CHAPTER 8. IMPLEMENTATION COSTS AND FUNDING SOURCES

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CHAPTER 8. IMPLEMENTATION COSTS AND FUNDING SOURCES

***[Note to Reviewers:** This chapter will ultimately address both estimated BDCP implementation costs and sources of funding that will be relied upon to cover these costs. This draft provides descriptions of the assumptions used to develop cost estimates associated with the implementation of the BDCP conservation measures, program administration, and other Plan related actions. Cost estimates presented in this chapter are preliminary. Cost estimates are dependent on the consultant's assumptions about how individual actions will be designed and constructed and could change significantly as these assumptions are reviewed and revised by the BDCP Steering Committee and the project applicants. Readers should note that cost estimates include budget contingencies of twenty to fifty percent due to uncertainty regarding the elements of each proposed action. The cost estimates set out in this chapter will also be adjusted as conservation measures are added, deleted, or modified and when more detailed cost information becomes available. Costs for some parts of the Conservation Strategy (e.g., the monitoring and research program) have not been estimated at this time as there is need for additional specific cost information or additional information or refinement to the actions. Section 8.11, Funding Sources and Assurances, will not be prepared until the total cost estimate has been completed, and hence funding needs can be ascertained and a funding plan developed.*

No agreement has been reached on the apportionment of funding of the various components of this plan beyond the state and federal contractors' commitment to funding the new conveyance and related mitigation costs. Substantial public and other sources of funding are expected to contribute to the cost of implementing the other elements of the Plan.

The BDCP Steering Committee members have submitted comments to various drafts of this chapter during development, which may or may not have been incorporated into this November 18, 2010 draft. While the text of this chapter is subject to change and revision as the BDCP planning process progresses, the chapter has been drafted and formatted to appear as it may in a completed draft HCP/NCCP. Although the chapter includes declarative statements (e.g., the Implementation Office will…), it is nonetheless a "working draft" that will undergo further modification based on input from the BDCP Steering Committee, state and federal agencies, and the public.]

8.1 INTRODUCTION

This chapter outlines estimates of the costs associated with implementation of the Bay Delta Conservation Plan (BDCP) over the proposed 50-year term of the Plan, including the costs related to each of its primary components. The Endangered Species Act (ESA) requires that habitat conservation plans specify "the funding that will be available to implement" conservation actions that minimize and mitigate impacts on covered species.[1] The Natural Community Conservation Planning Act (NCCPA) requires that natural community conservation plans

[1] U.S.C. section 1539(a)(2)(A)

contain "provisions that ensure adequate funding to carry out the conservation actions indentified in the Plan."[2] Based on the estimated costs for BDCP implementation, this chapter identifies the sources of funding that will be relied upon for plan implementation and the mechanisms that will be utilized to secure such funds, and describes the basis for the assurances provided by the Plan Participants that adequate funding will be available to support the implementation of the Plan.

*[**Note to Reviewers**: "Sources and assurances of funding" will be described in a subsequent draft of this chapter.]*

8.1.1 Scope and Purpose of the Cost Analysis

The BDCP identifies a range of actions that will be implemented over the term of the Plan to meet the biological goals and objectives described in the Conservation Strategy and to comply with the requirements of the federal ESA and the NCCPA. Among those actions are measures to avoid, minimize, and mitigate the effects of activities covered by the BDCP on species and natural communities addressed by the Plan and to provide for the conservation of those species. In addition, the BDCP establishes commitments of the Plan Participants to carry out an adaptive management and monitoring program for the species covered by the Plan and to take identified steps to respond to changed circumstances. The BDCP also establishes specific obligations of the Plan Participants regarding Plan implementation.

The cost analysis conducted for the BDCP quantifies both the overall cost of the BDCP and the cost of specific plan components. These estimates were used to establish the funding requirements for plan implementation over the course of a 50-year term and to guide decisions regarding the allocation of funding responsibilities among the Plan Participants.

Specifically, the analysis addresses costs related to the following components of the BDCP:

- **Conservation Measures**
  - **Water Facilities Construction and Operations.** This category covers those conservation measures related to water facilities and water operations. The costs associated with these measures include the development of new water conveyance and other water management facilities that will be located both within and around the Delta. This category also includes actions associated with the operations of both existing and new facilities. These actions were described in Chapter 3, *Conservation Strategy*.
  - **Physical Habitat Restoration and Protection.** This category includes conservation measures associated with the preservation, restoration, and protection of habitat. Specifically, the cost analysis considered actions related to the restoration of 65,000 acres of tidal wetland and associated estuarine habitat, 5,000 acres of riparian habitat, 2,000 acres of grassland, 400 acres of nontidal wetlands and associated aquatic habitat, 200 acres of vernal pool complex, up to 5,000 acres of managed wetlands,

[2] Cal. Fish and Game Code section 2820(a)(10)

and 10,000 acres of floodplain habitat; the enhancement of 20 linear miles of channel margin habitat; and the protection of existing 8,000 acres of grassland, 400 acres of nontidal wetlands, 300 acres of vernal pool complex, 400 acres of seasonal alkali wetland complex, up to 2,000 acres of managed wetlands, and up to 32,640 acres of agricultural land. The analysis also covers costs related to the mitigation of impacts to terrestrial habitat that are expected to occur as a result of certain covered activities. These measures are described in Chapter 3, *Conservation Strategy*.

- **Other Stressors.** This category covers conservation measures designed to reduce the direct and indirect adverse effects of various stressors on ecological functions, covered species, and natural communities. Such stressors include toxic contaminants and other factors affecting water quality, nonnative species, harvest, hatcheries, diversions unrelated to the State Water Project (SWP) or the Central Valley Project (CVP), predators, and migration barriers and other impediments to movement. The range of conservation measures that address other stressors are described in Chapter 3, *Conservation Strategy*.

- **Monitoring and Adaptive Management**. This category includes the start-up and on-going costs of the monitoring, research, and adaptive management programs, including expenses related to research and data collection, management, and analysis. The BDCP monitoring and adaptive management programs are described in Chapter 3, *Conservation Strategy*.

- **Changed Circumstances.** This category covers the cost of implementing measures to respond to changed circumstances. Those measures are set forth in Chapter 6, *Implementation Plan*.

- **Program Administration.** This category consists of expenditures necessary to administer the BDCP. It includes the start-up cost of establishing the BDCP Implementation Office and the ongoing costs of administration, including expenses associated with personnel, offices and other facilities, equipment, vehicles, contracted services, and other overhead and related expenses. A description of the approach to the administration of the BDCP is described in Chapter 7, *Implementation Structure*.

The cost analysis includes sections describing how funding needs were estimated for each plan component, including the assumptions and data used to determine the level and timing of funding needed over the course of plan implementation. Many of the cost estimates are based on conceptual and engineering designs for water facilities and habitat restoration projects available at the time of plan formulation.

This chapter also identifies the sources of funding to implement the BDCP and sets out assurances that adequate funding will be available to perform the terms and conditions of the Plan, consistent with the ESA and the NCCPA. Both the ESA and the NCCPA require that conservation plans include provisions that ensure adequate funding to carry out identified conservation actions. The nature of the BDCP assurances of funding for each of the primary

components of the Plan, including actions associated with conservation measures, adaptive management and monitoring, and plan administration, is described in this chapter.

8.1.2 Organization of Chapter

The remainder of this chapter is organized as follows:

- Section 8.2 describes common assumptions used to estimate BDCP implementation costs.
- Sections 8.3 to 8.7 describe the methods, data, and specific assumptions used to estimate implementation costs related to conservation measures, monitoring, research, adaptive management, plan administration, and mitigation.
- Section 8.8 provides the costs of mitigation measures identified in the BDCP EIR/EIS.
- Section 8.9 summarizes the overall implementation costs for the Plan.
- Section 8.10 provides an analysis of net costs of BDCP implementation.
- Section 8.11 identifies the sources of funding for the BDCP and describes how such funding will be assured by the Plan participants.

Appendix J, *Implementation Costs Supporting Materials* provides additional detail on the data and assumptions used to estimate costs presented in this chapter.

8.2 COMMON ASSUMPTIONS FOR COST ESTIMATION

Certain common assumptions were applied to all cost estimates developed for the BDCP. These common assumptions are described in the following subsections.

8.2.1 Cost Periods

Cost estimates are described within 5-year periods, commencing with the first year in which regulatory authorizations have been issued by the fish and wildlife agencies, and concluding at the expiration of the permit's term. The cost estimation assumes that the initial 5-year period covers 2012 to 2016 and the final 5-year period covers 2057 to 2061. Every cost estimate has a temporal dimension, reflecting when those costs are expected to be incurred over the term of the BDCP. The timing of Plan implementation costs are based on the schedule of implementation presented in Chapter 6.

8.2.2 Cost Ranges

Low and high cost estimates are presented for the habitat and other stressor conservation measures. In most cases the low and high estimates reflect different assumptions in project design and/or unit costs. In cases where this was not possible, the low is assumed to be 10 percent less than the estimated cost and the high is assumed to be 10 percent more than the estimated cost.

8.2.3 Cost Contingency

The American Association of Cost Engineers define contingency as a specific provision for unforeseeable elements of cost within the defined project scope. Cost uncertainties may result from incomplete design, unforeseen and unpredictable conditions, or uncertainties within the defined project scope. The amount of contingency will depend on the status of design, procurement, and construction; and the complexity and uncertainties of the component parts of the project. For planning studies, standard contingencies typically range from 20 and 30 percent, but may be as high as 50 percent for experimental or special conditions. Cost estimates developed for major plan elements, such as water facilities, tidal habitat creation, and Yolo Bypass improvements, include various contingencies as specific cost line items. In those cases where cost contingency has not been explicitly factored into a cost estimate, a 20 percent contingency is added.

8.2.4 Financial Assumptions

In cases where present values were calculated or capital costs were amortized, a nominal discount rate of 4.375 percent and a long-term inflation rate of 2.1 percent are assumed. The discount rate was selected to match the fiscal year (FY) 2010 rate that the U.S. Army Corps of Engineers (USACE) and the U.S. Bureau of Reclamation (USBR) are required to use for developing and evaluating proposed plans for water project plan formulation and evaluation.[3] The long-term inflation rate is based on the spread between nominal and inflation-indexed 30-year Treasury notes, as published in Appendix C of Office of Management and Budget (OMB) Circular No. A-94 (revised January 2008).

Costs are reported in constant 2010 dollars.[4] Historical costs have been converted to 2010 dollars using various price indices, including consumer price indices published by the Bureau of Labor Statistics and civil works construction cost indices published by the USACE.

8.2.5 Delta Real Estate Values

Interests in land for the purpose of physical habitat restoration actions, resource protection, and water facilities development may be obtained through the acquisition of fee title or through easement. Estimated costs of acquiring land in fee or by easement to facilitate physical habitat restoration within ROAs in the Delta are based on the per acre land values shown in Table 8-1. Estimated costs of acquiring Delta land in fee or by easement for terrestrial land conservation and water facilities construction are based on the per acre land values shown in Table 8-2. Average land values within the ROAs are expected to be lower than for the broader Delta due to differences in land use and quality.

[3] The published rate of 4.0 percent (rounded) does not include any adjustment that may be needed to show the maximum rate of change of ¼ of one percent per year. The FY 2009 rate was 4.625 percent, hence the adjusted FY 2010 rate cannot be less than 4.375 percent.

[4] This means the costs presented in this chapter have been adjusted to reflect 2010 price levels and dollar purchasing power. Adjusting costs for inflation in this way allows for a more accurate comparison of costs over time.

ROA Land Values: Existing agricultural and native vegetation land uses in each ROA were grouped into the following categories:[5] (1) field and pasture crop production, which includes pasture, hay, grain, and other field crops; (2) vegetable crop production; (3) orchard; (4) vineyard; and (5) native vegetation. Land value data published by the California Chapter of the American Society of Farm Managers and Rural Appraisers (CSFMRA 2009) was used to estimate typical land values for agricultural land uses in each ROA. Values for Cache Slough, Suisun Marsh, and Yolo Bypass ROAs were based on data for field crop land (Class II/III), vegetable crop land (Class I/II), pear orchard, vineyards, and rangeland in CSFMRA Region I, South Sutter, Western Placer, Solano and Yolo Counties. Values for Cosumnes/Mokelumne, South Delta, and West Delta ROAs were based on data for Delta cropland, cherry orchard, vineyards, and rangeland in CSFMRA Region III, San Joaquin County. For each agricultural land use, the likely ROA value was set to the average of the low and mid CSFMRA valuation. Values for native vegetation land uses were based on parcel-level county assessment data.[6] The land values shown in Table 8-1 are an acreage-weighted average value based on the mix of land uses in each ROA.

Table 8-1. ROA Land Value Assumptions

ROA	*Avg. Fee Title Value [1] ($/Acre)*
Cache Slough	$4,100
Cos./Mokelumne/East Delta	$5,600
South Delta	$5,500
Suisun Marsh	$3,600
West Delta	$3,200
Yolo Bypass	$4,200

[1] Avg. fee value is the acreage-weighted average value based on the hypothetical tidal habitat restoration footprints used to cost Conservation Measure 4 (CM4), except in the case of Yolo Bypass, where it is the acreage-weighted average value for the entire bypass.

Broader Delta Land Values: A similar procedure was used to estimate typical land values for agricultural and native vegetation land uses for the broader Delta. In the case of Delta land uses outside of the ROAs, the expected value was set to the mid-point CSFMRA value to reflect the greater extent of higher quality agricultural land that may be acquired by BDCP. Table 8-2 shows the land values for specific land use categories used to estimate the cost of land acquisition for terrestrial conservation measures and water facilities. Note that by itself Table 8-2 does not indicate the expected cost of land acquisition for terrestrial conservation measures or water facilities. For a given conservation measure, the expected cost of land acquisition depends

[5] California Department of Water Resources (DWR) land use survey data at the Detailed Analysis Unit (DAU) level were used to classify existing ROA land uses. The DWR Land and Water Use Program collects land use data and develops water use estimates used in statewide water planning. It accomplishes this by conducting surveys of agricultural, urban and environmental land uses, and developing annual estimates of land uses on a regional basis. Since 1986, DWR has compiled land use survey data into georeferenced digital maps. The smallest level of resolution for these maps is the DAU, the smallest study area used by DWR, generally defined by hydrologic features or boundaries or organized water service agencies. In the major agricultural areas, a DAU typically includes 100,000 to 300,000 acres.

[6] Parcels with assessments made between 2000 and 2009 and having at least two-thirds of their land uses classified as native vegetation were used to estimate the average value of land classified as native vegetation in the ROAs. Assessed values were adjusted using USDA's California land value index for non-irrigated farmland to reflect changes in rural land values since the time of the assessment.

upon the mix of existing land uses on the acreage that will be acquired. Those costs are presented later in this chapter.

Table 8-2. Broader Delta Land Value Assumptions

County	*$/Per Acre*					
	Native Veg.	**Field Crop**	**Truck Crop**	**Orchard**	**Vineyard**	**Rangeland**
Contra Costa	$1,500	$5,900	$5,900	$17,800	$16,800	$5,100
Sacramento	$1,500 $	7,000	$8,400 $	9,200	$20,400	$3,100
San Joaquin	$1,500	$5,900	$5,900	$17,800	$16,800	$5,100
Solano	$1,500 $	7,000	$8,400 $	9,200	$20,400	$3,100
Yolo	$1,500 $	7,000	$8,400 $	9,200	$20,400	$3,100

Easement Costs: Easement values in the Delta vary widely, depending on type of easement and restrictions placed on land use. Expressed as a percent of fee title value, surface easement costs may range between 10 and 90 percent while subsurface easements may range between 30 and 50 percent (Davis, per. comm.). For cost estimation, it was assumed surface easements would average 60 percent of fee title value and subsurface easements would average 40 percent of the fee title value.

8.2.6 Transaction Costs Associated with the Acquisition of Interests in Land

Purchases of interests in land, either through fee title or through easements, for the purpose of carrying out habitat restoration actions, ensuring the protection of resources, and undertaking construction of water facilities, are assumed to involve transactional costs in addition to the price paid for that property interest. These transaction costs are likely to consist of: (1) the cost of conducting due diligence, and (2) the cost of undertaking pre-acquisition boundary and habitat surveys. The common assumptions used for computing due diligence and pre-acquisition survey costs are set forth in Table 8-3 and Table 8-4, respectively. Transactional costs are based on the average parcel size and boundary length computed for each BDCP Conservation Zone (CZ), Restoration Opportunity Area (ROA), floodplain region, and water facility right-of-way.[7]

Table 8-3. Land Acquisition Due Diligence Cost Assumptions

Due Diligence Multiplier [1]	1.25
Appraisal Cost ($/Parcel)	$5,300
Preliminary Title Report ($/Parcel)	$530
Phase 1 Site Assessment ($/Parcel)	$6,900
Legal Description ($/Parcel)	$4,300
Boundary Survey ($/Linear Foot of Boundary)	$0.48
Monumentation ($/Linear Foot of Boundary)	$0.37

[1]Applied to the number of acquired parcels to account for the number of parcels considered for purchase but ultimately not purchased.

[7] Transaction costs assumptions based on real estate due diligence and survey costs in *Final East Contra Costa County Habitat Conservation Plan and Natural Community Conservation Plan*. Direct and indirect costs for staff and legal assistance supporting BDCP land acquisition are included as part of the BDCP Implementation Office cost estimate.

Table 8-4. Pre-Acquisition Survey Cost Assumptions

Survey Multiplier [1]	1.25
Land Cover Type Survey (hrs/100 acres)	12
Covered Species Habitat Survey (hrs/100 acres)	16
Covered Plant Habitat Survey (hrs/100 acres)	32
Covered Wildlife Survey (hrs/100 acres)	28
Contractor Cost ($/hr)	$130

[1]Applied to the number of acquired acres to account for the number of acres surveyed for purchase but ultimately not purchased.

8.2.7 Employee Salary Costs and Benefits Multiplier

Plan administration costs include salary costs (Section 8.4, *Plan Administration*). The BDCP Implementation Office will build a staff to oversee or carry out the actions outlined in the BDCP (Chapter 7, *Implementation Structure*). The salary cost estimates associated with these personnel needs are based on proposed FY 2008-09 salary scales for reference positions within various departments of the California Natural Resources Agency, as reported by the California Department of Finance.[8] While federal employees may also be involved in the BDCP Implementation Office, differences between federal and state salaries are expected to be small and inconsequential with respect to overall BDCP administrative costs.

The cost analysis includes a benefits multiplier to account for certain assumed benefits, such as paid leave, health, retirement and other employee benefits, that would be provided to employees of the BDCP Implementation Office. A benefits multiplier of 1.35 was applied to all staff salary costs associated with the BDCP Implementation Office, except in cases where the estimated staffing cost accounted for employee benefits.[9]

8.3 COST ESTIMATE FOR CONSERVATION MEASURES

This section describes the data, methods, and assumptions used to estimate the cost of implementing the BDCP conservation measures. Different costing approaches were used for different conservation measures, depending on the conceptual and engineering design and cost information available at the time of Plan formulation. The approach taken for each conservation measure and the sources of data and other information used for the analysis are described in the following subsections.

8.3.1 CM1: Water Facilities and Operation

*[**Note to Reviewers**: In the main text, the mid-point construction cost estimate is presented for the all pipeline/tunnel conveyance facility option. Because a preferred project has not been selected at this time, the preliminary cost estimate for the eastern alignment option for the conveyance facility is also presented at the end of this section. For the pipeline/tunnel alignment,*

[8] www.dof.ca.gov/budget/historical/2008-09/salaries_and_wages/index.htm

[9] The multiplier is based on average benefits paid by state and local governments as a percent of total employee compensation in 2009, as reported by the U.S. Bureau of Labor Statistics.

the mid-point estimate is the average of the Delta Habitat Conservation and Conveyance Program (DHCCP) PTO Rev. 1 September 2010 construction cost estimate and the 5RMK Independent February 2010 construction cost estimate (escalated using same percentage as DHCCP Rev. 1). Costs are in 2010 dollars. Water facility mitigation costs for non-biological resources, other than property tax revenue replacement, are still being developed and are not included in this draft of chapter 8.]

Cost estimates are presented for the following components of water facilities construction and operation:

- Design, project management, construction management;
- Intake and conveyance construction costs;
- Construction cost contingency;
- Land acquisition;
- Annual operation, maintenance, power, and capital replacement; and
- Local Property Tax and Assessment Revenue Replacement.

Facility features are summarized in Table 8-5. . The mid-point cost estimates for design, project management, construction, contingency and land acquisition are shown in Table 8-6. Operation, maintenance, power, and capital replacement costs are summarized in Table 8-7.

8.3.1.1 Design, Project Management, and Construction Management Costs

Design, project management and construction management costs are assumed to be 18 percent of construction cost. This percentage was derived from comparing historical data from previous programs.

8.3.1.2 Direct Construction Costs

Direct construction costs are based on the Conceptual Engineering Report – All Tunnel Option (now called the Pipeline/Tunnel Option), dated March 2010 as modified by Addendum in August 2010.

The Association for the Advancement of Cost Estimating (AACE International) classifies cost estimates using guidelines identified in Recommended Practice No. 17R-97. Cost estimates are generally classified using several characteristics, the most significant being level of project definition, end usage and methodology.

- **Project Definition (Primary Characteristic) -** These reports are generally considered to be at an approximately 10 percent design level. The cost estimates would therefore fall into the Class 4 or Class 3 Estimate Class.

- **End Usage (Secondary Characteristic) –** These cost estimates are expected to be used for Feasibility or Budget purposes, which would also fall into the Class 4 or Class 3 categories.
- **Methodology –** These estimates were created using a mix of Stochastic and Deterministic methods (primarily Stochastic), which indicates a Class 3 category.

The construction cost estimates developed for the Plan are considered to be in the Class 3 Estimate Class and should have an expected accuracy range of +50 percent / -25 percent.

The estimates are based on a combination of stochastic and deterministic cost estimation methodologies, but primarily stochastic.

Stochastic methodology is defined in this case as involving the probability that an activity will result in a specific cost. This involved researching similar activities from previous projects and reconciling them to the current situation (quantity, year performed, site and market conditions, etc.). These costs were then sorted and a representative unit price selected. This was done without a bottoms-up review of labor, equipment, and materials, etc. The process resulted in a database of "unit prices" that were then applied to activities in the current estimate.

Deterministic methodology is defined in this case to mean a more bottoms-up approach to estimating the cost of an activity. An activity is broken down into its component parts and each part is assigned a set of resources (labor, equipment, materials, etc.) and a production rate (x cubic yards of soil excavated per hour) and the cost is determined.

The construction cost estimates were created using a combination of unit prices developed for similar work in various locations around the United States; historical unit prices compiled over time by the DHCCP estimating staff members; average unit prices recorded by the State of California Department of Transportation in the Contract Cost Data guide; budgetary vendor pricing; and bottoms-up estimates developed specifically for portions of work by the DHCCP estimators. Unit prices were converted to 2010 dollars using United States Bureau of Reclamation (USBR) cost index charts or other methods.

For all activities that required bottoms-up (or deterministic) methods of estimation – e.g., labor, equipment and materials - resource costs were identified as follows:

- **Labor** – General prevailing wage determinations made by the Director of Industrial Relations for Northern California and Sacramento, San Joaquin, Yolo, Solano and Contra Costa counties. Employer cost as well as overhead was calculated and special shift arrangements were factored for overtime.
- **Equipment** – Project rates were developed using USACE, Region VII "Construction Equipment and Operating Expense Schedule," the State of California Department of Transportation "Labor Surcharge and Equipment Rental Rates," and quotes from Northern California equipment rental companies.

- **Materials –** Material quotes were received from various Northern California material vendors. Pumping plant equipment quotes from major national and international suppliers (pumps, valves, etc.) were used**.**

Contingencies were added to the various facility construction costs. In the case of all tunneling work, a contingency of 35 percent was added. For all other work, a contingency of 25 percent was added.

At this stage of project planning, certain assumptions were necessarily made in the creation of the estimate:

- It was assumed that land would be acquired which would be sufficient to "borrow" soil from to construct each facility (canal and forebay embankments, pumping plant pads, etc). These borrow sites will be within a 5-mile haul (one way, using off-highway equipment).
- All excess or unsuitable soil will be deposited (spoiled) within a 1-mile haul from the facility (one-way, using off-highway equipment).
- It is assumed that the soil can be dewatered effectively.
- Installation of sheet pile cofferdams is planned to occur during the allowable windows, however once cofferdams are in place, work within the cofferdam will be allowed to occur year round.
- Tunneling work may continue 24/7; all other work is expected to be performed on five-day, ten-hour shift basis with two shifts per day.
- For the Isolated Conveyance Facility (ICF) East Option, it is assumed that certain sloughs can be completely diverted to allow for complete box culvert siphon construction.

Construction Cost Decomposition: the cost estimate for each conveyance option was decomposed into a logical division of work such as river intake structures, pumping plants, conveyance pipelines, canals, culvert siphons, tunnels, bridges, utilities, forebays, controls and communications, and power supply and grid connections. Major project components were further decomposed into subcomponents which were distinguishable. Decomposition continued until a discreet activity could be identified and either "unit prices" or a detailed estimate could be applied. The following is an example of this decomposition for pumping plants:

- Intake Pumping Plants
- Intermediate Pumping Plant
    - Mobilization/Site Prep/Temporary Facilities
    - Clearing and Grubbing
    - Pumping Plant Excavation and Backfill

- Approach from Forebay
  - Excavation and Export
  - Excavation and Stockpile
  - Place Stockpiled Material as Backfill
  - Construct Concrete Approach
  - Rebar for Concrete Approach

Activity costs were then summarized at the facility level and all facility costs were summarized for a total alternative cost estimate.

Table 8-5. Summary of Intake and Conveyance Facility Features

Item	*Quantities*
Intake Capacity	15,000 CFS
Intake Pumping Plants	5 @ 3,000 CFS each
Intermediate Pumping Plant Capacity	15,000 CFS
Gravity Bypass Capacity	Up to 7,000 CFS
Installed Power Demand	210 MW
Surge Towers	5 each
Conveyance Pipeline	8 miles (twin 16 ft diameter)
Tunnels	2 ea 33 ft dia at 33.5 miles, 1 ea 29 ft dia at 5.2 miles
Canals	1 mile
Box Culvert Siphons	None
Forebay Total Acreage	1,400 acres
Existing Utilities Affected	70 primary conflicts
New Bridges	none

Estimated Privately Owned Acreage Required for Facility, Staging and Borrow Site Footprints, by Land Use and County

Surface Acreage	*Alameda/Contra Costa*	*Sacramento*	*San Joaquin*	*Yolo*
Ag – Field Crop	744	2,284	738	88
Ag – Truck Crop	0	268	368	46
Ag – Orchard	0	431	0	120
Ag – Vineyard	299	709	0	107
Semiagricultural	65	184	67	68
Urban	11	61	5	38
Native	281	384	98	177
Total Surface Acreage	1400	4,321	1276	644
Subsurface Acreage	***Alameda/Contra Costa***	***Sacramento***	***San Joaquin***	***Yolo***
Ag – Field Crop	31	354	510	
Ag – Truck Crop	28	31	13	
Ag – Orchard		113		
Ag – Vineyard		16		
Semiagricultural	7	28	17	
Urban	3	18	6	
Native	14	72	123	
Total Subsurface Acreage	83	632	669	

CFS = cubic feet per second. MW = megawatts

Table 8-6. Water Conveyance Capital Cost

Capital Cost Items	*Mid-Point Cost Estimate*[1] *(in millions)*
PM/CM/Final Design and Construction	**$9,602.1**
Contingency	$2,932.2
Total Cost of Conveyance Facility, including Contingency	**$12,534.3**
Land Acquisition	**$130.4**
Contingency $2	6.1
Total Cost of Land Acquisition, including Contingency	**$156.5**
Total Capital Costs	**$12,690.8**

[1]Mid-point construction cost estimate is the average of the DHCCP PTO Rev. 1 September 2010 construction cost estimate and the 5RMK Independent February 2010 construction cost estimate (escalated using same percentage as DHCCP Rev. 1). Estimated land acquisition costs based DHCCP Revision 7b Engineering GIS data (8/6/2010).

Table 8-7. Water Conveyance Annual Operations Cost

Annual Operations Cost Items [1]	*Mid-Point Cost Estimate* [2] *(in millions)*
SWP Power	$14.3/Yr
CVP Project Power	$3.5/Yr
Operations & Maintenance	$18.9/Yr
Capital Replacement	$45.9/Yr
Property Tax Revenue Replacement[3] $1	.9/Yr

[1]Annual SWP Power, CVP Project Power, and Operations & Maintenance costs assumed to commence by the 11th year of the permit period. Annual Capital Replacement costs assumed to commence by the 21st year of the permit period.

[2] Mid-point annual operations cost estimate is the average of the low and high DHCCP PTO Rev. 1 September 2010 operations cost estimate.

[3]While state agencies such as DWR are statutorily prohibited from making payments in lieu of taxes, recently passed legislation requires payment in lieu of taxes for land used in mitigation of new Delta conveyance facilities. The land acquisition cost estimate includes a provision for payments in lieu of taxes, but does not assign those costs to any specific party.

8.3.1.3 Land Acquisition Costs

Data from DWR land use surveys for Delta counties were combined with hypothetical facility, staging, and borrow site footprints to estimate facility land acquisition and easement requirements.[10] Land acquisition costs were estimated using the per acre fee title, surface easement, and subsurface easement cost assumptions presented in Section 8.2. Transaction costs are approximately 10 percent of fee title value and a 20 percent contingency was added to account for market uncertainties.

8.3.1.4 Facility Operation Costs

Estimated power requirements were based on simulated operations of each of the five intakes and the intermediate pumping plant using output from CALSIM II at 15 minute intervals from October 1974 through September 1991 for a total of 17 years of hydrologic record. Diversion

[10] Acreage amounts are reflective of the DHCCP Revision 7b Engineering GIS data (8/6/2010).

flows were dynamically simulated using operating rules in DSM2. Results were used to characterize typical diversion volumes during wet, normal, and dry year hydrologic conditions. Power requirements for pumping were estimated as a function of the pumping flow rate, total dynamic head, and combined efficiency of the pumps and motors. Pumping power requirements were then increased by 15 percent to account for all other project power uses (e.g. Heating, Ventilating, and Air Conditioning [HVAC], general operations and maintenance, lighting, etc.).

Annual power costs are based on a combination of Western Area Power Administration (WAPA) unit energy costs, estimates of bulk power purchased in northern California, and an estimate of CVP Project Power, with CVP Project Power supplying power for 40 percent of pumped water. The 15-minute model outputs were used to estimate on-peak and off-peak power purchases for typical diversion volumes in wet, normal, and dry year hydrologic conditions. The resulting costs for each hydrologic year were averaged to produce the average annual power cost shown in Table 8-7.[11]

General operations and maintenance (O&M) costs were based on estimated staffing requirements for facility operations and maintenance of the proposed conveyance facilities. Unit staffing costs were based on salary and wage rates, including benefits and overhead, for existing SWP operations.

In addition to general O&M and power costs, annual operating costs include contributions to a reliability and replacement fund to cover costs of major repairs and replacement of major capital equipment (e.g. pumps, motors, high voltage switchgear) over the permit period. For purposes of cost estimating, it is assumed that between $43 and $48 million is contributed to the fund annually starting in the 21st year of the permit period.

8.3.1.5 Property Tax and Assessment Revenue Replacement

New Delta conveyance facilities are required under the California Water Code to offset impacts to property tax or assessments levied by local governments or special districts.[12] Publicly available parcel-level local tax assessment data were combined with the proposed footprint of the conveyance facility to estimate potential impacts on local tax revenues. The average cost of property tax and assessment revenue replacement over the 50-year permit period for private lands acquired for conveyance was estimated to range between $1.5 and $2.3 million per year. While state agencies such as DWR are statutorily prohibited from making payments in lieu of taxes, recently passed legislation requires payment in lieu of taxes for land used in mitigation of new Delta conveyance facilities. The land acquisition cost estimate includes a provision for payments in lieu of taxes, but does not assign those costs to any specific party.

[11] Hydrologic year classifications are established by California Department of Water Resources and are primarily based on annual precipitation and unimpaired flow in the Sacramento River watershed.
[12] California Water Code Section 85088 (2009 Nov SB 1).

[Eastern Alignment Surface Canal Conveyance Option Cost Estimate]

*[**Note to Reviewers**: Because a preferred project has not been selected the preliminary cost estimate for the eastern alignment conveyance facility is presented in the following tables. Estimated construction costs from DHCCP PTO Rev. 1 September 2010 construction cost estimate, including cost of on-bank intake structures. Estimated land acquisition costs are based DHCCP Revision 7b Engineering GIS data (8/6/2010).]*

Table 8-A. Summary of Features for the East Canal Conveyance Option

Item	*East Canal Conveyance*
Intakes with Pumping Plants	*5@3,000 CFS*
Conveyance Pipeline	*5.9 miles (twin 16' diameter)*
Intermediate Pumping Plant	*15,000 CFS*
Intake Capacity	*15,000 CFS*
Canals	*40 miles*
Tunnels	*4 each (2.1 miles)*
Box Culvert Siphons	*8 each*
Forebay Total Acreage	*630 acres*
Bridges	*18 bridges*
Utilities	*150 conflicts*
Gravity Bypass	*none*
Installed Power Demand	*95 MW*
Surge Towers	*none*

Assumptions made for estimating East Canal Conveyance costs and schedule include:

- *All import borrow will be available at an average 5-mile haul using off-highway equipment.*
- *All excess dirt can be spoiled at an average 1-mile haul using off-highway equipment.*
- *No import borrow royalty payment is included.*
- *No allowance for upgrading the existing roadways and/or bridges to accommodate the required number of highway truck trips is included.*
- *The soil can be dewatered effectively.*
- *Certain sloughs can be completely diverted to allow for complete box culvert siphon construction.*
- *For construction of the North Delta Intake facility, once sheet pile cofferdams are in place, work can continue year-round in water.*
- *Work would proceed on a ten-hour day, six-days per week schedule with potentially two shifts per day. All required permits would be in place prior to start of construction.*
- *Real estate acquisition would not delay the construction schedule.*

Table 8-B. East Canal Capital Cost

Capital Cost Items	Cost Estimate [1] *(in millions)*
PM/CM/Final Design and Construction	**$6,334.2**
Contingency	$1,680.6
Total Cost of Conveyance Facility, including Contingency	**$8,014.8**
Land Acquisition	**$344.5**
Contingency $6	8.9
Total Cost of Land Acquisition, including Contingency	**$413.4**
Total Capital Costs	**$8,428.2**

[1]DHCCP PTO Rev. 1 September 2010 construction cost estimate. Includes cost for on-bank intakes. Estimated land acquisition costs based DHCCP Revision 7b Engineering GIS data (8/6/2010).

Table 8-C. East Canal Annual Operations Cost

Annual Operations Cost Items [1]	*Cost Estimate* [2] *(in millions)*
Project Power	$33.6/Yr
Operations & Maintenance	$17.9/Yr
Capital Replacement	$45.9/Yr
Property Tax Revenue Replacement[3] $2	.2/Yr

[1]Annual SWP Power, CVP Project Power, and Operations & Maintenance costs assumed to commence by the 11th year of the permit period. Annual Capital Replacement costs assumed to commence by the 21st year of the permit period.
[2]DHCCP December 2009 operations cost estimate, updated to 2010 dollars.
[3]While state agencies such as DWR are statutorily prohibited from making payments in lieu of taxes, recently passed legislation requires payment in lieu of taxes for land used in mitigation of new Delta conveyance facilities. The land acquisition cost estimate includes a provision for payments in lieu of taxes, but does not assign those costs to any specific party.

8.3.2 CM2: Yolo Bypass Fisheries Enhancements

This conservation measure provides for the implementation of physical modifications within the Yolo bypass to enhance floodplain habitat for spawning and rearing splittail and rearing habitat of juvenile Sacramento River salmonids, as described in Chapter 3, *Conservation Strategy*. The measure includes development of a Yolo Bypass Fishery Enhancement Plan (YBFEP) to determine the best approaches for achieving biological objectives. The key features of the major facilities identified in the conservation measure were used for cost estimating purposes and are summarized below.

1. **Fremont Weir Fish Ladder Replacement**. The existing Fremont Weir Denil fish ladder will be removed and replaced with new salmonid passage facilities. Specific design criteria of the ladder have not yet been determined. This facility will incorporate monitoring technologies to allow for collection of information to evaluate its efficacy at passing adult fishes.

2. **Experimental Sturgeon Ramps**. One or more experimental ramps will be constructed at the Fremont Weir to allow for the effective passage of adult sturgeon and lamprey. Specific design criteria of ramps have not yet been determined. This facility will incorporate monitoring technologies to allow for collection of information to evaluate its efficacy at passing adult fishes.

3. **Deep Fish Passage Gates and Channel**. To enhance adult fish passage through the Fremont Weir, as part of modifications to the Fremont Weir (see action #8, below), a deep fish passage notch will be cut through a much smaller section of the Fremont Weir to an elevation of 11.5 feet (NAVD88). This notch will be fitted with operable "fish passage gates" that will allow controlled flow into the Yolo Bypass. A "fish passage channel" will be excavated to convey water from the Sacramento River to the new fish passage gates, and from the fish passage gates to the Tule Canal.

4. **Stilling Basin Modification**. Modifications will be made to the existing Fremont Weir stilling basin to ensure that the basin drains sufficiently into the deep fish passage channel.

5. **Sacramento Weir Improvements**. Modifications will be made to reduce leakage at the Sacramento Weir and therefore reduce attraction of fish from the Yolo Bypass to the weir. For comparative analysis purposes, YBFEP will review the benefits and necessity of constructing fish passage facilities at the Sacramento Weir to reduce juvenile fish stranding and improve upstream adult fish passage. 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 a portion of the weir, and minor modifications to the stilling basin of the weir to ensure proper basin drainage. Specific design criteria of ramps would need to be determined. The low cost estimate assumes Sacramento Weir improvements are not needed, while the high cost estimate assumes they are.

6. **Tule Canal/Toe Drain and Lisbon Weir Improvements**. The YBFEP will include physical modifications to passage impediments, including road crossings and agricultural impoundments in the Tule Canal/Toe Drain to improve fish passage and survival. The cost estimate assumes the replacement of three existing structures at the northern end of the Tule Canal with bridges or other structures to allow adult fish passage. Lisbon Weir will be redesigned to improve fish passage while maintaining or improving water capture efficiency for irrigation.

7. **Lower Putah Creek Improvements**. The cost estimate assumes a realignment of Lower Putah Creek to improve upstream and downstream passage of Chinook salmon and steelhead in Putah Creek and floodplain habitat restoration to provide benefits for multiple species on existing public lands.

8. **Fremont Weir Modification**. The cost estimate includes engineering designs to physically modify the Fremont Weir to manage the timing, frequency, and duration of inundation of the Yolo Bypass with Sacramento River flows. It was assumed a section of the Fremont Weir will be lowered to 17.5 feet (NAVD88) and fitted with operable gates that will allow for controlled flow into the Yolo Bypass when the Sacramento River stage at the weir exceeds 17.5 feet. New flood channels would be excavated to connect the Sacramento River to the new gate structure and to connect the new gate structure to the Yolo Bypass.

9. **Yolo Bypass Modification**. Grading, removal of existing berms, levees, and water control structures, construction of berms or levees, re-working of agricultural delivery channels, and earthwork or construction of structures to reduce Tule Canal/Toe Drain channel capacities will be conducted to the extent 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. The YBFEP will include modifications that will allow water to inundate in certain areas of the bypass to maximize biological benefits and keep water away from other areas to reduce stranding of covered fish species in isolated ponds, minimize impacts to terrestrial covered species, including giant garter snake, and accommodate other existing land uses (e.g., wildlife, public, and agricultural use areas). If necessary, lands will be acquired, in fee-title and through conservation or flood easements.

10. **Westside Option**. The YBFEP will include a feasibility study and evaluation of a gated channel to provide flows into Yolo Bypass along the west side. Potential flow sources are the Sacramento River, Colusa Basin Drain or Sacramento River flows through Knights Landing Ridge Cut, or augmentation of other western tributaries. Some modification of the existing configuration of the discontinuous channels along the western edge of the Yolo Bypass may also be required. If effective at meeting biological objectives, this option could be included in the implementation of the conservation measure. The low cost estimate assumes a gated channel is not constructed. The high cost estimate assumes it is constructed.

8.3.2.1 Yolo Bypass Improvement Options

The preferred design of Yolo Bypass improvements has not been determined. For purposes of cost estimation, two alternative design options were considered. These are as follows:

- **Option 1:** *Fremont Weir and All Fish Passage Improvements*. This option includes extensive improvements to Fremont Weir, as well as improvements to Lisbon Weir, Tule Canal/Toe Drain, Lower Putah Creek, Los Rios Creek, Yolo Bypass Modification, and some improvements to Sacramento Weir (to reduce stranding juvenile fish). It may optionally include a Westside Option. The high cost estimate for this option includes an allowance for a Westside Option, while the low estimate does not.
- **Option 2:** *Sacramento Weir and Lisbon Weir, Los Rios, and Putah Fish Passage Improvements*. This option includes extensive improvements to Sacramento Weir, as well as improvements to Lisbon Weir, Tule Canal/Toe Drain, Lower Putah Creek, Los Rios Creek, and Yolo Bypass Modification, and some improvements to Fremont Weir fish passage structures to prevent stranding juvenile fish. It does not include a Westside Option.

8.3.2.2 Estimated Construction Costs

*[**Note to Reviewers:** Yolo Bypass improvement options and costs are being reviewed and may be revised by DHCCP-Engineering. It also should be noted that it may be possible to cost-share*

improvements for Fremont and Sacramento Weir with State flood agencies, which would result in a lower overall cost for this conservation measure than estimated below.]

The estimated construction costs for the two options are summarized in Table 8-8. Construction costs are based on the *Yolo Bypass Construction Cost Estimate*, dated September 14, 2010, prepared by DHCCP-Engineering. The construction cost estimates developed for the Plan are considered to be in the Class 4 Estimate Class and should have an expected accuracy range of +120 percent / -60 percent. Costs were estimated using the same cost estimation methodology used to estimate costs for Conservation Measure 1, *Water Facilities and Operations*. Low and high cost estimates for each option are presented. Costs for Option 1 are used in the BDCP cost summaries presented in Section 8.9 because this option provides a more conservative basis for Plan cost estimation.

Table 8-8. Yolo Bypass Improvement Options Construction Costs

Construction Element		***Low Cost Estimate (in millions)***	
Fac #	Description	Option 1	Option 2
1-4,8	Fremont Weir Fish Facilities	$141.4	$9.0
1-4,8	Other Civil/Site Work near Fremont Weir	$12.0	$0.0
1-4, 6, 8	Other Civil/Site Work for Fremont Weir	$20.0	$0.0
5 Sacram	ento Weir $4	7.6	$192.7
6 Li	sbon Weir	$23.3	$23.3
6	Los Rios Check Structure	$16.8	$16.8
7	Putah Creek - Gate Structure	$16.8	$16.8
7	Putah Creek Realignment	$6.6	$6.6
10 West	side Option	$0.0	$0.0
	Total Direct Cost	$284.6	$265.3
	Planning, Preliminary Engineering & Permitting at 8%	$22.8	$21.2
	Contingency at 50%	$142.3	$132.6
Su	btotal	$449.6	$419.1
	PM/CM/Final Design at 18%	$76.8	$71.6
	Total Construction Cost, including Contingency	$526.4	$490.8
Construction Element		***High Cost Estimate (in millions)***	
Fac #	Description	Option 1	Option 2
1-4,8	Fremont Weir Fish Facilities	$168.6	$9.0
1-4,8	Other Civil/Site Work near Fremont Weir	$41.4	$0.0
1-4, 6, 8	Other Civil/Site Work for Fremont Weir	$20.0	$0.0
5 Sacram	ento Weir $4	7.6	$192.7
6 Li	sbon Weir	$23.3	$23.3
6	Los Rios Check Structure	$16.8	$16.8
7	Putah Creek - Gate Structure	$16.8	$16.8
7	Putah Creek Realignment	$16.7	$16.7
10 West	side Option	$58.3	$0.0
	Total Direct Cost	$435.3	$275.3
	Planning, Preliminary Engineering & Permitting at 8%	$168.6	$22.0
	Contingency at 50%	$41.4	$137.7
Su	btotal	$687.8	$435.0
	PM/CM/Final Design at 18%	$168.6	$74.3
	Total Construction Cost, including Contingency	$805.3	$509.4

8.3.2.3 Estimated Costs for Flowage and Levee Easements

Flowage easement costs are expected to depend on the incremental changes in flood frequency and duration in the bypass. Bypass acreage was categorized as minimally, moderately, or significantly impacted by incremental flows caused by the weir and other modifications to the bypass. Flowage easements on minimally impacted acreage were assumed to cost 12.5 percent of fee value. Flowage easements on moderately impacted acreage were assumed to cost 25 percent of fee value. Flowage easements on significantly impacted acreage were assumed to cost 37.5 percent of fee value. The fee values for Yolo Bypass described in Section 8.2 were used to calculate easement costs.

The low cost estimate assumed new flowage easements would be required for 21,500 acres within the eastern part of the bypass.[13] It assumed one-third of this acreage would be minimally impacted, one-third moderately impacted, and one-third significantly impacted.

The high cost estimate assumed western tributary flows would cause land within the central and western part of the bypass to also be affected. The high cost estimate assumed new flowage easements would be required for up to 48,000 acres.[14] It assumed 42.5 percent of this acreage would be minimally impacted, 42.5 percent moderately impacted, and 15 percent significantly impacted.[15]

A lump sum allowance of $5 million for levee easements to offset land encroachments for levee widening and other levee modifications to address potential scour and underseepage was also added to the estimate.

Estimated costs for flowage and levee easements are summarized in Table 8-9.

Table 8-9. Yolo Bypass Flowage and Levee Easement Costs

Cost Items	*Low Estimate (in millions)*	*High Estimate (in millions)*
Flowage Easements		
Affected Acreage	21,500	48,000
Easement Cost	**$25.1**	**$48.0**
Contingency at 20%	$5.0 $9	.6
Easement Cost, including Contingency	**$30.1**	**$57.6**
Allowance for Levee Easements	**$5.0**	**$5.0**
Total Easement Cost	**$35.1**	**$62.6**

[13] This is based on the estimated extent of flooded acreage given a flow of 6000 cfs over Fremont Weir, per Table 2 of *Technical Study #2: Evaluation of North Delta Migration Corridors: Yolo Bypass*, Updated April 2009.

[14] The estimated extent of flooded acreage under very high Fremont Weir flows, per Table 3 of *Technical Study #2: Evaluation of North Delta Migration Corridors: Yolo Bypass*, Updated April 2009, is used as a proxy of the amount of potentially impacted acreage.

[15] Percentages were calculated by assuming the same distribution of impacted acreage within the eastern part of the bypass as the low cost estimate, and that half the additional 26,500 acres impacted within the central and western parts of the bypass would be minimally impacted, and half would be moderately impacted.

8.3.3 CM3: Natural Communities Protection

This conservation measure provides for the establishment of a preserve system to protect and enhance areas of existing natural communities and covered species habitat, protect and maintain occurrences of selected plant species with very limited distributions, provide sites suitable for restoration of natural communities and covered species habitat, and provide habitat connectivity among the various BDCP conservation land units in the preserve system. Costs were estimated for land acquisition, habitat creation, and nonnative weed control during the plant establishment period.

Land acquisition costs are based on the Terrestrial Habitat Restoration Land Base Requirements (SAIC, 2010). The assumed schedule of land acquisition is shown in Table 8-10. Assumptions for land acquisition and habitat construction cost by type of terrestrial habitat are as follows:

- *Vernal Pool Complex Terrain* – Land acquisition costs are based on acquiring fee-title interest in 300 acres of rangeland in the Conservation Zones listed in Table 8-10. Land costs are based on the land value assumptions presented in Section 8.2 and include allowances for transaction costs and contingency. Vernal pool habitat construction costs are based on costs for comparable restoration projects occurring in and around the Delta (Gause, per. comm.). Costs for vernal pool creation were estimated to range between $25,000 and $40,000 per acre of pool built. Vernal pools were assumed to occupy 45 acres, or 15 percent, of the 300 acre vernal pool complex. The other 255 acres were assumed to be supporting grassland habitat. Costs for grassland habitat restoration were estimated to range between $1,000 to $1,400 per acre. Ten to 20 percent of complex acreage is expected to require weed management each year during the establishment period. Weed management costs were estimated to range between $150 and $500 per treated acre, depending on type of management protocol.
- *Alkali Seasonal Wetland Complex* – Costs are based on acquiring fee-title interest in 400 acres of rangeland in the Conservation Zones listed in Table 8-10 to preserve existing alkali seasonal wetland complex. Land costs are based on the land value assumptions presented in Section 8.2 and include allowances for transaction costs and contingency.
- *Grassland* – Land acquisition costs are based on acquiring fee-title interest in 8,000 acres of rangeland in the Conservation Zones listed in Table 8-10. Land costs are based on the land value assumptions presented in Section 8.2 and include allowances for transaction costs and contingency. Costs for grassland habitat restoration were estimated to range between $1,000 to $1,400 per acre (Gause, per. comm.). It was assumed weed management would be required during the habitat establishment period at a cost of $200 to $400 per acre, depending on type of management protocol (Gause, per. comm.).
- *Cultivated (ag) Habitat* – Costs are based on acquiring fee-title interest in approximately 9,800 acres and securing conservation easements on an additional 22,800 acres of agricultural lands in the Conservation Zones listed in Table 8-10. Fee-title and easement

costs are based on the land value assumptions presented in Section 8.2 and include allowances for transaction costs and contingency.

Estimated costs to preserve natural communities are summarized in Table 8-11.

Table 8-10. Land Acquisition Schedule for CM3 Preserve System

Vernal Pool Complex Terrain											
Conservation Zone	**Acres Acquired by Period**										***Total Acreage***
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
1	44	23	31	16							114
8	43		31	17							91
11	44	20	31								95
Total	131	43	93	33	0 0		0 0 0			0	300
Alkali Seasonal Wetland Complex											
Conservation Zone	**Acres Acquired by Period**										***Total Acreage***
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
1	10		89	50							149
8	5	8	89								102
11	10		89	50							149
Total	25	8	267	100	0 0		0 0 0			0	400
Grassland											
Conservation Zone	**Acres Acquired by Period**										***Total Acreage***
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
1	500		443	500 7	50 7	44	900	1,000			4,837
8	1,000		307								1,307
11	500		250	500 2	50 2	56	100				1,856
Total	2,000	0	1,000	1,000 1	,000 1	,000	1,000 1	,000	0	0	8,000
Agricultural Lands											
Conservation Zone	**Acres Acquired by Period**										***Total Acreage***
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
1	473	481 3	08	308 3	09 3	09	309 3	08			2,805
2	1,720	1,752 1	,123	1,123 1	,123 1	,123	1,123 1	,123			10,210
4	1,654	1,684 1	,079	1,079 1	,079 1	,080	1,080 1	,080			9,815
7	1,653	1,683 1	,079	1,079 1	,079 1	,079	1,079 1	,079			9,810
Total	5,500	5,600 3	,589	3,589 3	,590 3	,591	3,591 3	,590	0	0	32,640

Table 8-11. Estimated Costs to Establish Natural Communities Land Preserve

Land Acquisition		*Estimated Cost (in millions)*
Vernal Pool Complex		$1.0
Alkali Seasonal Wetland Complex		$1.4
Grassland Complex		$35.7
Cultivated Habitat		$259.8
Subtotal Land Acquisition		**$297.9**
Contingency at 20%		*$59.6*
Land Acquisition, including contingency		**$357.5**
Habitat Construction	***Low Estimate (in millions)***	***High Estimate (in millions)***
Vernal Pool Complex	$1.4	$2.3
Grassland Complex	$14.4	$24.0
Subtotal Habitat Creation	**$15.8**	**$26.3**
Contingency at 20%	*$3.2*	*$5.3*
Construction Cost, including contingency	**$19.0**	**$31.6**
Total Cost to Create Preserve System	**$376.5**	**$389.1**

8.3.3.1 Property Tax and Assessment Revenue Replacement

Foregone property tax and assessments levied by local governments or special districts on private lands converted to terrestrial habitat will be offset by the BDCP. The annual cost of these offsets was estimated to range between three-quarters and one percent of the estimated market value of the converted private acreage.[16] The average cost of property tax and assessment revenue replacement over the 50-year permit period for private lands converted for the preservation of natural communities was estimated to range between $0.6 and $0.8 million per year. While state agencies such as DWR are statutorily prohibited from making payments in lieu of taxes, recently passed legislation requires payment in lieu of taxes for land used in mitigation of new Delta conveyance facilities. The land acquisition cost estimate includes a provision for payments in lieu of taxes, but does not assign those costs to any specific party.

8.3.4 CM4: Tidal Habitat Restoration

Tidal habitat restoration cost estimates are based on the extent and location of hypothetical tidal habitat restoration footprints for the near-term (Plan Year 10), early long-term (Plan Year 15), and late long-term (Plan Year 40) time periods. Table 8-12 shows the amount to tidal restoration that was assumed to have occurred by the end of each plan phase.[17] Chapter 5, *Effects Analysis*, provides a description of how the hypothetical habitat restoration designs were developed. This section presents the estimated costs for tidal habitat land acquisition, county tax revenue replacement, and habitat construction.

[16] Property tax and assessment burdens on parcels within the conveyance facility footprint were calculated to determine the average tax and assessment burden as a percent of estimated market value. Annual burden rates varied by county, but generally ranged between 0.75 and 1.0 percent of estimated market value, which is used to estimate forgone tax and assessment revenue for land converted to tidal and terrestrial habitat.
[17] The acreage foot prints were derived from RMA modeling conducted for the BDCP effects analysis.

Table 8-12. Tidal Habitat Restoration Acreage

Plan Phase	*Acres*	*Cumulative Acres*
Near-Term (Plan Year 10)	14,000	14,000
Early Long-Term (Plan Year 15)	11,000	25,000
Late Long-Term (Plan Year 40)	40,000	65,000

8.3.4.1 Tidal Habitat Restoration Land Acquisition Costs

Spatial data from DWR land use surveys, county parcel maps, and the tidal habitat footprints were combined to determine the number of parcels and amount of acreage by land use classification that would need to be acquired in each ROA.[18] Costs for land acquisition were calculated by multiplying this acreage by the average ROA land values listed in Table 8-1. Estimated transaction costs and contingency were then added to the estimate. Land acquisition costs for tidal habitat are summarized in Table 8-13.

Table 8-13. Tidal Habitat Land Acquisition Costs

ROA	*Estimated Cost (in millions)*
Cache Slough	$106.6
Cosumnes/Mokelumne $2	1.9
South Delta	$151.2
Suisun Marsh	$31.9
West Delta	$10.4
Subtotal Land Acquisition	**$322.1**
Contingency at 20%	*$64.4*
Land Acquisition, including contingency	**$386.5**

8.3.4.2 Property Tax and Assessment Revenue Replacement

Foregone property tax and assessments levied by local governments or special districts on private lands converted to tidal habitat will be offset by the BDCP. The annual cost of these offsets was estimated to range between three-quarters and one percent of the estimated market value of the converted private acreage.[19] The average cost of property tax and assessment revenue replacement over the 50-year permit period for private lands converted to tidal habitat was estimated to range between $1.3 and $1.8 million per year. While state agencies such as DWR are statutorily prohibited from making payments in lieu of taxes, recently passed legislation requires payment in lieu of taxes for land used in mitigation of new Delta conveyance facilities. The land acquisition cost estimate includes a provision for payments in lieu of taxes, but does not assign those costs to any specific party.

[18] Parcels were counted only if at least 10 percent of their acreage was included in the footprint in order to avoid counting parcels just touching the footprint or having very little acreage in it.

[19] Property tax and assessment burdens on parcels within the conveyance facility footprint were calculated to determine the average tax and assessment burden as a percent of estimated market value. Annual burden rates varied by county, but generally ranged between 0.75 and 1.0 percent of estimated market value, which is used to estimate forgone tax and assessment revenue for land converted to tidal and terrestrial habitat.

8.3.4.3 Tidal Habitat Construction Cost Estimates

Tidal habitat restoration will involve a broad range of construction activities, as described in Chapter 3, *Conservation Strategy*. Mass grading and construction of temporary and permanent flood-protection levees will account for most of the construction cost. Low and high construction cost estimates were developed, which differ in terms of the extent of mass grading necessary. Two scenarios were assessed because the extent to which surface grading will be used to adjust the mix of intertidal (mainly marsh plain) and subtidal (mainly estuarine aquatic) habitat has not been determined. The estimated intertidal and subtidal habitat acreages for the low and high cost scenarios are summarized in Table 8-14. Acreages in the table are based on the hypothetical tidal habitat footprint and phasing assumptions used for the effects analysis, with minor modifications in the West Delta ROA.[20]

Table 8-14. Tidal Habitat Restoration Area Estimates by Scenario

	Habitat Area (acres)			
	Tidal Marsh	**Subtidal**	**Other**	**Total**
Low Cost Estimate	14,500	33,000	17,500	65,000
High Cost Estimate	29,000	26,500	9,500	65,000

The acreage footprints are derived from hydrodynamic modeling for a July 2002 base period. Tidal habitat is defined as the area between mean lower low water (MLLW) and mean higher high water (MHHW). Subtidal habitat is defined as the area below MLLW. Other habitat includes areas which are currently within intertidal elevations, but would be above high tides, based on the modeling predictions, once restoration is complete. The tidal ranges and associated acreages shown in the table do not account for long-term forecasts of sea level rise.

Large areas within the ROAs have subsided to a degree that natural sedimentation processes alone will not increase intertidal elevations to levels necessary to support the establishment of vegetation. To establish suitable elevations for intertidal marsh restoration, fill will need to be placed (mechanically or hydraulically) in subsided areas or biomass accumulation (also referred to as subsidence reversal) will need to occur prior to levee breaching. Because the extent to which grading will be needed to achieve the desired mix of intertidal and subtidal habitat has not been determined, cost estimates were developed for two conceptual mass grading scenarios. For each scenario, fill settlement has been taken into account in the volume calculations as a function of fill height and approximate depth of underlying peat soils.

The low cost grading scenario assumes 4.9 million cubic yards (MCY) of fill placement would be used to raise grades to suitable intertidal marsh elevations in parts of the West Delta ROA. The high cost grading scenario assumes an additional 13.7 MCY of grading and fill placement would be used to expand the intertidal area in the West Delta, Cache Slough, South Delta, and Cosumnes-Mokelumne ROAs.

Cost estimates were based on the following mass grading assumptions for each ROA.[21]

[20] Due to substantial fill and grading requirements in the West Delta ROA under the original hypothetical footprint, the footprint assumed for the cost analysis was reconfigured slightly to avoid tidal habitat construction in the most subsided parts of the ROA.

[21] It should be noted that alternative methods for converting subtidal habitat to intertidal marsh, such as bioaccumulation (subsidence reversal) and more extensive dredged material fill placement, have not been included in the cost estimates. Bioaccumulation involves planting and

Suisun Marsh: The cost estimate assumed no mass grading would be required. Suisun Marsh has a relatively high potential for estuarine deposition to raise elevations from subtidal to intertidal compared to the Delta ROAs. In addition, because of the regional geomorphic setting of Suisun Marsh, the tide signal is not expected to be as compressed as modeled in the long term, resulting in a relatively high extent of intertidal habitat area created without fill placement.

West Delta: The low cost scenario assumed restoration areas on subsided West Delta islands would be filled with hydraulically-placed dredged material to create a mix of approximately 20 percent intertidal and 80 percent subtidal habitat in all except the most deeply subsided areas (deeper than approximately 9 feet below mean low low-water (MLLW). The high cost scenario assumed these same restoration areas would be filled to create 100 percent intertidal habitat, again with the exception of the most deeply subsided areas. Both cost scenarios assumed the Dutch Slough site mass grading would consist of land-based fill placement (from local borrow and the Ironhouse Sanitary parcel), per the current DWR restoration plan (PWA 2006). Both scenarios assumed existing artificial fill above intertidal elevations would be removed at no cost to the project. West Delta fill costs were based on estimated costs of placing dredged material and the planning-level cost estimate for Dutch Slough.

Cache Slough, South Delta, and Cosumnes-Mokelumne: For these ROAs, the low cost scenario assumed no mass grading is required. The high cost scenario assumed some land-based cut and fill. To estimate the volume of fill required, it was assumed that lands with elevations up to one foot above mean high high-water (MHHW) would be lowered to the MHHW elevation. The cut material would then be placed in shallow subtidal areas to raise them up to the MLLW elevation. Additionally, mass grading costs for the Cache Slough ROA are based on the assumption that earthmoving would be phased over several decades, requiring interim stockpiling of fill material on one or more parcels. Cut and fill areas were broadly categorized based on anticipated haul distances, and the need for interim stockpiling. Unit costs for grading and fill were based on grading and fill costs for a sample of regional tidal marsh restoration projects.

Flood protection levees would be necessary to protect adjacent developed and other lands that have not been protected for tidal habitat restoration. Levee cost estimates were based on a total of 44 miles of permanent levees along the upland edges of the ROAs, 32 miles of permanent levees on subsided areas in the interiors of the ROAs, and 50 miles of temporary levees that would need to be breached or removed as restoration progresses. Estimated levee heights and unit volumes for each type of levee, by ROA, are shown in Table 8-15.

controlled flooding of marsh vegetation (e.g., tules, cattails) to allow for the accumulation of organic material over time to increase surface elevations. Allowing bioaccumulation to occur over a period of 20-30 years prior to breaching could increase grades by approximately three feet relative to the tides, assuming an accretion rate of one foot every six years. Bioaccumulation is most applicable to late long term restoration actions because of the time needed to increase surface elevations. To use this approach, the rate of land acquisition set out in the BDCP would need to be accelerated to provide sufficient opportunities for bioaccumulation to occur.

Table 8-15. Estimated Levee Heights and Unit Volumes by ROA

ROA	*FEMA Base Flood Elevation (ft NAVD)*	*Temporary Levees*		*Permanent Levee (subsided areas)*		*Permanent Levee (upland edge)*	
		Total Height* (ft)	**Unit Volume (cy/lf)**	**Total Height* (ft)**	**Unit Volume (cy/lf)**	**Total Height* (ft)**	**Unit Volume (cy/lf)**
Cache Slough	17.0	19.8	62.4			12.1	26.3
Suisun Marsh	10.0	10.8	21.4	9.3	16.7	-	-
Cosumnes-Mokelumne 20	.0	-	-	22.5	79.0	-	-
West Delta	9.0	-	-	18.0-26.0	53-105	-	-
South Delta	14.0			20.2	64.9	10.7	21.2

* Total levee height includes allowance for settlement, future sea level rise, and freeboard.

The typical levee height for permanent levees was calculated as the difference between the Federal Emergency Management Agency (FEMA) 100-year flood elevation and a typical ground elevation, plus an allowance for settlement, freeboard and future sea level rise. Typical ground elevation was estimated by ROA and by levee type. Settlement was estimated for each levee type within an ROA as a function of levee height and approximate depth of underlying peat soils. A crest width of 16 feet was assumed for all levees, with average side slopes of 5:1 and 2:1 (horizontal:vertical) on the outboard and inboard sides, respectively.

Unit costs were derived from per cubic yard costs based on similar constructed projects. Unit costs ranging from $5 to $30 per cubic yard, depending on anticipated soil strength and distance of fill material source, were applied. It was assumed that the fill necessary for levee construction would be obtained from sources within the ROA. For island levees, it was assumed that material would be imported from offsite locations by barge and conveyor system.

A unit cost of $3,600 per acre was applied to the acreages shown in Table 8-14 to account for restoration elements other than mass grading and flood protection levees. This unit cost is based on costs for typical, large-scale tidal marsh restorations that have been completed (or are in final stages of design) in the San Francisco Bay: Napa Salt Ponds, South Bay Salt Ponds (multiple sites), Eden Landing Ecological Reserve, Bahia Wetlands, Petaluma Marsh, Cooley Landing, Outer Bair Island and Blacklock Marsh (Suisun Bay). Projects located in San Francisco Bay were used as analogues because of the lack of large-scale tidal habitat restoration projects within the Delta to serve as reference sites.

There are several challenges and limitations associated with estimating construction costs for the tidal habitat restoration. Consequently, estimates of construction costs and of the expected outcomes regarding the extent of habitat acreages created may ultimately be low or high. The uncertainties potentially affecting cost estimates are largely related to the following factors:

- Few, if any, examples of large-scale, planned tidal habitat restoration projects exist in the Delta to serve as reference sites.
- Flexible restoration footprints within the ROAs.
- Flexible sequencing of restoration projects.

- Future determinations regarding desired mix of intertidal marsh and subtidal habitat and therefore relative emphasis on using mass grading and fill to expand intertidal areas.
- Future evaluation of site specific features (e.g., utilities), conditions (e.g., weak soils, degraded levees), and adjacent land uses that may require additional design effort and construction costs.
- Future assessment of actual (versus modeled) changes to tide range over time due to phased restoration actions, geomorphic evolution, and sea level rise.

Each restoration site will have its own unique characteristics, causing actual construction costs to differ from the estimates set out in this chapter. Factors that may affect actual costs include: relocation of existing utilities, improvements necessary for site access, and accommodation for a phased approach to construction. The precise cost of restoration projects will not be known until site-specific designs are completed. A 35 percent contingency was applied to estimated construction costs to account for these unknowns.

Low and high construction cost estimates for tidal habitat restoration are summarized in Table 8-16.

Table 8-16. Total Construction Costs for Tidal Habitat Restoration

Construction Costs	*Low Estimate (in millions)*	*High Estimate (in millions)*
Restoration Costs	$232.2	$235.7
Mass Grading Costs	$36.0	$234.5
Long-term Levee Costs	$307.7	$307.7
Temporary Levee Costs	$241.0	$241.0
Subtotal Construction Costs	**$816.9**	**$1,018.9**
Contingency at 35%	*$285.9*	*$356.6*
Total Construction Costs	**$1,102.9**	**$1,375.5**
Related Costs		
Permitting, Survey & Design at 20%	$220.6	$275.3
Construction Administration at 7%	$77.2	$96.3
Vegetation Establishment at 3%	$33.1 $4	1.3
Subtotal Related Costs	**$330.9**	**$412.9**
Total Tidal Habitat Construction Costs	**$1,433.7**	**$1,788.4**

8.3.5 CM5: Seasonally Inundated Floodplain Restoration

*[**Note to Reviewers**: At this point in time, cost estimates are presented for two floodplain restoration cost sharing options in order to support deliberations on selection of a preferred option. Once the selection of a preferred option has been made, Chapter 8 will be revised to present the cost estimate for just that option.]*

This conservation measure provides for the creation of 10,000 acres of seasonally inundated floodplain habitat along the San Joaquin River downstream of Vernalis and along Old and/or Middle rivers. The locations identified in this analysis were used solely to estimate costs. The

BDCP floodplain restoration conservation measures provide flexibility for restoration actions to occur along any major channel in the north, east, and south Delta. For cost estimation, it was assumed that floodplain habitat will be created by setting back existing levees, approximately 1,000 feet on each side of a channel. For areas along the San Joaquin River between Vernalis and French Camp Slough, it was assumed that 7,000 acres of floodplain habitat will be created through the relocation of approximately 29 miles of existing levees. It was assumed an additional 3,000 acres of floodplain habitat will be created along Old and/or Middle rivers by moving approximately 12 miles of existing levees.

The assumed schedule of setback levee construction and floodplain habitat creation over the term of the BDCP is shown in Table 8-17.

Table 8-17. Miles of Setback Levees and Acres of Created Floodplain Habitat

Miles of Setback Levees	***Cost Period***									
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**
San Joaquin R.	-	0.9	2.0	5.2	5.2	5.2	5.2	5.2		
Old/Middle R.	-	0.4	0.9	2.2	2.2	2.2	2.2	2.2		
Total Miles	-	1.3	2.9	7.4	7.4	7.4	7.4	7.4	-	-
Running Total	**-**	***1.3***	***4.2***	***11.6***	***19.0***	***26.4***	***33.8***	***41.3***	***41.3***	***41.3***
Acres of Floodplain	-	300	700	1800	1800	1800	1800	1800	-	-
Running Total	**-**	**300**	**1,000**	**2,800**	**4,600**	**6,400**	**8,200**	**10,000**	**10,000**	**10,000**

Setback levees for both project and non-project levees[22] were assumed to be constructed to the PL84-99 (Delta Specific) Standard. Levees along the San Joaquin River were assumed to already meet this standard, while levees along Old and Middle rivers were assumed to be non-project levees that do not meet this standard. The average levee height was assumed to be 20 feet, with a 5:1 interior slope, a 2:1 exterior slope, and a 16-foot wide crest. It was also assumed a graded, sloping bench to provide opportunities for both passive and active establishment of riparian vegetation will be added to the water-side of the levee.

Floodplain development costs were grouped as follows: (1) land acquisition costs for floodplain habitat and setback levee footprint; (2) planning, design, engineering, and permitting costs; (3) construction management costs; (4) construction costs; and (5) contingency costs.

8.3.5.1 Floodplain Habitat Land Acquisition

Land requirements for floodplain development are summarized in Table 8-18. Floodplain development is expected to involve land acquisition through fee title and easements. Land for graded benches and other habitat features on the water-side of the setback levees are expected to require fee-title acquisition. This accounts for approximately 80 percent of the acreage listed in

[22] Project levees are part of the Sacramento Flood Control Project, which was completed by USACE in 1960. Non-project levees are not part of a federal flood control project. Non-project levees are maintained by local districts with financial assistance from the state.

Table 8-18. It is assumed the remaining 20 percent can be secured through easements. Land acquisition costs are summarized in Table 8-19.

Table 8-18. Flood Plain Habitat Land Requirements

Flood Plain Land Acquisition	*Plan Year*									
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**
Cumulative Flood Plain Created (Acres)	-	300	1,000	2,800	4,600	6,400	8,200	10,000	10,000	10,000
Cumulative Easement/Purchase (Acres)	-	348	1,160	3,248	5,336	7,424	9,512	11,600	11,600	11,600

Table 8-19. Flood Plain Land Acquisition Costs

Cost Items	*Low Estimate (in millions)*	*High Estimate (in millions)*
Land Acquisition		
Fee Title Purchases	$58.1	$71.0
Easements $9	.5	$11.6
Subtotal Land Acquisition	**$67.6**	**$82.6**
Contingency at 20%	*$13.5*	*$16.5*
Land Costs, including Contingency	**$81.1**	**$99.1**

8.3.5.2 Property Tax and Assessment Revenue Replacement

Foregone property tax and assessments levied by local governments or special districts on private lands converted to floodplain habitat will be offset by the BDCP. The annual cost of these offsets was estimated to range between three-quarters and one percent of the estimated market value of the converted private acreage. The average cost of property tax and assessment revenue replacement over the 50-year permit period for private lands converted to floodplain habitat was estimated to range between $0.2 and $0.3 million per year. While state agencies such as DWR are statutorily prohibited from making payments in lieu of taxes, recently passed legislation requires payment in lieu of taxes for land used in mitigation of new Delta conveyance facilities. The land acquisition cost estimate includes a provision for payments in lieu of taxes, but does not assign those costs to any specific party.

8.3.5.3 Setback Levee Construction Costs

Levee construction cost estimates for setback levees were taken from levee cost studies done for Delta Visions (Betchart, 2008). Cost estimates were updated to 2010 dollars using USACE's Civil Works Construction Cost Index for levees and floodwalls. It was assumed upgrading existing levees to the PL84-99 (Delta-specific) standard will cost from $1.5 to $2.1 million per mile. It was assumed setting back levees will cost $2.3 million per mile, while creating the water-side benches for habitat development will cost between $1.2 million and $2.3 million per

mile.[23] Based on these estimates, the construction costs to set back levees and create water-side benches for habitat were assumed to be $4.5 million per mile for project levees and $6.8 million per mile for non-project levees. The cost estimate assumed fill will be obtained locally. If fill needs to be imported, costs per mile will increase. The cost estimate includes allowances for mobilization (10 percent), surveys, design, construction management and administration (30 percent), and contingency (10 percent). Low and high costs for levee construction are summarized in Table 8-20.[24]

8.3.5.4 Low and High Cost Share Estimates

*[**Note to Reviewers:** cost estimates are presented for two floodplain restoration cost sharing options in order to support deliberations on selection of a preferred option. Once the selection of a preferred option has been made, Chapter 8 will be revised to present the cost estimate for just that option.]*

Some costs of floodplain development are expected to be funded by state flood management programs. The BDCP cost summaries in Section 8.9 assume that state flood management programs will cover a portion of the setback levee costs. The low cost estimate assumes BDCP will pay for half the incremental levee setback costs, all the habitat development costs, and half the land acquisition costs, while state flood programs will pay for half the setback and land acquisition costs plus upgrading non-project levees to the P.L.84-99 (Delta-specific) standard. The high cost estimate assumes BDCP will pay for all incremental levee setback cost, all habitat development costs, and all land acquisition costs, while state flood programs will pay for upgrading non-project levees to the P.L.84-99 (Delta-specific) standard. These assumptions result in a 50 to 75 percent BDCP cost share. BDCP costs are summarized in Table 8-21.

Table 8-20. Estimated Cost of Setback Levee Construction

Construction Costs	*Low Estimate (in millions)*	*High Estimate (in millions)*
Planning/Design/Permitting	$85.3	$104.3
Direct Construction	$284.3	$347.5
Construction Contingency at 10%	*$28.4*	$34.8
Construction Costs, including Contingency	**$398.0**	**$486.6**

Table 8-21. Low and High Cost Sharing Estimates for Floodplain Habitat

BDCP Cost Share	*Low Estimate (in millions)*	*High Estimate (in millions)*
Land Acquisition and Construction	$239.6	$439.3

[23] The cost ranges cited here are in 2010 dollars. The cost estimates reported in Betchart (2008) were developed by the Delta Risk Management Strategy (DRMS)/URS Levee Optimization workgroup. The estimates are based on a basic estimating system using assumed material quantities and unit prices and are considered to be first-order planning level estimates. Actual costs for constructing levee setbacks would be subject to substantial variation based on local conditions, availability of fill material, and changes in other construction assumptions.

[24] Low and high estimate are +/- 10 percent of the estimated costs for levee construction.

8.3.6 CM6: Channel Margin Habitat Enhancement

This conservation measure provides for the enhancement of 20 linear miles of channel margin habitat in the Delta.[25] For the cost analysis, it was assumed that channel margin habitat enhancement will entail creating low benches that support emergent vegetation and higher elevation benches that support riparian vegetation along existing levees. Large woody material (e.g., tree trunks and stumps) may be anchored into constructed low benches or in existing riprapped levees to provide similar habitat functions.

Channel margin enhancement cost estimates are based on conceptual design cross sections and budget-level cost estimates for 95 USACE bank stabilization project sites (approximately 76,000 linear feet) along the Sacramento River and its tributaries (USACE, 2009). Only bank stabilization projects that included channel margin habitat enhancements for species that are covered under the BDCP were considered for the BDCP cost analysis.

Line item cost estimates for each project were obtained from USACE. Cost items included expenditures for: (1) soil cover, (2) in-stream woody material, (3) fascines, (4) landscape materials, and (5) wetlands construction. Across the 95 projects, the cost of channel margin enhancements averaged $538 per linear foot. This estimate includes the cost of planning, engineering and design (at 12 percent of construction cost), construction management (at 8 percent of construction cost), and contingency (at 20 percent of construction cost). USACE assumed channel margin enhancement projects would not require land purchases or easements, though in some cases construction was assumed to require land-side access to target sites. The BDCP cost estimate adopted the same assumptions.

Estimated costs of channel margin enhancements are presented in Table 8-22. [26]

Table 8-22. Estimated Costs of Channel Margin Improvements by Cost Period

Construction Costs	*Low Estimate (in millions)*	*High Estimate (in millions)*
Planning/Design/Permitting	$4.5	$5.5
Direct Construction	$40.2	$49.1
Construction Contingency at 20%	*$8.9*	$10.9
Construction Costs, including Contingency	**$53.6**	**$65.5**

8.3.7 CM7: Riparian Habitat Restoration

This conservation measure provides for the establishment of 5,000 acres of riparian forest and scrub within areas of restored tidal marsh, floodplain, and channel margin. Establishment of riparian habitat will rely on both natural recruitment and active planting. Nonnative vegetation in riparian restoration areas will be controlled during the first three years of native riparian

[25] This could increase to up to 40 linear miles if adaptive management results in the deobligation of funds from other conservation measures.

[26] Low and high estimate are +/- 10 percent of the estimated costs for channel margin enhancement.

establishment. Assumptions used to estimate the costs of this conservation measure are as follows.

Natural Recruitment in Tidal Marsh Restoration Areas: Natural recruitment of riparian forest and scrub was assumed to occur above the tidal range from MHHW to MHHW +2.5 feet at sites that support suitable soils. Natural recruitment was assumed to take place in up to 20 percent of areas with generally suitable soils, and in up to 40 percent of areas with more fluvial disturbance (e.g., portions of the Cosumnes-Mokelumne ROA), where there is more potential for fluvial inundation and scour to refresh soil surfaces.

Active Planting in Tidal Marsh Restoration Areas: Active planting of riparian forest and scrub was assumed to occur in areas adjacent to naturally recruited vegetation in order to increase riparian patch size and enhance riparian habitat quality. It was assumed that active planting acreage would equal 30 percent of natural recruitment acreage in each ROA. A plant density of 170 plants per acre was assumed, which is consistent with an "over-planting" approach designed to rapidly establish native riparian species and reduce the need for replanting. A 70 percent survivorship rate was assumed over the three-year establishment period. Active planting was estimated at $4,000 per acre, including management, field preparation, irrigation installation, and planting costs. The unit cost assumption is based on riparian establishment costs for comparable projects in the Central Valley. A 20 percent cost contingency was added to the estimate.

Management of Riparian Vegetation in Tidal Marsh Restoration Areas: Control of nonnative vegetation during the three-year establishment period will be required. Control of nonnative vegetation will take place in both natural recruitment and active planting areas. It was assumed that control will occur on 100 percent of active planting areas and 50 percent of natural recruitment areas. Annual control cost in areas of active planting was estimated at $1,300 per acre. The unit cost assumption is based on nonnative vegetation control costs for comparable projects in the Central Valley. Control of nonnative vegetation in natural recruitment areas was assumed to cost 40 percent more than in active planting areas to account for more varied and difficult nonnative control conditions. A 20 percent cost contingency was added to the estimate.

Active Planting in Floodplain and Channel Margin Restoration Areas: The amount of active planting acreage in floodplain and channel margin restoration areas was based on the difference between targeted riparian acreage and estimated tidal marsh riparian acreage for the near-term, early long-term, and late long-term periods of the BDCP. Establishment of riparian habitat within restored floodplain was assumed to occur primarily in the South Delta ROA along the San Joaquin, Old, and Middle Rivers. Natural recruitment in floodplain areas and along channel margins was not assumed to contribute to riparian target acreage because of the likelihood native species composition and density would not result in quality riparian habitat.[27] Active planting

[27] Some funds for active planting in floodplain and channel margin restoration areas could be shifted to other conservation measures if subsequent monitoring shows that natural recruitment in these areas creates good riparian habitat.

cost assumptions in floodplain and channel margin restoration areas are the same as for tidal marsh restoration areas.

Management of Riparian Vegetation in Floodplain and Channel Margin Restoration Areas: Nonnative vegetation control costs per acre during the three-year establishment period in floodplain and channel margin restoration areas were assumed to be the same as for tidal marsh restoration areas.

Estimated riparian establishment costs over the term of the BDCP are summarized in Table 8-23.[28]

Table 8-23. Estimated Costs of Riparian Habitat Restoration

Plant Establishment	*Low Estimate (in millions)*	*High Estimate (in millions)*
Active Planting	$12.1	$14.8
Nonnative Control during Establishment	$15.7	$19.2
Subtotal Riparian Establishment	**$27.8**	**$34.0**
Contingency at 20%	$5.6	$6.8
Riparian Establishment Cost, including Contingency	**$33.4**	**$40.8**

8.3.8 CM8: Grassland Communities Resotration

This conservation measure provides for the restoration of 2,000 acres of grassland habitat within Conservation Zones 1, 8, and/or 11 (Figure 3.6). Costs were estimated for land acquisition, habitat creation, and on-going weed management during the establishment period.

8.3.8.1 Grassland Communities Land Acquisition Cost

Spatial data from DWR land use surveys and county parcel maps were combined to estimate the expected number of parcels and amount of acreage by land use classification in each Conservation Zone that would need to be acquired, per the acquisition schedule shown in Table 8-24. Costs for land acquisition were calculated by multiplying the acreage in each land use category by the land values listed in Table 8-2. Estimated transaction costs and contingency were then added to the estimate. Land acquisition costs for tidal habitat are summarized in Table 8-25.

Table 8-24. Land Acquisition Schedule for Grassland Habitat

Land Acquisition by CZ	Acres Acquired by Period										*Total Acres*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
1	250	250	25	25	25	125					1,000
8		250									250
11	250		25	25	25	125					750
Total	**500**	**500**	**250**	**250**	**250**	**250**					**2,000**

[28] Low and high cost estimates are +/- 10 percent of the riparian establishment cost estimate.

Table 8-25. Grassland Communities Land Acquisition Cost

Cost Items	Cost Estimate *(in millions)*
Land Acquisition	
Fee Title Purchases	$6.9
Subtotal Land Acquisition	**$6.9**
Contingency at 20%	*$1.4*
Land Costs, including Contingency	**$8.3**

8.3.8.2 Property Tax and Assessment Revenue Replacement

Foregone property tax and assessments levied by local governments or special districts on private lands converted to grassland habitat will be offset by the BDCP. The annual cost of these offsets was estimated to range between three-quarters and one percent of the estimated market value of the converted private acreage. The average cost of property tax and assessment revenue replacement over the 50-year permit period for private lands converted to grassland habitat was estimated to range between $0.04 and $0.05 million per year. While state agencies such as DWR are statutorily prohibited from making payments in lieu of taxes, recently passed legislation requires payment in lieu of taxes for land used in mitigation of new Delta conveyance facilities. The land acquisition cost estimate includes a provision for payments in lieu of taxes, but does not assign those costs to any specific party.

8.3.8.3 Grassland Habitat Establishment Costs

Grassland habitat construction costs were based on costs for comparable restoration projects occurring in and around the Delta (Gause, per. comm.). Grassland restoration was estimated to cost $1,000 to $1,400 per acre for grading, disking, and seeding, and seed stock. Annual cost of weed management over the establishment period is expected to range between $200 and $400 per acre.[29] Grassland habitat establishment costs are summarized in Table 8-26.

Table 8-26. Estimated Costs to Restore Grassland Habitat Restoration

Plant Establishment	*Low Estimate (in millions)*	*High Estimate (in millions)*
Active Planting	$2.0	$2.9
Weed Control during Establishment	$1.6	$3.3
Subtotal Grassland Establishment	**$3.6**	**$6.2**
Contingency at 20%	*$0.7*	$1.2
Grassland Establishment Cost, including Contingency	**$4.3**	**$7.4**

8.3.9 CM9: Vernal Pool Complex Restoration

This conservation measure provides for the restoration of 200 acres of vernal pool complex habitat within Conservation Zones 1, 8, and/or 11 (Figure 3.6). Costs were estimated for land

[29] Herbicide choice and type of weeds can greatly affect price. If the sites can be pre-treated for weeds prior to planting using a combination of cultural and chemical control methods the costs for future weed control may be reduced by half.

acquisition, habitat creation, and on-going weed management during the establishment period for the vernal pool complex terrain.

8.3.9.1 Vernal Pool Complex Land Acquisition Cost

Spatial data from DWR land use surveys and county parcel maps were combined to estimate the expected number of parcels and amount of acreage by land use classification in each Conservation Zone that would need to be acquired, per the acquisition schedule shown in Table 8-27. Costs for land acquisition were calculated by multiplying the acreage in each land use category by the land values listed in Table 8-2. Estimated transaction costs and contingency were then added to the estimate. Land acquisition costs for 200 acres of vernal pool complex are summarized in Table 8-28.

Table 8-27. Land Acquisition Schedule for Vernal Pool Complex

Land Acquisition by CZ	**Acres Acquired by Period**										*Total Acres*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
1	40		22								62
8	27			22							49
11	20	29	20	20							89
Total	**87**	**29**	**42**	**42**	**0**	**0**	**0**	**0**	**0**	**0**	**200**

Table 8-28. Vernal Pool Complex Land Acquisition Cost

Cost Items	*Cost Estimate (in millions)*
Land Acquisition	
Fee Title Purchases	$0.7
Subtotal Land Acquisition	**$0.7**
Contingency at 20%	*$0.1*
Land Costs, including Contingency	**$0.8**

8.3.9.2 Property Tax and Assessment Revenue Replacement

Foregone property tax and assessments levied by local governments or special districts on private lands converted to vernal pool habitat will be offset by the BDCP. The annual cost of these offsets was estimated to range between three-quarters and one percent of the estimated market value of the converted private acreage. The average cost of property tax and assessment revenue replacement over the 50-year permit period for private lands converted to vernal pool complex was estimated to range between $4 and $5 thousand per year. While state agencies such as DWR are statutorily prohibited from making payments in lieu of taxes, recently passed legislation requires payment in lieu of taxes for land used in mitigation of new Delta conveyance facilities. The land acquisition cost estimate includes a provision for payments in lieu of taxes, but does not assign those costs to any specific party.

8.3.9.3 Vernal Pool Complex Establishment Cost

Vernal pool habitat construction costs are based on costs for comparable restoration projects occurring in and around the Delta (Gause, per. comm.). Costs for vernal pool creation were estimated to range between $25,000 and $40,000 per acre of pool built. Vernal pools were assumed to occupy 30 acres, or 15 percent, of the 200 acre vernal pool complex. The other 170 acres were assumed to be supporting grassland habitat. Costs for grassland habitat restoration were estimated to range between $1,000 to $1,400 per acre. Ten to 20 percent of complex acreage is expected to require weed management each year during the establishment period. Weed management costs were estimated to range between $150 and $500 per treated acre, depending on type of management protocol. Vernal pool complex establishment costs are summarized in Table 8-29.

Table 8-29. Estimated Vernal Pool Complex Establishment Cost

Vernal Pool Establishment Costs	**Low Estimate** *(in millions)*	**High Estimate** *(in millions)*
Vernal Pool Construction	$0.8	$1.2
Grassland Establishment	$0.2	$0.2
Weed Control during Establishment	$0.0	$0.1
Subtotal Vernal Pool Establishment	**$1.0**	**$1.5**
Contingency at 20%	*$0.2*	$0.3
Vernal Pool Complex Cost, including Contingency	**$1.2**	**$1.8**

8.3.10 CM10: Nontidal Marsh Restoration

This conservation measure provides for the restoration of 400 acres of nontidal freshwater marsh within Conservation Zones 2 and 4 (Figure 3-1). Restored habitat will be distributed in patches of at least 25 acres and associated with occupied giant garter snake habitat within the proposed 1,000-acre giant garter snake preserves designed to enhance the Caldoni Marsh/White Slough and the Yolo Basin/Willow Slough giant garter snake populations. Costs were estimated for land acquisition, habitat creation, and a backup water supply.

8.3.10.1 Nontidal Freshwater Marsh Land Acquisition Cost

For purposes of cost estimation, it was assumed 200 acres of agricultural land within Conservation Zone 4 would be acquired by year 5 of the Plan and an additional 200 acres of agricultural land within Conservation Zone 2 would be acquired by year 10 of the Plan. Spatial data from DWR land use surveys and county parcel maps were combined to estimate the expected number of parcels and amount of acreage by land use classification in each Conservation Zone that would need to be acquired. Costs for land acquisition were calculated by multiplying the acreage in each land use category by the appropriate land values listed in Table 8-2. Estimated transaction costs and contingency were then added to the estimate. Land acquisition costs for 400 acres of nontidal freshwater marsh are summarized in Table 8-30.

Table 8-30. Nontidal Freshwater Marsh Land Acquisition Cost

Cost Items	Cost Estimate *(in millions)*
Land Acquisition	
Fee Title Purchases	$4.4
Subtotal Land Acquisition	**$4.4**
Contingency at 20%	*$0.9*
Land Costs, including Contingency	**$5.3**

8.3.10.2 Property Tax and Assessment Revenue Replacement

Foregone property tax and assessments levied by local governments or special districts on private lands converted to nontidal freshwater marsh will be offset by the BDCP. The annual cost of these offsets was estimated to range between three-quarters and one percent of the estimated market value of the converted private acreage. The average cost of property tax and assessment revenue replacement over the 50-year permit period for private lands converted to vernal pool complex was estimated to range between $0.04 and $0.05 million per year. While state agencies such as DWR are statutorily prohibited from making payments in lieu of taxes, recently passed legislation requires payment in lieu of taxes for land used in mitigation of new Delta conveyance facilities. The land acquisition cost estimate includes a provision for payments in lieu of taxes, but does not assign those costs to any specific party.

8.3.10.3 Nontidal Freshwater Marsh Establishment Cost

Estimated costs for nontidal freshwater marsh habitat establishment are based on costs for comparable restoration projects occurring in and around the Delta (Gause, per. comm.). Construction of nontidal freshwater marsh habitat, including permitting, project management, monitoring, grading, seeding, and other planting was estimated to cost between $4,600 and $8,100 per acre. This assumes two-thirds of the acreage is converted to aquatic habitat and one-third to upland habitat. The cost estimate also includes allowances for two wells for backup water supply. Well costs were estimated to range between $125,000 and $150,000 per well. Estimated costs for nontidal freshwater marsh establishment are summarized in Table 8-31.

Table 8-31. Nontidal Freshwater Marsh Establishment Cost

Nontidal Freshwater Marsh Establishment Costs	Low Estimate *(in millions)*	High Estimate *(in millions)*
Marsh Construction	$1.8	$3.3
Wells $0	.3	$0.3
Subtotal Freshwater Marsh Establishment	**$2.1**	**$3.6**
Contingency at 20%	*$0.4*	$0.7
Freshwater Marsh Cost, including Contingency	**$2.5**	**$4.3**

8.3.11 CM11: Natural Communities Enhancement and Management

*[**Note to Reviewers**: Preserve land management costs are preliminary and subject to revision.]*

This conservation measure provides for the development and implementation of management plans for all conservation lands. This management will provide for the maintenance of the habitat functions of protected existing habitat and restored habitats described in CM3, CM4, CM5, CM6, CM7, CM8, CM9, CM10, and CM11.

Management Costs During Permit Period: Habitat management costs for BDCP conservation lands were based on operating budgets for western U.S. National Wildlife Refuges (NWR) managed by the U.S. Fish and Wildlife Service (USFWS) (USFWS 2007). Data on operating budgets and acreage under management were used to estimate unit costs for habitat management. Estimation details are provided in Appendix J, *Implementation Costs Supporting Materials*.

Habitat acreage was assumed to come under management in the period following the one in which existing habitat was acquired or new habitat restored. Tidal marsh, floodplain, and terrestrial/nontidal wetlands acreage were treated as separate management units and separate unit cost assumptions were applied to these acreages. Unit costs shown in the table are averages across all habitat types.

Non-Wasting Endowment Funding Costs: A non-wasting endowment is expected to be established to pay for the costs of land management following the 50-year permit period. The endowment would be funded over the 50-year permit period. Interest from the fund would be used to pay for on-going land management costs following the end of the permit. This would require contributions of approximately $2 million per year (in 2010 dollars), resulting in a fund balance of approximately $182 million (in 2010 dollars) by the end of the permit period.

Annual costs for land management and endowment funding are summarized in Table 8-32.[30]

Table 8-32. Annual Cost of Preserve Management and Endowment Funding

Preserve Management and Endowment Costs	***Low Estimate*** *(in millions)*	***High Estimate*** *(in millions)*
Preserve Management [1]	$3.1/Yr	$3.8/Yr
Contingency at 20% $0	.6/Yr $0	.8/Yr
Subtotal Preserve Management	**$3.7/Yr**	**$4.6/Yr**
Endowment Funding	*$2.0/Yr*	$2.0/Yr
Total Preserve Management, including Contingency and Endowment	**$5.7/Yr**	**$6.6/Yr**

[1]Annual cost for fully established preserve system.

8.3.12 CM12: Methylmercury Management

BDCP actions to minimize the potential for bioaccumulation of mercury that could occur in areas of restoration actions (CM12) include (1) site characterization of mercury prior to acquisition, (2) restoration design modification to address unacceptable concentrations of mercury in substrate,

[30] Low and high estimated costs are +/- 10 percent of the estimated costs for land management and endowment funding. Note that Table 8-32 is representing the annual management cost once the preserve system is fully established. Annual management costs will increase to this level over the permit period as land is added to the preserve system.

(3) long-term monitoring and (4) adaptive management. This cost estimate addresses actions (1) and (2); costs associated with actions (3) and (4) are included in costs for specific habitat measures (e.g., tidal habitat restoration, CM4). The mercury sampling results described in this section will inform site selection and habitat restoration design for tidal and floodplain habitat (CM 4 and 5, respectively). Costs associated with modified site selection and habitat design fall within the contingencies for those two conservation measures, and therefore are not shown here. Costs for ongoing monitoring of mercury methylation within BDCP habitat are subsumed within the cost estimate for Monitoring, Research, and Adaptive Management. This section describes the assumptions used to estimate the incremental costs associated with soil sampling that will be used to identify mercury hot spots within the restoration opportunity areas.

Pre-Acquisition Site Characterization: Pre-acquisition surveys for mercury, grain size and total organic content would be conducted for proposed tidal habitat areas (CM4; 65,000 acres) and floodplain restoration (CM5; 10,000 acres). The 4,000 acres of West Delta tidal restoration acreage can be eliminated from pre-acquisition surveys because these areas will be extensively filled to attain the targeted elevations, resulting in a total of 71,000 acres to be surveyed. For costing purposes the lower end of a range of sample densities from regional surveys (Heim et al., 2010) is used, 1 sample per 300 acres. Consideration is given to the fact that some sites may require an increased sample density, reflected in a high-end cost estimate that assumes one-quarter of the total restoration acreage would be sampled at a density of 1 sample per 50 acres. Survey costs are based on an estimate of $200,000 for a two-week survey to collect, analyze and provide report of results for 175 samples.

Project Design Surveys: More detailed mercury surveys may be required for designing specific restoration plans. Approximate acreages that may require project design surveys are based on the low-end and high-end scenarios described for tidal habitat restoration, CM4, in Section 8.4.4. For a low end cost estimate, project design surveys for mercury would be conducted for approximately 46,100 acres of restoration area at 1 sample per 300 acres. For the high end cost estimate, sampling density would be increased to 1 sample per 50 acres and would include collection and analysis of composite samples representing the 0 to 12-inch depth interval and on a more limited basis the12-inch to 14 or 16-inch depth interval.

Low and high cost estimates for methylmercury site characterization and project design surveys are summarized in Table 8-33.

Table 8-33. Methylmercury Site Characterization and Project Design Surveys

Methylmercury Survey Cost	***Low Estimate*** *(in millions)*	***High Estimate*** *(in millions)*
Site Characterization Surveys	$0.3	$0.8
Project Design Surveys	$0.3	$1.5
Subtotal Methylmercury Survey Cost[1]	**$0.5**	**$2.3**
Contingency at 20%	*$0.1*	$0.5
Methylmercury Survey Cost, including Contingency	**$0.6**	**$2.8**

[1] Subtotal may not reflect sum of survey costs due to rounding.

8.3.13 CM13: Nonnative Aquatic Vegetation Control

This conservation measure provides for the control of Brazilian waterweed (*Egeria densa*), water hyacinth (*Eichhornia crassipes*), and other nonnative submerged and floating aquatic vegetation (SAV and FAV) in BDCP tidal habitat restoration areas. To implement this conservation measure, the BDCP will apply existing methods used by the California Department of Boating and Waterways' (DBW) *Egeria densa* and Water Hyacinth Control Programs, such as applying herbicides as specific as possible to these species, conducting mechanical removal, and/or using other methods of removal as dictated by site-specific conditions and intended outcome/goal. Application of herbicides or other means to control SAV/FAV will be timed to eliminate or minimize potential negative effects of SAV/FAV removal on covered species.

Nonnative vegetation control costs can vary greatly in the Delta, depending on location, plant density, time of year, method of eradication, and need for environmental monitoring. In recent years, environmental monitoring and regulatory compliance costs have comprised approximately 40 percent of total eradication costs, adding substantially to costs of eradication per acre (DBW 2006). Between 2003 and 2005, DBW's aquatic vegetation removal program costs averaged about $2,500 per acre (2010 dollars). Budgetary estimates contained in the 2006 addendum to DBW's *Egeria densa* EIR suggest per acre costs as high as $4,500 per acre (DBW 2006). However, this higher cost was based on high regulatory compliance costs. Because regulatory costs for BDCP vegetation control are not expected to be this high, the cost estimate for this conservation measure is based on the average cost of $2,500 per acre (2010 dollars) reported by DBW for the period 2003 to 2005.

The amount of acreage that will require treatment annually is expected to vary. The low cost estimate assumes, on average, 5 percent of tidal habitat acreage would be treated each year.[31] The high cost estimate assumes, on average, 10 percent of tidal habitat acreage would be treated each year. Average annual treatment costs are summarized in Table 8-34.[32]

Table 8-34. BDCP Aquatic Vegetation Removal Cost

Aquatic Vegetation Removal Cost	***Low Estimate*** *(in millions)*	***High Estimate*** *(in millions)*
Average Acres Treated	1,679/Yr	3,358/Yr
Average Annual Cost	$4.3/Yr	$8.6/Yr
Subtotal Aquatic Vegetation Removal Cost	**$4.3/Yr**	**$8.6/Yr**
Contingency at 20%	*$0.9/Yr*	$1.7/Yr
Aquatic Vegetation Removal, including Contingency	**$5.2/Yr**	**$10.3/Yr**

[31] Treated acreage is calculated as a percentage of the total tidal marsh footprint, including upland acreage. Therefore, the amount of treated tidal and subtidal acreage, as a percentage of total restored tidal and subtidal acreage, would be much higher than the percentages listed above.

[32] Note that annual removal costs will increase over the permit period with the addition of more tidal marsh habitat. Table 8-34 shows the average annual cost over the 50-year permit period.

8.3.14 CM14: Stockton Deep Water Ship Channel Dissolved Oxygen Levels

This conservation measure, which will occur within the Stockton Deep Water Ship Channel, is designed to maintain dissolved oxygen concentrations at levels that will not adversely affect covered fish species during periods when these fish are present in the channel. The BDCP Implementation Office will operate and maintain an oxygen aeration facility in the channel to increase dissolved oxygen concentrations between Turner Cut and Stockton to meet total maximum daily load (TMDL) objectives established by the Central Valley Regional Water Quality Control Board (above 6.0 mg/L from September 1 through November 30 and above 5.0 mg/L [milligrams per liter] at all times). The existing aeration facility will be modified as necessary and, if necessary, additional aerators and associated infrastructure will be added to optimize oxygen delivery to the river, contingent upon results of an ongoing demonstration project conducted by DWR. Operating costs at DWR's existing demonstration facility vary depending on the flows through the ship channel. During dry years, the facility may operate for up to 100 days per year, while in wet years no operations may be required. Depending on flow conditions, annual operating costs range from $10,000 to $300,000 per year. For the purpose of cost estimation, an average annual operating cost of $150,000 has been assumed. Given expected flows through the ship channel, this provides a conservative estimate of likely operating cost (McLaughlin, pers. comm.).[33]

The existing aeration facility was build in 2007 and cost $3.5 million. It is expected to have a 15 year useful life (McLaughlin, pers. comm.).

Low and high estimated costs over the term of the BDCP are shown in Table 8-35 and Table 8-36.[34]

Table 8-35. SDWSC Dissolved Oxygen Diffuser Capital Cost

Diffuser Capital Costs	**Low Estimate** *(in millions)*	**High Estimate** *(in millions)*
Facility Capital Replacement [1] $9	.6	$11.8
Subtotal Diffuser Facility Capital Cost	**$9.6**	**$11.8**
Contingency at 20%	*$1.9*	$2.4
Diffuser Facility Capital Costs, including Contingency	**$11.5**	**$14.2**

[1]Assumes diffuser facility replacement between the 11th and 15th, 26th and 30th, and41st and 50th years of the permit period.

[33] The operating cost estimate prepared by DWR assumed the facility would operate on average 50 days per year. However, recent changes to the City of Stockton's Regional Wastewater Treatment Facility have resulted in improved water quality in the ship channel. If ship channel water quality improves further as a result of San Joaquin River restoration or Delta improvements, average operating days may dip below the level assumed for the cost analysis.

[34] Low and high estimates are +/- 10 percent of the diffuser cost estimate.

Table 8-36. SDWSC Dissolved Oxygen Diffuser Operation Cost

Diffuser Operation Costs	***Low Estimate*** *(in millions)*	***High Estimate*** *(in millions)*
Avg. Annual Diffuser Operation Cost	$0.14/Yr	$0.17/Yr
Subtotal Diffuser Operation Cost	**$0.14/Yr**	**$0.17/Yr**
Contingency at 20%	*$0.03/Yr*	$0.03/Yr
Diffuser Operation Costs, including Contingency	**$0.17/Yr**	**$0.20/Yr**

8.3.15 CM15: Predator Control

This conservation measure addresses the local effects of nonnative predators on covered fish species by supporting focused predator control in high predator density locations. The BDCP will conduct focused predator control using a variety of methods in locations in the Delta that are known to have high densities of predators ("predator hot spots"). Locations of hot spots in which focused predator control will occur and assumptions used to estimate predator control costs for these sites are listed in Table 8-37.

Table 8-37. Focused Predator Control Locations in Delta

Delta Nonnative Predator Hot Spot	***Assumptions for Cost Estimate***
1. Old structures in or hanging over Delta waterways, such as pier pilings or other artificial structures, that are no longer functional or have been abandoned but affect flow fields and provide shade	Up to 20 structures removed per year
2. Vessels that were abandoned throughout the Delta	Up to 10 vessels removed per year
3. New intake structures of the North Delta Diversions	Daily predator harvest using large purse seine nets at 5 locations from October through May.
4. The deep hole just downstream of the Head of Old River in the San Joaquin River	Daily predator harvest using large purse seine nets at 1 location from October through May.
5. Specific locations in Georgiana Slough, as identified by fishery agencies	Daily predator harvest using large purse seine nets at 3 locations from October through May.
6. Specific locations in Sutter and Steamboat sloughs, as identified by fishery agencies	Daily predator harvest using large purse seine nets at 4 locations from October through May.
7. Release sites of salvaged fish from CVP/SWP facilities	Weekly predator harvest using large purse seine nets at 4 locations from October through May.

8.3.15.1 Structure Removal Cost Assumptions

An average cost of $7,800 per structure was assumed. Average structure removal costs are based on costs to remove 30 feet of docking with piles spaced at 10 foot intervals. Dock demolition and disposal was assumed to cost $100 per foot. Pile removal was assumed to cost $800 per pile. Dock and pile removal costs are based on cost information provided by the Contra Costa County Sheriff Department (Powell, pers. comm.) It was assumed that up to 20 structures per year will be removed.

8.3.15.2 Vessel Removal Cost Assumptions

Vessel removal costs are based on the average cost per vessel for removal of 408 vessels in 2002-03 and 2003-04 by the Department of Boating and Waterways (DBW 2005). The average cost of removal was approximately $3,050 per vessel (in 2010 dollars). It was assumed that up to 10 vessels would be removed per year.

8.3.15.3 Focused Predator Control Cost Assumptions

Predator control using large purse seine nets was assumed to occur daily at 13 locations and weekly at 4 locations in the Delta (Table 8-37) between October and May. A predator control event was assumed to require three boat passes over a hot spot, requiring on average 1.5 hours, plus 0.5 hours for travel between sites. It was estimated that 3.4 full-time-equivalent boat crews would be required to operate 241 days per year.

Boat crews were assumed to consist of two mates and a California Department of Fish and Game (DFG) fish habitat specialist. Labor rates were based on FY 2008-09 salary scales for reference positions within the DFG, as reported by the California Department of Finance (CDFA 2009). Labor rates were increased by a factor of 1.35 to account for benefits. A cost contingency of 20 percent was added to calculated labor costs.

Boats used for predator control were assumed to cost $40,000 and have a 10-year useful life.[35] An annual operating cost, covering fuel, maintenance, repairs, and other incidental costs of $48,200 per boat was estimated.[36] A cost contingency of 20 percent was added to calculated boat purchase and operating costs.

Average annual costs for nonnative predatory control are summarized in Table 8-38.[37]

Table 8-38. Focused Nonnative Predator Control Cost

Nonnative Predator Control Cost Items	***Low Estimate*** *(in millions)*	***High Estimate*** *(in millions)*
Hot Spot Predator Removal	$0.55/Yr	$0.68/Yr
Abandoned Vessel Removal	$0.03/Yr	$0.03/Yr
Abandoned Structure Removal	$0.14/Yr	$0.17/Yr
Subtotal Nonnative Predator Control Cost	**$0.72/Yr**	**$0.88/Yr**
Contingency at 20%	*$0.14/Yr*	$0.18/Yr
Nonnative Predator Control Cost, including Contingency	**$0.86/Yr**	**$1.06/Yr**

[35] Boat cost assumption based on a sample of prices for new 20-25 foot center console fishing boats.

[36] Operating costs are based on sample of hourly vessel operating costs for DFG 20-25 foot boats used for IEP surveys. Costs include fuel, maintenance, repairs, and haul out. Operating costs calculated with DFG Vessel Op Costs spreadsheet model (VesselOpCosts2009.xls).

[37] Low and high estimates are +/- 10 percent of the estimated costs for nonnative predator control.

8.3.16 CM16: Non-Physical Fish Barriers

This conservation measure provides funding for the installation and operation of non-physical barriers at the heads of various Delta channels to redirect outmigrating juvenile salmonids. Potential locations for non-physical barriers are described in Chapter 3, *Conservation Strategy*, and include the Head of Old River, the Delta Cross Channel, Georgiana Slough, Turner Cut, Columbia Cut, the Delta Mendota Canal intake, and the Clifton Court Forebay (CFF).

A pilot project was carried out at the Head of Old River, using 14 sections of bubble generators, each 8 meters long. This project used leased equipment and consultant operators. For the spring season of 2009, equipment and operating costs totaled $1.3 million dollars (Holderman, pers. comm.). DWR expects the experience gained through this pilot program will allow a 10 percent reduction in future operating costs. Operating costs were reduced by 10 percent, resulting in an estimated annual cost of $1.2 million per location, to which a 20 percent contingency was added. Non-physical barriers are expected to be operated at seven Delta locations during outmigration periods. Low and high estimated costs to construct and operate the seven barriers over the term of the BDCP are summarized in Table 8-39.[38]

Table 8-39. Estimated Non-Physical Barriers Program Cost (Millions of 2010 dollars)

Non-Physical Fish Barrier Cost	***Low Estimate*** *(in millions)*	***High Estimate*** *(in millions)*
No. of Barrier Locations	7	7
Equipment Lease and Operation	$7.5/Yr	$9.1/Yr
Subtotal Non-Physical Barrier Cost	**$7.5/Yr**	**$9.1/Yr**
Contingency at 20%	*$1.5/Yr*	$1.8/Yr
Non-Physical Barrier Cost, including Contingency	**$9.0/Yr**	**$10.9/Yr**

8.3.17 CM17: Hatchery and Genetic Management Plans

This conservation measure provides for the accelerated development and implementation of Hatchery and Genetic Management Plans (HGMPs) for state Chinook salmon and steelhead hatcheries located in California's Central Valley. Several coordinating actions with DFG and National Marine Fisheries Services (NMFS) associated with this conservation measure will be undertaken by the BDCP Implementation Office. The costs associated with these efforts will primarily be staff-related and were included in the estimated costs for BDCP Program Administration presented later in this chapter.

In addition to these coordinating actions, the BDCP Implementation Office will provide funding for: (1) the development of the HGMPs, (2) a new DFG HGMP staff position, and (3) additional staff at Central Valley hatcheries needed for HGMP implementation and updating. The costs estimated for each action are as follows.

[38] Low and high estimates are +/- 10 percent of the estimated costs for non-physical barriers.

8.3.17.1 HGMP Development and Updating

The cost analysis assumed 12 HGMPs would be updated every five years.[39] Recent genetic management plans developed by DWR for the Feather River Hatchery have cost $125,000 on average, with approximately 90 percent of this being consultant time, and 10 percent DWR staff time (Kindopp pers. comm.). The estimated cost for all 12 plans is estimated to be $1.5 million every five years.

8.3.17.2 DFG HGMP Coordinator Staff Position

An HGMP Coordinator will be hired to coordinate the development, updating, and implementation of the HGMPS among the state hatcheries. It was assumed the salary for this position would be equivalent to that for a Supervising Biologist with DFG's Fisheries Division. DFG estimated overhead and operating costs for the position at $20,000 per year (Shaffer pers. comm.). Total estimated cost to fund the position, including employee benefits and overhead, is $128,000 per year.

8.3.17.3 Central Valley Hatcheries Staff Positions and Operations

It was assumed that each hatchery would need to hire a biologist to oversee the implementation of the individual management plans. DFG estimated the cost of the position at $92,000 per year, including benefits (Shaffer pers. comm.). It was assumed four biologists would be needed for the state hatcheries and two for the federal hatcheries. DFG estimated overhead and operating costs for each position at $20,000 per year (Shaffer pers. comm.). Each hatchery was assumed to undertake genetic testing of ten salmonids stocks every three years. The cost analysis assumed each test would require 50 samples at a cost of $200 per sample. It was also assumed each hatchery would need to seasonally hire technicians to collect and record population data during salmon runs at a cost of $40,000 per year (Lee pers. comm.).

Average annual costs over the permit period are summarized in Table 8-40.[40]

Table 8-40. Estimated HGMP Development and Implementation Support Cost

HGMP Development & Implementation	***Low Estimate*** *(in millions)*	***High Estimate*** *(in millions)*
HGMP Development & Updates	$0.3/Yr	$0.3/Yr
DFG HGMP Coordinator	$0.1/Yr	$0.1/Yr
Hatcheries Staff & Operations	$0.7/Yr	$0.8/Yr
Subtotal HGMP Cost	**$1.1/Yr**	**$1.2/Yr**
Contingency at 20%	*$0.2/Yr*	$0.3/Yr
HGMP Cost, including Contingency	**$1.3/Yr**	**$1.6/Yr**

[39] Appendix J, *Implementation Costs Supporting Materials* provides the list of Central Valley hatcheries for which it is assumed HGMPs will be developed.

[40] Low and high estimates are +/- 10 percent of the estimated costs for HGMP development.

8.3.18 CM18: Illegal Harvest

This conservation measure provides for the funding of actions designed to reduce incidence of illegal harvest of covered fish species. Over the course of the BDCP, funding will be provided to support 17 field wardens and five supervisory staff that will be assigned to the Delta-Bay Enhanced Enforcement Program (DBEEP). Funding will be used to cover the following expenses: (1) salaries, wages, and benefits, (2) operating expenses, (3) minor equipment, (4) major equipment, and (5) overhead. Cost estimates for each category of expense are based on information provided by DFG.

8.3.18.1 Salaries, Wages, and Benefits

Estimated annual staffing costs are based on the DFG positions and salaries shown in Table 8-41, and the employee benefit assumptions described in Section 8.2.

Table 8-41. DFG Game Warden and Support Staff Wage and Salary Assumptions

Position	*Annual FTE Salary**	*FTE Positions*	*Resources Agency Reference Position*
Fish & Game Warden	$61,000	17	Fish and Game Warden, DFG Law Enforcement Div.
Patrol Lieutenant - Supervisor	$75,000	1.0	Fish and Game Patrol Lieutenant – Supervisor, DFG Law Enforcement Div.
Associate Governmental Program Analyst	$62,000 1.	0	Associate Governmental Program Analyst, DFG Law Enforcement Div.
Staff Services Analyst-General	$50,000	2.0	Staff Services Analyst-General, DFG Law Enforcement Div.
Secretary $39,000		1.0	Secretary, DFG Law Enforcement Div.

*Salary estimates based on proposed salaries for 2008-09 for corresponding positions within the Resources Agency, as reported by the California Department of Finance (www.dof.ca.gov/budget/historical/2008-09/salaries_and_wages/index.htm).
* FTE = full-time equivalent
Annual salary amounts shown in this table were multiplied by 1.35 to account for paid leave, health, retirement and other benefits.

8.3.18.2 Operating Expenses

Operating expenses have been estimated by DFG to be approximately $1.3 million annually. Operating costs include allowances for facilities, vehicles, travel, training, general office expenses, and employee overtime (Naslund pers. comm.).

8.3.18.3 Minor and Major Equipment

Costs for minor equipment were estimated by DFG to be approximately $410,000. Minor equipment is expected to be replaced every five years. Costs for major equipment were estimated by DFG to be approximately $892,000. Major equipment is expected to be replaced every ten years. Boat costs were estimated by DFG to cost $1.15 million. Boats are expected to be replaced every 15 years.

8.3.18.4 Overhead

An overhead multiplier of 0.23 was applied to labor, operating, and equipment costs to account for associated overhead costs DFG expects to incur to support the additional staff and equipment assigned to the DBEEP program.

Average annual costs to reduce illegal harvest are summarized in Table 8-42.[41]

Table 8-42. Estimated Illegal Harvest Reduction Costs by Cost Period

Illegal Harvest Reduction	*Low Estimate* *(in millions)*	*High Estimate* *(in millions)*
Salaries & Benefits	$1.6/Yr	$2.0/Yr
Operating Expenses, including equipment	$1.5/Yr	$1.8/Yr
Overhead $0	.7/Yr	$0.9/Yr
Subtotal Illegal Harvest Reduction Cost	**$3.8/Yr**	**$4.7/Yr**
Contingency at 20%	*$0.8/Yr*	$0.9/Yr
HGMP Cost, including Contingency	**$4.6/Yr**	**$5.6/Yr**

8.3.19 CM19: Conservation Hatcheries

This conservation measure provides for the support of existing and establishment of new conservation propagation programs for delta and longfin smelt. The conservation measure includes the following: (1) the development of a USFWS delta and longfin smelt conservation hatchery to house a delta smelt refugial population and provide a source of delta and longfin smelt for supplementation or reintroduction, if deemed necessary by fishery agencies, and (2) the expansion of the refugial population of delta smelt and establishment of a refugial population of longfin smelt at the University of California, Davis Fish Conservation and Culture Laboratory to serve as a population safeguard in case of a catastrophic event in the wild.

8.3.19.1 USFWS Delta and Longfin Smelt Conservation Hatchery

The proposed USFWS hatchery is described in Chapter 3, *Conservation Strategy*. Estimated construction costs for the facility, as developed by USFWS, are $19.4 million (Clarke pers. comm.). Annual operating costs, also developed by USFWS, are $1.5 - $2.0 million (Clarke pers. comm.). It was assumed the facility will be constructed by the end of the fifth year of the BDCP and that an annual operating cost of $1.75 million will be incurred starting in the sixth year of the BDCP.

8.3.19.2 Expansion of Delta and Longfin Smelt Refugial Population

The current fish facility at the University of California, Davis will be expanded to support delta and longfin smelt refugial populations in the near term. U.C. Davis has estimated facility expansion will cost $5 million. It is also estimated that annual operating costs will be $2 million. Operating costs are expected to decrease to approximately $800,000 in the eighth year, once the

[41] Low and high cost estimates are +/- 10 percent of the estimated costs for staff, equipment, and overhead.

USFWS hatchery is in full operation (Lindberg pers. comm.). It is further assumed that expansion will be completed within the first two years of plan implementation and that annual operating costs will accrue starting the third year of plan implementation.

Construction and operation costs for conservation hatcheries are shown in Table 8-43 and Table 8-44, respectively.[42]

Table 8-43. Smelt Propagation Facilities Construction Costs

Smelt Propagation Facilities Costs	***Low Estimate*** *(in millions)*	***High Estimate*** *(in millions)*
FWS Smelt Hatchery Construction	$17.8	$21.8
UC Davis Smelt Refugium Expansion	$4.6	$5.6
Subtotal Smelt Facilities Construction Costs	**$22.4**	**$27.4**
Contingency at 20%	*$4.5*	$5.5
Smelt Facilities Construction Costs, including Contingency	**$26.9**	**$32.9**

Table 8-44. Smelt Propagation Facilities Operation Costs

Smelt Facilities Operation Costs *1/*	***Low Estimate*** *(in millions)*	***High Estimate*** *(in millions)*
FWS Smelt Hatchery Construction	$1.8/Yr	$2.2/Yr
UC Davis Smelt Refugium Expansion	$0.9/Yr	$1.1/Yr
Subtotal Smelt Facilities Operation Costs	**$2.7/Yr**	**$3.3/Yr**
Contingency at 20%	*$0.5/Yr*	$0.7/Yr
Smelt Facilities Operation Costs, including Contingency	**$3.2/Yr**	**$4.0Yr**

1/ Average annual over 50-year permit period.

8.4 PLAN ADMINISTRATION COST ESTIMATE

[Note to Reviewers: *The composition of the BDCP Implementation Office is still under development and the staff and related costs presented in this section are likely to change as the BDCP Implementation Office is better defined. The assumption that the BDCP Implementation Office is an independent entity is adopted only for the purpose of cost estimation. The specific structure of the BDCP Implementation Office and its relationship to existing state and federal agencies will be determined and described in Chapter 7 of the Plan.]*

The costs associated with the administration of the BDCP reflect all of the expenditures that will be reasonably necessary for the BDCP Implementation Office to effectively oversee the implementation of the BDCP throughout the term of the Plan. Program administration costs include expenditures related to employees, facilities, equipment, vehicles, and associated overhead necessary to support the BDCP Implementation Office. Associated overhead costs include employee benefits, insurance, legal and financial assistance, and travel. For the purpose of the cost analysis, the BDCP Implementation Office is assumed to be an independent entity

[42] Low and high estimates are +/- 10 percent the estimated costs for conservation hatchery construction and operating cost.

located in Sacramento, California. This assumption provides a conservative basis from which to estimate program administration costs. Administrative costs that may be incurred by entities other than the BDCP Implementation Office (e.g., supporting entities – see Chapter 7, *Implementation Structure*) are not included in the program administration cost estimate.

8.4.1.1 Staff and Related Costs

The BDCP Implementation Office employee costs are based on a staffing plan developed for BDCP and the salary and benefit assumptions described in Section 8.2 (see Appendix J, *Implementation Costs Supporting Materials* for details). Staffing costs include allowances for benefits, travel, and training. Staffing levels assumed for the cost estimate vary over the permit period, from a low 41 full-time equivalent (FTE) positions in the first five years of Plan implementation to a maximum of 57 FTE positions by the 21st year of Plan implementation.

8.4.1.2 Office Space and Related Costs

Office space and related costs include the office rental costs, utilities, general office equipment, employee-assigned office equipment, geographic information system (GIS) hardware and software, and public outreach materials. Cost assumptions for each of these items are as follows:

Office Space and Utilities: An office space requirement of 250 square feet per FTE was assumed. Unfurnished office space was estimated to cost $2.50 per square foot per month, including utilities.[43]

General Office Equipment: General office equipment includes copy machines, telephone systems, printers, fax machines, and specialized equipment such as digital cameras, trunked radio systems, and publications and subscriptions. It also includes common area office furniture. Annual costs were estimated by amortizing the purchase cost of each type of equipment or furniture over its useful life.[44] Some items were assumed to include annual service contract costs (see Appendix J, *Implementation Costs Supporting Materials* for details).

Employee-Assigned Office Equipment: Employee-assigned office equipment includes cubicle office furniture, computers, cell phones, and office supplies. Annual costs were estimated by multiplying the number of FTE staff positions by the amortized cost of equipment. Some items were assumed to include annual service contract costs. See Appendix J, *Implementation Costs Supporting Materials* for specific employee-assigned equipment cost assumptions.

GIS Hardware and Software: This category includes a dedicated GIS/database server, tablet personal computer, plotter, global positioning system (GPS) unit, GIS software, and related computer software. Annual costs are based on the estimated purchase cost for each item amortized over its useful life. Some items were assumed to include annual service contract

[43] The rental rate assumption is approximately 125 percent of current office rental rates if downtown Sacramento. The 25 percent premium is added to account for the currently depressed commercial real estate market in Sacramento.

[44] This is equivalent to assuming general office equipment and furniture is leased by the BDCP Implementation Office.

costs. See Appendix J, *Implementation Costs Supporting Materials* for specific GIS equipment cost assumptions.

Public Outreach Costs: This category includes an annual allowance for printed material, public meetings and focus groups, including costs for design, layout, printing, postage, web services, and facilities rental. Annual public outreach costs were assumed to vary over the term of the BDCP. See Appendix J, *Implementation Costs Supporting Materials* for specific public outreach cost assumptions.

8.4.1.3 Vehicle and Related Costs

Vehicle costs include the costs for owned and rented vehicles and as well as allowances for fuel, maintenance, and insurance. Owned vehicle annual costs were based on the vehicle's estimated purchase cost amortized over its useful life plus an annual allowance for fuel, maintenance, and insurance. Annual costs for rented vehicles were based on a daily rental rate multiplied by the number of rental days per year per 1,000 acres of habitat under management. See Appendix J, *Implementation Costs Supporting Materials* for the specific vehicle quantity and cost assumptions.

8.4.1.4 Legal, Accounting, and Insurance Costs

Insurance requirements for the BDCP Implementation Office were assumed to include directors and officers insurance, general liability insurance, and professional liability insurance. Liability insurance was assumed to total $30,000 per year, or $150,000 every five years.[45] The BDCP Implementation Office was assumed to require outside legal and accounting assistance throughout the term of the BDCP.[46] Outside legal costs were calculated by multiplying an hourly rate by annual hours of assistance. The amount of outside legal assistance needed by the Implementing Office was assumed to vary over the term of the BDCP. Accounting assistance costs were based on an annual lump sum allowance for auditing and other financial services. See Appendix J, *Implementation Costs Supporting Materials* for specific legal and accounting assistance cost assumptions.

8.4.1.5 Summary of Program Administration Costs

Annual average program administration costs are summarized in Table 8-45. The allocation of program administration costs to specific program functions is shown in Table 8-46.[47]

[45]Vehicle and employee health/disability/workers compensation insurance costs are calculated separately from liability insurance costs. Vehicle insurance costs are included in the vehicle cost estimate, while employee insurance costs are captured by the benefits multiplier applied to wage and salary costs.

[46] These services would be in addition to legal counsel and budget analyst positions within the Implementing Office. See Appendix J, *Implementation Costs Supporting Materials for details.*

[47] Implementation of conservation measures addressing other stressors will be paid for by the contributors to that stressor or by public dollars. However, the SWP and CVP will provide funding for a program that is projected to be about $1 million per year to pay for staff in the BDCP Implementation Office to advocate and pursue research to continue evaluation of other stressors and engage the regulatory agencies to take actions based upon improved scientific understanding to reduce the affects of these stressors on the health of at risk fish species in the Delta.

Table 8-45. Estimated BDCP Implementation Office Costs

Implementation Office Costs 1/	*Low Estimate (in millions)*	*High Estimate (in millions)*
Salary & Benefits	$3.9/Yr	$4.8/Yr
Office, Furniture, Computers	$0.5/Yr	$0.6/Yr
Vehicles $0	.2/Yr	$0.3/Yr
Legal, Accounting, Insurance	$0.5/Yr	$0.6/Yr
Total Implementation Office Costs	**$5.2/Yr**	**$6.4/Yr**

1/ Average annual over 50-year permit period.

Table 8-46. Functional Allocation of BDCP Implementation Office Costs

Implementation Office Cost Allocation	*Low Estimate (in millions)*	*High Estimate (in millions)*
Program Administration	$1.9/Yr	$2.3/Yr
Restoration	$1.8/Yr	$2.2/Yr
Other Stressors Program	$0.9/Yr	$1.1/Yr
Monitoring & Research	$0.7/Yr	$0.8/Yr
Total Implementing Office Cost (Mil/Year)	**$5.2/Yr**	**$6.4/Yr**

8.5 MONITORING/RESEARCH AND AVOIDANCE AND MINIMIZATION MEASURES COST ESTIMATE

*[**Note to Reviewers:** Monitoring/research and avoidance and minimization measure cost estimates are under development and not included in this draft of Chapter 8. These costs have been roughly estimated to range between $60 and $90 million/year, inclusive of on-going IEP expenditures of roughly $30 million/year.]*

8.6 ADAPTIVE MANAGEMENT PROGRAM COST ESTIMATE

Costs for adaptive management are included in the contingencies of each conservation measure's cost estimate, and therefore are not estimated separately.

8.7 CHANGED CIRCUMSTANCES COST ESTIMATE

The changed circumstances provisions of the BDCP are intended to address reasonably foreseeable events that may impede or prevent the BDCP from achieving its biological goals and objectives within the Plan Area. Section 6.3.2, *Changed Circumstances*, of the BDCP identifies a broad range of potential changed circumstances. As noted in Section 6.3.2, responses to changed circumstances will largely be developed and implemented as part of the adaptive management program. In some cases the expected costs associated with responses to changed circumstances are accounted for directly or implicitly through contingencies in the estimated costs of conservation measures. However, responses to certain changed circumstances are expected to result in additional implementation costs, if such responses become necessary. This section describes these costs and how they were estimated.

For purposes of cost estimation, the changed circumstances described in Section 6.3.2 of the BDCP were divided into three categories:

1. Changed circumstances for which responses beyond those contemplated by the adaptive management program would likely be impracticable and ineffective;
2. Changed circumstances for which response costs are accounted for directly or implicitly in the estimated costs of conservation measures, including adaptive management; and
3. Changed circumstances for which responses are expected to result in additional implementation costs.

Changed circumstances for which responses beyond those contemplated by the adaptive management program would likely be impracticable and ineffective. This category includes changed circumstance related to climate, water temperature, ocean conditions, and long-term temperature and precipitation patterns. Responses to significant changes in any of these circumstances, beyond the basic responses dictated by the adaptive management program, are not expected to be practicable or effective, and, as such, are not provided for under the BDCP.

Changed circumstances for which response costs are accounted for directly or implicitly in the estimated costs of conservation measures. This category includes changed circumstances related to water operations infrastructure, conflicts with state or federal environmental regulation, new species listings, invasive species, and toxic or hazardous spills.

- *Water Operations Infrastructure*: A changed circumstance in water operations infrastructure is defined as a malfunction or breakdown of water operations conveyance facilities which precludes or substantially inhibits the ability to manage water operations within the water operations parameters in effect at the time of the infrastructure failure. The planned response to this changed circumstance is to work with DWR and/or Reclamation to make repairs to the affected facilities and restore operations to normal as quickly as possible. The expected costs of minor and major repair and replacement of water operations infrastructure are accounted for directly in the operating cost estimate for Conservation Measure 1, *Water Facilities and Operation*. Costs for minor repairs and maintenance are included in annual costs for O&M, while costs for repairs to and/or replacement of major components of water operations infrastructure are included in the annual reliability and replacement fund, which over the 50-year permit period, provides for roughly $2 billion for these purposes.
- *Conflicts with state or federal environmental regulation*: Responses to conflicts with State or federal environmental regulation include modifying conservation measures to ensure compliance and/or implementing alternative conservation measures that provide equivalent ecological benefits. The cost contingencies, which range from 20 to 50 percent, included in the conservation measure cost estimates are deemed sufficient to accommodate changes in design or implementation required to ensure compliance with applicable state and federal environmental regulations. If compliance necessitates

implementation of alternative conservation measures, it is expected that costs would be comparable to the costs of the measures being replaced.

- *New species listing*: In the event that a fish or wildlife agency lists a species not covered by the BDCP, the BDCP Implementation Office will evaluate potential impacts of covered activities on the species and conduct an assessment of suitable habitat in areas of potential effect. It will also implement measures to avoid impacts to the newly listed specified until such time as the BDCP has been amended to include the newly listed species as a covered species. Any incremental costs of these activities are expected to fall within the cost contingencies applied to the conservation measure cost estimates including adaptive management. It is anticipated that the natural communities protected and restored in the Plan Area under the BDCP will include suitable habitat for most if not all newly listed species having a presence in the Plan Area and therefore no additional land acquisition costs would be incurred.
- *Introduction of new invasive species*: Responses to new invasive species will be determined through the adaptive management process and may include measures to reduce or control the adverse effect of new nonnative species and/or implementation of alternative conservation measures that provide equivalent levels of benefit to applicable covered species. The cost contingencies, which range from 20 to 50 percent, included in the conservation measure cost estimates are deemed sufficient to accommodate changes in design or implementation required to control adverse effects of new nonnative species. If presence of new nonnative species necessitates implementation of alternative conservation measures, it is expected that costs would be comparable to the costs of the measures being replaced.
- *Toxic of hazardous spills*: Cost liability is assumed to rest with the party responsible for the spill event. Thus spill events that are not attributable to BDCP actions would not result in additional BDCP cost. Construction activity is considered to be the most likely source of a spill event caused by a BDCP action. In such situations, construction contingencies and bonding/insurance requirements of contractors are expected to cover any costs of spill remediation.

Changed circumstances for which responses are expected to result in additional implementation costs. This category includes changed circumstances related to failure of BDCP constructed levees and damage to BDCP protected lands caused by non-prescribed fire.

- *Failure of BDCP constructed levees*: Both tidal habitat restoration and floodplain development involve modification of existing and/or construction of new levees. Notwithstanding the integrity of constructed levees, the BDCP Implementation Office may encounter circumstances in which these levees subsequently fail. In such an event, the BDCP Implementation Office may be responsible for undertaking actions to restore the functions of habitat degraded or lost as a result of failure. For cost estimating purposes, the response is assumed to include a contribution to repair of the damaged levee and restoration or replacement of damaged habitat. Because of differences in geographic location, land

use, and levee design, expected costs of levee failure were estimated separately for levees connected to tidal habitat restoration and floodplain development.[48]

Levees constructed for tidal habitat restoration: A probabilistic model of levee failure was used to estimate the likelihood of a levee failure in each permit year. Failure due to both flood and seismic events was considered. Risk of failure due to flood events was estimated by converting a 1:100 year level of flood protection into an expected rate of failure per mile of constructed levee. Seismic failure rates per mile were assumed to be similar to those for existing levees within the relevant ROA, as estimated by the Delta Risk Management Strategy Phase 1 report.[49] The flood and seismic failure rates per mile were added together to get the composite rate of failure per mile. The composite rate was then multiplied by the number of miles of BDCP constructed levees in each permit year to get the probability of a levee failure for each permit year. A low and high estimate of levee repair cost was used to calculate the expected cost of levee repair in each permit year. The high estimate assumes repair costs for tidal habitat levees would be similar to the average cost of repair for a significant levee failure, as reported by Suddeth, Mount, and Lund (2010).[50] The low estimate set repair costs at half the average cost, on the assumption that it may not be necessary to repair every breach or reclaim all flooded land in tidal habitat zones. It was also assumed that a failed tidal habitat levee would, on average, require reconstruction of 10 percent of the affected tidal habitat at a cost of $6,000 per acre.[51] Expected costs over the 50-year permit period are summarized in Table 8-46 and work out to approximately 10 to 15 percent of the tidal habitat construction cost for Conservation Measure 4, *Tidal Habitat Restoration*.

Levees constructed for floodplain development: A probabilistic model of levee failure similar to the one developed for tidal habitat was used to estimate the probability of floodplain levee failure in each permit year. The average cost of repair for a significant levee failure, as reported by Suddeth, Mount, and Lund (2010). Additionally, it was assumed that damages to land and assets protected by a breached floodplain levee would equal 10 percent of the flooded island's or tract's land and asset value. The two costs were multiplied by the probability of failure for each permit year to estimate the expected cost of floodplain levee failure of the 50-year permit period. This cost was then allocated between the BDCP and state/federal flood agencies according to the cost share percentages used to calculate the low and high cost estimates for Conservation Measure 5 (CM 5), *Seasonally Inundated Floodplain Restoration*.

Damage to BDCP protected lands caused by non-prescribed fire: Most natural communities in the Plan Area, including valley/foothill riparian, wetlands, and agriculture, are typically not prone to fire. The non-aquatic lands within the Plan Area are primarily characterized by intensively managed agriculture, which generally does not provide the conditions for

[48] The detailed calculations are presented in Appendix J, *Implementation Costs Supporting Materials*.

[49] Seismic levee failure probabilities for Delta islands and tracts within each ROA were taken from Table 13-3 of the Final Delta Risk Management Strategy Phase 1 Report. These island failure probabilities were converted to seismic failure rates per mile of levee using data on island levee miles reported in Table 13-1 of the Final Delta Risk Management Strategy Phase 1 Report. The average of these probabilities was used to estimate the seismic risk per mile of BDCP constructed levees in each ROA.

[50] They estimate the average cost of repair, which includes costs of mobilization, breach stabilization, breach closure, and island pump-out, averages $25 million, based on data compiled by the Delta Risk Management Strategy, DWR, and interviews with various Delta engineers.

[51] The per acre cost is derived from the tidal habitat construction cost estimate developed for conservation measure 4 and includes the habitat restoration costs other than land acquisition, levee construction, and major grading.

uncontrolled or extensive fire events. Non-prescribed fire on restored riparian acreage is more likely to go unchecked and may result in significant impairment of habitat function. If it is determined through monitoring that burned riparian vegetation is not recovering at a sufficient rate through natural processes, active reestablishment may be required. These costs are not expected to exceed 5 percent of the initial cost of riparian habitat establishment estimated for Conservation Measure 7, *Riparian Habitat Restoration*.

Average annual incremental costs for changed circumstances are summarized in Table 8-47.

Table 8-47. Incremental Costs of Changed Circumstances

Changed Circumstances Costs [1]	***Low Estimate*** *(in millions)*	***High Estimate*** *(in millions)*
Failure of Constructed Levees for Tidal Habitat	$2.0/Yr	$3.3/Yr
Failure of Constructed Levees for Floodplain Habitat	$0.8/Yr	$1.2/Yr
Restoration of Habitat damaged by Fire	$0.1/Yr	$0.1/Yr
Incremental Costs of Changed Circumstances	**$2.9/Yr**	**$4.6/Yr**

[1]Average annual over 50-year permit period.

8.8 MITIGATION MEASURES COST ESTIMATE

*[**Note to Reviewers:** This section will present costs for mitigation measures, which are still underdevelopment. Per Steering Committee request, it will present NEPA/CEQA mitigation costs for non-biological resources to the extent that such costs are developed through the EIR/EIS process.]*

8.9 SUMMARY OF PROGRAM COSTS

BDCP capital outlays over the 50-year permit period are summarized in Table 8-48 for the low and high cost estimates. Capital outlays are shown in five-year increments. Approximately 90 percent of capital outlays are expected to occur within the first 15 years of Plan implementation. Approximately 80 percent of capital outlays are for water conveyance and 20 percent are for habitat conservation measures. Figure 8-1 depicts capital outlays graphically over the 50-year permit period for the midpoint of the low and high cost estimates.

BDCP operating outlays over the 50-year permit period are summarized in Table 8-49 for the low and high cost estimates. Operating outlays are shown in five-year increments. Operating outlays for habitat and other stressor conservation measures are spread fairly evenly over the 50-year permit period. Operating outlays for water conveyance step up significantly starting in the eleventh year of Plan implementation, as the conveyance facility becomes fully operational, and again in the 21st year when contributions to the capital replacement fund are assumed to begin. Approximately 57 percent of operating outlays are for water conveyance, 7 percent are for habitat conservation measures, 27 percent are for other stressor measures, and 9 percent are for program oversight. *[**Note to Reviewers:** share of operating costs for other stressor measures and program oversight will increase once costs for CM 12 and monitoring, research, and avoidance & minimization measures are included in the cost estimate.]* Figure 8-2 depicts operating outlays graphically over the 50-year permit period for the midpoint of the low and high cost estimates.

Table 8-48. BDCP Capital Outlays in Five-Year Increments

Low Estimate *(millions)*	***Plan Year***									
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**
Water Conveyance [1]										
Subtotal	$5,170	$7,521	$ 0	$0	$0	$ 0	$ 0	$0	$0	$0
Habitat Restoration										
Subtotal	$567	$522	$ 448	$317	$319	$ 319	$ 306	$306	$2	$2
Other Stressors										
Subtotal	$0	$0	$4	$0	$0	$4	$0	$0	$4	$0
Total Capital Outlays	**$5,737**	**$8,042**	**$452**	**$317**	**$319**	**$323**	**$306**	**$306**	**$6**	**$2**

High Estimate *(millions)*	***Plan Year***									
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**
Water Conveyance [1]										
Subtotal	$5,170	$7,521	$ 0	$0	$0	$ 0	$ 0	$0	$0	$0
Habitat Restoration										
Subtotal	$765	$695	$ 610	$391	$394	$ 394	$ 377	$377	$3	$3
Other Stressors										
Subtotal	$0	$0	$5	$0	$0	$5	$0	$0	$5	$0
Total Capital Outlays	**$5,935**	**$8,216**	**$614**	**$391**	**$394**	**$398**	**$377**	**$377**	**$7**	**$3**

[1] CM1: Midpoint estimate

Table 8-49. BDCP Operating Outlays in Five-Year Increments

Low Estimate *(millions)*	**Plan Year**									
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**
Water Conveyance [1]										
Subtotal	$10	$10	$ 192	$192	$422	$ 422	$422	$ 422	$422	$422
Habitat Restoration										
Subtotal	$10	$22	$ 28	$32	$36	$ 39	$42	$ 45	$46	$46
Other Stressors										
Subtotal	$116	$106	$ 110	$115	$119	$ 123	$128	$ 132	$132	$132
Program Oversight [2]										
Subtotal	$25	$32	$ 37	$39	$39	$ 45	$47	$ 48	$46	$46
Total Operating Outlays	**$161**	**$170**	**$367**	**$378**	**$615**	**$629**	**$638**	**$646**	**$646**	**$646**

1

High Estimate *(millions)*	**Plan Year**									
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**
Water Conveyance [1]										
Subtotal	$10	$10	$ 192	$192	$422	$ 422	$422	$ 422	$422	$422
Habitat Restoration										
Subtotal	$13	$27	$ 35	$40	$45	$ 49	$53	$ 57	$59	$59
Other Stressors										
Subtotal	$144	$137	$ 146	$157	$165	$ 174	$183	$ 191	$191	$191
Program Oversight [2]										
Subtotal	$31	$42	$ 49	$52	$52	$ 61	$65	$ 66	$65	$65
Total Operating Outlays	**$197**	**$216**	**$422**	**$441**	**$684**	**$706**	**$723**	**$736**	**$737**	**$736**

[1]Midpoint estimate

[2]Monitoring, Research, and Avoidance & Minimization Measures cost under development and not included in subtotal and grand total.

Figure 8-1. BDCP Capital Outlays in Five-Year Increments – Midpoint Cost Estimate (Millions of 2010 Dollars)

Click here to view figure

Figure 8-2. BDCP Operating Outlays in Five-Year Increments – Midpoint Cost Estimate (Millions of 2010 Dollars)

Click here to view figure

Note: Subtotal for Program Oversight does not include costs for Monitoring, Research, and Avoidance & Minimization Measures

8.10 NET BDCP COSTS

[Note to Reviewers: *This section will compare total to net costs of BDCP implementation. Total costs are the sum of costs for all plan components expected to be incurred over the 50-year planning period. Net costs recognize that some of these costs might be incurred even if the Plan were not put into operation. This will be the last step in the cost analysis and cannot be completed until the analyses of total costs for all conservation measures and related activities are completed.]*

8.11 FUNDING SOURCES AND ASSURANCES

[Note to Reviewers: *Funding Sources and Assurances are not included with this draft. This section will be completed following completion of the cost analysis and the development of the funding plan. It should be emphasized that the PREs have not committed to pay for any BDCP costs beyond the conveyance component, and substantial public and other sources of funding are expected to contribute to the cost of implementing the elements of the Plan.]*