design elements that minimize any conditions that could be conducive to increases of bioavailable selenium in restored areas. Before ground-breaking activities associated with site specific restoration occur, identify and evaluate potentially feasible actions for the purpose of minimizing conditions that promote bioaccumulation of selenium in restored areas.
28	Geotechnical Studies	Conduct geotechnical investigations 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. The geotechnical investigation will also include a small-scale environmental screening to assess the presence or absence of dissolved gases that will help guide the tunnel ventilation design and disposal considerations for excavated materials and tunnel cuttings. Detailed subsurface investigations will be performed at the locations of the water conveyance alignment and facility locations and at material borrow areas.

Number	Title	Summary
29	Design Standards and Building Codes	Ensure that the standards, guidelines, and codes, which establish minimum design criteria and construction requirements for project facilities, will be followed. Follow any other standards, guidelines, and code requirements that are promulgated during the detailed design and construction phases and during operation of the conveyance facilities.
30	Transmission Line Design and Alignment Guidelines	The location and design of the proposed new transmission lines will be conducted in accordance with electric and magnetic field (EMF) guidance adopted by the California Public Utility Commission, *EMF Design Guidelines for Electrical Facilities* (2006). The alignment of proposed transmission lines will be designed to avoid sensitive terrestrial and aquatic habitats when siting poles and towers to the maximum extent feasible. When not feasible, impacts will be minimized to the greatest degree feasible and disturbed areas will be returned, as near as reasonably and practically feasible, to preconstruction conditions. Tower and pole placement will avoid existing structures to the extent feasible. Where poles or towers are to be constructed in agricultural areas, the following BMPs will be implemented, as applicable and feasible.
31	Noise Abatement	Develop and implement a plan to avoid or reduce potential construction-, maintenance-, and operation-related in-air noise impacts. To the extent feasible, the contractor will employ best practices to reduce construction noise, particularly during daytime and evening hours (7:00 a.m. to 10:00 p.m.) such that construction noise levels do not exceed 60 dBA L_{eq} (1 hour) at the nearest residential land uses.
32	Hazardous Material Management	Develop and implement site specific plans that will provide detailed information on the types of hazardous materials used or stored at all sites associated with the water conveyance facilities (e.g., intake pumping plants, maintenance facilities); phone numbers of applicable city, county, state, and federal emergency response agencies; primary, secondary, and final cleanup procedures; emergency-response procedures in case of a spill; and other applicable information. The plan will include appropriate practices to reduce the likelihood of a spill of toxic chemicals and other hazardous materials during construction and facilities operation and maintenance. A specific protocol for the proper handling and disposal of hazardous materials will be established before construction activities begin.
33	Mosquito Management	To aid in mosquito management and control during construction of project facilities, consult with appropriate Mosquito and Vector Control Districts (MVCDs). Consultation will occur before the sedimentation basins, solids lagoons, and the intermediate forebay inundation area become operational. Once these components are operational, consult again with the MVCDs to determine if mosquitoes are present in these facilities, and implement mosquito control techniques as applicable. Develop and implement a mosquito management plan, in consultation with appropriate MVCDs, for designing and planning restoration and conservation activities.
34	Construction Site Security	All security personnel will receive environmental training similar to that of onsite construction workers so that they understand the environmental conditions and issues associated with the various areas for which they are responsible at a given time. Security operations and field personnel will be given the emergency contact phone numbers of environmental response personnel for rapid response to environmental issues resulting from vandalism or incidents that occur when construction personnel are not onsite.

Number	Title	Summary
35	Fugitive Dust Control	Implement basic and enhanced control measures at all construction and staging areas to reduce construction-related fugitive dust and ensure the project commitments are appropriately implemented before and during construction, and that proper documentation procedures are followed. Ensure that measures will be implemented to the extent feasible to control dust during general construction activities.
36	Notification of Activities in Waterways	Before in-water construction or maintenance activities begin, appropriate agency representatives will be notified when these activities could affect water quality or aquatic species. The notification procedures will follow stipulations included in applicable permit documents for the construction operations.
37	Recreation	Implement measures to site and construct trails and other recreational facilities to avoid and minimize effects on sensitive habitat areas.

Implementation of this conservation measure will be informed through compliance and effectiveness monitoring and adaptive management, as described in Chapter 3, *Conservation Strategy,* (Section 3.4.22) of the BDCP.

3.6.4 Water Conveyance Operational Components

Water operations (CM1) were developed with the goals of improving aquatic habitat conditions and continuing SWP and CVP Delta exports in accordance with the concepts described below. The various operational scenarios introduced in Section 3.4.1.2 are defined in detail in Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*.

- Provisions to limit diversions at north Delta intakes to periods when Sacramento River flows would provide fish screen sweeping velocities[28] that comply with NMFS and USFWS protective criteria for salmonids and delta smelt.
- Operational criteria for SWP and CVP south Delta export facilities including seasonal export limits to minimize OMR reverse flows that appear to be related to fish salvage rates at SWP and CVP south Delta export facilities, while reducing hydraulic residence times through the Delta and improving south Delta water quality in summer months.
- Provisions to protect downstream habitat with bypass flow requirements that reflect historical hydrologic conditions.
- Seasonally adjusted Delta inflow and outflow to improve estuarine habitat
- Increased frequency and duration of floodplain inundation in Yolo Bypass to improve habitat conditions for covered fish species and increase transport of phytoplankton, zooplankton, and other organic food supply material from the Yolo Bypass floodplain to Cache Slough, the lower Sacramento River, the west Delta, and Suisun Bay (while these actions are associated with CM2, the hydrodynamic effects of these proposed changes have been incorporated into modeling for CM1).

[28] Sweeping velocity is the flow velocity component parallel to the fish screen face.

- Operational criteria for Delta Cross Channel gates to improve fish migration, hydraulic residence time, and food and organic material transport through the Delta while maintaining adequate water quality of SWP and CVP exports.
- Provisions for fish movement in the Sacramento River using bypass flow rules prior to diversion.
- Operational criteria to maintain sufficient Sacramento River flows at Rio Vista to minimize impacts on aquatic habitat conditions.
- Maintenance of water quality for in-Delta agricultural, municipal, and industrial water quality requirements.

3.6.4.1 Operations of Covered Activities and Associated Federal Actions

This section describes existing water conveyance facilities, related operations, maintenance, and monitoring activities, and how they are associated with the BDCP and its alternatives for the purposes of ESA and CESA compliance (e.g., as covered activities or as associated federal actions). Proposed modifications to the operations of these facilities as part of CM1 are described in Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*, and in Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*.

Covered Activities

The BDCP (or an alternative) would guide the continued water conveyance operations for each covered activity described in Section 3.3.1. These include operations and maintenance of SWP facilities in the Delta after the north Delta intakes become operational and operations of new water facilities constructed as part of CM1 or CM2. ESA and CESA coverage for existing operation and maintenance of the SWP and coordinated operations with the CVP prior to construction and operation of the north Delta intakes, however, are addressed through separate compliance processes and not addressed in the BDCP.

The BDCP (or an alternative) would cover operations, but not construction, of any new facility associated with the North Bay Aqueduct Alternative Intake Project. It is not yet known for certain when this facility will be constructed, nor have the details of construction been finalized. Construction of this facility will require separate environmental compliance, and compliance with ESA Section 7 and CESA. Operations will necessarily be an indirect effect to be evaluated under ESA Section 7 and compliance with applicable BiOps will ensure that the facility is operated in a manner that minimizes incidental take and avoids jeopardy or adverse modification of critical habitat. The BDCP addresses the possibility of providing further mitigation for permitted operational incidental take, and operational effects to non-ESA-listed covered species. The Proposed Authorized Entities will address these issues on behalf of the facility operator. This project includes an additional intake on the Sacramento River that would operate in conjunction with the existing North Bay Aqueduct intake at Barker Slough. The project would be used to accommodate projected future peak demand of up to 240 cfs.

Suisun Marsh Facilities Operations and Maintenance

The existing Suisun Marsh facilities are listed below.

- Suisun Marsh Salinity Control Gates.

- Morrow Island Distribution System.
- Roaring River Distribution System.
- Goodyear Slough Outfall.
- Various salinity monitoring and compliance stations throughout the Marsh.

Since the early 1970s, the California State Legislature, State Water Board, Reclamation, CDFW, SRCD, DWR, and other agencies have engaged in efforts to preserve beneficial uses of Suisun Marsh to mitigate for potential impacts on salinity regimes associated with reduced freshwater flows to the marsh. Initially, salinity standards for Suisun Marsh were set by the State Water Board's Decision 1485 to protect alkali bulrush production, a primary waterfowl plant food. Subsequent standards set under the State Water Board's Decision-1641 reflect the intention of the State Water Board to protect multiple beneficial uses. A contractual agreement between DWR, Reclamation, CDFW, and SRCD includes provision for measures to mitigate the effects of operation of the SWP and CVP and other upstream diversions on Suisun Marsh channel water salinity. The Suisun Marsh Preservation Agreement requires DWR and Reclamation to meet specified salinity standards, sets a timeline for implementing the Plan of Protection, and delineates monitoring and mitigation requirements.

The existing operation of the Suisun Marsh Facilities is covered for ESA and CESA compliance under the NMFS and USFWS BiOps and the related consistency determination. Coverage under the BDCP (or an alternative) would supersede coverage under the NMFS and USFWS BiOps. The Suisun Marsh Facilities will be covered under the BDCP for existing operations criteria and for future criteria discussed below.

The BDCP and its alternatives include covered activities that would change land use and water operations in Suisun Marsh over time. See Section 3.6.2.3 for a description of tidal brackish marsh restoration (CM4 *Tidal Natural Communities Restoration*) and Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*, for a description of water operations (*CM1 Water Facilities and Operation*). Other conservation measures may also be implemented in the Marsh. The existing operation and maintenance of the Suisun Marsh Salinity Control Gates and other facilities would not change until BDCP actions require changes in their operation. Operations of the Suisun Marsh Facilities under the existing operational criteria, as well as changes to operation as described in CM1, would be covered by BDCP. Generally, as habitat restoration in Suisun Marsh is conducted with the implementation of BDCP conservation measures, and changes in land uses occur, the Suisun Marsh Salinity Control Gates would be operated as open. While the BDCP proposes considering changes to the gate operations in coordination with the Suisun Principals, the impact analysis used a conservative approach, assuming no operation of the gates.

The BDCP and its alternatives cover operations of the Morrow Island Distribution System, Roaring River Distribution System, Goodyear Slough Outfall, and various salinity monitoring and compliance stations throughout the Marsh under the existing and future operational criteria, and future construction and maintenance of tidal habitat in Suisun Marsh identified in CM1 and CM4. These activities/actions are included as covered activities and associated federal actions and the effects of those activities/actions are addressed by the BDCP.

Monitoring Activities

Monitoring activities specific to BDCP include compliance monitoring, which verifies BDCP compliance with terms of the Plan, and effectiveness monitoring, which tracks status of covered species and natural communities, and also tracks Plan progress toward achieving the biological objectives. Monitoring protocols will be developed and proposed by the Adaptive Management Team and are subject to review and approval by the fish and wildlife agencies. All BDCP monitoring activities undertaken by the Implementation Office are covered activities authorized under the terms of the ESA Section 10(a)(1)(b) incidental take permit requested for nonfederal activities. All covered monitoring activities will be carried out in a manner consistent with protocols recommended by the Adaptive Management Team and approved by the fish and wildlife agencies.

Water Transfers

Water transfers are important water resource management measures to address water shortages, provided that certain protections to source areas and users are incorporated into the water transfer. Transfers requiring conveyance through the Delta are done at times when pumping and conveyance capacity at the SWP or CVP export facilities is available to move the water to areas south of the Delta such that the capabilities of the projects to exercise their own water rights or to meet their legal and regulatory requirements are not diminished or limited in any way. Water transfers of post-1914 water rights also must comply with State Water Board requirements, including not substantially injuring other legal users of water; and not causing an unreasonable effect on fish, wildlife, or other instream beneficial uses.

Transfers that convey water through the Delta are difficult to predict with certainty because of the many factors which parties must consider who are interested in a water transfer agreement. Each transfer is unique and is dependent upon (1) location and amount of the water available from the seller; (2) availability of the water in storage facilities, if applicable; (3) timing of the transfer; (4) surplus capacity in conveyance facilities, including SWP and CVP Delta conveyance facilities, which have a range of available capacity depending upon water year type and water demands; and (5) capability of conveying water through the Delta in accordance with regulatory requirements.

Entities currently request and will continue to request water transfers through the Delta, with or without the BDCP. However, because of the many factors affecting the ability to transfer water through the Delta, the actual quantities of water transfer water that may be facilitated as a result of the BDCP is speculative. In any case, with the BDCP, water operations with and without transfers would need to be compliant with any State Water Board or other regulatory requirements, including those that may be imposed on CM1.

There could be additional indirect effects of water transfers related to methods used to make the water available. However, these methods will be unique to each water transfer and frequently have varied annually. Methods of making water available for water transfers could include reservoir reoperation, crop idling or shifting, groundwater substitution, or other methods and combinations of methods. Therefore, it would be speculative to define specific methods or ranges of methods to be considered for future water transfers through the Delta. Future environmental documents and State Water Board approvals for transfers, as discussed above, would need to be completed in accordance with the requirements of the California Water Code, CEQA, NEPA, local requirements, and specific requirements related to use of SWP and CVP water and/or facilities. These processes are intended to prevent the implementation of water transfers that would result in harm to other legal users of water and to the aquatic species being protected under the BDCP (or an alternative), and provide the opportunity for public participation in the review of proposed transfers.

Additional information regarding water transfers is provided in Appendix 1E, *Water in California: Types, Recent History, and General Regulatory Setting*; Appendix 5C, *Historical Background of Cross-*

Delta Water Transfers and Potential Source Regions; and Appendix 5D, *Water Transfer Analysis Methodology and Results.*

Federal Actions Associated with BDCP

As described in Chapter 1, Section 1.6.1, *Overview of BDCP Approval Process*, Reclamation's action in relation to the BDCP would be to adjust CVP operations specific to the Delta to accommodate new conveyance facility operations and/or flow requirements under the BDCP, in coordination with SWP operations. The activities described in this section have been designated as *federal actions associated with the BDCP*. These actions consist of certain CVP-related activities within the Delta that would be authorized, funded, or carried out by Reclamation. These federal actions differ from covered activities, which encompass those BDCP actions that are the responsibility of non-federal entities.

The CVP's Delta Division[29] facilities in the Plan Area include the Delta Cross Channel, the Tracy Fish Collection Facility, the northern portion of the Delta Mendota Canal, the joint point of diversion facilities to be constructed in the north Delta, and the associated conveyance to export facilities in the south Delta. These facilities are used to convey water from the Sacramento River in the north Delta to the south Delta and to export that water from the Delta into canals and pipelines that carry it to agricultural and municipal and industrial contractors to the south and west of the Delta. These facilities are integral components of the CVP and contribute to the functional capacity of the overall system. This section describes the existing facilities, their operational requirements, and the actions necessary to maintain their viability. The operation and maintenance of these facilities are not only integral to the water supply system, but are also important to the BDCP conservation strategy and the protection and conservation of the aquatic ecosystem and covered fish species.

The existing CVP facilities described in this section would continue to be operated under the BDCP. The BDCP operational criteria and adaptive operational range are described in Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*, and include descriptions of operations of CVP facilities in the Plan Area.

All operations and maintenance of CVP facilities described in this section are federal actions associated with the BDCP (or an alternative).

Delta Cross Channel

The Delta Cross Channel is a gated diversion channel between the Sacramento River near Walnut Grove, and Snodgrass Slough. Flows into the Delta Cross Channel from the Sacramento River are controlled by two 60-foot-by-30-foot radial gates. When the gates are open, water flows from the Sacramento River through the cross channel to Snodgrass Slough and from there to channels of the lower Mokelumne River and into the central Delta. Once in the central Delta, the water is conveyed primarily via Old and Middle Rivers to the Jones Pumping Plant by the draw of the pumps. The Delta Cross Channel operation improves water quality in the interior Delta by improving circulation patterns of good-quality water from the Sacramento River towards Delta diversion facilities.

Reclamation operates the Delta Cross Channel in the open position to achieve the following objectives.

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[29] The Delta Division is one of several CVP divisions covering various geographical areas and facilities of the CVP; these include the American River, Friant, East Side, Sacramento River, San Felipe, West San Joaquin, and Shasta/ Trinity River Divisions. The CVP Delta Division includes facilities within the Plan Area (described in this chapter) and facilities outside the Plan Area (not described in this chapter).

- Increase the transfer of water from the Sacramento River to the export facilities at the SWP Banks (see description of SWP facilities) and CVP Jones Pumping Plants.
- Improve water quality in the southern Delta by increasing deliveries of fresh water from the Sacramento River to the south Delta.
- Reduce salt water intrusion rates in the western Delta.

During the late fall, winter, and spring, the gates are often periodically closed to protect outmigrating salmonids from entering the interior Delta, where they may experience lower rates of survival due to a longer, less direct migration route with higher levels of predation and greater potential for entrainment at the CVP and SWP south Delta export facilities. When flows in the Sacramento River at Sacramento reach 20,000 to 25,000 cfs (on a sustained basis) the gates are closed to reduce potential scouring and flooding that might occur in the channels on the downstream side of the gates. See Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*, for a description of operations of the Delta Cross Channel gates under the BDCP to provide for protection of salmon in conjunction with water conveyance.

Jones Pumping Plant

The CVP and SWP use the Sacramento River, San Joaquin River, and Delta channels to transport water to pumping plants located in the south Delta. The CVP's Jones Pumping Plant, about 5 miles northwest of Tracy, consists of six available pumps. The Jones Pumping Plant is located at the end of an earth-lined intake channel about 2.5 miles in length. The Jones Pumping Plant has a physical capacity of 5,100 cfs and the State Water Board-permitted diversion capacity of 4,600 cfs with maximum pumping rates ranging from 4,300 to 4,500 cfs during the peak of the irrigation season and approximately 4,200 cfs during the winter nonirrigation season (prior to operation of the Delta Mendota Canal/California Aqueduct Intertie). The wintertime physical constraints on the Jones Pumping Plant operations are the result of a Delta Mendota Canal freeboard constriction near O'Neill Forebay, O'Neill Pump-Generating Plant capacity, and the current water demand in the upper sections of the Delta Mendota Canal. See Section 3.6.4.2 for description of operation of SWP and CVP in the south Delta under the BDCP to provide for protection of covered fish species in conjunction with water conveyance and diversion.

Tracy Fish Facility

At the head of the intake channel leading to the Jones Pumping Plant, Tracy Fish Facility louver screens intercept fish that are then collected, held, and transported by tanker truck to Delta release sites away from the south Delta facilities. The Tracy Fish Facility uses behavioral barriers consisting of primary and secondary louvers to guide entrained fish into holding tanks. The primary louvers are located in the primary channel just downstream of the trashrack. The secondary louvers are located in the secondary channel just downstream of the traveling water screen. The louvers allow water to pass through onto the Jones Pumping Plant but the openings between the slats are tight enough and angled against the flow of water in such a way as to prevent most fish from passing between them and instead enter one of four bypass entrances along the louver arrays. The holding tanks on hauling trucks used to transport salvaged fish to release sites are injected with oxygen and contain an eight-parts-per-thousand salt solution to reduce stress on fish. The CVP uses two release sites, one on the Sacramento River near Horseshoe Bend and the other on the San Joaquin River immediately upstream of the Antioch Bridge.

Central Valley Project Diversions

The volume of water delivered by the CVP is and will continue to be variable, but in any year will be equal to the amount of water that is hydrologically available and that can be diverted under current contractual rights consistent with the terms and conditions of the BDCP conservation strategy and then-existing permits and regulations. Reclamation delivers water transported through facilities in the Delta to senior water rights contractors, long-term CVP water service contractors, refuges and waterfowl areas, and temporary water service contractors south of the Delta. The total volume under contract, including Level 2 refuge supplies, is approximately 3.3 MAF. Additionally, the CVP provides Level 4 refuge water totaling approximately 100,000 af. In addition, as part of the San Joaquin River Restoration Program implementation, Reclamation anticipates submitting a petition to the State Water Board to add a point of diversion to allow diversion of the restoration flows either upstream of or in the Delta. Moreover, in wet hydrologic conditions when CVP storage space is not available and the Delta is in excess conditions, water is made available under temporary contracts for direct delivery. The volume of water available for conveyance through the Delta is a result of hydrologic conditions, upstream reservoir operations, upstream demands, regulatory constraints on CVP operations, and transfers of water from upstream water users to south of Delta water users.

See Section 3.6.4.2, *North Delta and South Delta Water Conveyance Operational Criteria*, for a description of operation of CVP and SWP under the BDCP to provide for protection of covered fish species in conjunction with water conveyance and diversion. All CVP diversions described in this section are federal actions associated with the BDCP.

Joint Point of Diversion Operations

Under State Water Board D-1641 (December 1999, revised March 2002), Reclamation and DWR are authorized to use/exchange diversion capacity between the SWP and CVP to enhance the beneficial uses of both projects. The use of one project's diversion facility by the other project is referred to as the JPOD. There are a number of requirements in D-1641 that restrict JPOD to protect water quality and fishery resources.

In general, JPOD capabilities are used to accomplish four basic SWP and CVP objectives.

- When wintertime excess pumping capacity becomes available during Delta excess conditions (i.e., all in-Delta conditions have been met) and total SWP/CVP San Luis storage is not projected to fill before the spring pulse flow period, the project with the deficit in San Luis storage may elect to use JPOD capabilities.
- When summertime pumping capacity is available at Banks Pumping Plant and CVP reservoir conditions can support additional releases, the CVP may elect to use JPOD capabilities to enhance annual CVP south of Delta water supplies.
- When summertime pumping capacity is available at Banks or Jones Pumping Plant to facilitate water transfers, JPOD may be used to further facilitate the water transfer.
- During certain coordinated SWP/CVP operation scenarios for fish species entrainment management, JPOD may be used to shift SWP/CVP exports to the facility with the least fishery entrainment effect while minimizing export at the facility with the most fish species entrainment impact.

All in-Delta JPOD operations are included as either covered activities or federal actions associated with the BDCP (or an alternative) and the effects of those activities/actions are addressed by the BDCP.

Associated Maintenance Activities

Maintenance and replacement means those activities that maintain the capacity and operational features of the existing CVP water diversion and conveyance facilities described above, including the Delta Cross Channel, Jones Pumping Plant, Tracy Fish Collection Facility, and Contra Costa Diversion Facilities. Maintenance activities include maintenance of electrical power supply facilities; maintenance as needed to ensure continued operations and replacement of facility or system components when necessary to maintain system capacity and operational capabilities; and upgrades and technological improvements of facilities to maintain system capacity and operational capabilities, improve system efficiencies, and reduce operations and maintenance costs.

All CVP maintenance described in this section is a federal action associated with the BDCP (or an alternative) and will be covered in Section 7 consultation.

Operations of New Water Intake and Conveyance Facilities

Although DWR would own and operate the new intake and conveyance facilities, and their operations would be covered activities as described in Section 3.6.4.2, Reclamation would likely enter into an agreement with DWR to wheel CVP water through the new facilities, and this action by Reclamation would be an associated federal action.

All operations of new intake and conveyance facilities are included as either covered activities or federal actions associated with the BDCP (or an alternative) and the effects of those activities/actions are addressed by the BDCP and at a project-level of detail in this EIR/EIS.

3.6.4.2 North Delta and South Delta Water Conveyance Operational Criteria

Water conveyance operational criteria include north Delta diversion bypass flow criteria, south Delta OMR flow criteria, south Delta E/I ratio, flows over Fremont Weir into Yolo Bypass via operable gates, Delta inflow and outflow criteria, Delta Cross Channel gate operations, additional Rio Vista minimum flow requirements, operations for Delta water quality and residence criteria, and water quality criteria for agricultural and municipal/industrial diversions.

Scenario A

North Delta Diversion Bypass Flow Criteria

The objectives of the north Delta diversion bypass flow criteria include regulation of diversions so that river flows (1) maintain fish screen sweeping velocities; (2) reduce upstream transport from downstream channels; (3) support salmonid and pelagic fish transport to regions of suitable habitat; (4) reduce predation effects downstream; and (5) maintain or improve rearing habitat in the north Delta.

To ensure that these objectives are met, diversions must be reduced at certain times of the year (more severely from December through June) when juveniles are present. A process of preserving upstream pulse flows below the Freeport gage is described below. Protection of these pulses is intended to promote safe juvenile passage past the intakes and Georgiana Slough.

The initial pulse is a natural occurrence caused by the first runoff event of the season. Monitoring has shown that large numbers of juvenile salmonids migrate into the Delta during these pulses. When the initial pulse operation is triggered, flow (and fish) will be protected through initiation of low-level pumping rules, as described below. If the initial pulse operation is triggered prior to December 1, additional pulse protection would be initiated during the second pulse of the season. A flow condition will be categorized as an initial pulse based on real-time monitoring of fish movement (as described in BDCP Chapter 3, Section 3.4.1.4.5, *Rapid Response Operations*). The definition of the initial pulse for the purposes of modeling is provided below.

At the end of the initial pulse phase, a following phase termed *post-pulse operations* (December through June) will apply. The conditions that trigger the transition from the initial pulse protection phase to the post-pulse phase are described below, along with bypass operating rules for the post-pulse phase, which provide for restricted levels of pumping.

In July through September, the bypass rules allow for a greater portion of the Sacramento River to be diverted as described in Table 3-16. In October through November the bypass amount is increased.

To illustrate the effect of the bypass rules on amounts of Sacramento River flow that may be diverted, Table 3-17 shows the allowable north Delta diversions by month and by post-pulse phase, based on Sacramento River flows at Freeport.

The north Delta diversion bypass flow criteria comprise three parameters that are applied to the Sacramento River: constant low-level pumping, initial pulse protection, and three levels of post-pulse operations as summarized below.

- **Constant Low-Level Pumping** (could apply between December and June). Diversions of up to 6% of total Sacramento River flow such that bypass flow never falls below 5,000 cfs. No more than 300 cfs can be diverted at any one intake. While referred to as *constant*, pumping would vary with flows at Freeport. *Constant* refers to the percentage of river flow that could be diverted; it is not a continuous pumping level.
- **Initial Pulse Protection**. Under this concept, low-level pumping is maintained through the initial pulse period. After the flow pulse period has ended, water operations would be guided by post-pulse bypass flows presented in Table 3-16. (These parameters are for the purpose of modeling only; actual water operations would be based on real-time monitoring of fish movement, as described in BDCP Chapter 3, Section 3.4.1.4.5, *Rapid Response Operations*.)
    - If the initial pulse period begins before December 1, May post-pulse bypass criteria would be implemented following the initial pulse period; and the second pulse period would have the same protective operation as the initial pulse period. For the purposes of modeling only, the governing bypass flow criteria for the period between the initial and second pulse was used instead of the May post-pulse bypass criteria. This results in a flow condition that is more conservative for aquatic resource impact analysis.
    - For the purpose of modeling, the initiation of the pulse is defined by the following criteria: (1) increase in flow of the Sacramento River at Wilkins Slough by more than 45% within a 5-day period, and (2) Sacramento River flows greater than 12,000 cfs measured at Wilkins Slough. Low-level pumping continues until (1) Wilkins Slough returns to pre-pulse flows

(flow on first day of 5-day increase); (2) Sacramento River at Wilkins Slough flows decrease for 5 consecutive days; or (3) bypass flows are greater than 20,000 cfs for 10 consecutive days. This second criteria was modeled as Wilkins Slough flow falls below 12,000 cfs. The modeling represents a more conservative approach regarding aquatic resource impact analysis.

- **Post-Pulse Water Operations** (could apply during any month, but are designed for between December and June and are most likely to apply between October and June). After initial pulse(s), implement Level I post-pulse bypass rule (Table 3-16) until the occurrence of 15 total days of bypass flows above 20,000 cfs. Then implement Level II post-pulse bypass rule (Table 3-16) until 30 total days of bypass flows occur above 20,000 cfs as measured at Freeport. At this point, implement Level III post-pulse bypass rule (Table 3-16) so that bypass flows are sufficient to prevent upstream tidal transport at two points of control: (1) Sacramento River upstream of Sutter Slough, and (2) Sacramento River downstream of Georgiana Slough. These points of control are used to prevent upstream transport toward the proposed intakes and to prevent upstream transport into Georgiana Slough.

South Delta Channel Flows Criteria

The objectives of the south Delta channel flows criteria are to minimize take at south Delta pumps by reducing incidence and magnitude of reverse flows during critical periods for covered fish species. The south Delta channel flow criteria are based on the parameters for OMR Flows, as summarized below.

- **OMR Flows.** The criteria are derived from fish protection triggers in the USFWS and NMFS BiOps RPA Actions. The criteria are consistent with the No Action Alternative.

1 **Table 3-16. North Delta Bypass Flow Criteria: Post-Pulse Water Operations**

Level I Post-Pulse Operations			Level II Post-Pulse Operations			Level III Post-Pulse Operations		
If Sacramento River at Freeport flow is over…	But not over…	The bypass is…	If Sacramento River at Freeport flow is over…	But not over…	The bypass is…	If Sacramento River at Freeport flow is over…	But not over…	The bypass is…
October–November								
The bypass flow is the lesser of Sacramento River flow at Freeport and 7,000 cfs			The bypass flow is the lesser of Sacramento River flow at Freeport and 7,000 cfs			The bypass flow is the lesser of Sacramento River flow at Freeport and 7,000 cfs		
December–April								
0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs
5,000 cfs	15,000 cfs	Flows remaining after constant low level pumping	5,000 cfs	11,000 cfs	Flows remaining after constant low level pumping	5,000 cfs	9,000 cfs	Flows remaining after constant low level pumping
15,000 cfs	17,000 cfs	15,000 cfs plus 80% of the amount over 15,000 cfs	11,000 cfs	15,000 cfs	11,000 cfs plus 60% of the amount over 11,000 cfs	9,000 cfs	15,000 cfs	9,000 cfs plus 50% of the amount over 9,000 cfs
17,000 cfs	20,000 cfs	16,600 cfs plus 60% of the amount over 17,000 cfs	15,000 cfs	20,000 cfs	13,400 cfs plus 50% of the amount over 15,000 cfs	15,000 cfs	20,000 cfs	12,000 cfs plus 20% of the amount over 15,000 cfs
20,000 cfs	No limit	18,400 cfs plus 30% of the amount over 20,000 cfs	20,000 cfs	No limit	15,900 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	No limit	13,000 cfs plus 0% of the amount over 20,000 cfs
May								
0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs
5,000 cfs	15,000 cfs	Flows remaining after constant low level pumping	5,000 cfs	11,000 cfs	Flows remaining after constant low level pumping	5,000 cfs	9,000 cfs	Flows remaining after constant low level pumping
15,000 cfs	17,000 cfs	15,000 cfs plus 70% of the amount over 15,000 cfs	11,000 cfs	15,000 cfs	11,000 cfs plus 50% of the amount over 11,000 cfs	9,000 cfs	15,000 cfs	9,000 cfs plus 40% of the amount over 9,000 cfs

Level I Post-Pulse Operations			Level II Post-Pulse Operations			Level III Post-Pulse Operations		
If Sacramento River at Freeport flow is over…	But not over…	The bypass is…	If Sacramento River at Freeport flow is over…	But not over…	The bypass is…	If Sacramento River at Freeport flow is over…	But not over…	The bypass is…
17,000 cfs	20,000 cfs	16,400 cfs plus 50% of the amount over 17,000 cfs	15,000 cfs	20,000 cfs	13,000 cfs plus 35% of the amount over 15,000 cfs	15,000 cfs	20,000 cfs	11,400 cfs plus 20% of the amount over 15,000 cfs
20,000 cfs	No limit	17,900 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	No limit	14,750 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	No limit	12,400 cfs plus 0% of the amount over 20,000 cfs
June								
0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs
5,000 cfs	15,000 cfs	Flows remaining after constant low level pumping	5,000 cfs	11,000 cfs	Flows remaining after constant low level pumping	5,000 cfs	9,000 cfs	Flows remaining after constant low level pumping
15,000 cfs	17,000 cfs	15,000 cfs plus 60% of the amount over 15,000 cfs	11,000 cfs	15,000 cfs	11,000 cfs plus 40% of the amount over 11,000 cfs	9,000 cfs	15,000 cfs	9,000 cfs plus 30% of the amount over 9,000 cfs
17,000 cfs	20,000 cfs	16,200 cfs plus 40% of the amount over 17,000 cfs	15,000 cfs	20,000 cfs	12,600 cfs plus 20% of the amount over 15,000 cfs	15,000 cfs	20,000 cfs	10,800 cfs plus 20% of the amount over 15,000 cfs
20,000 cfs	No limit	17,400 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	No limit	13,600 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	No limit	11,800 cfs plus 0% of the amount over 20,000 cfs
July–September								
The bypass flow is the lesser of Sacramento River flow at Freeport and 5,000 cfs			The bypass flow is the lesser of Sacramento River flow at Freeport and 5,000 cfs			The bypass flow is the lesser of Sacramento River flow at Freeport and 5,000 cfs		

Table 3-17. Allowable Post-Pulse North Delta Diversions in Different Months for a Range of Sacramento River Flows at Freeport (cfs)

Months	Oct-Nov	Dec-Apr	Dec-Apr	Dec-Apr	May	May	May	Jun	Jun	Jun	Jul-Sep
Post-Pulse Level		I	II	III	I	II	III	I	II	III	
Sacramento River at Freeport Flow (cfs)		first 15 days of bypass flows greater than 20,000 cfs	second 15 days of bypass flows greater than 20,000 cfs	after 30 days of bypass flows greater than 20,000 cfs	first 15 days of bypass flows greater than 20,000 cfs	second 15 days of bypass flows greater than 20,000 cfs	after 30 days of bypass flows greater than 20,000 cfs	first 15 days of bypass flows greater than 20,000 cfs	second 15 days of bypass flows greater than 20,000 cfs	after 30 days of bypass flows greater than 20,000 cfs	
5,000	-	-	-	-	-	-	-	-	-	-	-
10,000	3,000	600	600	500	600	600	600	600	600	700	5,000
15,000	8,000	900	1,600	3,000	900	2,000	3,600	900	2,400	4,200	10,000
20,000	13,000	1,600	4,100	7,000	2,100	5,250	7,600	2,600	6,400	8,200	15,000
25,000	15,000	5,100	8,100	12,000	6,100	9,250	12,600	6,600	10,400	13,200	15,000
30,000	15,000	8,600	12,100	15,000	10,100	13,250	15,000	10,600	14,400	15,000	15,000
35,000	15,000	12,100	15,000	15,000	14,100	15,000	15,000	14,600	15,000	15,000	15,000
40,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000

Note: Low-level pumping is included in December–June estimates.

Fremont Weir and Yolo Bypass Criteria

The objectives of the Fremont Weir and Yolo Bypass criteria are based on considerations for (1) increasing the areal and temporal extent of spawning and rearing habitat for splittail and rearing habitat for salmonids for windows greater than 30 days; (2) providing an alternate migration corridor to the mainstem Sacramento River; and (3) improving habitat values and food transport in Cache Slough. The Fremont Weir and Yolo Bypass criteria use four parameters: Sacramento Weir, Lisbon Weir, Fremont Weir, and Fremont Weir Gate Operations, as summarized below.

- **Sacramento Weir.** No change in current operations. Improve upstream fish passage facilities.
- **Lisbon Weir.** No change in current operations. Improve upstream fish passage facilities.
- **Fremont Weir.** Improve fish passage by constructing an opening and installing operable gates and fish passage facilities at elevation 17.5 feet. In addition, construct a smaller opening with operable gates and fish passage enhancement at elevation 11.5 feet. While these assumptions were used for the purposes of modeling, CM2 is a programmatic element that will be further developed and analyzed in future technical and environmental reviews.
- **Fremont Weir gate operations.** From December 1 to April 30 (may be extended to May 15, depending on hydrologic conditions and measures to minimize land use and ecological conflicts), open the 17.5-foot and 11.5-foot elevation gates when Sacramento River flow at Freeport is greater than 25,000 cfs to provide local and regional flood management benefits, while coinciding with pulse flows and juvenile salmonid migration cues, and to provide seasonal floodplain inundation for salmonid food production, juvenile rearing, and spawning. This action based on modeling assumptions would cause Yolo Bypass inundation of 3,000–6,000 cfs depending on river stage.

The 17.5-foot elevation gates would be closed when Sacramento River flow at Freeport recedes to less than 20,000 cfs, but the 11.5-foot elevation gate would remain open to provide greater opportunity for fish in the Yolo Bypass to migrate upstream into the Sacramento River. The 11.5-foot elevation gates would be closed when Sacramento River flow at Freeport recedes to less than 15,000 cfs or the operational window closes.

Delta Cross Channel Gate Operations Criteria

The objectives of the Delta Cross Channel gate operations criteria, summarized below, are based on considerations to (1) reduce transport of outmigrating Sacramento River fish into the central Delta; (2) maintain flows downstream on the Sacramento River; and (3) provide sufficient Sacramento River flow into the interior Delta when water quality for municipal, industrial, and agricultural users may be of concern. For the purposes of modeling, the operational criteria for the Delta Cross Channel were assumed to be consistent with the No Action Alternative.

- **October–November.** Delta Cross Channel gates closed if fish are present (for modeling, assumed closed 15 days per month; may be longer depending upon actual presence of fish).
- **December–June.** Delta Cross Channel gates closed.
- **July–September.** Delta Cross Channel gates open.

Rio Vista Minimum Instream Flow Criteria

The objectives of the Rio Vista minimum instream flow criteria, summarized below, are to maintain minimum flows for outmigrating salmonids and smelt.

- **September through December.** Operate in accordance with State Water Board D-1641.
- **January through August.** Minimum of 3,000 cfs.

Delta Inflow and Outflow Criteria

The objectives of the Delta inflow and outflow criteria are to (1) provide sufficient outflow to maintain a desirable salinity regime downstream of Collinsville during the spring, and (2) explore a range of approaches toward providing additional variability to Delta inflow and outflow. These criteria are intended to provide the basis to operate in accordance with State Water Board D-1641, with Sacramento River inflow downstream of the proposed north Delta intakes used for the purposes of the E/I ratio.

Operations for Delta Water Quality and Residence Criteria

The objectives of the operations for Delta water quality and residence criteria, summarized below, are to (1) maintain a minimum level of pumping from the south Delta during summer to provide limited flushing to reduce residence times and improve water quality; (2) provide salinity improvements for municipal, industrial, and agricultural water users; and (3) allow operational flexibility during other periods to operate either north or south diversions based on real-time assessments of benefits to fish and water quality.

- **July–September.** Preferentially operate SWP and CVP south Delta export facilities up to 3,000 cfs of diversions before diverting from north Delta intakes.
- **October–June.** Preferentially operate north Delta intakes.

In-Delta Municipal, Industrial, and Agricultural Water Quality Requirements Criteria

The in-Delta municipal, industrial, and agricultural water quality requirements criteria would require the SWP and CVP to comply with existing agreements with water rights holders related to operations of the SWP and CVP. These requirements include water operations in accordance with State Water Board D-1641 related to north Delta and western Delta agricultural and municipal and industrial requirements, except that the Sacramento River compliance point for the agreement with the North Delta Water Agency would be moved from Emmaton to Threemile Slough. Any change in the compliance point would need to be reviewed and approved by the State Water Board.

Scenario B

Scenario B would incorporate criteria for the same elements as those referenced under Scenario A. However, under this scenario, south Delta channel flow criteria would include less negative OMR flow criteria (Tables 3-19 and 3-20), and Fall X2 criteria, as under the USFWS 2008 BiOp, would be incorporated, as would operations for Head of Old River Barrier (Table 3-20). This scenario applies to Alternatives 2A, 2B, and 2C.

North Delta Diversion Bypass Flow Criteria

The north Delta diversion bypass flow criteria under Scenario B would be the same as under Scenario A.

South Delta Channel Flows Criteria

The objectives of the south Delta channel flows criteria are to minimize take at south Delta pumps by reducing incidence and magnitude of reverse flows during critical periods for covered fish species. The south Delta channel flows criteria are based on OMR Flows and Head of Old River Barrier operations, as summarized below.

- **OMR Flows.** The criteria are derived from fish protection triggers in the USFWS and NMFS BiOps RPA Actions. It is assumed under Scenario B that the additional OMR criteria presented in Table 3-18 would be compared to the OMR criteria included in the No Action Alternative to select the greater OMR value for operations. In April, May, and June, OMR minimum allowable values would be based upon the San Joaquin River inflow relationship to OMR, as presented in Table 3-19. In October and November, OMR and south Delta export restrictions are based upon State Water Board D-1641 pulse trigger, as follows.[30]
  - Before State Water Board D-1641 pulse trigger: no OMR restrictions.
  - During State Water Board D-1641 pulse trigger: no south Delta exports.
  - Following State Water Board D-1641 pulse trigger: OMR operated up to -5,000 cfs through November.
- **Head of Old River Barrier Operations.** A permanent operable barrier would be constructed at the head of Old River, at the confluence of San Joaquin River and Old River. Scenario B assumes that all other existing agricultural barriers in the central and south Delta continue to be installed and removed seasonally. If San Joaquin River flows at Vernalis are greater than 10,000 cfs, the Head of Old River Barrier would remain open. For modeling of Scenario B, the installation and operations of the Head of Old River Barrier are assumed as summarized in Table 3-20. Beginning in January, the Head of Old River Barrier would be closed 50% if salmon fry are emigrating, which generally occurs during flood flow releases in the San Joaquin River watershed. For modeling purposes only, in November, operations are based upon State Water Board D-1641 pulse trigger, as follows.
  - Before State Water Board D-1641 pulse trigger: Head of Old River Barrier open.
  - During State Water Board D-1641 pulse trigger: Head of Old River Barrier closed.
  - Following State Water Board D-1641 pulse trigger: Head of Old River Barrier open 50% for 2 weeks.

[30] For the purposes of modeling, it was assumed that the D-1641 pulse in San Joaquin River occurs in the last 2 weeks of October.

1 **Table 3-18. Old and Middle River Flow Criteria – Scenario B**

	Combined Old and Middle River Flows to be No Less than Values Below[a] (cfs)				
Month	Wet Water Year	Above Normal Water Year	Below Normal Water Year	Dry Water Year	Critical Dry Water Year
January	0	-3,500	-4,000	-5,000	-5,000
February	0	-3,500	-4,000	-4,000	-4,000
March	0	0	-3,500	-3,500	-3,000
April	see Table 3-19	see Table 3-19	see Table 3-19	see Table 3-19	see Table 3-19
May	see Table 3-19	see Table 3-19	see Table 3-19	see Table 3-19	see Table 3-19
June	see Table 3-19	see Table 3-19	see Table 3-19	see Table 3-19	see Table 3-19
July	N/A[b]	N/A[b]	N/A[b]	N/A[b]	N/A[b]
August	N/A[b]	N/A[b]	N/A[b]	N/A[b]	N/A[b]
September	N/A[b]	N/A[b]	N/A[b]	N/A[b]	N/A[b]
October[c]	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.
November[c]	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.
December[d]	-5,000	-5,000	-5,000	-5,000	-5,000

[a] Values are monthly averages for use in modeling. Under Scenario B, the model compares these minimum allowable OMR values to 2008 USFWS BiOp RPA OMR requirements and uses the less negative flow requirement.

[b] For the purposes of modeling, it was assumed that there would be no restrictions during these months. However, the expectation is that specific additional criteria would be developed for juvenile sturgeon protection, as described in BDCP Chapter 3, Section 3.4.1.4.5, *Rapid Response Operations*.

[c] The allowable OMR varies depending on the State Water Board D-1641 pulse timing.

- Before the D-1641 pulse: Head of Old River Barrier open 50% for two weeks and OMR must be greater than or equal to -5,000 cfs.
- During the D-1641 pulse (assumed to occur October 16-31 in the modeling): Head of Old River Barrier closed and no south Delta exports.
- Following the D-1641 pulse: Head of Old River Barrier open 50% for two weeks. OMR must be greater than or equal to -5,000 cfs all of November.

[d] OMR restrictions of -5,000 cfs for Sacramento River winter-run Chinook salmon when North Delta initial pulse is triggered, or OMR restrictions of -2,000 cfs when delta smelt triggers occur.

Table 3-19. San Joaquin Inflow Relationship to Old and Middle River Flow Criteria

April and May		June	
If San Joaquin River flow at Vernalis is (cfs):	Average OMR flows would be at least the following[a] (cfs):	If San Joaquin flow at Vernalis is the following (cfs):	Average OMR flows would be at least the following[b] (cfs):
≤ 5,000	-2,000	≤ 3,500	-3,500
6,000	+1,000	3,501 to 10,000	0
10,000	+2,000		
15,000	+3,000	10,001 to 15,000	+1,000
≥30,000	+6,000	>15,000	+2,000

[a] Interpolated linearly between values.

[b] Based on a stepwise function.

Table 3-20. Head of Old River Operable Barrier Operations Criteria if San Joaquin River Flows at Vernalis are Equal to or Less Than 10,000 cfs

Month	Percent of Time Head of Old River Barrier is Open
Oct [a]	50% (except during the pulse) [a]
Nov [a]	100% (except during the post-pulse period) [a]
Dec	100%
Jan [b]	50%
Feb	50%
Mar	50%
April	50%
May	50%
Jun 1–15	50%
Jun 16–30	100%
Jul	100%
Aug	100%
Sep	100%

[a] The allowable OMR varies depending on the State Water Board D-1641 pulse timing.

- Before the D-1641 pulse: Head of Old River Barrier operation is triggered based upon State Water Board D-1641 pulse trigger. For the purposes of modeling, it was assumed that the Head of Old River Barrier is open 50% for two weeks and OMR requirement is greater than or equal to -5,000 cfs.
- During State Water Board D-1641 pulse trigger: Head of Old River Barrier closed and no south Delta exports. For the purposes of modeling, it was assumed that during the D-1641 pulse (assumed to occur October 16-31 in the modeling): Head of Old River Barrier closed and no south Delta exports.
- Following State Water Board D-1641 pulse trigger: Head of Old River Barrier open 50% for two weeks, and OMR operated up to 5,000 cfs through November. For the purposes of modeling, it was assumed that following the D-1641 pulse: Head of Old River Barrier open 50% for two weeks and OMR requirement is greater than or equal to -5,000 cfs all of November.

[b] The Head of Old River Barrier becomes operational at 50% when salmon fry are emigrating (based on real time monitoring). For the purposes of modeling, it was assumed that salmon fry are emigrating starting on January 1.

Fremont Weir and Yolo Bypass Criteria

The Fremont Weir and Yolo Bypass Criteria use four parameters: Sacramento Weir, Lisbon Weir, Fremont Weir, and Fremont Weir Gate Operations, as summarized below.

- **Sacramento Weir.** No change in current operations. Improve upstream fish passage facilities.
- **Lisbon Weir.** No change in current operations. Improve upstream fish passage facilities.
- **Fremont Weir.** Improve fish passage by constructing an opening and installing operable gates and fish passage facilities at elevation 17.5 feet. In addition, construct a smaller opening with operable gates and fish passage enhancement at elevation 11.5 feet.
- **Fremont Weir gate operations.** Operations would be consistent to those described under Scenario A.

Delta Cross Channel Gate Operations Criteria

Delta Cross Channel gates would be operated in accordance with State Water Board D-1641 with additional closures in accordance with NMFS BiOp Action IV.1.2v and closed during flushing flows between October 1–December 14 unless water quality conditions would become adverse for other beneficial uses. For the purposes of modeling, the operational criteria for the Delta Cross Channel were assumed to be consistent with the No Action Alternative.

Rio Vista Minimum Instream Flow Criteria

The Rio Vista minimum instream flow criteria under Scenario B would be the same as under Scenario A.

Delta Inflow and Outflow Criteria

- **December–August.** Delta outflow in accordance with State Water Board D-1641.
- **September–November.** Delta outflow to implement Fall X2 in accordance with the USFWS 2008 BiOp, which applies to wet and above normal water year types. The Fall X2 rule requires X2 to be at or downstream of Collinsville in above normal years and downstream of Chipps Island in wet years.

Operations for Delta Water Quality and Residence Criteria

The operations for Delta water quality and residence criteria under Scenario B would be the same as under Scenario A.

In-Delta Municipal, Industrial, and Agricultural Water Quality Requirements Criteria

The in-Delta municipal, industrial, and agricultural water quality requirements criteria under Scenario B would be the same as under Scenario A.

Scenario C

Scenario C would incorporate all the No Action rules, including the Fall X2 criteria. The north Delta intake bypass flow rules would be the same as those under Scenario A. Operational Scenario C was used in the CALSIM modeling for Alternative 5. The north Delta operations were limited because of the reduced conveyance capacity, entailing a single 3,000 cfs intake on the Sacramento River.

North Delta Diversion Bypass Flow Criteria

The north Delta diversion bypass flow criteria under Scenario C would be the same as under Scenario A.

South Delta Channel Flows Criteria

The OMR flow criteria under Scenario C would be the same as under Scenario A. The San Joaquin River inflow-south Delta export ratio under Scenario C would be assumed to be based upon San Joaquin River at Vernalis flows that limit exports in April and May in accordance with the NMFS BiOp RPA IV.2.1, as assumed in the No Action Alternative.

Fremont Weir and Yolo Bypass Criteria

The Fremont Weir and Yolo Bypass criteria under Scenario C would be the same as under Scenario A.

Delta Cross Channel Gate Operations Criteria

The Delta Cross Channel gate operations criteria under Scenario C would be the same as under Scenario A.

Rio Vista Minimum Instream Flow Criteria

The Rio Vista minimum instream flow criteria under Scenario C would be the same as under Scenario A.

Delta Inflow and Outflow Criteria

Under Scenario C, the Delta inflow and outflow criteria would be as follows.

- **December-August.** Delta outflow in accordance with State Water Board D-1641.
- **September-November.** Delta outflow to implement Fall X2 in accordance with the USFWS 2008 BiOp.

Operations for Delta Water Quality and Residence Criteria

The operations for Delta water quality and residence criteria would be the same under Scenario C as under Scenario A.

In-Delta Municipal, Industrial, and Agricultural Water Quality Requirements Criteria

The in-Delta municipal, industrial, and agricultural water quality requirements criteria under Scenario C would be the same as under Scenario A.

Scenario D

Scenario D would be similar to Scenario A, but would be modified to eliminate use of south Delta diversion points. For the SWP this means the gated intake on Old River, Clifton Court Forebay, and the Skinner Fish Facility would no longer be operated. For the CVP this means the diversion point on Old River and the Tracy Fish Collection Facility would no longer be operated. Therefore, there are no criteria related to south Delta channel flows or Delta water quality and residence time, as are included under other scenarios (e.g. preferential operation of south Delta export facilities between

July and September). This scenario would also add criteria related to Fall X2 in accordance with the USFWS BiOp. This scenario applies to Alternatives 6A, 6B, and 6C.

North Delta Diversion Bypass Flow Criteria

Under Scenario D, the north Delta diversion bypass flow criteria would be the same as under Scenario A.

Fremont Weir and Yolo Bypass Criteria

The Fremont Weir and Yolo Bypass criteria under Scenario D would be the same as under Scenario A.

Delta Cross Channel Gate Operations Criteria

The Delta Cross Channel gate operations criteria under Scenario D would be the same as under Scenario A.

Rio Vista Minimum Instream Flow Criteria

The Rio Vista minimum instream flow criteria under Scenario D would be the same as under Scenario A.

Delta Inflow and Outflow Criteria

Under Scenario D, the Delta inflow and outflow criteria would be as follows:

- **December–August.** Delta outflow in accordance with State Water Board D-1641.
- **September–November.** Delta outflow to implement Fall X2 in accordance with the USFWS 2008 BiOp.

In-Delta Municipal, Industrial, and Agricultural Water Quality Requirements Criteria

The in-Delta municipal, industrial, and agricultural water quality requirements criteria under Scenario D would be the same as under Scenario A.

Scenario E

Scenario E criteria for bypass flows, Fremont Weir gate operations, Rio Vista minimum flows, Delta outflow, and south Delta export operations would be modified from Scenario A. This scenario applies to Alternative 7.

North Delta Diversion Bypass Flow Criteria

The objectives of the north Delta diversion bypass flow criteria include regulation of diversions so that river flows (1) maintain fish screen sweeping velocities; (2) reduce upstream transport from downstream channels; (3) support salmonid and pelagic fish transport to regions of suitable habitat; (4) reduce predation effects downstream; and (5) maintain or improve rearing habitat in the north Delta.

The north Delta diversion bypass flow criteria comprise three parameters: Constant Low Flow Pumping, Initial Pulse Protection, and three levels of post-pulse operations as summarized below.

- **Constant Low Flow Pumping—December through June.** Diversions of up to 5% of river flow can occur in periods when flows are greater than 5,000 cfs, with no more than 300 cfs diverted at any one intake. While referred to as constant, pumping would vary with flows at Freeport. *Constant* refers to the percentage of river flow that could be diverted; it is not a continuous pumping level.

- **Initial Pulse Protection.** Under this concept, low-level pumping is maintained through the initial pulse period. After the pulse period has ended, water operations would return to the bypass flows presented in Table 3-16. (These parameters are for the purpose of modeling only; actual water operations would be based on real-time monitoring of fish movement as described in BDCP Chapter 3, Section 3.4.1.4.5, *Rapid Response Operations*).

  If the initial pulse period begins before December 1, May post-pulse bypass criteria would be implemented following the initial pulse period; and the second pulse period would have the same protective operation as the initial pulse period. For the purposes of modeling only, the governing bypass flow criteria for the period between the initial and second pulse was used instead of the May post-pulse bypass criteria. This results in a flow condition that is more conservative for aquatic resource impact analysis.

  For the purpose of modeling, the initiation of the pulse is defined by the following criteria: (1) increase in flow of the Sacramento River at Wilkins Slough by more than 45% within a 5-day period, and (2) Sacramento River flows greater than 12,000 cfs measured at Wilkins Slough. Low-level pumping continues until (1) Wilkins Slough returns to pre-pulse flows (flow on first day of 5-day increase); (2) Sacramento River at Wilkins Slough flows decrease for 5 consecutive days; or (3) bypass flows are greater than 20,000 cfs for 10 consecutive days. The first criteria was modeled as Wilkins Slough flow falls below 12,000 cfs. The modeling represents a more conservative approach regarding aquatic resource impact analysis.

- **Post-Pulse Water Operations.** After initial pulse(s), implement Level I post-pulse bypass rule (Table 3-16) until the occurrence of 20 total days of bypass flows above 20,000 cfs. Then implement Level II post-pulse bypass rule (Table 3-16) until 45 total days of bypass flows occur above 20,000 cfs as measured at Freeport. At this point, implement Level III post-pulse bypass rule (see Table 3-16) so that bypass flows are sufficient to prevent upstream tidal transport at two points of control: (1) Sacramento River upstream of Sutter Slough, and (2) Sacramento River downstream of Georgiana Slough. These points of control are used to prevent upstream transport toward the proposed intakes and to prevent upstream transport into Georgiana Slough.

South Delta Channel Flows Criteria

The objectives of the south Delta channel flows criteria are to minimize take at south Delta pumps by reducing incidence and magnitude of reverse flows during critical periods for covered fish species. The south Delta channel flows criteria use two parameters: OMR flows and San Joaquin River Inflow-South Delta Export Ratio, as summarized below. Under Scenario E, the south Delta channel flows criteria would be substantially different from those under Scenario A, and are as follows.

OMR Flows

- **December–March.** South Delta exports cannot cause OMR to be less than +1,000 cfs.

- **June.** South Delta exports cannot cause OMR to be less than +3,000 cfs.

- **April–May and October–November.** No exports from south Delta intake facilities.
- **San Joaquin River Inflow-South Delta Export Ratio.** This ratio would be 50% in December–March and June.

Fremont Weir and Yolo Bypass Criteria

Operations of the Sacramento and Lisbon Weirs under Scenario E would be the same as under Scenario A. The Fremont Weir and Fremont Weir gate operations under Scenario E would be as summarized below.

- **Fremont Weir.** Install operable gates at elevation 17.5 feet.
- **Fremont Weir gate operations.** From December 1 to April 30 (may be extended to May 15, depending on hydrologic conditions and measures to minimize land use and ecological conflicts), open the 17.5-foot elevation gates to provide local and regional flood management benefits, while coinciding with pulse flows and juvenile salmonid migration cues, and to provide seasonal floodplain inundation for salmonid food production, juvenile rearing, and spawning. This action would cause Yolo Bypass inundation of 3,000–8,000 cfs depending on river stage. When the river stage is at or above the existing Fremont Weir crest elevation, the notch gates are assumed to be closed. While desired inundation period is 30–45 days, duration is governed by Sacramento River flow conditions. The opening at 11.5 feet is not included in the scenario.

Delta Cross Channel Gate Operations Criteria

The Delta Cross Channel gate operations criteria under Scenario E would be the same as under Scenario A.

Rio Vista Minimum Instream Flow Criteria

The Rio Vista minimum instream flow criteria under Scenario E would be similar to Scenario A. Like Scenario A, the September through December flow criteria would be in accordance with State Water Board D-1641. However, under this scenario the January through August flows would be a minimum of 5,000 cfs.

Delta Inflow and Outflow Criteria

The Delta inflow and outflow criteria under Scenario E would be as follows.

- **December–August.** Delta outflow in accordance with State Water Board D-1641.
- **September–November.** Delta outflow to implement Fall X2 in accordance with USFWS BiOp.

Operations for Delta Water Quality and Residence Criteria

Under Scenario E, the operations for Delta water quality and residence criteria would be the same as under Scenario A.

In-Delta Municipal, Industrial, and Agricultural Water Quality Requirements Criteria

The in-Delta municipal, industrial, and agricultural water quality requirements criteria under Scenario E would be the same as under Scenario A.

Scenario F

Scenario F would be modified from Scenario E and would include specific Delta outflow criteria and cold water pool management criteria for specific reservoirs. This scenario applies only to Alternative 8.

North Delta Diversion Bypass Flow Criteria

The objectives of the north Delta diversion bypass flow criteria include regulation of diversions so that river flows (1) maintain fish screen sweeping velocities; (2) reduce upstream transport from downstream channels; (3) support salmonid and pelagic fish transport to regions of suitable habitat; (4) reduce predation effects downstream; and (5) maintain or improve rearing habitat in the north Delta.

The north Delta diversion bypass flow criteria comprise three parameters: Constant Low Flow Pumping, Initial Pulse Protection, and three levels of Post-Pulse Operations as summarized below.

- **Constant Low Flow Pumping—December through June.** Diversions of up to 5% of river flow can occur in periods when flows are greater than 5,000 cfs, with no more than 300 cfs diverted at any one intake. While referred to as constant, pumping would vary with flows at Freeport. *Constant* refers to the percentage of river flow that could be diverted; it is not a continuous pumping level.
- **Initial Pulse Protection.** Under this concept, low-level pumping is maintained through the initial pulse period. After the pulse period has ended, water operations would return to the bypass flows presented in Table 3-16. (These parameters are for the purpose of modeling only; actual water operations would be based on real-time monitoring of fish movement as described in BDCP Chapter 3, Section 3.4.1.4.5, *Rapid Response Operations*).

  If the initial pulse begins before December 1, May post-pulse bypass criteria would be implemented following the initial pulse period; and the second pulse period would have the same protective operation as the initial pulse period. For the purposes of modeling only, the governing bypass flow criteria for the period between the initial and second pulse was used instead of the May post-pulse bypass criteria. This results in a flow condition that is more conservative for aquatic resource impact analysis.

  For the purpose of modeling, the initiation of the pulse is defined by the following criteria: (1) increase in flow of the Sacramento River at Wilkins Slough by more than 45% within a 5-day period, and (2) Sacramento River flows greater than 12,000 cfs measured at Wilkins Slough. Low-level pumping continues until (1) Wilkins Slough returns to pre-pulse flows (flow on first day of 5-day increase); (2) Sacramento River at Wilkins Slough flows decrease for 5 consecutive days; or (3) bypass flows are greater than 20,000 cfs for 10 consecutive days. The first criteria was modeled as Wilkins Slough flow falls below 12,000 cfs. The modeling represents a more conservative approach regarding aquatic resource impact analysis.
- **Post-Pulse Water Operations.** After initial pulse(s), implement Level I post-pulse bypass rule (Table 3-16) until the occurrence of 20 total days of bypass flows above 20,000 cfs. Then implement Level II post-pulse bypass rule (Table 3-16) until 45 total days of bypass flows occur above 20,000 cfs as measured at Freeport. At this point, implement Level III post-pulse bypass rule (see Table 3-16) so that bypass flows are sufficient to prevent upstream tidal transport at two points of control: (1) Sacramento River upstream of Sutter Slough, and (2) Sacramento River downstream of Georgiana Slough. These points of control are used to prevent upstream

transport toward the proposed intakes and to prevent upstream transport into Georgiana Slough.

South Delta Channel Flows Criteria

The objectives of the south Delta channel flows criteria are to minimize take at south Delta pumps by reducing incidence and magnitude of reverse flows during critical periods for covered fish species. The south Delta channel flows criteria use two parameters: OMR Flows and San Joaquin River Inflow-South Delta Export Ratio, as summarized below.

OMR Flows. The OMR flow criteria would be as follows.

- **December–March.** South Delta exports cannot cause OMR to be less than +1,000 cfs.
- **June.** South Delta exports cannot cause OMR to be less than +3,000 cfs.
- **April–May and October–November.** No exports from south Delta intake facilities.
- **San Joaquin River Inflow-South Delta Export Ratio.** This ratio would be 50% in December-March and June.

Fremont Weir and Yolo Bypass Criteria

The objectives of the Fremont Weir and Yolo Bypass criteria are based on considerations for (1) increasing the areal and temporal extent of spawning and rearing habitat for splittail and rearing habitat for salmonids for windows greater than 30 days; (2) providing an alternate migration corridor to the mainstem Sacramento River; and (3) improving habitat values and food transport in Cache Slough. The Fremont Weir and Yolo Bypass Criteria use four parameters: Sacramento Weir, Lisbon Weir, Fremont Weir, and Fremont Weir Gate Operations, as summarized below.

- **Sacramento Weir.** No change in current operations. Improve upstream fish passage facilities.
- **Lisbon Weir.** No change in current operations. Improve upstream fish passage facilities.
- **Fremont Weir.** Install operable gates at elevation 17.5 feet.
- **Fremont Weir gate operations.** From December 1 to April 30 (may be extended to May 15, depending on hydrologic conditions and measures to minimize land use and ecological conflicts), open the 17.5-foot elevation gates to provide local and regional flood management benefits, while coinciding with pulse flows and juvenile salmonid migration cues, and to provide seasonal floodplain inundation for salmonid food production, juvenile rearing, and spawning. This action would cause Yolo Bypass inundation of 3,000–8,000 cfs, depending on river stage, for 30–45 days. Flows of less than 3,000 cfs through the Fremont Weir gate could be implemented if physical modifications were completed in the Yolo Bypass and along the Toe Drain to achieve desired floodplain habitat.

Delta Cross Channel Gate Operations Criteria

The objectives of the Delta Cross Channel gate operations criteria, summarized below, are based on considerations to (1) reduce transport of outmigrating Sacramento River fish into the central Delta; (2) maintain flows downstream on the Sacramento River; and (3) provide sufficient Sacramento River flow into the interior Delta when water quality for municipal, industrial, and agricultural users may be of concern. For the purposes of modeling, the operational criteria for the Delta Cross Channel were assumed to be consistent with the No Action Alternative.

- **October–November.** Delta Cross Channel gates closed if fish are present (for modeling, assumed closed 15 days per month; may be longer depending upon actual presence of fish).
- **December–June.** Delta Cross Channel gates closed.
- **July–September.** Delta Cross Channel gates open.

Rio Vista Minimum Instream Flow Criteria

The objectives of the Rio Vista minimum instream flow criteria, summarized below, are to maintain minimum flows for outmigrating salmonids and smelt.

- **September through December.** Operate in accordance with State Water Board D-1641.
- **January through August.** Minimum of 5,000 cfs.

Delta Inflow and Outflow Criteria

The objectives of the Delta inflow and outflow criteria are to (1) provide sufficient outflow to maintain a desirable salinity regime downstream of Collinsville during the spring, and (2) explore a range of approaches toward providing additional variability to Delta inflow and outflow.

- **January–June:** Delta outflow equal to the greater of 55% of Unimpaired Flow in the Sacramento River at Freeport (with an upper limit of 40,000 cfs) or State Water Board D-1641 Delta outflow requirements.
- **July–August, December.** Delta outflow in accordance with State Water Board D-1641.
- **September–November.** Delta outflow to implement Fall X2 in accordance with USFWS BiOp 2008.

In addition, during January through June months a minimum instream flow equal to the 55% of Unimpaired Flow in the Sacramento River at Freeport is maintained at Freeport, with an upper limit of 40,000 cfs. To balance SWP and CVP contributions to the Freeport requirement, a minimum requirement is applied simultaneously at the mouth of the Feather River that is a proportional amount of the 55% Unimpaired Flow at Freeport.

Cold Water Pool Storage Criteria

Storage criteria in Trinity, Shasta, and Folsom lakes and Oroville reservoir would be modified to enable more cold water pool storage. Project Storage below 75% of maximum storage would be limited to releases for environmental uses or superior water rights.

Operations for Delta Water Quality and Residence Criteria

The objectives of the operations for Delta water quality and residence criteria, summarized below, are to (1) maintain a minimum level of pumping from the south Delta during summer to provide limited flushing to reduce residence times and improve water quality; (2) provide salinity improvements for municipal, industrial, and agricultural water users; and (3) allow operational flexibility during other periods to operate either north or south diversions based on real-time assessments of benefits to fish and water quality.

- **July–September.** Preferentially operate SWP and CVP south Delta export facilities up to 3,000 cfs of diversions before diverting from north Delta intakes.

- **October–June.** Preferentially operate north Delta intakes.

In-Delta Municipal, Industrial, and Agricultural Water Quality Requirements Criteria

The in-Delta municipal, industrial, and agricultural water quality requirements criteria would require the SWP and CVP to comply with existing agreements with water rights holders related to operations of the SWP and CVP. These requirements include water operations in accordance with State Water Board D-1641 related to north Delta and western Delta agricultural and municipal and industrial requirements, except that the Sacramento River compliance point for the agreement with the North Delta Water Agency would be moved from Emmaton to Threemile Slough.

Scenario G

Operations under Scenario G would be similar to those described under Scenario A, but would be modified to conform to the conveyance components of the separate corridors option. This scenario applies only to Alternative 9 and does not include new north Delta intakes. Instead, water continues to flow by gravity from the Sacramento River into two existing channels, Delta Cross Channel and Georgiana Slough. Therefore, this scenario does not include North Delta Diversion Bypass Flow Criteria and Operations for Delta Water Quality and Residence Time. Operational rules at the Delta Cross Channel and Georgiana Slough would be such that the gates would only be open under higher flow conditions. Additionally, these gates would not be overtopped during flood conditions. Additional criteria are provided for operations of operable barriers on the Mokelumne River system.

South Delta Channel Flows Criteria

OMR flow criteria under Scenario G would be the same as under Scenario A. However, the San Joaquin River inflow-south Delta export ratio would differ and would be as described below.

San Joaquin River Inflow-South Delta Export Ratio. This ratio is assumed be based upon San Joaquin River at Vernalis flows that limits exports in April and May in accordance with the NMFS BiOp, as assumed in the No Action Alternative.

Fremont Weir and Yolo Bypass Criteria

The Fremont Weir and Yolo Bypass criteria under Scenario G would be the same as under Scenario A.

Delta Cross Channel Gate Operations Criteria

The Delta Cross Channel gate operations criteria under Scenario G are summarized below.

- **Sacramento River flows at Delta Cross Channel are less than 11,000 cfs or greater than 25,000 cfs.** Delta Cross Channel gates closed.
- **Sacramento River flows at Delta Cross Channel 11,000–25,000 cfs.** Delta Cross Channel gates operated to divert up to 25% of Sacramento River flow at Delta Cross Channel.

Georgiana Slough Operations Criteria

The objectives of the Georgiana Slough gate operations would be limit flow from the Sacramento River into Georgiana Slough to less than 7,500 cfs to reduce impingement of fish onto fish screens at Georgiana Slough. Generally, flows are approximately 7,500 cfs in Georgiana Slough when flows in the Sacramento River at Georgiana Slough are approximately 45,000 cfs.

Rio Vista Minimum Instream Flow Criteria

The Rio Vista minimum instream flow criteria under Scenario G would be the same as under Scenario A.

Delta Inflow and Outflow Criteria

The Delta inflow and outflow criteria under Scenario G would be as follows.

- **December–August.** Delta outflow in accordance with State Water Board D-1641.
- **September–November.** Delta outflow to implement Fall X2 in accordance with the USFWS BiOp.

Mokelumne River Barrier Operations Criteria

The objectives of the operations for new barriers on the Mokelumne River system near the confluence with the Sacramento River and Delta Cross Channel would be to protect migrating salmonids through the Mokelumne River system.

- **January–July. Operable barriers closed and possible inclusion of fish ladders at some barriers.**
- **August–December. Operable barriers open.**

In-Delta Municipal, Industrial, and Agricultural Water Quality Requirements Criteria

The in-Delta municipal, industrial, and agricultural water quality requirements criteria under Scenario G would be the same as under Scenario A.

Operational Criteria for Additional Facilities

Under Scenario G, these facilities would be operated in accordance with the following criteria.

- An operable barrier at Threemile Slough to reduce salinity in the San Joaquin River during low Delta outflow and potentially to reduce fish movement from the Sacramento River to the San Joaquin River.
- Operable barriers along Middle River at Connection Slough, Railroad Cut, Woodward Canal, and immediately downstream of Victoria Canal to isolate Middle River from Old River. These barriers would be closed unless San Joaquin River flow is greater than 10,000 cfs.
- Intertie canal with a control gate between Clifton Court Forebay and the Tracy Fish Facility.
- Closure of the Clifton Court Forebay inlet gate from Old River.
- Closure of channel between Old River and the Tracy Fish Facility except when San Joaquin River flow is greater than 10,000 cfs. Closure would include channel modification to allow continued access to River's End Marina from Old River.
- Operable barriers along the San Joaquin separate fish movement corridor at the upstream confluence of Old River and the San Joaquin River (head of Old River), Fisherman's Cut at False River, and Franks Tract to isolate Old River (San Joaquin separate fish movement corridor) from the San Joaquin River. These barriers would be closed unless San Joaquin River flow is greater than 10,000 cfs.

- A pumping plant on the San Joaquin River at the head of Old River to convey additional flows with organic material into Old River. This plant would pump 250 cfs from downstream to upstream across the proposed operable barrier in the San Joaquin River near head of Old River unless San Joaquin River flow is greater than 10,000 cfs.
- A pumping plant on Middle River upstream of Victoria Canal to convey additional flows with lower salinity than Old River into Old River. This plant would pump 250 cfs from downstream to upstream across the proposed operable barrier in the Middle River upstream of Victoria Canal unless San Joaquin River flow is greater than 10,000 cfs. The existing temporary barrier in this location would be modified to be an operable barrier under this scenario.
- The two existing temporary barriers on the Old River and the barrier on the Grant Line Canal would be removed under this scenario.
- Passive culvert siphons would connect Victoria Canal to Clifton Court Forebay.

Scenario H

Scenario H would incorporate criteria for the same elements as those referenced under Scenario B (the south Delta components of which are also sometimes referred to as Scenario 6). However, under this scenario, Delta outflow requirements in the spring and fall would be determined by the outcome of the decision tree. This scenario consists of four possible combinations of spring and fall outflow criteria that could result from the decision tree. Although the EIR/EIS only applies this scenario to Alternative 4 (the CEQA Preferred Alternative), Scenario H could be implemented with any other project alternative in order to create a hybrid alternative within the bookends created by the entire range of alternatives addressed in the EIR/EIS. As discussed in Section 3A.10.6.3 in Appendix 3A, if such a hybrid alternative is ultimately identified, the analysis of Alternative 4 (and Scenario H) in the EIR/EIS will provide important evidence and analysis to assist the public and decision makers to determine the relative impacts of the hybrid in combination with such outflow criteria.

North Delta Diversion Bypass Flow Criteria

The north Delta diversion bypass flow criteria under Scenario H would be the same as under Scenario A.

South Delta Channel Flows Criteria

The objectives of the south Delta channel flows criteria are to minimize take at south Delta pumps by reducing incidence and magnitude of reverse flows during critical periods for covered fish species. The south Delta channel flows criteria are based on OMR Flows and Head of Old River Barrier operations, as summarized below.

- **OMR Flows.** The criteria are derived from fish protection triggers described in the USFWS and NMFS BiOps RPA Actions. It is assumed under Scenario H that the additional OMR criteria presented in Table 3-21 would be compared to the OMR criteria included in the No Action Alternative to select the greater OMR value for operations. In April, May, and June, OMR minimum allowable values would be based upon the San Joaquin River inflow relationship to

OMR, as presented in Table 3-22. In October and November, OMR and south Delta export restrictions are based upon State Water Board D-1641 pulse trigger, as follows.[31]

- Before State Water Board D-1641 pulse trigger: no OMR restrictions.
- During State Water Board D-1641 pulse trigger: no south Delta exports.
- Following State Water Board D-1641 pulse trigger: OMR operated up to -5,000 cfs through November.

- **Head of Old River Barrier Operations.** A permanent operable barrier would be constructed at the head of Old River, at the confluence of San Joaquin River and Old River. Scenario H assumes that all other existing agricultural barriers in the central and south Delta continue to be installed and removed seasonally. If San Joaquin River flows at Vernalis are greater than 10,000 cfs, the Head of Old River Barrier would remain open. For modeling of Scenario H, the installation and operations of the Head of Old River Barrier are assumed as summarized in Table 3-23. In January, the Head of Old River Barrier would be open 50% if salmon fry are immigrating, which generally occurs when flood flow releases are occurring in the San Joaquin River watershed. For modeling purposes only, in November, operations are based upon State Water Board D-1641 pulse trigger, as follows.
  - Before State Water Board D-1641 pulse trigger: Head of Old River Barrier open.
  - During State Water Board D-1641 pulse trigger: Head of Old River Barrier closed.
  - Following State Water Board D-1641 pulse trigger: Head of Old River Barrier open 50% for two weeks.

[31] For the purposes of modeling, it was assumed that the D-1641 pulse in San Joaquin River occurs in the last 2 weeks of October.

Table 3-21. Old and Middle River Flow Criteria – Scenario H

	Combined Old and Middle River Flows to be No Less than Values Below[a] (cfs)				
Month	Wet Water Year	Above Normal Water Year	Below Normal Water Year	Dry Water Year	Critical Dry Water Year
January	0	-3,500	-4,000	-5,000	-5,000
February	0	-3,500	-4,000	-4,000	-4,000
March	0	0	-3,500	-3,500	-3,000
April	see Table 3-22	see Table 3-22	see Table 3-22	see Table 3-22	see Table 3-22
May	see Table 3-22	see Table 3-22	see Table 3-22	see Table 3-22	see Table 3-22
June	see Table 3-22	see Table 3-22	see Table 3-22	see Table 3-22	see Table 3-22
July	N/A[b]	N/A[b]	N/A[b]	N/A[b]	N/A[b]
August	N/A[b]	N/A[b]	N/A[b]	N/A[b]	N/A[b]
September	N/A[b]	N/A[b]	N/A[b]	N/A[b]	N/A[b]
October[c]	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.
November[c]	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.	Based on State Water Board D-1641 pulse trigger.
December[d]	-5,000	-5,000	-5,000	-5,000	-5,000

[a] Values are monthly averages for use in modeling. Under Scenario H, the model compares these minimum allowable OMR values to 2008 USFWS BiOp RPA OMR requirements and uses the less negative requirement.

[b] For the purposes of modeling, it was assumed that there would be no restrictions during these months. However, the expectation is that specific additional criteria would be developed for juvenile sturgeon protection, as described in BDCP Chapter 3, Section 3.4.1.4.5, *Rapid Response Operations*.

[c] The allowable OMR varies depending on the State Water Board D-1641 pulse timing.

- Before the D-1641 pulse: Head of Old River Barrier open 50% for two weeks and OMR must be greater than or equal to -5,000 cfs.
- During the D-1641 pulse (assumed to occur October 16-31 in the modeling): Head of Old River Barrier closed and no south Delta exports.
- Following the D-1641 pulse: Head of Old River Barrier open 50% for two weeks. OMR must be greater than or equal to -5,000 cfs all of November.

[d] OMR restrictions of -5,000 cfs for Sacramento River winter-run Chinook salmon when North Delta initial pulse is triggered, or OMR restrictions of -2,000 cfs when delta smelt triggers occur.

Table 3-22. San Joaquin Inflow Relationship to Old and Middle River Flow Criteria

April and May		June	
If San Joaquin River flow at Vernalis is (cfs):	Average OMR flows would be at least the following[a] (cfs):	If San Joaquin flow at Vernalis is the following (cfs):	Average OMR flows would be at least the following[b] (cfs):
≤ 5,000	-2,000	≤ 3,500	-3,500
6,000	+1,000	3,501 to 10,000	0
10,000	+2,000		
15,000	+3,000	10,001 to 15,000	+1,000
≥30,000	+6,000	>15,000	+2,000

[a] Interpolated linearly between values.

[b] Based on a stepwise function.

Table 3-23. Head of Old River Operable Barrier Operations Criteria if San Joaquin River Flows at Vernalis are Equal To or Less Than 10,000 cfs

Month	Percent of Time Head of Old River Barrier is Open
Oct [a]	50% (except during the pulse) [a]
Nov [a]	100% (except during the post-pulse period) [a]
Dec	100%
Jan [b]	50%
Feb	50%
Mar	50%
April	50%
May	50%
Jun 1–15	50%
Jun 16–30	100%
Jul	100%
Aug	100%
Sep	100%

[a] The allowable OMR varies depending on the State Water Board D-1641 pulse timing.

- Before the D-1641 pulse: Head of Old River Barrier operation is triggered based upon State Water Board D-1641 pulse trigger. For the purposes of modeling, it was assumed that the Head of Old River Barrier is open 50% for two weeks and OMR requirement is greater than or equal to -5,000 cfs.
- During State Water Board D-1641 pulse trigger: Head of Old River Barrier closed and no south Delta exports. For the purposes of modeling, it was assumed that during the D-1641 pulse (assumed to occur October 16-31 in the modeling): Head of Old River Barrier closed and no south Delta exports.
- Following State Water Board D-1641 pulse trigger: Head of Old River Barrier open 50% for 2 weeks, and OMR operated up to 5,000 cfs through November. For the purposes of modeling, it was assumed that following the D-1641 pulse: Head of Old River Barrier open 50% for 2 weeks and OMR requirement is greater than or equal to -5,000 cfs all of November.

[b] The Head of Old River Barrier becomes operational at 50% when salmon fry are emigrating (based on real time monitoring). For the purposes of modeling, it was assumed that salmon fry are emigrating starting on January 1.

Fremont Weir and Yolo Bypass Criteria

The Fremont Weir and Yolo Bypass Criteria use four parameters: Sacramento Weir, Lisbon Weir, Fremont Weir, and Fremont Weir Gate Operations, as summarized below.

- **Sacramento Weir.** No change in current operations. Improve upstream fish passage facilities.
- **Lisbon Weir.** No change in current operations. Improve upstream fish passage facilities.
- **Fremont Weir.** Improve fish passage by constructing an opening and installing operable gates and fish passage facilities at elevation 17.5 feet. In addition, construct a smaller opening with operable gates and fish passage enhancement at elevation 11.5 feet.
- **Fremont Weir gate operations.** Operations would be consistent to those described under Scenario A.

Delta Cross Channel Gate Operations Criteria

Delta Cross Channel gates would be operated in accordance with State Water Board D-1641 with additional closures in accordance with NMFS BiOp Action IV.1.2v and closed during flushing flows between October 1–December 14 unless water quality conditions would become adverse for other beneficial uses. For the purposes of modeling, the operational criteria for the Delta Cross Channel were assumed to be consistent with the No Action Alternative.

Rio Vista Minimum Instream Flow Criteria

The Rio Vista minimum instream flow criteria under Scenario H would be the same as under Scenario A.

Delta Inflow and Outflow Criteria

The Delta outflow criteria under Scenario H would be determined based on monitoring and research to support decision tree outcomes that would address uncertainties about spring outflow for longfin smelt and fall outflow for delta smelt (see BDCP Chapter 3, Section 3.4.1, *Conservation Measure 1 Water Facilities and Operation*). To address these key areas of uncertainty, Scenario H includes two decision trees, one for fall outflow and one for spring outflow, that specify alternative outcomes for each criterion. For spring outflow (March through May), the decision tree outcomes include operations consistent with D-1641 standards or average monthly outflow, depending on the expected hydrologic conditions as summarized in Table 3-24. For the purposes of modeling, the hydrologic condition, as indicated by the forecasted March-May Eight-River Index, was used to determine the outflow target.

Table 3-24. March-May Average Outflow Criteria for "High Outflow" Outcome of Spring Outflow Decision Tree

Exceedance	Outflow criterion (cfs)
10%	>44,500
20%	>44,500
30%	>35,000
40%	>32,000
50%	>23,000
60%	17,200
70%	13,300
80%	11,400
90%	9,200

For fall outflow in September, October and November, the decision tree outcomes include either the existing BiOp requirements (FWS 2008) or D-1641 standards.

Decision Trees

The decision tree process is a focused form of adaptive management that will be used to determine, at the start of new operations the fall and spring, outflow criteria that are required to achieve the conservation objectives of the BDCP for delta smelt and longfin smelt and to promote the water supply objectives of the BDCP. Other BDCP-covered fish species, including salmonids and sturgeon, may also be affected by outflow. Their outflow needs will also be investigated as part of the decision tree process.

Under Scenario H, CM1 includes two decision trees, one for fall outflow and one for spring outflow, that specify potential alternative outcomes for each criterion. Because each decision tree identifies two possible outcomes, the decision trees lay out four potential outcomes in outflow criteria when the spring and fall outflow components are combined, as described in Table 3-25. These four outcomes will be aggressively investigated through the decision tree process. Project operating criteria will be subject to a new determination by the fish and wildlife agencies, consistent with the adaptive management process for the BDCP, based on best available science developed as described below, specifying what the spring and fall outflow criteria will be at the time CM1 operations begin.

Under the decision-tree process, hypotheses supporting each criterion will be tested in detail during the years before CM1 operations commence. The information gained during this period will be used to conduct a reevaluation of the initially specified criteria, based on all new scientific information, to decide what criteria will be selected for implementation at the beginning of CM1 operations. The decision-tree process will involve the following steps.

1. Clearly articulate scientific hypotheses designed to reduce uncertainty about what outflow criteria are needed to achieve the biological objectives for covered smelt species, salmonids, and sturgeon.
2. Develop and implement a science plan and data collection program based on the decision tree management alternatives to test the hypotheses and reduce uncertainties.
3. At the time CM1 operations begin, the fish and wildlife agencies identify spring and fall outflow criteria sufficient to meet the Plan's biological objectives for covered fish species.

Once CM1 operations begin, the decision-tree process will end. Thereafter, the adaptive management and monitoring program will continue as the primary process for adjusting all aspects of the conservation strategies, including spring and fall outflow operating criteria for CM1 operations for all covered species.

The Spring Outflow Decision Tree

Current science indicates that the decline in longfin smelt abundance has been a result of food web changes and reductions of winter-spring outflow from the Delta. Studies dating as far back as the 1980s suggest that the spring (March–May) outflow is an important driver of longfin smelt abundance. Investigations related to the relationship between food, flow, and longfin smelt abundance continue in many venues; meanwhile, uncertainty exists regarding the mechanism through which higher Delta outflow improves the production and survival of early life stages of longfin smelt. Results of these investigations, including those directly related to the decision-tree process, will continue to be reviewed and considered in the coming years, in making management decisions regarding the contribution of winter-spring Delta outflow to meeting the population growth and abundance objectives for longfin smelt.

The Fall Outflow Decision Tree

How fall outflow affects delta smelt abundance and habitat quality is an active area of research, and understanding of these effects is expected to improve in the coming years. That improved understanding is likely to materially affect the conservation measures developed to achieve Objective DTSM2.1 (see Section 3.3.7.1.3 in Chapter 3, *Conservation Strategy*, of the BDCP) —which concerns availability of delta smelt habitat and is defined in terms of habitat area with a specific range of salinities, turbidities, flows, and other features—and Objective DTSM1.3 — which concerns increasing delta smelt abundance through management of Fall X2. Under the USFWS BiOp (2008), it is hypothesized that the fall habitat objective will be achieved by providing fall (September–November) flows necessary to position X2 in or near Suisun Bay in wet or above-normal years. This hypothesis is currently being tested in the FLaSH studies (Delta Stewardship Council 2010), and informed by annual reviews of USFWS (2008) BiOp effectiveness (Anderson et al. 2012); it will continue to be evaluated in the decision-tree process. Alternatively, it is hypothesized that new shallow-water habitat areas created through restoration of tidal natural communities (CM4) could accomplish this objective with lower outflow during the fall. If restoration of habitat for delta smelt is successful, there may be no need to provide the fall outflows prescribed under the high-outflow scenario (Table 3-25) to meet the biological objectives for this species. Collaborative scientific research to test each of these hypotheses will be conducted before initial operations of the north Delta facility.

Evaluation of the Decision Trees in Impact Analysis

As described in the sections above, Scenario H includes two decision trees and each decision tree has two possible outcomes. When combined, there are four possible outcomes (scenarios) in outflow criteria. Because the environmental effects resulting from each of these scenarios may differ, in some resource chapters, Scenario H is divided into four scenarios, as shown Table 3-25. The range of environmental effects that could result from these four scenarios of the decision trees is then presented.

Table 3-25. Potential Outcomes for Delta Outflow under Scenario H Operations (Alternative 4)

		March–May	
		Outflows per D-1641 with adaptive management	Outflows per Table 3-24
September–November	Outflows per D-1641 with adaptive management	Scenario H1	Scenario H2
	Outflows per USFWS delta smelt BiOp for Fall X2	Scenario H3	Scenario H4

Operations for Delta Water Quality and Residence Criteria

The operations for Delta water quality and residence criteria under Scenario H would be the same as under Scenario A.

In-Delta Municipal, Industrial, and Agricultural Water Quality Requirements Criteria

The in-Delta municipal, industrial, and agricultural water quality requirements criteria under Scenario H would be the same as under Scenario A.

3.7 Environmental Commitments

As part of the project planning and environmental assessment process, DWR will incorporate certain environmental commitments and BMPs into the proposed action alternatives to avoid or minimize potential impacts. DWR will also coordinate planning, engineering, design and construction, operation, and maintenance phases of the Plan with the appropriate agencies. Environmental commitments that will be incorporated in the project are described in Appendix 3B, *Environmental Commitments*.

3.8 SWP Long-Term Water Supply Contract Amendment

DWR administers the SWP Long-term Water Contracts (Water Contracts), which are central to SWP construction, operation, and funding. In return for the state financing, construction, operation, and maintenance of the SWP facilities, the SWP water contractors contractually agree to repay all SWP capital and operating costs incurred for the water supply and fish and wildlife mitigation features. DWR annually charges its 29 SWP water agencies for costs of construction, operation, and maintenance of the SWP facilities. Various options, or funding methods, could be used separately or together to provide SWP funding for the construction, operation, and maintenance of a new conveyance facility described by any action alternative considered for the Plan or for other costs that the SWP contractors would be responsible to fund, such as mitigation for construction of the facility.

One funding method would be to use existing payment provisions of the SWP Water Contracts under which DWR would charge the SWP water agencies for the costs of the BDCP (or an alternative) conveyance facility as a project conservation facility. If SWP revenue bonds for the facility were issued, this approach by itself would suffice to provide funding. However, DWR could have interim funding needs pending issuance of revenue bonds, in which case additional funding mechanisms besides the SWP contract could be used.

As a second funding method, a separate funding mechanism or to meet interim or additional funding needs, DWR and SWP and CVP water agencies could enter into funding agreements similar to the funding agreement currently used for financing BDCP-Delta Habitat Conservation and Conveyance Program (DHCCP) planning costs.

A third method would be for DWR and the SWP water agencies to amend the SWP Water Supply Contracts to add new provisions that would modify methods for funding BDCP in a way different than would occur under the current contract. For example, the amendment could add a definition for the new conveyance facility and specific terms for its financing that may use conservation and transportation facility fees or new special fees. The amendment could identify allocation of benefits of the new conveyance facility that would be shared among contractors based on those who pay receiving the benefits attributed to BDCP.[32]

Any amendment of the Water Contracts would need to be agreed upon by DWR and the SWP contractors and could either be implemented by those willing to participate or conditioned on having all contractors participate. A consideration if all SWP contractors must participate in funding BDCP as a condition of an amendment is whether the costs to all contractors are feasible. Mechanisms to improve funding feasibility could be identified, which may require specific amendments to the contracts, or possibly be implemented through current Water Contract methods (such as exchanges or transfers of water), or possibly through separate agreements.

Water Contract amendments or new funding agreements for implementing BDCP that include provisions for allocating benefits, such as more reliable water supply, to contractors who pay for BDCP, could create the potential for redistributing SWP water south of the Delta. At this time, the potential for changes in SWP water distribution from a likely amendment or funding agreements are

[32] See SWP water agency funding agreements to pay for BDCP-DHCCP planning costs in which DWR and many SWP contractors agreed in principle that, among other things, they shall establish an agreement in principle of how the costs and benefits of the BDCP-DHCCP are to be determined and allocated. These agreements provide that: (1) if the BDCP-DHCCP is approved and implemented, then parties to the DHCCP SWP Funding Agreements or the BDCP-DHCCP Supplemental Funding Agreements who do not participate in implementation of the new conveyance will be reimbursed the funds they contributed under those agreements, and (2) if any SWP Water Contractor does not participate in implementation of the new conveyance, it shall not be entitled to any benefits provided by the new conveyance, including any new, existing, additional or incremental water supplies attributable to or made available by the BDCP-DHCCP in any given year. See section J.2 of DWR and SWP *Water Agency Agreement for Supplemental Funding For the Costs of Environmental Analysis, Planning and Design of Delta Conservation Measures, Including Delta Conveyance Options* (2012; "Agreement Funding Costs of Planning Delta Conveyance"). Furthermore, DWR and the water contractors intend that all SWP Water Supply Contractors, whether or not they were original parties to the DHCCP SWP Funding Agreements or the BDCP-DHCCP Supplemental Funding Agreements and whether or not they have withdrawn from either or both of those agreements, would be entitled to fully participate in the discussions and development of such an agreement. See section J.3 of Agreement Funding Costs of Planning Delta Conveyance.

generally considered in the analysis of Chapter 30, *Growth Inducement and Other Indirect Effects*. If the final agreements or amendments have potential to have an environmental effect not already contemplated in the BDCP EIR/EIS, DWR would prepare additional analysis. Any further analysis of potential growth-related issues associated with potential future contract amendments would be speculative at this time.

3.9 References Cited

Alee, W. C. 1931. *Animal Aggregations. A Study in General Sociology*. University of Chicago Press, Chicago, IL.

Anderson, J. J., J. A. Gore, R. T. Kneib, M. S. Lorang, J. M. Nestler, and J. Van Sickle. 2012. *Report of the 2012 Delta Science Program Independent Review Panel (IRP) on the Long-term Operations Opinions (LOO) Annual Review*. December 1.

Baxter, R., R. Breuer, L. Brown, M. Chotkowski, F. Feyrer, B. Herbold, P. Hrodey, A. Mueller-Solger, M. Nobriga, T. Sommer, and K. Souza. 2008. *Interagency Ecological Program 2008 Work Plan to Evaluate the Decline of Pelagic Species in the Upper San Francisco Estuary.* June 2. Interagency Ecological Program. Available: <http://www.science.calwater.ca.gov/pdf/ workshops/POD/2008_IEP-POD_Workplan_060208.pdf>. Accessed: June 12, 2013.

Baxter, R. R., R. Breuer, L. Brown, L. Conrad, F. Feyrer, S. Fong, K. Gehrts, L. Grimaldo, B. Herbold, P. Hrodey, A. Müller -Solger, T. Sommer, and K. Souza. 2010. *2010 Pelagic Organism Decline Work Plan and Synthesis of Results*. Interagency Ecological Program for the San Francisco Estuary, Sacramento, CA. Available: <www.water.ca.gov/iep/docs/FinalPOD2010Workplan12610.pdf>.

BDCP Steering Committee. 2007. *Conservation Strategy Options Evaluation Report*. September 17. Prepared by Science Applications International Corporation. Sacramento, CA. Available: <http://baydeltaconservationplan.com/Libraries/Dynamic_Document_Library/App_3A_Att03_ConsStrat.sflb.ashx>. Accessed: June 12, 2013.

California Department of Fish and Game. 2008. *California Aquatic Invasive Species Management Plan*. January. Available: http://www.dfg.ca.gov/invasives/plan/. Accessed: May 14, 2012.

California Department of Water Resources and State Water Project. 2012. *Water Agency Agreement for Supplemental Funding For the Costs of Environmental Analysis, Planning and Design of Delta Conservation Measures, Including Delta Conveyance Options*. SWPAO #09900S.

California State Water Resources Control Board. 2010. *Development of Flow Criteria for the Sacramento–San Joaquin Delta Ecosystem*. Prepared Pursuant to the Sacramento–San Joaquin Delta Reform Act of 2009. Sacramento, CA. Available: <http://www.waterboards.ca.gov/ waterrights/water_issues/programs/bay_delta/deltaflow/docs/final_rpt080310.pdf>. Accessed: June 12, 2013.

Delta Stewardship Council. 2010. *Fall Low Salinity Habitat (FLaSH) Studies and Adaptive Management Plan Review*. Available: <http://deltacouncil.ca.gov/science-program/fall-low-salinity-habitat-flash-studies-and-adaptive-management-plan-review-0>. Accessed: November 6, 2012.

Keeley, J. E. 1993. Assessing Suitable Sites for Grassland Restoration. In: J. E. Keeley (ed.). *Interface Between Ecology and Land Development in California*. Los Angeles, CA: Southern California Academy of Sciences. Pages 277–281.

National Marine Fisheries Service. 2009. *Biological and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project*. June 4. Long Beach, CA. Available: <http://www.swr.noaa.gov/ocap/NMFS_Biological_and_Conference_Opinion_on_the_Long-Term_Operations_of_the_CVP_and_SWP.pdf>. Accessed: June 12, 2013.

Public Service Commission of Wisconsin. 2011. *Underground Electric Transmission Lines*.

Siegel, S. W. 2007. *Starting the Discussion: Foundation Concepts and Some Initial Activities to Restore Ecosystem Functions to the California Delta*. Technical report prepared for the Delta Vision Blue Ribbon Task Force. December 14. Available: <http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v4c05a03_cwp2009.pdf>. Accessed: August 15, 2012.

Sommer, T. R., M. L. Nobriga, W. C. Harrell, W. Batham, and W. J. Kimmerer. 2001. Floodplain Rearing of Juvenile Chinook Salmon: Evidence of Enhanced Growth and Survival. *Canadian Journal of Fisheries and Aquatic Sciences* 58(2):325–333.

Sommer, T., C. Armor, R. Baxter, R. Breuer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Müller-Solger, M. Nobriga, and K. Souza. 2007. The Collapse of Pelagic Fishes in the Upper San Francisco Estuary. *Fisheries* 32:270–277.

U.S. Fish and Wildlife Service. 2008*. Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP)*. December 15. Region 8. Sacramento, CA.

Zook, B. and S. Phillips. 2012. *Uniform Minimum Protocols and Standards for Watercraft Interception Programs for Dreissenid Mussels in the Western United States (UMPS II).* Portland, OR: Pacific States Marine Fisheries Commission. Available: <http://www.aquaticnuisance.org/wordpress/wp-content/uploads/2010/01/UMPS_II_doc2_APRIL_5_2012_FINAL_final_edits.pdf>. Accessed: May 14, 2012.