Chapter 4 Evaluation and Comparison of Alternatives

This chapter develops the identified concept plans, described in Chapter 3, into detailed alternative plans for the Project. It provides engineering, operational, environmental, and economic evaluations and comparisons of the alternative plans.

Alternative Plans

This section describes a set of four plans that were formulated and retained for further development based on the screened resources management measures in Chapter 3. These plans include the No-Action Plan (the future-without-project condition) and Alternative Plans 1 through 3. It should be noted that the order in which the plans appear does not indicate their performance or standing. Elements of each plan are briefly described and a summary is given of its accomplishments, effects on significant resources, O&M considerations, economics, and implementation factors.

No-Action Plan

The No-Action Plan represents a projection of current conditions to reasonably foreseeable future conditions that could occur if no action alternatives are implemented (i.e., the future without the proposed Project). Reclamation recommends several criteria for including proposed future actions within the No-Action Plan. To be included in the No-Action Plan, proposed actions should be: (1) authorized, (2) approved through completion of NEPA, CEQA, and ESA compliance processes, (3) funded, and (4) permitted.

Under this plan, CCWD would continue to operate and maintain its existing facilities to maximize delivered water quality given the physical limitations of the existing infrastructure and consistent with environmental regulations and permit conditions. In the near term, no substantive or predictable operational changes would be implemented under the No-Action Plan. Under future levels of demand,[1] the No-Action Plan includes the expansion of the Old River pump station to a capacity of 320 cfs consistent with the *CCWD Future Water Supply Implementation Draft Environmental Impact Report* (CCWD, 1998).

The No-Action Alternative includes CCWD's Old River Water Quality Improvement Project and the Rock Slough Water Quality Improvement Project, both of which were recently completed, and the EBMUD Intertie with the

[1] Future demand level of development is 2020, consistent with OCAP studies completed by Reclamation and DWR.

FRWP, which is currently under construction. It would also include the Contra Costa Canal Encasement Project, for which the EIR/EIS was recently approved; Phase 1 of the project has been funded. These projects, which are described below, would also be included in background conditions for each of the considered alternative plans:

- The CALFED Old River Water Quality Improvement Project involved constructing a new pump station to provide a longer outfall for agricultural drainage from Byron Tract into Old River, near CCWD's Old River intake. The purpose of the project is to improve the quality of water (with respect to salinity, organic carbon, turbidity, nutrients, and pathogens) diverted at CCWD's existing Old River intake structure. This project has been completed.

- The CALFED Rock Slough Water Quality Improvement Project relocated the agricultural drainage discharge from Veale Tract 2 miles from its previous location to a point outside Rock Slough, where local currents convey the drainage farther away from Rock Slough. The purpose of the project is to improve the quality of the water (with respect to salinity, organic carbon, turbidity, nutrients, and pathogens) diverted at CCWD's Pumping Plant No. 1 at Contra Costa Canal (west of Rock Slough).

- The EBMUD Intertie with the FRWP involves a 58 cfs intertie to connect the EBMUD Mokelumne Aqueduct to the CCWD Los Vaqueros Pipeline for wheeling of up to 3,200 acre-feet annually of CCWD's water through the FRWA and EBMUD facilities into Los Vaqueros Reservoir. The purpose of this agreement is to offset the water quality degradation that is expected at CCWD's intakes from implementation of the FRWP. The intertie also provides an emergency water supply connection between CCWD and EBMUD.

- The Contra Costa Canal Encasement Project aims to eliminate water quality degradation in the unlined portion of the Contra Costa Canal, which extends 3.97 miles from the Rock Slough head works to Pumping Plant No. 1, by hydraulically isolating the canal from the salinity influences of local groundwater. The project involves installing a 10-foot-inside-diameter pipeline in the open water or under the northern berm of the unlined canal. The unlined canal would then be permanently dewatered and backfilled. The CEQA Mitigated Negative Declaration for the project was approved in November 2006 a NEPA FONSI was completed in August 2007. The first phase of the project has been funded and construction has started in October 2007.

Alternative Plan 1

Plan 1 would extend the current CCWD Old River intake to a new intake location on Victoria Canal. The new intake on Victoria Canal would protect and improve delivered water quality for CCWD customers by enabling CCWD to relocate some of its existing diversions from the Old River intake to Victoria Canal, a Delta location with better source water quality at times than is currently available at Old River. Victoria Canal receives its flows largely from the Middle River.

Plan 1 would also involve modifying CCWD permitted operations to enable CCWD to shift additional pumping from the unscreened Rock Slough intake to the proposed screened intake at Victoria Canal. Rock Slough would continue to provide a portion of CCWD supply, but would be used less frequently than under the No-Action Plan. Under this plan, CCWD would immediately apply to change its permits to allow diversion of up to 320 cfs through the Old River conveyance system rather than in the future, as planned. Combined diversions from the 250 cfs Old River pump station and the proposed 250 cfs Victoria Canal intake would be limited to 320 cfs by the capacity of the pipeline connecting the Old River pump station to CCWD's transfer station, which routes water either to Los Vaqueros Reservoir or the Contra Costa Canal. CCWD would not increase the average total annual quantity diverted from the Delta. This change would enable CCWD to relocate up to half of the current Rock Slough diversions to the new screened intakes. The Mallard Slough intake would continue to provide a portion of CCWD's water supply in a manner similar to its current operations.

Description

The main physical features of Plan 1 would be a new, screened water intake and pump station located along the lower third of Victoria Canal on Victoria Island in the central Delta, and a pipeline that would extend from the new intake directly across Victoria Island and Old River, and tie into CCWD's existing Old River conveyance system on Byron Tract. Figure 4-1 is a conceptual depiction of the proposed intake location on Victoria Canal and the direct pipeline route to CCWD's existing Old River facilities. The specific footprint of the proposed intake, pump station, and conveyance pipeline, with some surface appurtenances, would be determined during final design based on various factors, including the results of geotechnical data collection, environmental constraints, and landowner negotiations.

Plan 1 would include three components: an intake and pump station, levee improvements, and a conveyance pipeline. These facilities are described below.

Screened Intake and Pumping Station

Figure 4-2 is a preliminary section view of the proposed intake structure and pump station. The new intake structure would consist of a reinforced concrete structure with side retaining walls, suction pipes, and a fish screen open to Victoria Canal supported on concrete columns. The fish screen would provide a positive barrier against entrainment of fish and debris into the wet well/pump bays. The fish screen would be regularly cleaned with a mechanical cleaning system. The facility would be designed to meet fish screening requirements in the Delta. A pump station would lift water from the new intake and convey it through the pipeline system and to the existing Old River pump station system on Byron Tract. The intake pumps would be designed to operate at high and low water levels. The pumps would discharge through a header into a common pipeline.

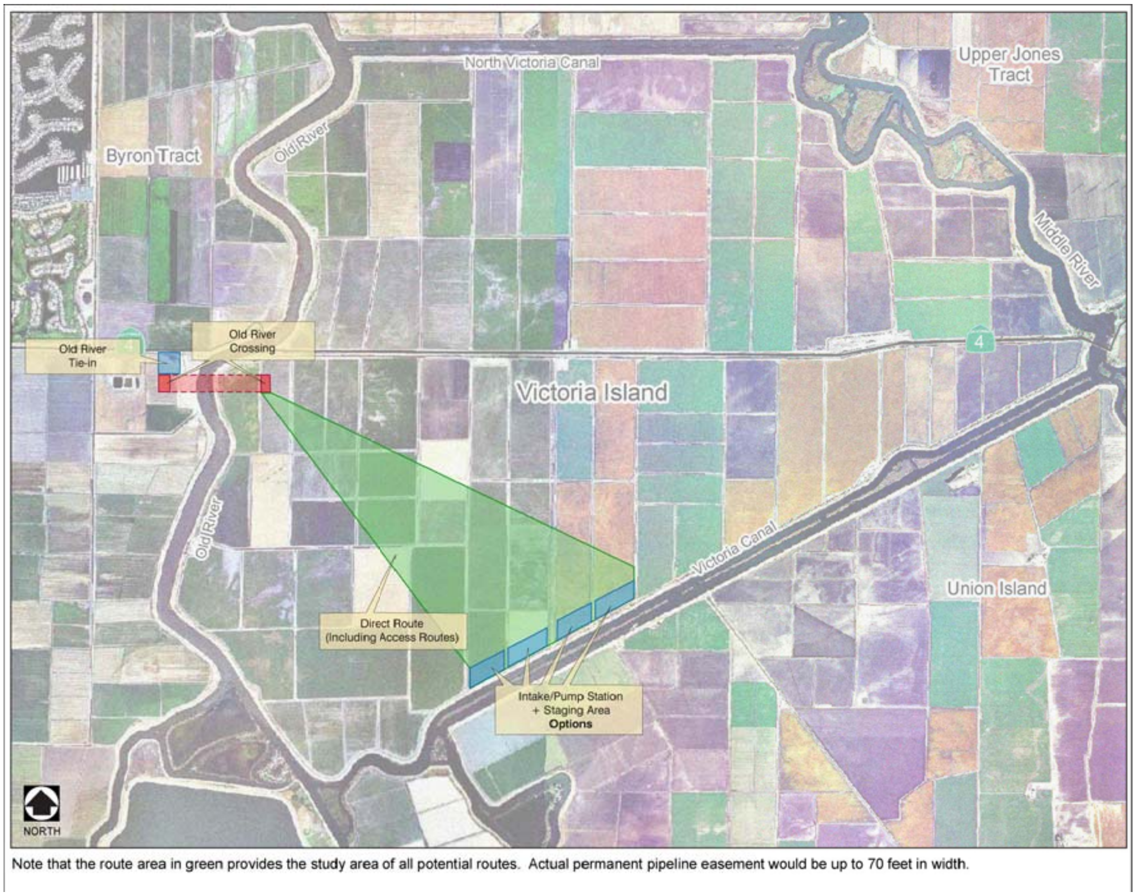
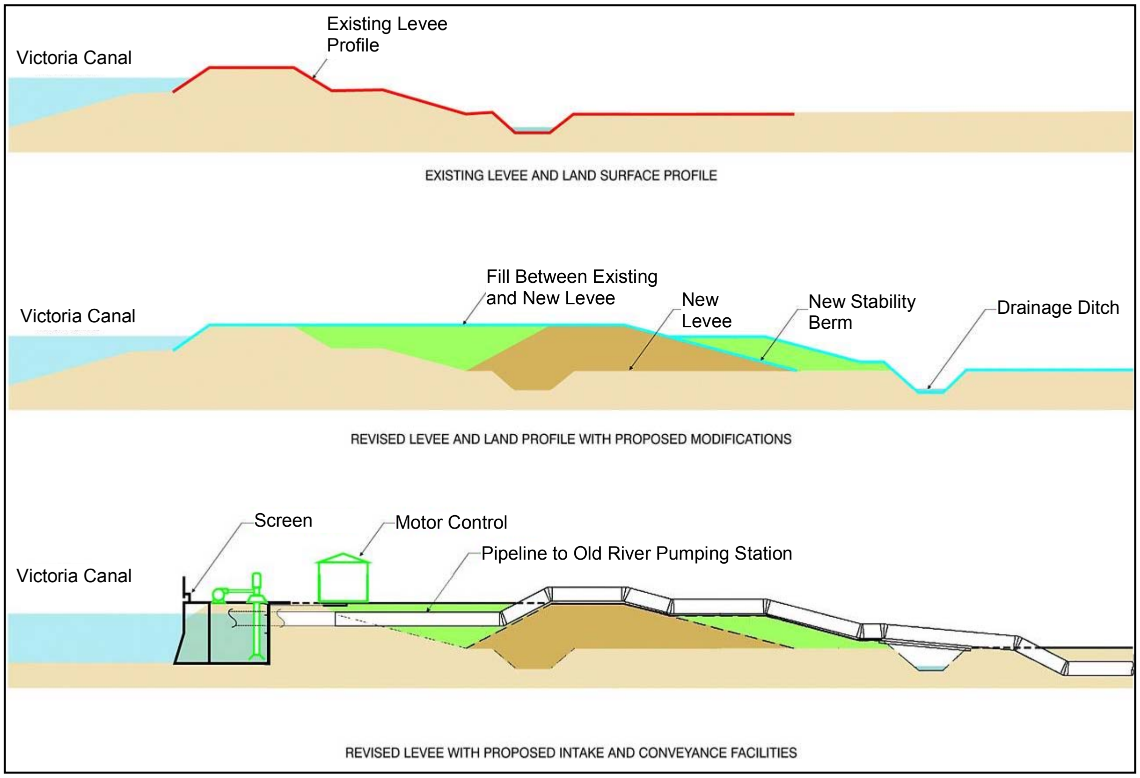


Figure 4-1. Plan 1 – Conceptual Location of the Proposed Victoria Canal Intake and Direct Pipeline to Old River Intake

Levee Improvements

The existing levee would be reinforced and reconfigured to serve as the engineered soil platform for the proposed intake/pump station facilities and to allow installation of the new intake structure. Figure 4-2 shows the proposed levee modifications. The approximate footprint area of the levee improvements (i.e., measured at the base of the side slopes) would be 250 to 300 feet wide by 1,000 to 1,200 feet long. Approximately 6 to 8 acres at the intake site would be removed from agricultural use by the proposed levee modification.

Levee construction would require approximately 140,000 to 170,000 cubic yards of fill material. The top of the reconfigured levee would be surfaced with aggregate base to maintain vehicular traffic during rain events. A ramp would allow access to the pump station and ancillary buildings. Slope protection (i.e., riprap) would be installed on the water side of the levee for up to 400 to 500 feet on each side of the intake structure.



Source: CCWD and Reclamation (2006)

Figure 4-2. Plan 1 – Conceptual Cross Sections of the Proposed Levee Modification and Proposed Intake and Conveyance Facilities

Conveyance Pipeline

The new conveyance pipeline would traverse Victoria Island buried within a trench from the new intake and pump facility on Victoria Canal to the Old River levee (see Figure 4-1). The pipeline, which is approximately 12,000 to 14,000 feet long, would be sized to accommodate a flow rate of up to 250 cfs using a pipe diameter of approximately 6 feet. Pipeline features such as an air release, control valves, cathodic protection test stations, and access hatches would be installed in vaults or on pads above ground along the pipeline route.

Existing irrigation and drainage ditches that potentially could be affected by the pipeline routing would be siphoned under, rerouted, crossed over, or replaced, based on considerations of both farming operations and construction costs. Nearly all effects on drainages would be temporary, as the affected ditches would be recontoured to their preproject dimensions where possible.

The pipeline crossing of Old River would be achieved through microtunneling. The conveyance pipeline would be tunneled under Old River at an elevation that would avoid unconsolidated soils and provide sufficient protection for the pipeline.

Operation and Maintenance Considerations

The pump station for the new intake on Victoria Canal would be operated similarly to the existing Old River pump station. The Old River pump station is normally operated remotely from the Bollman WTP but can be locally operated at the pump station itself. CCWD personnel sequentially start the pumps at the Old River pump station to initiate diversion from Old River. The number of pumps operating at any given time depends on CCWD's flow requirements and diversion strategy. When the pump station is taken off-line, the pumps are turned off and the wet well remains flooded.

Maintenance activities at the proposed new intake and pump station would be similar to maintenance activities currently conducted at the Old River pump station, including pump and equipment inspections and maintenance, water quality monitoring, and fish monitoring activities. Periodic maintenance dredging may also be required at the new intake facility. The existing Old River facility has not required any maintenance dredging to date, but an intake on Victoria Canal could experience different sedimentation conditions. Because the proposed new pump station would be unattended, CCWD personnel would monitor the station via telemetry as well as through regular inspections.

Alternative Plan 2

Plan 2 would install desalination treatment processes to reduce salinity and improve the quality of delivered supplies from Bollman WTP. It would also reduce overall demands on the Rock Slough unscreened intake by increasing diversions through the Mallard Slough screened intake. The plan would require the expansion of the existing Mallard Slough intake and pump station, as well as adding desalination treatment capacity at the existing Bollman WTP. This expansion would serve the demands of the treated water service area (TWSA) customers currently served by the Bollman WTP. It would also reduce overall demands on the Contra Costa Canal, such that the canal would primarily serve CCWD's untreated-water customers. A change in the current Mallard Slough water rights would be required for this capacity increase at the Bollman WTP.

Currently, CCWD has two permits for diversion at Mallard Slough, issued by the SWRCB. One allows for direct diversion of 39.3 cfs (24.5 mgd) through the Mallard Slough pump station and 3,780 acre-feet per year to storage. The total volume authorized under this permit is 14,880 acre-feet per calendar year. The other authorizes an additional 11,900 acre-feet per year to be diverted from August 1 to December 31 at a rate not to exceed 39.3 cfs. Together, the two permits authorize CCWD to divert 26,780 acre-feet per year. Because of high salinity during most of the year at the Mallard Slough intake, CCWD has historically diverted only a fraction of the permitted water right, typically during the spring months.

Description

Plan 2 would include the following major facilities: an expanded Mallard Slough intake and pumping plant, a new desalination plant located within the existing property boundary of CCWD's Bollman WTP, untreated-water conveyance pipeline from the intake/pumping plant to the desalination plant, and a concentrate disposal pipeline from the plant to Suisun Bay. Figure 4-3 shows the regional location of Plan 2 facilities. These facilities are described in the following subsections.

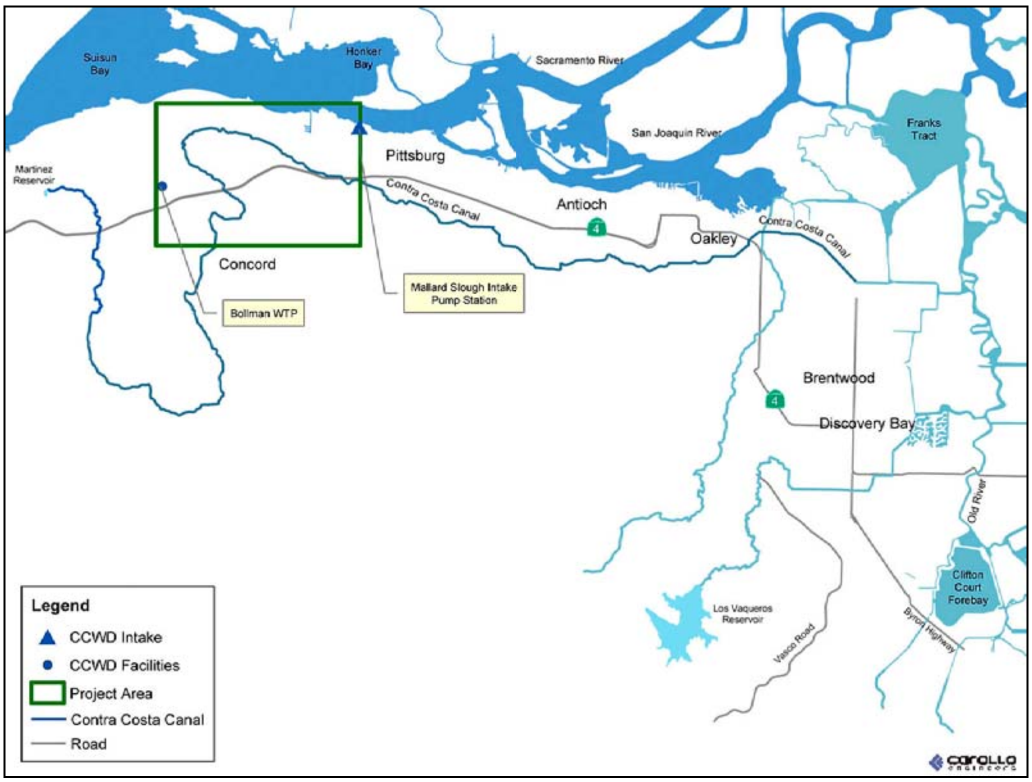


Figure 4-3. Plan 2 – Project Location of the Desalination Plant

Screened Intake and Pumping Station

The existing Mallard Slough intake and pump station are located at the southern end of a dredged channel due west of Mallard Slough. Plan 2 would require the expansion of the existing Mallard Slough intake and pump station from its current capacity of 60 cfs to a capacity of approximately 125 to 132 cfs. Pumped water can be either transferred via a pipeline to the Contra Costa Canal or directly to Mallard Reservoir at the Bollman WTP.

The expansion to the intake and pumping station would be within the existing CCWD property boundary. The new pumping station and supporting structure would be constructed similar to the existing pump station and would include a screened intake with an automatic cleaning system, additional pumps, and associated electrical system upgrades. The fish screen design would match the existing screen design and would meet required flow velocity limitations established by the resource agencies.

Conveyance Pipeline

A new pipeline 4 to 5 feet in diameter would be constructed to convey the additional flow from the expanded Mallard Slough intake to the desalination plant that would be constructed at the Bollman WTP site. The new conveyance pipeline would run parallel to the existing pipeline up to the Contra Costa Canal (Figure 4-4), at which point it would transition westward in an alignment parallel to that of the canal to its terminus at the Bollman WTP site. The entire untreated-water conveyance pipeline (approximately 40,000 feet) would be located within CCWD easements and rights-of-way.

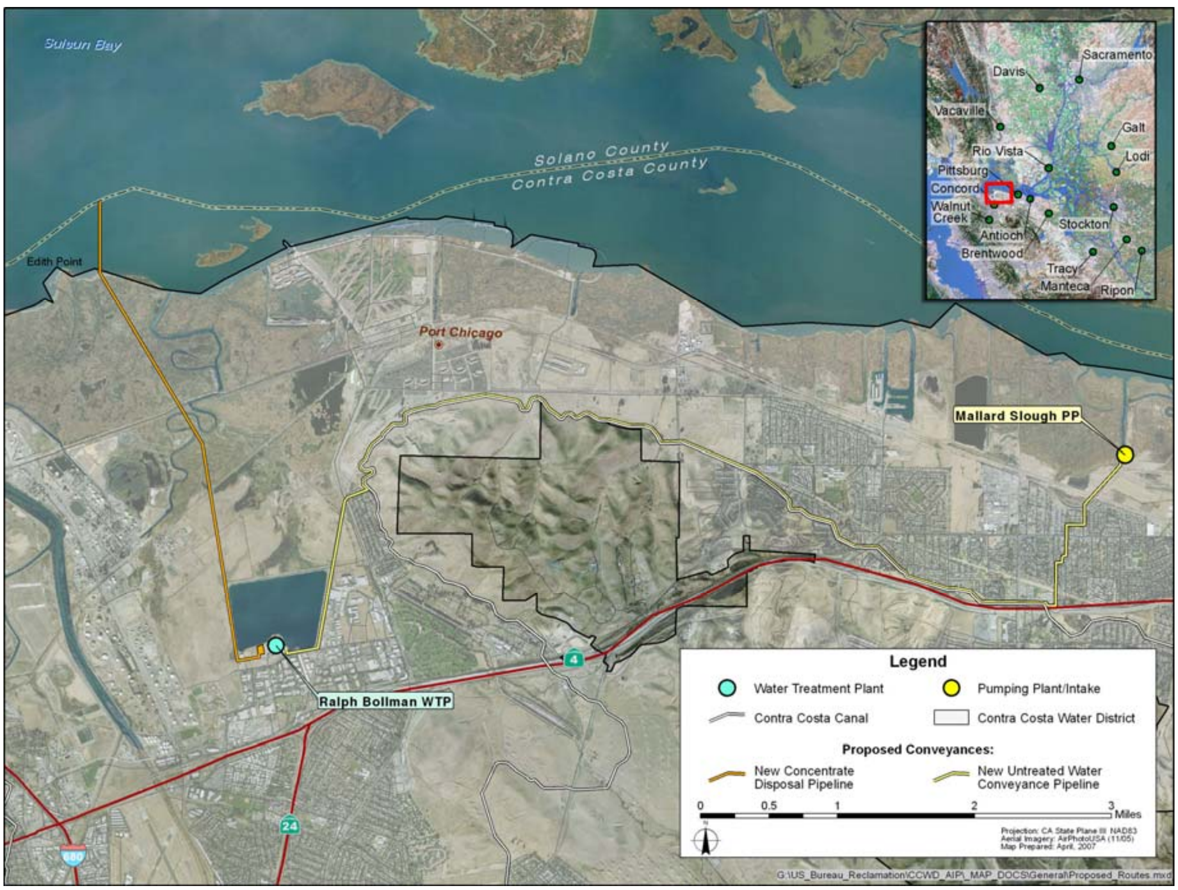


Figure 4-4. Plan 2 – Untreated Water and Concentrate Disposal Conveyance

Desalination Facilities

The new treatment systems would include a new reverse osmosis (RO) desalination plant constructed on vacant land within the boundaries of the existing Bollman WTP site in Concord. The major components of the existing Bollman WTP include Mallard Reservoir, where untreated water from the Contra Costa Canal is stored, and facilities for pretreatment, ozonation, filtration, chemical addition processes, and treated water storage.

For the new desalination plant, untreated water would be conveyed in the new conveyance pipeline to a direct tie-in to the existing pump station that feeds the Bollman WTP. Mixing in Mallard Reservoir would be avoided to prevent dilution of salinity levels that would reduce the efficiency of the RO process. Pretreatment would be through the existing conventional treatment facilities at the Bollman WTP.

Desalination treatment would occur in a new building constructed in a currently vacant area on the Bollman WTP property. The building would house the RO membranes, piping, booster pumps, filters, and chemicals, as well as space for offices, storage, and instrumentation. The finished water from the RO process would be blended and chemically conditioned for pH and alkalinity adjustment. The water would then be disinfected before delivery to the distribution system through existing treatment plant distribution pumping systems. Distribution of desalinated water to CCWD's treated water customers would be via CCWD's existing distribution system.

CCWD currently discharges waste solids (i.e., suspended solids and pretreatment flocculant solids) off site to a lagoon-type storage system for drying and disposal that is located at the Central Contra Costa Sanitation District treatment facility. Solids generated by the desalination pretreatment and treatment processes would be disposed of in the same manner using the existing facilities; no capacity upgrades to the solids handling systems are anticipated.

Concentrate Disposal Pipeline

Disposal of RO byproduct concentrate can be achieved through blending with treated wastewater effluent prior to discharge through a new pipeline to Suisun Bay. Blending the byproduct concentrate with wastewater is a potentially viable option, because the CCWD Bollman WTP site is near the Central Contra Costa Sanitation District wastewater treatment facilities. Prior to disposal, concentrate byproduct from the RO units would pass through an energy recovery turbine to maximize energy efficiency of the system.

The disposal facilities would include a new pump station, with a capacity of approximately 12 mgd, and pipeline approximately 14,000 to 15,000 feet long that would convey the concentrate byproduct to Suisun Bay (Figure 4-4). The pipeline includes an outfall diffuser located approximately 2,000 feet from the shoreline, in Contra Costa County, and at a water depth of 50 to 75 feet. It would be designed with nozzle-type ports to provide velocity and dispersion mixing of the concentrate sufficient to meet dilution standards. The discharge to Suisun Bay would require a discharge permit from the San Francisco Bay

Regional Water Quality Control Board (SFBRWQCB) and would conform to the SFBRWQCB Basin Plan.

Operation and Maintenance Considerations

Plan 2 would require diversions in excess of CCWD's current water rights at Mallard Slough intake. Increasing diversions could be accomplished either through the revision of existing water rights to increase the permitted diversion capacity at Mallard Slough, up to a total diversion of 125 to 132 cfs (approximately 80 to 85 mgd) to meet the demands of the Bollman WTP, or by adding Mallard Slough as a point of diversion under CCWD's CVP contract and diverting water in excess of CCWD's existing water rights as CVP water.

The new intake and pump station, associated with the expanded Mallard Slough intake, would be operated remotely from the Bollman WTP. Routine maintenance at the new intake would follow similar maintenance protocols to current operations. The new desalination facilities would operate 24 hours per day, averaging 5 months of use per year, and would require an increase of fewer than 10 staff people performing O&M at the Bollman WTP.

Alternative Plan 3

Plan 3 moves the Rock Slough intake to a new location on the Middle River that provides better water quality (Figure 4-5). The plan would involve building a new screened intake on the Middle River that would feed CCWD's existing Pumping Plant No. 1 through a pipeline to the Contra Costa Canal entrance. To eliminate potential water quality deterioration in the Contra Costa Canal sections between Pumping Plant No. 1 and the canal entrance, this plan assumes that the Contra Costa Canal Encasement Project would be implemented and is part of the future without-project condition. The new screened intake would contribute to an overall reduction in fisheries mortality rates compared to the current unscreened intake on Rock Slough.

Plan 3 would also involve modifying CCWD permitted Delta water operations to enable CCWD to shift its current diversions at Rock Slough to the proposed screened intake at the Middle River. CCWD would apply to change its permits to allow diversion of up to 340 cfs through the Middle River intake. This change would enable CCWD to relocate all of the current Rock Slough diversions to the new screened intake, but would not increase the average total annual quantity diverted from the Delta. The Old River intake and Mallard Slough intake would continue to provide a portion of CCWD's water supply in a manner similar to without-project operations.

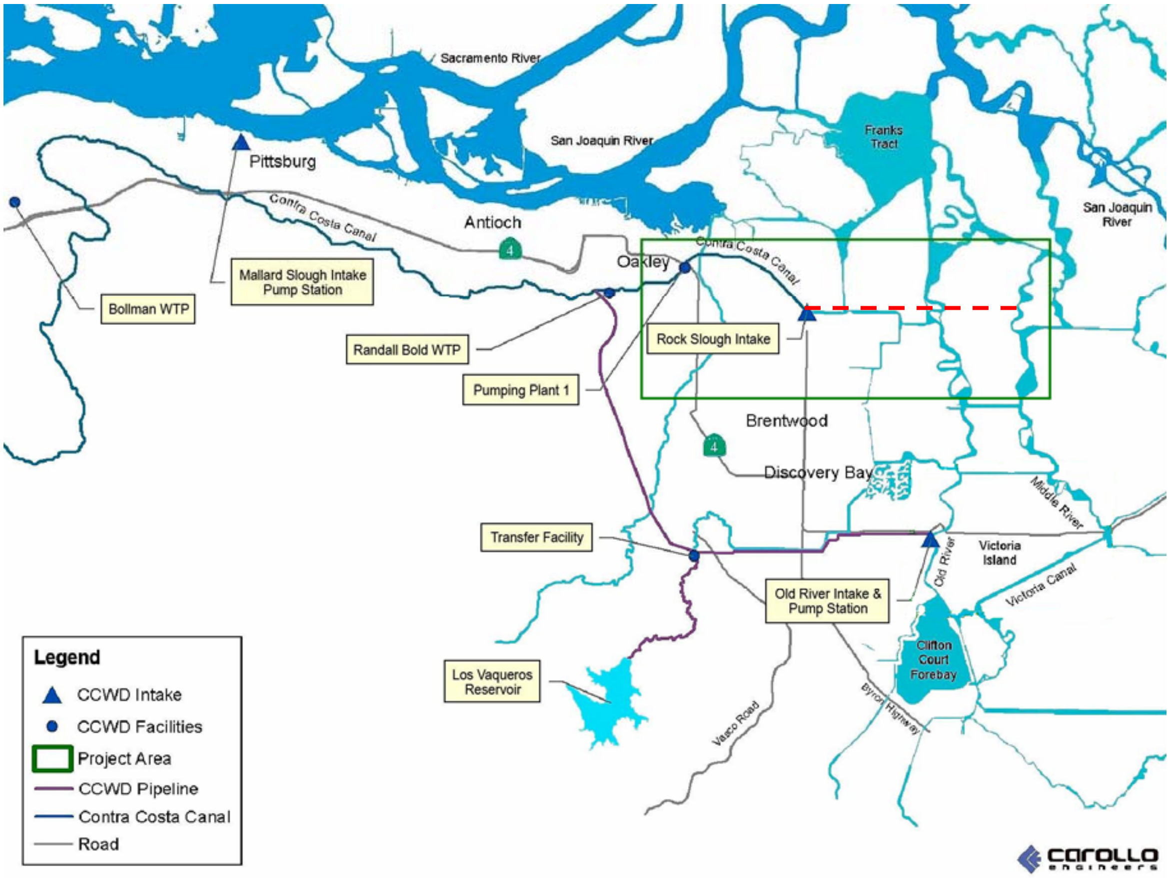


Figure 4-5. Plan 3 – Regional Map of the Proposed Middle River Intake Project

Description

Facilities required under Plan 3 would include a new intake and pumping station on the Middle River, a conveyance pipeline to the Contra Costa Canal with two river crossings, and a levee improvements component. These facilities are described below.

Screened Intake and Pump Station

The new intake on the Middle River would be located on Bacon Island. Figure 4-6 shows the approximate location of the new intake. Conceptually, the design of the intake would be similar to that described under Plan 1 for the intake on Victoria Canal, with the final sizing depending on approved fish screen design details, levee geotechnical design considerations, channel bathymetry, and economic considerations. A pump station would lift water from the new intake on Middle River and convey it through the pipeline system and to Contra Costa Canal.

Levee Improvements

The existing levee on Bacon Island would be reinforced and reconfigured to serve as the engineered soil platform for the proposed intake/pump station facilities and to allow installation of the new intake structure. Conceptually, these levee modifications could be similar to those described for Victoria Island levees under Plan 1 (Figure 4-2). As part of these modifications, a new setback levee would be constructed, which would be used to reroute Bacon Island Road, which currently runs on top of the existing levee on Bacon Island, bordering the Middle River. A ramp would be provided to allow access to the pump station and ancillary buildings. Slope protection (i.e., riprap) would be installed on the water side of the new levee on each side of the intake structure for 400 to 500 feet. The footprint of the area required for the new intake and the associated levee improvements would be approximately 6 to 10 acres.

Conveyance Pipeline

The new pipeline would traverse Bacon Island buried in a trench from the new intake and pump facility on Middle River to the entrance to the Contra Costa Canal. Two conceptual pipeline routings are shown in Figure 4-6. The first route would cross Bacon Island and Holland Tract, while the second route would cross Bacon Island, Palm Tract, and Veale Tract. Each route would have two water channel crossings, including a crossing of the Old River. The pipeline route from the new intake to Contra Costa Canal would be approximately 30,000 to 33,000 feet long. The pipeline would be approximately 8 feet in diameter to carry a flow rate of up to 340 cfs (i.e., maximum diversion capacity of Rock Slough intake).

Pipeline features such as an air release, control valves, cathodic protection test stations, and access hatches would be installed in vaults or on pads above ground along the pipeline route. Pipe crossings of existing irrigation and drainage ditches would be developed based on discussions with the landowner and considerations of both farming operations and construction costs. Channel crossings, including of the Old River and potentially Sand Mound Slough or Werner Dredger Cut (Figure 4-6), would be accomplished though microtunneling (similar to the Old River crossing described under Plan 1).

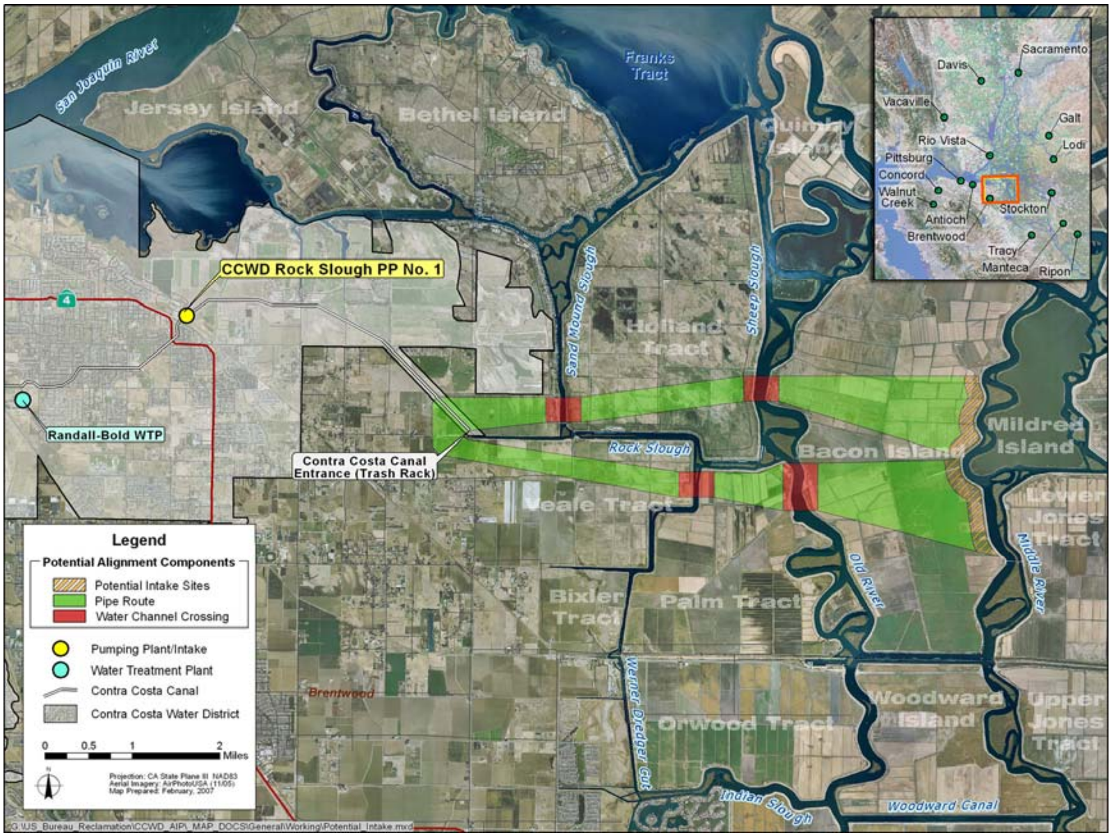


Figure 4-6. Plan 3 – Potential Pipeline Alignment for the Middle River Intake

Operation and Maintenance Considerations

The pump station for the new intake on Middle River would be operated similar to the existing Old River pump station. The Old River pump station is normally operated remotely from the Bollman WTP but can be locally operated at the pump station itself. The number of pumps operating at any given time depends on CCWD's flow requirements and diversion strategy. When the pump station is taken off-line, the pumps are turned off and the wet well remains flooded.

Maintenance activities at the proposed new intake and pump station would be similar to maintenance activities currently conducted at the Old River pump station, including pump and equipment inspections and maintenance, water quality monitoring, and fish monitoring activities. Periodic maintenance dredging may also be required at the new intake facility. The existing Old River facility has not required any maintenance dredging to date, but an intake on Middle River could experience different sedimentation conditions. Because the proposed new pump station would be unattended, CCWD personnel would monitor the station via telemetry as well as through regular inspections.

Plan Accomplishments

This section discusses and evaluates how each alternative concept plan (Plans 1 through 3) contributes to the planning objectives of the study. The section describes the operational and water quality modeling conducted to develop the evaluation metrics, followed by the evaluation of the performance of the alternative plans.

CCWD System Operations and Water Quality Modeling

To quantify and compare accomplishments and benefits of the alternative plans, computer modeling was used to simulate CCWD system operations under each of the alternative plans, including the No-Action Plan. Computer modeling used historical California hydrology data to represent the variety of historically accurate weather and hydrologic patterns, including wet periods and droughts, under which the CCWD system would be operated. It should be noted that historic Delta operations were not used in the modeling; rather, the historic hydrologic data were used in conjunction with modeled operations to represent future conditions. For the purpose of this analysis, “future conditions” were based on forecasted 2020 Delta demands and reasonably foreseeable Delta projects and facilities. The historic hydrologic data used as input were from a 73-year (1922 through 1994) period of hydrologic record. Details of the modeling approach and results are documented in Appendix A (AIP EIR/EIS, 2006) and Appendix B (operations and water quality modeling for Alternative Plan 3).

Under the alternative plans, operations of the CCWD system would change in response to the different strategies employed to achieve the study planning objectives. These changes in CCWD operations can be described using the distribution of CCWD average annual diversions between CCWD intakes (Figure 4-7). Under the No-Action Plan (future without-project condition), most CCWD supplies would be diverted from the Old River intake (approximately 73 percent), with Rock Slough and Mallard Slough contributing 23 percent and 5 percent, respectively. Under the three alternative plans, diversions would be shifted away from both the Old River and Rock Slough intakes to improve delivered water quality, while maintaining the same levels of diversion from the Delta. Plan 1 would shift these diversions to a new intake on Victoria Canal. Plan 2 would shift these diversions to an expanded Mallard Slough intake. Plan 2 would also slightly increase overall diversions by about 3 TAF due to generation of desalination byproduct. Plan 3 would shift these diversions to a new intake on the Middle River.

These shifts in the location of diversions would also be accompanied by a shift in the timing of diversions. Because of better source water quality at the new intake locations, access to better quality water during the late summer and early fall periods would allow for more Delta diversions during these periods, reducing blending demands on Los Vaqueros Reservoir (Appendix A and B). Decreasing the demand on reservoir supplies for blending would increase overall reservoir storage, and allow CCWD to enter critically dry periods with comparatively more storage in Los Vaqueros Reservoir, eliminating or postponing the depletion of stored blending water supply during these periods. The implication of these changes in operation for delivered water quality, fisheries protection, and reliability during emergencies is discussed in the following sections.

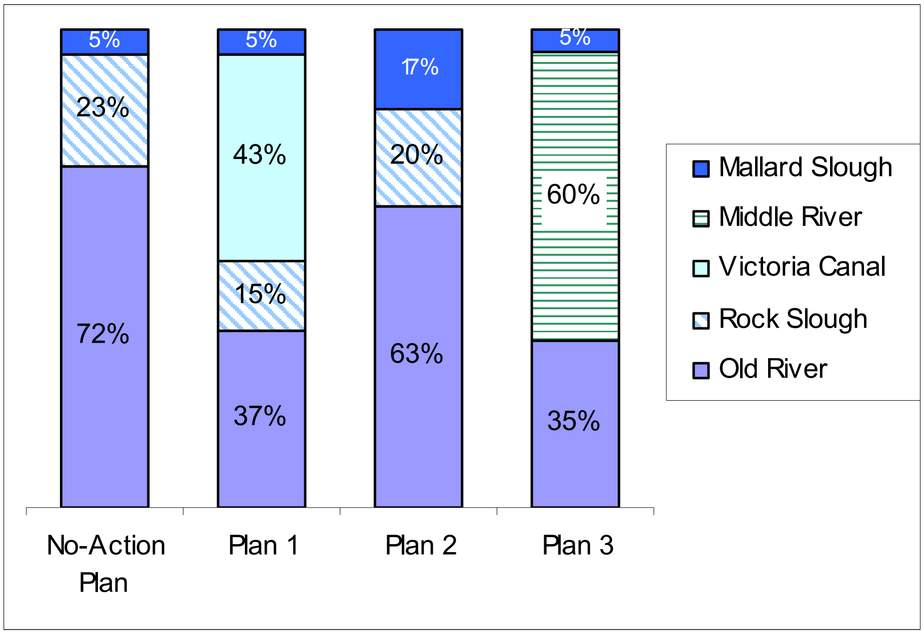


Figure 4-7. Comparison of the Long-Term Average Distribution of CCWD Diversions Under the Alternative Plans

Evaluation of Plan Performance

The evaluation is broken into three subsections corresponding to the planning objectives: (1) maintaining and improving quality of delivered supplies to CCWD customers, (2) protecting and improving fisheries conditions around CCWD's intakes, and (3) improving reliability and maintaining quality of delivered supplies during emergencies.

Improving and Maintaining Delivered Water Quality

Plan 1 would allow CCWD to access better water quality from Victoria Canal during key periods (particularly late summer, early fall, and drought periods) and deliver it to Los Vaqueros Reservoir or the CCWD service area through the Old River conveyance system. Plan 2 would provide improved water quality to the Bollman WTP service area through desalination of expanded Mallard Slough diversions. Plan 3 would allow CCWD to replace Rock Slough diversions with higher quality water from the Middle River that would be delivered to the CCWD service area through the Contra Costa Canal. Each of these plans would enable CCWD to protect and improve the quality of water deliveries to its customers. Table 4-1 quantifies and compares the expected water quality improvements under each of the concept plans based on the modeling results (Appendix B). It should be noted that although results in Table 4-1 are presented for chlorides, they would be indicative of overall salinity changes in CCWD delivered water quality, including bromide and TDS.

Water quality modeling results, based on the 73-year period of hydrologic record, are summarized using four metrics that measure chloride in CCWD's delivered supplies. These metrics are (1) percentage of time that deliveries meet CCWD's chloride goal of 65 mg/L, (2) long-term average delivered chloride concentration (mg/L), (3) longest duration of consecutive months in which delivered chloride concentration exceeds the goal of 65 mg/L, and (4) maximum delivered chloride concentration (mg/L). The first two metrics assess the expected long-term water quality improvements. The other two metrics assess the water quality improvements during extended multiyear droughts when available water for blending in Los Vaqueros Reservoir would be exhausted and CCWD would have to deliver water directly from its Delta intakes to customers.

Table 4-1 and Figure 4-8 show that all alternative plans (Plans 1 through 3) would improve quality of delivered supplies compared to the No-Action Plan. Plan 3 would slightly outperform Plan 1 according to all water quality metrics, especially in reducing the length of the period during which the water quality goal is exceeded. Plan 2 would significantly improve water quality for treated water customers served by the Bollman WTP because the desalination plant would allow deliveries of 65 mg/L chlorides or less at all times to the Bollman WTP service area (approximately 30 percent of CCWD deliveries). However, Plan 2 would only result in modest gains in water quality improvements for the Randall Bold WTP service area and untreated-water customers, which represent 70 percent of CCWD deliveries. These modest water quality improvements in this part of CCWD's service area would be realized because the desalination plant would reduce the demand on Los Vaqueros blending water.

Table 4-1. CCWD Delivered Chloride Performance Under Alternative Plans

Alternative Plans	% of time Chloride ≤ 65 mg/L		Average Delivered Chloride		Longest Duration Chloride > 65 mg/L		Maximum Delivered Chloride	
	%	Change[1] (%)	mg/L	Change[1] (%)	Months	Change[1] (%)	mg/L	Change[1] (%)
No-Action Plan	86%	-	55	-	16	-	250	-
Plan 1	95%	+9%	46	-16%	10	-38%	125	-50%
Plan 2[2]	90%	+4%	53	-4%	15	-6%	250	0%
Plan 2[3]	100%	+14%	40	-27%	0	-100%	65	-74%
Plan 3	96%	+10%	43	-22%	6	-63%	119	-52%

Notes:
[1] Change with respect to the future without-project condition (i.e., the No-Action Plan)
[2] Plan 2 water deliveries to the Randall-Bold WTP treated-water service area and untreated-water customers (approximately 70 percent of CCWD deliveries).
[3] Plan 2 water deliveries to the Bollman WTP service area from the desalination treatment plant (30 percent of CCWD deliveries).

Key:
CCWD = Contra Costa Water District
mg/L = milligram per liter
WTP = water treatment plant

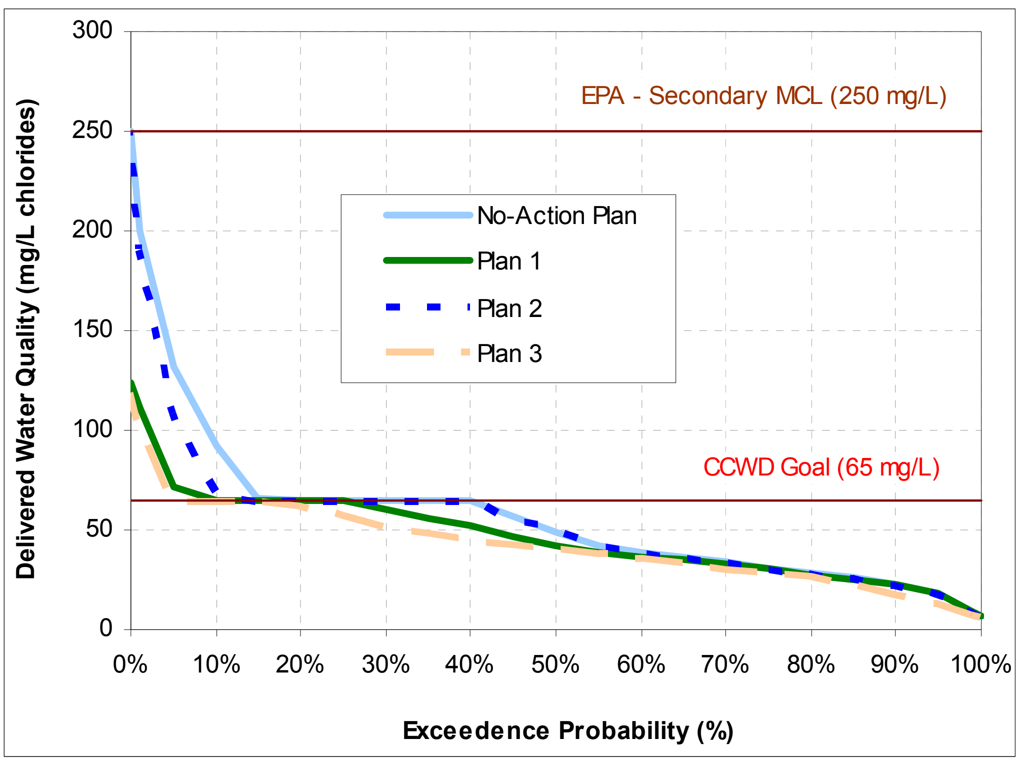


Figure 4-8. Comparison of Delivered Water Quality for the Alternative Plans

Protecting and Improving Fisheries Conditions

The greatest impacts to fisheries from operation of CCWD's intakes are associated with operations of the unscreened Rock Slough intake. Improvements in fisheries conditions could result from reducing diversions from the unscreened intake, especially during critical fish periods. Table 4-2 summarizes the reductions in diversions from the unscreened Rock Slough intake based on the simulated 73-year hydrologic record. All three alternative plans would reduce Rock Slough diversions compared to the future-without project condition, both on an annual basis and during spring. Plan 1 would relocate a portion of Rock Slough pumping to the Old River intake or the new Victoria Canal intake. Plan 2 would shift some of the CVP water right diversions at Rock Slough to the Mallard Slough intake. Plan 3 would relocate the Rock Slough intake to a new screened intake on the Middle River. Based on Table 4-2, Plan 3 would result in the greatest expected fisheries benefits because it would relocate 100 percent of the diversions at the unscreened Rock Slough intake to a new screened intake on the Middle River. Plan 1 would outperform Plan 2 in terms of reducing diversions at the Rock Slough intake.

Table 4-2. Comparison of Rock Slough Diversions Under Alternative Plans

Alternative Plans	Average Annual Diversion		Average Spring Diversions	
	TAF	Change[1] (%)	TAF	Change[1] (%)
No-Action Plan	37.7	-	14.8	-
Plan 1	23.8	-37%	13.9	-6%
Plan 2	33.8	-10%	14.2	-4%
Plan 3	0.0	-100%	0.0	-100%

Notes:
[1] Change with respect to the No-Action Plan

Key:
TAF = thousand acre-feet

To assess the impacts of changes in diversions on fish species, modeling results of the 73-year hydrologic record were used to investigate the potential effects of the alternative plans on habitat conditions supporting fish and macroinvertebrates. Comparative analysis between the future without-project conditions and the Project alternatives was conducted to assess changes in potential entrainment and impingement losses in the vicinity of CCWD's intakes. Table 4-3 summarizes the indices of estimated net fisheries entrainment and/or impingement losses for the Project alternatives compared to the No-Action Plan. It should be noted that fish indices provide relative comparison basis, not actual numbers of fish.

All three plans show significant benefits to fisheries at the Rock Slough intake because of the reduced diversions and resultant decrease in fish entrainment at the intake. Additional fisheries benefits would also occur as a result of shifting some diversions away from the Old River intake. However, since overall levels of CCWD diversions would remain the same under the three plans, reduced diversions at the Rock Slough and Old River intakes would be compensated for by increased diversions at different locations (i.e., Victoria Canal under Plan 1, Mallard Sough under Plan 2, and the Middle River under Plan 3). Therefore, some impacts to fisheries associated with increased diversions would occur around these locations (see Table 4-3). Overall, Plan 1 and Plan 3 would result in net benefits to fisheries because of the large reduction of diversions at the Rock Slough intake. Plan 2 would also result in net benefits to most fish species except delta smelt because larval delta smelt would be adversely impacted by increased diversions from Mallard Slough.

Table 4-3. Index of Estimated Net Fish Entrainment/Impingement Losses Under Alternative Plans Compared to the No-Action Plan

Taxa	Rock Slough	Old River	Mallard Slough	Victoria Canal	Middle River	Overall Net Change
Plan 1 Compared to the No-Action Plan						
Larval delta smelt	-730	-2,404	0	1,619	-	-1,515
Juvenile Chinook salmon	-251	-61	0	45	-	-267
Juvenile delta smelt	-93	-52	0	25	-	-120
Juvenile splittail	-1,669	-174	0	175	-	-1,668
Juvenile steelhead	-13	-202	0	2	-	-213
Juvenile striped bass	-13,541	-1,422	0	1,582	-	-13,381
Plan 2 Compared to the No-Action Plan						
Larval delta smelt	-484	-876	6,811	-	-	5,451
Juvenile Chinook salmon	-122	-13	9	-	-	-126
Juvenile delta smelt	-45	-4	5	-	-	-44
Juvenile splittail	-527	-11	28	-	-	-510
Juvenile steelhead	-4	-1	0	-	-	-5
Juvenile striped bass	-4,171	-139	296	-	-	-4,014
Plan 3 Compared to the No-Action Plan						
Larval delta smelt	-5,291	-1,408	0	-	928	-5,771
Juvenile Chinook salmon	-1,071	-47	0	-	70	-1,049
Juvenile delta smelt	-570	-15	0	-	39	-546
Juvenile splittail	-25,714	113	0	-	1,054	-24,547
Juvenile steelhead	-24	-4	0	-	3	-25
Juvenile striped bass	-94,464	-615	0	-	4,904	-90,175

Notes:
Negative values denote a net reduction in entrainment/impingement, (i.e., fisheries improvement benefit).

Plan 3 would result in the greatest benefits to fisheries because it would eliminate fish entrainment caused by the operations of the Rock Slough intake (i.e., 100 percent reduction in fish losses compared to the No-Action Plan).

Plan 1 would reduce fish impacts at the Rock Slough intake by 21 percent, on average, compared to the No-Action Plan (actual reduction ranges between 14 percent and 56 percent for species presented in Figure 4-9). Plan 2 would reduce fish impacts at the Rock Slough intake by 9 percent, on average, compared to the No-Action Plan (actual reduction ranges between 2 percent and 17 percent for species presented in Figure 4-9).

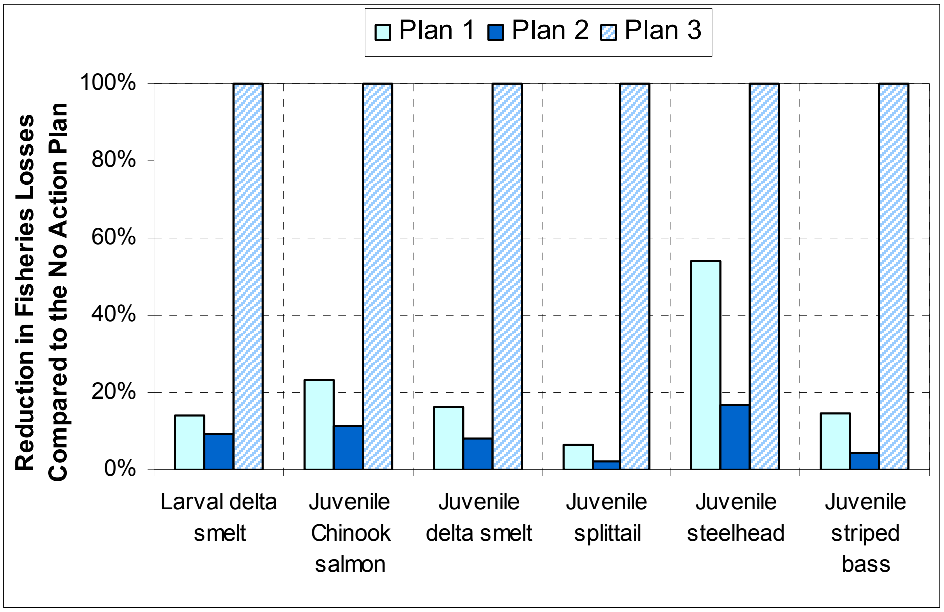


Figure 4-9. Reduction in Fisheries Losses at Rock Slough Intake Under the Alternative Plans Compared to the No-Action Plan

Maintaining Reliable Quality of Delivered Supplies During Emergencies

Improving the reliability of CCWD's system to deliver water supplies of adequate quality during emergencies could be achieved through two primary mechanisms: (1) increasing operational flexibility of the system by providing additional intake locations on the Delta that would allow shifting of diversions in case of rapid deterioration in water quality at a certain intake, and (2) increasing carryover storage in Los Vaqueros Reservoir by reducing demand on reservoir releases for blending, such that more storage would be available during emergencies. Demands on Los Vaqueros Reservoir could be reduced if adequate water quality for direct delivery to CCWD customers could be increased. Providing CCWD with better water quality at its intakes or through additional treatment (i.e., desalination) would require less blending water to be released from Los Vaqueros Reservoir to meet the delivered water quality goal of 65 mg/L chloride.

Contribution of operational flexibility to system reliability is highlighted by the June 2004 levee break on Jones Tract that forced CCWD to temporarily cease diversions at the Old River intake and use the Rock Slough intake because of water quality concerns associated with the levee break. More widespread or severe levee breaks during critical periods could result in serious impacts on CCWD's ability to maintain its deliveries. Moreover, increasing operational flexibility would also contribute to overall improvement of delivered water quality with respect to constituents of concern, such as organic carbon. For example, CCWD could respond to events in the Delta that affect constituents other than salinity by shifting diversions between intakes, as well as by making adjustments at the treatment plants.

Two metrics are used to measure how each alternative plan would contribute to improving system reliability during emergencies. These metrics are (1) number of Delta intakes available for CCWD that serve as a surrogate for operational flexibility, and (2) increase in carryover storage in Los Vaqueros Reservoir as a result of reduced demands on water for blending. Carryover storage in Los Vaqueros is evaluated both over the 73-year hydrologic record, representing a long-term average, and also during critical dry years. Table 4-4 summarizes the reliability performance of the alternative plans.

Plans 1 and 3 would result in the largest emergency reliability improvement benefits over the No-Action Plan, with Plan 3 slightly outperforming Plan 1. Table 4-4 shows that CCWD would have access to four Delta diversions points under Plan 3. This is based on the assumption that although Plan 3 would relocate Rock Slough intake to the Middle River, diversions from Rock Slough would still be possible during emergency conditions. Plan 2 would provide limited emergencies supply benefits primarily because deliveries from the desalination plant are limited to the Bollman WTP service area (30 percent of CCWD's deliveries).

Table 4-4. Comparison of CCWD System Reliability During Emergencies Under the Alternative Plans

Alternative Plans	Number of CCWD Delta Intakes	Average Los Vaqueros Storage		Average Los Vaqueros Storage in Critical and Dry Years	
		TAF	Change[1] (%)	TAF	Change[1] (%)
No-Action Plan	3	77	-	49	-
Plan 1	4	86	+12%	56	+14%
Plan 2	3	80	+4%	52	+6%
Plan 3	4[(2)]	89	+16%	60	+22%

Notes:
[1] Change with respect to the future without-project conditions (i.e., the No-Action Plan)
[2] Assumes that diversions from Rock Slough would be possible during emergency conditions.
Key:
- = N/A
CCWD = Contra Costa Water District
TAF = thousand acre-feet

Summary of Effects on Significant Environmental Resources

This section summarizes and compares the environmental effects of each of the alternative plans on the significant resources in the study area. Discussion of significant resources is limited to Delta water resources, including local hydrology and water quality, Delta fisheries and aquatic resources, and wildlife and other terrestrial resources. The analysis presented in this section is largely based on the Project EIR/EIS.

Delta Water Resources

The AIP is a water quality project, with additional benefits to fisheries and reliability improvement, and is not a water supply project. None of the alternative plans would result in increase in water supply for CCWD. These plans would rely on CCWD's existing CVP, Los Vaqueros, and Mallard Slough water rights. Plans 1 and 3 would shift the timing of some CVP diversions, but the diversion locations would remain in the central Delta. The impact of these shifts in the timing of some diversions would be negligible, and the water supplies of the CVP, SWP, or other Delta users would not be affected. Computer simulation of CCWD's water system confirmed that no significant long-term effects on Delta water supplies and Delta water levels would be expected from any of the alternative plans.

Plan 2 would result in a slight increase in CCWD's Delta diversions due to losses in the desalination process. This increase in diversions would be about 3 thousand acre-feet (TAF)/year on average, a portion of which would be returned to the Delta as concentrate discharge. Plan 2 would also include shifting some of CCWD's diversions from the central Delta to the western Delta (i.e., shifting diversions to the Mallard Slough intake). However, the effects of both of these changes would not be detectable in Delta outflow and would not adversely affect any other Delta water supplies.

Modeling results also show that water quality changes resulting from the operational changes associated with the alternative plans would be too small to adversely affect Delta diversions, CVP/SWP operations, or other beneficial uses. Based on the results of the 16-year Delta Simulation Model (DSM2), there would be no significant changes in water quality at key Delta stations, including Chipps Island, Collinsville, Jersey Point, Emmaton, and Rock Slough. Plan 2 would discharge concentrate byproducts from the desalination process into Suisun Bay. However, these discharges would not result in substantial water quality degradation that would adversely affect beneficial uses in Suisun Bay. Therefore, overall, no significant effects on Delta water resources would result from the alternative plans under consideration.

Local Hydrology and Water Quality

While Plans 1 and 3 could result in potentially significant impacts related to the temporary degradation of surface water quality as a result of construction activity, these impacts would be reduced to a less-than-significant level with the preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP). These two alternatives also have the potential to make a considerable cumulative contribution to temporary water quality degradation if constructed simultaneously with some of the SDIP construction activities; however, coordination with SDIP construction activity to minimize simultaneous in-water construction and cumulative water quality effects would reduce this cumulative impact to a less-than-significant level.

Plans 1 and 3 would result in less-than-significant impacts related to the potential contribution of project facilities to flooding. While Plan 2 would result in a potentially significant flooding impact associated with the addition of impervious surfaces at the Bollman WTP site, this impact would be reduced to a less-than-significant level with the preparation of a drainage study and implementation of the resulting recommendations.

Plans 1 and 3 would result in less-than-significant impacts related to changes in local flooding potential as a result of levee modifications. Construction activities at the intake/pump station site on Victoria Canal and on the Middle River have the potential to weaken the local levee system and increase the possibility of flooding. However, the levee construction method and planned improvements to the levee at the location of the intake sites would ensure that levee stability would be increased over existing conditions. Plan 2 would have no impact related to levees.

Delta Fisheries and Aquatic Resources

All three alternative plans would result in a beneficial impact with respect to net fish losses through entrainment and impingement because some or all pumping would be relocated from the unscreened Rock Slough intake to screened intakes, where fisheries impacts would be limited. Figure 4-10 summarizes the reduction in fisheries losses due to entrapment and impingement under the three alternative plans compared to the No-Action Plan. The net benefit for fisheries would be greatest under Plan 3 because it would enable CCWD to relocate all of the current Rock Slough diversions to a new screened intake on the Middle River. Plan 2, which relocates a portion of Rock Slough diversions to Mallard Slough, would result in the lowest overall net benefits. Under Plan 2, most fisheries species would experience net benefits, except delta smelt because larval delta smelt would be adversely impacted by increased diversions from Mallard Slough.

During construction, all three alternative plans would adversely affect fisheries and aquatic resources because of underwater sound pressure impacts, potential chemical spills, and fish and macroinvertebrate stranding. All of these construction-related effects are expected to be reduced to a less-than-significant level with mitigation. In addition, Plan 2 would also result in a potentially significant impact because of saline discharges from the new concentrate disposal pipeline. However, this impact would be reduced to a less-than-significant level through mitigation. It should be noted that these saline concentrate discharges to Suisun Bay would require a discharge permit from the SFBRWQCB and would conform to the SFBRWQCB Basin Plan.

Terrestrial Biological Resources

All three alternative plans would result in less-than-significant direct and cumulative impacts (with mitigation) to sensitive habitat, and special-status wildlife and plant species.

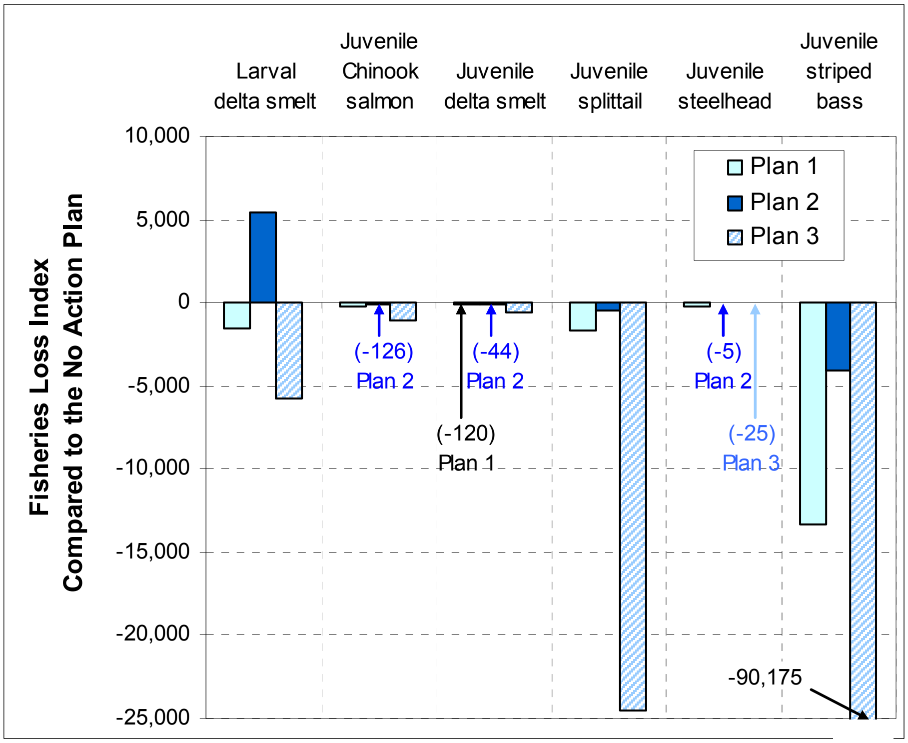


Figure 4-10. Fisheries Impacts Due to CCWD Diversions Under the Alternative Plans Compared to the No-Action Plan

Significant Effects on Other Resources

Based on the environmental resource evaluations presented in the Project EIR/EIS, the alternative plans would result in adverse environmental effects to the resource areas of agricultural and air quality that cannot be reduced to a less-than-significant level. The facilities associated with Plans 1 and 3 would require permanent conversion of approximately 6 to 10 acres of Prime Farmland and Farmland of Statewide Importance. Construction activities associated with all plans would result in short-term direct and/or cumulative construction emissions of criteria air pollutants. In addition, these activities would result in short-term construction-related impacts such as interference with local traffic and circulation, increase in ambient noise levels, dust generation, disturbance of wildlife, etc. However, these impacts would be temporary, occurring only during construction, and would not alter long-term productivity of the natural environment.

Mitigation and Environmental Monitoring

The alternative plans under consideration would generally have low potential to cause adverse effects to special-status species and their habitats. Moreover, for fish species, the alternative plans would have a long-term beneficial effect by reducing net fish entrainment and impingement losses at CCWD intakes (amount of benefits would vary by plan). As part of designing, constructing, and operating the alternative plans, however, a suite of monitoring and mitigation/conservation measures would be implemented to avoid and minimize the potential effects to fisheries and aquatic resources, including incidental take and adverse effects on habitat. These mitigation measures and monitoring plans would typically be developed as an ASIP in coordination with CCWD and appropriate fisheries and wildlife agencies. This section summarizes the likely mitigation measures and monitoring plan associated with an ASIP for the alternative plans under consideration.

Mitigation Measures

Based on the evaluation of the potential direct and indirect adverse effects associated with construction of the alternative plans, a series of mitigation/conservation measures was identified. These conservation measures are designed to reduce and avoid incidental take of special-status species, as well as protect their critical habitat. Key conservation measures that would serve to protect and minimize impacts to fisheries are summarized below:

- Minimize turbidity, sedimentation, and other water quality impacts during construction
- Implement measures to reduce and/or avoid underwater sound pressure impacts
- Develop and implement a hazardous materials control and spill prevention and response plan to prevent/avoid hazardous materials impacts
- Develop and implement a fish rescue program during construction to prevent stranding in the cofferdam
- Compensate for the permanent loss of shallow water aquatic habitat at the intake site
- Minimize fish entrainment and impingement at the new intake site

Key conservation measures that would serve to protect and minimize impacts to special-status plants and wildlife species and their habitat are summarized below:

- Minimize potential fill of jurisdictional waters of the United States and loss of sensitive habitat, and compensate for unavoidable impacts
- Minimize potential effects on special-status plants, and mitigate for loss, if required
- Implement measures as needed to minimize potential effects on giant garter snake
- Conduct surveys and implement protective measures, if needed, to minimize potential effects on Swainson's hawk, white-tailed kite, northern harrier, and other raptors
- Conduct surveys and implement protective measures, if required, to minimize potential effects on burrowing owl, western pond turtle, and tricolored blackbird, if required

Environmental Monitoring Plan

To determine the actual effects of the project on protected species and their habitats and to document the implementation and effectiveness of the mitigation/conservation measures, a monitoring plan would be developed and implemented in coordination with CCWD and the appropriate resource agencies. Information gathered during monitoring would be used to adaptively manage implementation of the measures. The monitoring plan would also be developed in conjunction with Mitigation Monitoring and Reporting Program requirements under CEQA so that the plan meets both ASIP and CEQA monitoring requirements.

Monitoring objectives, methods, schedule, and duration would be developed individually for each mitigation/conservation measure. Monitoring methods, schedule, and duration would vary between conservation measures. Primarily, the duration of monitoring would be through the construction period. The only long-term monitoring would be fish screen monitoring.

Construction-related impacts could affect both aquatic and terrestrial resources. Consequently, monitoring of both aquatic and terrestrial habitats should be incorporated during construction activities. Monitoring throughout the construction period, with notification of appropriate agencies as needed, would occur and would be specific to each conservation measure.

Long-term monitoring of O&M of the fish screen would be conducted. Monitoring would include approach velocity measurements and periodic visual inspections to remove accumulated debris and repair screen panels as necessary.

Fish screen efficiency and effectiveness tests would be reported to the appropriate fisheries agencies to confirm that the fish screen meets the required approach velocity.

Long-term monitoring would also incorporate entrainment monitoring for fish eggs, larvae, and juveniles at the new intake consistent with the ongoing fishery monitoring being conducted at other CCWD facilities. These monitoring activities and their frequency would be periodically reviewed for modification or discontinuation in coordination with appropriate fisheries agencies.

Adaptive Management Plan

CCWD would adaptively respond to ongoing environmental issues associated with Delta conditions that are related to, or substantially affected by, construction and operation of any of the considered alternative plans. The conservation measures would form the basis for developing the adaptive management plan. In addition, results of performance monitoring as part of routine intake operations would also provide information that would be used by CCWD to consider feasible adjustments to Project facilities' operations and/or maintenance. Adaptive management would typically follow an iterative approach to long-term management of natural communities, habitat types, and species within the Project area.

Plan Features and Costs

This section describes total implementation costs for alternative plans, including construction costs, annual O&M, and replacement costs. Construction cost estimates include appropriate factors for contingencies, indirect costs, and interest during construction. Cost estimates developed in this section are at the appraisal-level, per Reclamation guidance, and are primarily used to compare alternative plans. Table 4-5 summarizes physical features of the alternative plans that are included in the cost estimate.

Table 4-5. Physical Features Summary for the Alternative Plans

Physical Features	Description		
	Plan 1	Plan 2	Plan 3
Screened Intake [1]	1,250 ft² effective screen area	350 ft² effective screen area	1,750 ft² effective screen area
Raw Water Pumping Station	250 cfs, 316 feet total head	72 cfs, 188 feet total head	340 cfs, 354 feet total head
Power Supply	20,000 feet of transmission lines	-	5 miles of transmission lines
Levee Improvements [2]	1,200 feet of levees	-	1,200 feet of levees
Raw Water Conveyance [3]	14,000 feet, 66-inch diameter	40,000 feet, 42-inch-diameter	30,000 feet, 78-inch-diameter
Wide Channel Crossings [4]	1,100 feet, 78-inch diameter	-	2,000 feet, 90-inch-diameter
Desalination Facilities [5]	-	70 mgd reverse osmosis filtering facility	-
Desalination Concentrate Discharge Pumping Station	-	12 mgd (18 cfs), 100 feet total head	-
Desalination Concentrate Discharge Pipeline	-	15,000 feet, 24-inch diameter	-
Desalination Concentrate Discharge Offshore Outfall	-	2,000 feet, 24-inch-diameter	-
Land	6 to 8 acres	-	8 to 10 acres

Notes:
[1] Flat panel rectangular wedge-wire fish screen, including a cleaning mechanism (similar to the Old River intake's fish screen design). Effective screen area is based on diversion capacity and desirable approach velocity of 0.2 feet per second.
[2] Levee improvements include relocating and reinforcing existing levees (see Figure 4-2).
[3] Material for conveyance pipeline would be either reinforced concrete cylinder pipe (RCCP) or welded steel pipe (WSP). Pipeline construction method would be conventional open trench.
[4] Channel crossings would be achieved using microtunneling.
[5] Pretreatment and posttreatment and solids handling for the desalination plant would be provided through existing facilities at the Bollman WTP.

Key:
- = N/A
cfs = cubic feet per second
ft² = cubic feet
mgd = millions gallon per day
WTP = water treatment plant

Construction Cost

Designs and costs for alternative plans are based primarily on the design cost estimate developed for Plan 1 (CCWD, 2006) and appraisal-level cost estimates developed for the Los Vaqueros Expansion Investigation (Reclamation, 2006). Unit costs were updated to 2006 prices using the Engineering News Record construction cost index (CCI) for the San Francisco region. The total construction cost includes 15 percent for unlisted items and an additional 25 percent contingency, per Reclamation guidance for appraisal-level cost estimates. To obtain an estimate of total implementation cost, 25 percent was added to the total field cost to account for engineering design, construction inspection, administrative, and legal costs.

Interest during construction (IDC), which accounts for costs incurred during the construction period, is computed using the Federal discount rate of 4 ⅞ percent from the construction start date to the beginning of the period of analysis, and assuming a construction duration of 3 years. IDC is applied to total field cost (including unlisted items and contingencies, but excluding engineering design, inspection, administrative, and legal costs). IDC was calculated based on 2006 construction dollars.

Annual Operation, Maintenance, and Replacement Costs

Annual O&M and replacement values were developed as percentages of facility design and construction costs (including unlisted items and contingencies). The O&M percentages are based partially on industry averages but primarily on actual O&M costs incurred by CCWD for the existing Los Vaqueros Project. Annual O&M factors are 0.5 percent for pipelines, 1.0 percent for intake facilities and the pumping station, 1.0 percent for the desalination plant, and 0.8 percent for power supply facilities.

Replacement cost is 35 percent of design and construction costs for each replacement cycle over the 40 years project life. Life cycle for all facilities is assumed to be 40 years, except the desalination plant (7-year replacement cycle). Therefore, replacement costs are only calculated for the desalination plant.

Power costs would include pumping costs associated with the operation of Delta intakes, as well as energy costs required for the desalination plant. The alternative plans would affect pumping volumes and timing at CCWD's Rock Slough, Old River, and Mallard Slough intakes, as well as the Los Vaqueros Transfer Pumping Plant. Therefore, energy costs are reported as net energy costs, which are estimated as the difference in pumping costs between the with-project and without-project conditions at these facilities. An average rate of $0.10 per kilowatt-hour (kWh) was used to estimate the cost of pumping.

Costs Not Included

Costs not included in this initial economic analysis include the following:

- Mitigation costs were not directly calculated, but are believed to be represented within the appraisal-level provisions for unlisted items and contingencies.
- Avoided costs related to O&M or replacement of existing facilities that would be replaced or abandoned are not considered in this analysis.
- Land acquisition costs do not include easements for long-term access to facilities or temporary construction easements. These easements fee could potentially cost more than the land acquisition costs.

Summary of Plan Cost

Project costs for the three alternatives evaluated in this report are summarized in Table 4-6.

Table 4-6. Summary of Alternative Plans Appraisal-Level Cost Comparison

Component	Cost Estimate ($millions)[1]		
	Plan 1	**Plan 2**	**Plan 3**
Screened Intake and Pumping Station	$12.76	$9.46	$17.02
Levee Improvements	$6.90	$-	$6.90
Power Supply (transmission lines)	$1.50	$-	$1.98
Raw Water Conveyance	$14.60	$26.00	$46.62
Wide Channel Crossing (microtunneling)	$11.92	$-	$27.10
Desalination Facilities	$-	$205.00	$-
Concentrate Discharge Pumping Station	$-	$3.30	$-
Concentrate Discharge Pipeline	$-	$5.40	$-
Concentrate Discharge Outfall	$-	$1.20	$-
Total Field Cost	**$47.68**	**$250.36**	**$99.62**
Unlisted Items @ 15%	$7.15	$37.55	$14.94
subtotal	$54.83	$287.92	$114.56
Construction Contingency @ 25%	$13.71	$71.98	$28.64
Total Construction Cost	$68.54	$359.90	$143.21
Indirect Costs @ 25 %[2]	$17.13	$89.97	$35.80
subtotal	$85.67	$449.87	$179.01
Interest During Construction (IDC)[3]	$6.43	$ 33.75	$13.43
Land Acquisition[4]	$2.00	$-	$2.50
Total Implementation Cost	**$94.11**	**$483.63**	**$194.95**
	Annual Cost ($millions/year)		
Annualized Implementation Cost over 40 Years	$5.40	$33.17	$11.17
Annual O&M[5]	$0.39	$3.31	$0.80
Annual Net Additional Energy Cost[6]	$0.01	$5.81	$0.02
Annualized Replacement Cost[7]	$-	$11.78	$-
Annualized Project Cost over 40 Years	**$5.80**	**$54.07**	**$11.99**

Notes:
[1] Appraisal-level cost estimates are in 2006 dollars, and are based on predesign cost estimates developed by CCWD for Plan 1 (Victoria Canal intake). Costs do not specifically include environmental mitigation.
[2] Indirect costs include engineering, administrative, and legal fees.
[3] Interest during construction is based on an assumed construction period of 3 years. Federal discount rate used is 2006 rate of 4 ⅞ percent.
[4] Land acquisition costs do not include long-term or temporary construction easements.
[5] Annual O&M factors are 0.5 percent for pipelines, 1.0 percent for intake facilities and pumping station, 1.0 percent for desalination plant, and 0.8 percent for power supply facilities.
[6] Net additional energy costs are the incremental energy costs above the project costs for the No-Action Plan (i.e., future without-project condition).
[7] Annualized replacement costs are calculated for components with life cycle less than 40 years. Only the reverse osmosis desalination treatment components have a life cycle of less than 40 years (7-year life cycle is assumed in this analysis). Federal discount rate used is 2006 rate of 4 ⅞ percent.

Key: - = NA   CCWD = Contra Costa Water District   O&M = operation and maintenance

Economic Analysis

This section describes the methods used to estimate project benefits, and derive the total annual equivalent benefits. It also develops preliminary economic evaluation of Project alternative plans.

Economic Valuation Methods

Consistent with Federal economic principles for evaluation of Federal water resources projects, market-based techniques will be used to value the benefits of Project alternatives. Market values may be determined by one of two basic methods: user-value (willingness to pay) or least-cost alternative to accomplish the same goals. The user-value, or willingness to pay, method refers to the maximum value of the resource to the consumer, which can be estimated using market marginal valuation or willingness to pay surveys. The least-cost alternative method identifies the lowest cost for meeting a particular objective, and the net benefit would be calculated by subtracting the cost of the project alternative under consideration from the identified lowest cost alternative. The application of these methods to the three objectives of the Project is described in the following sections.

Improving and Maintaining Delivered Water Quality

Benefits resulting from water quality improvements through the Project would include improved health, safety, and aesthetic aspects of water deliveries, cost savings from reduced treatment requirements, and cost savings to consumers. Potential approaches for directly evaluating these benefits are summarized below:

- Valuation of improvements to health, safety, and aesthetic aspects of delivered water is difficult to develop because without-project water quality levels already meet all current Federal and State standards and regulations for water quality. A potential approach to value these benefits is to use contingent valuation, by which direct questioning or surveys can be used to elicit customers' willingness to pay for improvements in water quality. However, these surveys can be difficult and costly to perform and results may be biased.

- Improvements in raw water quality, such as lower turbidity, TOC, and bromides, can reduce municipal water treatment costs. Savings in WTP operating costs might include the avoided cost of advanced treatment, reduced energy or chemical use, or other operating efficiencies.

- Consumer cost savings related to water quality can be estimated by considering the number of households receiving benefits related to (1) reduced bottled water purchases, (2) longer life of household appliances, plumbing, and fixtures, (3) lower use of home water softeners, and/or (4) reduced purchases of soaps and detergents. These benefits would occur when water supplies with lower TDS and total hardness are delivered to households served by WTPs that receive water supply with improved quality. The economic benefit would then be estimated from the consumer cost savings. However, it should be noted that, to realize some of these consumer savings, improvement in water quality needs to be significant enough for consumers to detect to induce behavioral changes (e.g., reduce the use of bottled water).

Indirect valuation of water quality improvement benefits can also be achieved using the least-cost method. Using the least-cost method, water quality benefits are estimated using the avoided cost of the next least-cost alternative that would produce equivalent water quality improvements. Under the Project, the primary improvements in water quality are the reduced salinity and bromide concentration in delivered water. Achieving similar reductions in salinity and bromide would require either (1) blending supplies with better source water quality, or (2) desalination of a portion of the delivered water supplies.

Protecting and Improving Fisheries Conditions

Reduced diversions at the unscreened Rock Slough intake would provide an overall benefit by reducing net entrainment and impingement losses at Rock Slough compared to the No-Action Plan. The fisheries benefit of diverting water through a screened intake versus an unscreened intake could be valued by estimating the avoided cost of equivalent fish screens at Rock Slough.

For this analysis, the least-cost approach based on the equivalent cost of fish screens at Rock Slough will be used to develop a surrogate monetary value for fisheries benefits. This approach may represent a more direct approach to value the contribution of the Project to fisheries protection around the Rock Slough intake.

Maintaining Reliable Quality of Delivered Supplies During Emergencies

Reliability benefits to the CCWD system during water emergencies are evaluated based on the increased operational flexibility of the system gained by providing additional intake locations on the Delta, and increased carryover storage in Los Vaqueros Reservoir because of the reduced demand for blending water. Emergency supply benefits may be estimated using a combination of reduced conservation costs, avoided damage costs during shortages, and/or avoided cost of providing short-term water supplies. Contingent valuation or customers’ willingness to pay to avoid shortages can also be used. Valuation of the reliability benefits of the Project can be achieved by considering the likelihood of an emergency event (e.g., a seismic event resulting in water supply infrastructure damage), and the value of the emergency water supply.

For this analysis, valuation of the emergency supply benefits of the Project will primarily focus on increased emergency storage in Los Vaqueros Reservoir. Valuation of the contribution of increased operational flexibility to emergency supply benefits will not be developed in this analysis because the relative contribution of operational flexibility would be small compared to increased Los Vaqueros storage. This is due to the small probability associated with an event that only restricts the operations of CCWD's existing intakes, but not the new intake added under the Project.

Preliminary Valuation of Benefits

This section develops preliminary monetary valuation of benefits associated with the Project alternative plans. The monetary valuation of each category of benefits (i.e., water quality improvement, fisheries protection, and emergency supply reliability) presents a potential range of the estimated benefits based on the approach discussed in the preceding sections.

Valuation of Water Quality Improvement Benefits

Valuation of water quality improvement benefits includes valuing improved health, safety, and aesthetic aspects of water deliveries, cost savings from reduced treatment requirements, and cost savings to consumers. Improvements to health, safety, and aesthetic aspects of delivered water can be valued using contingent valuation. Published regional and national surveys have estimated that customer willingness to pay for improved water quality is between $2 and $17 per month for each household (PAUAC, 2004; Piper, 2003). This wide range reflects the inherent bias in the willingness to pay surveys, which can be attributed in part to the customers' inability to recognize the incremental marginal improvement in water quality. For this analysis, this range of willingness to pay for improved water quality will be used to assess potential health, safety, and aesthetic benefits. This range is assumed to reflect customers' willingness to pay to ensure that the quality of delivered water supplies always meets the goals adopted by CCWD. Benefits under each alternative plan are calculated as a function of ability to meet the water quality goals adopted by CCWD.

Cost savings to consumers because of improved water quality, namely reduced TDS concentrations, was estimated for South Bay Aqueduct (SBA) users by Sonnen (2002). These cost savings are estimated at $2.10 per acre-foot per mg/L of TDS reduced for treated water deliveries (2006 dollars). A similar study by Reclamation and Metropolitan Water District of Southern California (MWD) (1998) estimated that annual damage due to salinity in southern California is about $0.50 per acre-foot per mg/L of TDS above 100 mg/L in the quality of Delta exports (1998 dollars). For this analysis, these two estimates for consumer savings are used to represent the range of potential customer savings from the alternative plans.

Additional treatment cost, associated with reducing source water bromide below 50 μg/L to avoid formation of bromate under ozone treatment, has been estimated at $224 per acre-foot for Delta export to urban areas, including CCWD (CALFED, 1999). Costs of treatment at CCWD WTPs, as a function of salinity, have been estimated at $0.2 per mgd for each 1 mg/L of TDS above 100 mg/L, which corresponds to $0.07 per mg/L of TDS reduced per acre-foot.

These estimates were developed for the Bollman WTP as part of the valuation of the benefits of the Los Vaqueros Project (CCWD, 1988). Avoided treatment costs for bromide, proportional to the actual reduction in bromide under each plan, and the O&M cost savings associated with reduced salinity, represent the bulk of water quality benefits associated with reduced treatment costs.

Table 4-7 summarizes the economic valuation of water quality improvement benefits. Health, safety, and aesthetic benefits, and consumer savings benefits are presented as ranges based on the published estimates for these benefits. Table 4-7 shows that total estimated water quality benefits (in 2006 dollars) for the three alternatives are generally comparable. Plan 3 would result in the largest water quality benefits. Water quality benefits estimated for Plan 2 are similar to those of Plan 1, although the overall water quality performance of Plan 1 exceeds that of Plan 2 (see Figure 4-8). This can be explained by the fact that this analysis of water quality benefits focused primarily on delivered M&I supplies. Under Plan 2, the desalination treatment process would significantly improve the quality of delivered treated water to the Bollman WTP service area, which represents 30 percent of CCWD total deliveries, and approximately 50 percent of all M&I deliveries. Therefore, water quality improvements under Plan 2 showed economic benefits similar to those of Plan 1.

Table 4-7. Range of Estimated Water Quality Improvement Benefits

Alternative Plan	Health, Safety, and Aesthetic[1] ($ millions/year)	Consumer Savings[2] ($ millions/year)	Treatment Cost Savings[3] ($ millions/year)	Total Benefits ($ millions/year)
Plan 1	$0.92 ~ $7.79	$0.91 ~ $3.14	$ 4.90	$6.73 ~ $15.84
Plan 2	$0.92 ~ $7.79	$0.86 ~ $2.97	$ 4.65	$6.43 ~ $15.41
Plan 3	$1.02 ~ $8.66	$1.22 ~ $4.19	$ 6.54	$8.77 ~ $19.38

Notes:
[1] Based on willingness to pay surveys (PAUAC, 2004; Piper, 2003).
[2] Based on Sonnen (2002) and Reclamation and MWD (1998).
[3] Based on treatment costs for removal of bromide (CALFED, 1999).

Valuation of Fisheries Improvement Benefits

Benefits of fisheries protection around the Rock Slough intake can be evaluated using the least-cost approach (i.e., the next least-cost method of achieving the same level of benefits). The least-cost alternative to protect fisheries at Rock Slough is through constructing a fish screen at the existing intake. The avoided cost of the fish screen would represent the equivalent fisheries benefits under the alternative plans, proportional to the expected reduction in fisheries impacts under that plan.

Reclamation is mandated under the CVPIA to "develop and implement a program to mitigate for fishery impacts resulting from operations of the Contra Costa Canal Pumping Plant No. 1." Under this authorization, Reclamation developed a design for a fish screen structure at Rock Slough (Reclamation, 1997). The structure is 320 feet in length, with an estimated construction cost of about $16 millions (2001 dollars). However, completion of the Rock Slough fish screen project has been delayed to further review and optimize the current design. Some of the concerns with the proposed design were the difficulty meeting the required approach velocity (0.2 feet per second, (fps)), due to the operations of CCWD's Pumping Plant No. 1, and tidal flows in Rock Slough. Although the proposed design concept for the fish screen might change in the future, this design represents the current least-cost alternative for providing fisheries protection at the Rock Slough intake. Given the concerns about over-sizing the fish screen, the cost of the Rock Slough fish screen may result in a conservative estimate of fisheries protection benefits. However, because of the comparative nature of this economic analysis, a conservative estimate of benefits should not invalidate this appraisal-level analysis.

Based on Figure 4-9, average reductions in fisheries losses at the Rock Slough intake for Plans 1, 2, and 3, compared to the No-Action Plan, are 21, 9, and 100 percent, respectively. These average reductions are calculated assuming that all modeled fisheries species are weighed equally. The construction cost for the Rock Slough fish screen is updated to 2006 dollars and adjusted to include indirect costs, IDC, and O&M costs. The equivalent annual fish screen cost over 40 years would be approximately $2.0 million per year. Calculated fisheries protection benefits for the three alternative plans are presented in Table 4-8.

Table 4-8. Valuation of Fisheries Protection Benefits

Alternative Plan	Average Reduction in Fisheries Losses at Rock Slough	Cost of Rock Slough Fish Screen	Estimated Benefit
	(%)	($ millions/year)	($ millions/year)
Plan 1	21%	$2.0	$0.43
Plan 2	9%		$0.18
Plan 3	100%		$2.00

Valuation of Emergency Supply Improvement Benefits

Valuation of increased Los Vaqueros Reservoir storage requires assessing the value of a unit of emergency supply and likelihood of an emergency event. The likelihood of an emergency event that would disrupt CCWD's ability to divert and deliver Delta water supplies is assumed to be 2 percent per year for this analysis. This is based on the combined likelihood of a flood or an earthquake event that could potentially disrupt water operations (i.e., a 100-year flood event and/or an earthquake event resulting in five levee breaches (CALFED and DWR, 2005).

The value of emergency supply can be estimated using a combination of reduced conservation costs, avoided damage costs during shortages, and/or avoided cost of short-term supplies. Avoided damage costs due to supply shortages for industrial water users, which would result in large short-term economic impacts of lost production, have been estimated to be approximately $3,300 to $8,400 per acre-foot annually for California urban water agencies (Wade et al., 1991). Costs associated with relatively low-cost water conservation measures vary between $70 and $650 per acre-foot (CALFED, 1997).

For emergency water supplies, other than Los Vaqueros Reservoir storage, CCWD could use groundwater, recycled water, and/or emergency interties with EBMUD and Eastern Contra Costa Irrigation District. However, these supplies are limited in quantity and geographic availability within the CCWD service area (CCWD, 2005). In addition to a transfer agreement for 3,200 acre-feet per year through the intertie with EBMUD, CCWD also has an emergency arrangement with EBMUD that allows use of the intertie to deliver a portion of CCWD diversions. This emergency arrangement stipulates a transfer fee of $200 per acre-foot for O&M (CCWD, 2007). It should be noted that water transfers through the Delta are typically not considered part of the emergency supply options because of the assumed interruption to intake operations.

For the purpose of this economic analysis, emergency supply benefits will be estimated using the least-cost approach. The least-cost emergency water supply option for CCWD would be through the intertie with EBMUD at $200 per acre-foot. Table 4-9 develops estimates of emergency supply benefits for Project alterative plans based on the average increase in Los Vaqueros Reservoir storage under each plan, and the assumed likelihood and unit emergency supply values. Estimated benefits under the three plans vary between $12,000 and $48,000 per year.

Table 4-9. Estimation of Emergency Supply Benefits

Alternative Plan	Average Increase in Los Vaqueros Storage (acre-feet)	Emergency Likelihood (% per year)	Emergency Supply Cost ($/acre-feet)	Estimated Benefit ($ /year)
Plan 1	9,000	2%	$200	$36,000
Plan 2	3,000			$12,000
Plan 3	12,000			$48,000

Comparison of Benefits and Costs

Overall benefits and costs of the three alternative plans are summarized in Tables 4-10 and 4-11, which compare performance of the alternative plans under the range of estimated benefits. Table 4-10 is based on the lower estimates of water quality benefits, whereas Table 4-11 is based on the higher estimates of water quality benefits (refer to Table 4-7). Under both comparison scenarios, Plan 1 would result in the largest benefit/cost (B/C) ratio. Plan 1 is also the only plan with a B/C ratio greater than 1 under the low and high estimates of benefits. Plan 3, which has the largest benefits of all three plans, would only result in a B/C ratio greater than 1 when the higher estimate of water quality benefits is used. Under Plan 2, costs would exceed estimated benefits under both the low and high estimates of benefits.

Table 4-10. Comparison of Economic Effects of Project Alternative Plans (based on lower estimate of water quality benefits)

	Plan 1	Plan 2	Plan 3
	($ millions/year (2006 dollars))		
- Water Quality Benefits	$6.73	$6.43	$8.77
- Fisheries Protection Benefits	$0.43	$0.18	$2.00
- Emergency Supply Benefits	$0.04	$0.01	$0.05
Total Benefits	$7.20	$6.62	$10.82
Implementation Cost	$5.80	$54.07	$11.99
B/C Ratio	1.24	0.12	0.90

Key:
B/C = benefit/cost

Table 4-11. Comparison of Economic Effects of Project Alternative Plans (based on higher estimate of water quality benefits)

	Plan 1	Plan 2	Plan 3
	($ millions/year (2006 dollars))		
- Water Quality Benefits	$15.84	$15.41	$19.38
- Fisheries Protection Benefits	$0.43	$0.18	$2.00
- Emergency Supply Benefits	$0.04	$0.01	$0.05
Total Benefit	$16.30	$15.60	$21.43
Implementation Cost	$5.80	$54.07	$11.34
B/C Ratio	2.81	0.29	1.79

Key:
B/C = benefit/cost

Sensitivity and Uncertainty

For this preliminary economic analysis, key areas of uncertainty include the following:

- Implementation costs of the Project alternatives are appraisal-level cost estimates that use conservative factors to account for unlisted items and contingencies. These cost estimates would likely be refined as detailed engineering and design work is conducted. However, the impact of this uncertainty on the overall findings of this economic analysis is likely to be limited because of the large magnitude of differences between the implementation costs of alternative plans.

- Uncertainties in the estimates of water quality improvement benefits are large, as demonstrated by the wide range of estimated water quality benefits for each alternative plan (see Table 4-7). These uncertainties are partially due to the difficulties of quantifying the effects of incremental improvement in quality of water supplies. An additional source of uncertainty is the fact that estimates of water quality benefits are based on regional and statewide studies that may not be representative of CCWD. Furthermore, there is a concern that willingness to pay surveys used to estimate the health, safety, and aesthetic benefits may account, in part, for some of the benefits covered under the consumer savings category, therefore resulting in double counting of benefits. This potentially large uncertainty is explicitly described in the range of low and high estimates of water quality benefits (Table 4-7).

- Potential uncertainty in the estimated fisheries benefits is related to the cost of the Rock Slough fish screen because of issues related to the current proposed design of the fish screen.

- The estimated benefits of water supply reliability (emergency supply) are potentially conservative because the $200 per acre-foot fee for transfers through EMBUD facilities may not be inclusive of all costs incurred by CCWD to obtain these supplies.

- Operational, water quality, and fisheries modeling results include an inherent level of uncertainty that is primarily related to the underlying assumptions of these models. However, the effect of this uncertainty is limited because of the comparative nature of this analysis.

Comparison Methodology

This section compares and evaluates all three alternative plans for the Project based on the Federal criteria established in the P&G: completeness, effectiveness, efficiency, and acceptability. For each criterion, specific quantitative and/or qualitative metrics for comparing the alternative plans are developed. Based on these metrics, a ranking of alternative plans is developed and recommended plan(s) will be advanced for further evaluation.

Completeness

Completeness is an indication of the extent to which an alternative provides and accounts for all necessary actions to ensure the realization of the planned effects. A complete alternative will (1) address and contribute to all planning objectives, (2) identify all necessary components and actions, including the adequate mitigation of significant adverse impacts, and (3) demonstrate a reasonable degree of certainty (or reliability) of achieving the intended objectives. These three characteristics of a complete plan represent qualitative metrics for assessing completeness of plans.

- **Planning Objectives** – All three alternative plans address and would contribute to the three planning objectives of improving delivered water quality, fisheries protection around CCWD intakes, and maintaining a reliable quality of delivered supplies during emergencies. Plans 1 and 3 would improve delivered water quality through new intakes at locations with better overall water quality than currently available to CCWD. Plan 2 would improve water quality through desalination of brackish water from Mallard Slough at the Bollman WTP. All three alternative plans would contribute to fisheries protection at the unscreened Rock Slough intake by reducing or eliminating diversions at the intake. Regarding reliability during emergencies, all three alternative plans include provisions for additional operational flexibility or ability to address rapid deterioration of water quality at CCWD intakes (i.e., through an additional intake location(s), or through additional desalination treatment). Reliability during emergencies is also addressed through the availability of additional emergency water supply stored in Los Vaqueros Reservoir.

- **Certainty** – The likely certainty and reliability that each of the three alternative plans would meet its intended objectives is high. This is because of the direct relationship between measures employed by each alternative plan and the study planning objectives, and because the alternative plans do not depend on any other actions. In addition, physical implementability of these measures is well demonstrated by similar projects within the study area and the region.

- **Environmental Impacts** – Environmental impacts of the alternative plans are generally short-term impacts associated with construction activities. These include impacts on local water quality, aquatic resources, air quality, and noise. However, these impacts would be reduced to less than significant with proposed mitigation measures during construction. Alternative plans would not increase water diversions, but may shift location and timing of diversions. This would have an overall beneficial impact on fisheries because of reduced diversions from the unscreened Rock Slough intake. Plans 1 and 3 would result in minor long-term impacts related to the permanent loss of some agricultural lands (6 to 10 acres). Plan 2 would result in long-term impacts on aquatic resources due to the discharge of desalination byproducts in the form of saline concentrate. The impacts of these discharges, which would require permits from SWRCB, would be reduced to less-than-significant levels with proper consideration in the design of the offshore outfall and diffuser. All three plans would include environmental monitoring plans and provisions for adaptive management that determine the actual effects of Project Delta diversions on protected species, and would implement corrective measures, if needed.

Therefore, based on these three qualitative metrics for completeness, all three alternative plans are ranked high on the completeness criteria. However, the No-Action Plan, which requires no future actions, is ranked very low because it addresses none of the planning objectives.

Effectiveness

Effectiveness is the extent to which a plan alleviates problems and achieves objectives. Based on the preceding evaluation of alternative plans in the Plan Accomplishments section, relative rankings for the three alternative plans are developed for their effectiveness relative to water quality improvement, fisheries protection, and improving reliability during emergencies. Based on these three relative rankings, an overall relative ranking for effectiveness is developed.

- **Water Quality Improvement** – The relative performance of alternative plans regarding water quality improvements is measured using four quantitative metrics, described in Table 4-1, which assess long-term and dry year water quality conditions. Based on these metrics, Plan 1 and Plan 3 are ranked high in achieving water quality improvements, as these two alternative plans significantly improve on all water quality metrics. Plan 3 would slightly outperform Plan1 according to all water quality metrics, especially in reducing the length of the period during which the water quality goal is exceeded. Plan 2 is assigned a moderate ranking because its water quality improvements are largely restricted to the area served by the Bollman WTP, which represents only 30 percent of CCWD service area.

- **Fisheries Protection** – All three plans show benefits to fisheries at the Rock Slough intake because of the reduced diversions and entrainment at the intake. Plan 3 would result in the greatest benefits to fisheries because it would result in a 100 percent reduction in fisheries losses caused by the operations of the Rock Slough intake compared to the No-Action Plan. Plan 1 would reduce fisheries impacts at the Rock Slough intake by 21 percent on average compared to the No-Action Plan. Plan 2 would reduce fisheries impacts at the Rock Slough intake by 9 percent on average compared to the No-Action Plan. Therefore, the relative fisheries protection rankings for Plans 1, 2, and 3 are moderate, low, and high, respectively.

- **Reliability During Emergencies** – Contribution of alternative plans to system reliability during emergencies is assessed based on the total number of Delta intakes, which is a surrogate for operational flexibility, and increased storage in Los Vaqueros Reservoir as a result of reduced demands on blending releases. Table 4-4 compares the reliability contribution of each alternative plan compared to the No-Action Plan (future without-project). Based on this comparison, Plan 1 and Plan 3 are rated high in their contribution to additional reliability during emergencies. In both plans, CCWD would have access to supplies from the Old River and Middle River, which allows CCWD to maximize its ability to optimize delivered water quality. However, Plan 3 would slightly outperform Plan 1 in increased emergency storage in Los Vaqueros Reservoir. Plan 2 is ranked moderate because most of its reliability benefits, due to the desalination plant, are restricted to CCWD customers served by the Bollman WTP, which represents only 30 percent of CCWD service area.

Based on the relative ranking for water quality improvement, fisheries protection, and improving reliability during emergencies, an overall relative ranking for effectiveness was developed for the three alternative plans. Plan 3 is rated high in effectiveness because it ranked high for all three categories. Plan 1 is rated moderate because it ranked moderate for fisheries, although it ranked high for water quality and reliability. It should be noted that although Plan 1 and Plan 3 ranked similarly for water quality and reliability, Plan 3 slightly outperforms Plan 1 for both categories. Plan 2 ranked low for overall effectiveness because it ranked moderate for water quality and reliability, and low for fisheries protection.

Efficiency

Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating specified problems and realizing specified needs and opportunities, consistent with protecting the environment. Possible approaches to evaluating efficiency include dollars per unit of economic benefit, least cost of attaining a given objective, or reduced opportunity costs relative to accomplishments of other alternatives. In this analysis, efficiency of each alternative plan is evaluated using its estimated B/C ratio, which is presented in Tables 4-10 and 4-11.

Based on Tables 4-10 and 4-11, Plan 1, which has the highest B/C ratio under both the low and high estimates of water quality benefits, is assigned a relative efficiency ranking of high. Plan 3, which would result in B/C ratio greater than 1 when using the higher estimated water quality benefits, is ranked moderate. Plan 2 is assigned a relative efficiency ranking of low because its B/C ratio is below 1 for both the low and high estimates of water quality benefits.

Acceptability

Acceptability is the feasibility of an alternative plan with respect to acceptance by State and local entities and the public, and compatibility with existing laws, regulations, and public policies. Acceptability of an alternative plan is evaluated according to (1) the ability of the plan to be implemented within existing laws, (2) acceptability by Federal and State resources agencies, (3) acceptability by the local partner(s), and (4) acceptability by public interest groups and individuals.

- **Existing Laws** – All three alternative plans appear to be consistent with existing laws and regulations that govern Delta operations. All the operation scenarios under the alternative plans are designed to meet these existing rules. The proposed plans would also seek permits and work to minimize construction-related impacts that may temporarily violate any air quality, noise, or water quality standards. However, Plan 2 may face challenges regarding the disposal of brine and concentrate discharge from the desalination treatment. Therefore, Plans 1 and 3 are ranked high for meeting existing laws and regulations, while Plan 2 is ranked medium.

- **Federal and State Resources Agencies, CCWD, and Public Stakeholders** –Plan 1 is the preferred alternative by the non-Federal sponsor of the Project (i.e., CCWD). However, because of the general similarity between the alternative plans, it appears that all three alternative plans would be similarly ranked regarding acceptability by stakeholders. Each of the alternative plans would need to be coordinated with other resources agencies and public interests based on the feedback documented in the Project EIR/EIS Scoping Report (CCWD, 2005). Therefore, at this stage of analysis, acceptability by stakeholders is not considered as a differentiating factor between the three plans.

Table 4-12. Summary Comparison of Alternative Plans

Comparison Criteria	No-Action Plan	Plan 1	Plan 2	Plan 3
Completeness	Does not address any of the planning objectives	Addresses all objectives and environmental effects, and is implementable	Addresses all objectives and environmental effects, and is implementable	Addresses all objectives and environmental effects, and is implementable
Relative Ranking	*Very Low*	*High*	*High*	*High*
Effectiveness		Water quality: high Fisheries: moderate Reliability: high	Water quality: moderate Fisheries: low Reliability: moderate	Water quality: high Fisheries: high Reliability: high
Relative Ranking	*None*	*Moderate*	*Low*	*High*
Efficiency		Maximizes net benefits	Costs exceeds benefits	Positive net benefits when a higher estimate of benefits is used
Relative Ranking	*None*	*High*	*Low*	*Moderate*
Acceptability	Does not address any of the planning objectives	Compatible with existing laws and regulations Preferred alternative by the non-Federal sponsor (CCWD)	Potential challenges regarding the disposal of brine and concentrate discharge to Suisun Bay	Compatible with existing laws and regulations
Relative Ranking	*Very Low*	*High*	*Moderate*	*High*

Conclusion

As described in the Comparison Methodology section, and summarized in Table 4-12, all three alternative plans are complete plans, with Plans 1 and 3 outperforming Plan 2 on effectiveness, efficiency, and acceptability. Plan 3 is the most effective alternative plan, which would result in the largest total benefits. However, Plan 1 is the most efficient plan, which would result in the largest B/C ratio. Plan 1 would result in a B/C ratio greater than 1 under the low and high range of potential benefits, whereas Plan 3 would only result in a B/C ratio greater than 1 under the high estimate of benefits.

Based on the acceptability criteria, Plans 1 and 3 are comparable, although Plan 1 is the preferred alternative by the non-Federal sponsor (CCWD). Long-term environmental impacts of the alternative plans on water resources, terrestrial and aquatic species, and other environmental resources would generally be insignificant. Short-term impacts associated with the alternative plans are limited to construction-related activities.

Based on the preceding engineering, operational, environmental, and economic evaluation, and comparison of the Project alternative plans, it appears that Alternative Plan 1 is the overall superior plan.

National Economic Development Account

Reclamation guidance for the economic evaluation of water resources project plans is provided by the Federal P&G, which establishes four accounts to facilitate evaluation, and display the effects of alternative plans. These accounts are National Economic Development (NED), Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE). The NED account, which contains changes in the economic value of the national output of goods and services in monetary units, is the only required account for evaluation of Federal projects. However, nonmonetary information that could have a bearing on Federal decision-making should be presented in the other accounts. For the purpose of this economic analysis, only the NED account will be considered.

NED costs are the opportunity costs of resource use, and require consideration of both private and public uses, now and in the future. Market prices should be used to determine NED costs, provided market prices reflect the full economic value of a resource to society (i.e., market valuation). If market prices do not reflect total resource values, surrogate values may be used that approximate opportunity costs based on an equivalent use or condition (i.e., nonmarket valuation). For this economic analysis, market-based techniques are used to value the contribution of Project alternatives to the planning objectives.

NED Formulation Approach

The Federal objective of water and related land resources project planning is to contribute to national economic development consistent with protecting the Nation's environment. The NED account evaluates the contributions of project alternatives to the national output of goods and services in monetary units. The two primary decision criteria used in a Federal economic analysis to compare alternative plans are net benefits and the benefit-cost ratio. The plan that reasonably maximizes net benefits is the "NED plan." This is not necessarily the plan with the greatest benefits, but rather the plan that maximizes benefits given the cost to the Nation. Section 1.10.2 of the P&G requires that the NED plan be selected unless the Secretary of the Interior grants an exception. The alternative plan with the greatest net national economic benefit (the NED plan) determines the greatest potential Federal investment in the project. If the local sponsor prefers a different plan than the NED plan, the NED plan can be used to define the Federal financial interest in the locally preferred plan.

The NED account may include net benefits to the following categories: M&I water supply, agriculture, urban flood damage reduction, power (hydropower), transportation (inland navigation and deep draft navigation), recreation, commercial fishing, unemployed or underemployed labor resources, and other direct benefits. For the Project, the NED account would include the M&I water supply category for water quality improvement and reliability benefits, as well as the other direct benefits category for fisheries protection benefits.

Environmental benefits, including fisheries and aquatic resources, are typically included in the EQ account if monetary units cannot be attributed to these benefits. However, for this analysis, fisheries benefits related to the AIP developed as monetary units, will be included in the NED account. The contribution of the Project to reduced fisheries impacts at CCWD's intakes, namely the Rock Slough intake, can be included in the NED account under the "other direct benefits" category.

The NED Plan

Overall benefits and costs of the three alternative plans are summarized in Tables 4-13, which compare performance of the alternative plans under the range of estimated benefits. Table 4-13 is based on the lower and higher estimates of water quality benefits described in Table 4-10 and Table 4-11. Under both comparison scenarios, Plan 1 would result in the largest net benefit. Plan 1 is also the only plan with a positive net benefit under the low and high estimates of benefits. Plan 3, which has the largest benefits of all three plans, would only result in a positive net benefit when the higher estimate of water quality benefits is used. Under Plan 2, costs would exceed estimated benefits under both the low and high estimates of benefits.

Therefore, Plan 1 is the NED plan for the Project because it maximizes the net benefits. Plan 3, although it would result in the greatest benefits overall, does not meet the criteria for the NED plan (i.e., maximizing net benefits). Plan 1 will be further analyzed and developed in following chapters.

Table 4-13. Comparison of Net Benefits for Project Alternative Plans

	Plan 1	Plan 2	Plan 3
	$ millions/year (2006 dollars)		
Total Project Cost	$5.80	$54.07	$11.99
Lower Estimate of Benefits	$7.20	$6.62	$10.82
Net Benefit Based on the Lower Estimate of Benefits	**$1.40**	**- $47.45**	**- $1.17**
Higher Estimate of Benefits	$16.30	$15.60	$21.43
Net Benefit Based on the Higher Estimate of Benefits	**$10.50**	**- $38.47**	**$9.44**

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