

# Chapter 6 Alternative Development

This chapter describes the development of the NODOS/Sites Reservoir Project alternatives.

## Previous Facility and Alternative Evaluations

The NODOS project alternatives combine numerous facilities, and cooperative operations with the existing CVP and SWP facilities are complex. The facilities and operations have been iteratively evaluated. Previous studies that informed the development of the alternatives presented in this chapter are described in Appendix A, Plan Formulation.

## Sites Reservoir Alternatives

In addition to the No Action Alternative, four action alternatives were identified for detailed evaluation. These alternatives consider a range of potential facilities and operations. The alternatives vary in reservoir size, number of intakes, regulating reservoir location and size, recreational facilities, road locations, transmission line locations, and operations (Table 6-1). The No Action Alternative and the four action alternatives are listed below.

- **No Action Alternative** – The No Action Alternative considers the future conditions of the Study Area and the future level of demand for water in 2025 if an action alternative is not implemented.
- **Alternative A** – Alternative A is a 1.3 MAF reservoir with a new intake (2,000 cfs) on the Sacramento River (Delevan Intake). Alternative A operations would deliver water for agricultural and M&I supply (with approximately 90 percent export), incremental Level 4 refuge water supply, and Delta environmental water quality. The alternative would be operated cooperatively with the CVP and SWP to provide benefits to anadromous fish.
- **Alternative B** – Alternative B is a 1.8 MAF reservoir with a release-only structure in place of a new intake on the Sacramento River. Alternative B operations would deliver water for agricultural and M&I supply (with approximately 90 percent export), incremental Level 4 refuge water supply, and Delta environmental water quality. The alternative would be operated cooperatively with the CVP and SWP to provide benefits to anadromous fish.
- **Alternative C** – Alternative C is a 1.8 MAF reservoir with a new intake (2,000 cfs) on the Sacramento River (Delevan Intake). Alternative C operations would deliver water for agricultural and M&I supply (with approximately 90 percent export), incremental Level 4 refuge water supply, and Delta environmental water quality. The alternative would be operated cooperatively with the CVP and SWP to provide benefits to anadromous fish.

Table 6-1. Summary of Alternatives for Detailed Evaluation

	Alternative A	Alternative B	Alternative C	Alternative D
<b>Storage Capacity</b>				
Sites Reservoir	1.3 MAF	1.8 MAF	1.8 MAF	1.8 MAF
Terminal Regulating Reservoir	2,000 TAF	2,000 TAF	2,000 TAF	1,200 TAF
<b>Conveyance Capacity (to Sites Reservoir)<sup>a</sup></b>				
Tehama-Colusa Canal	2,100 cfs	2,100 cfs	2,100 cfs	2,100 cfs
Glenn-Colusa Canal	1,800 cfs	1,800 cfs	1,800 cfs	1,800 cfs
Delevan Pipeline – Diversion <sup>b</sup>	2,000 cfs	Not applicable <sup>c</sup>	2,000 cfs	2,000 cfs
Delevan Pipeline – Release <sup>b</sup>	1,500 cfs	1,500 cfs	1,500 cfs	1,500 cfs
<b>Transmission for Sites Pumping/ Generating Plant and TRR</b>				
Transmission lines	Lines from new substation to either the existing PG&E or the existing WAPA lines near Funks Reservoir	Lines from new substation to either the existing PG&E or the existing WAPA lines near Funks Reservoir	Lines from new substation to either the existing PG&E or the existing WAPA lines near Funks Reservoir	Lines from new substation to either the existing PG&E or the existing WAPA lines near Funks Reservoir
<b>Transmission Line to Delevan Intake</b>				
Transmission lines	East-west from Holthouse Reservoir to Delevan Intake (shortest distance)	None required (no new intake)	East-west from Holthouse Reservoir to Delevan Intake (shortest distance)	North-south from Colusa to Delevan Intake (reduced impact to landowners and birds)

	Alternative A	Alternative B	Alternative C	Alternative D
<b>Operations</b>				
Summary of operations (see Table 6-3 for a detailed description of operations)	New facilities would be operated by the non-Federal sponsor. Deliveries to South Coast M&I would be high. Deliveries would also be provided for incremental Level 4 refuge water supply and Delta environmental water quality. Cooperative operations would be needed to secure coldwater benefits for anadromous fish at Trinity, Shasta, Oroville, and Folsom.	New facilities would be operated by the non-Federal sponsor. Deliveries to South Coast M&I would be high. Deliveries would also be provided for incremental Level 4 refuge water supply and Delta environmental water quality. Cooperative operations would be needed to secure coldwater benefits for anadromous fish at Trinity, Shasta, Oroville, and Folsom.	New facilities would be operated by the non-Federal sponsor. Deliveries to South Coast M&I would be high. Deliveries would also be provided for incremental Level 4 refuge water supply and Delta environmental water quality. Cooperative operations would be needed to secure coldwater benefits for anadromous fish at Trinity, Shasta, Oroville, and Folsom.	New facilities would be operated by the non-Federal sponsor, which would release water for water supply (export would require agreements with Reclamation and DWR for conveyance). Deliveries to the Sacramento Valley would be high. Deliveries would also be provided for incremental Level 4 refuge water supply and Delta environmental water quality. Cooperative operations would be needed to secure coldwater benefits for anadromous fish at Trinity, Shasta, Oroville, and Folsom. Releases for Delta environmental water quality would be reduced, but anadromous fish benefits would be increased.
<b>Recreation</b>				
Recreation areas	Stone Corral Lurline Headwaters Antelope Island	Stone Corral Lurline Headwaters Antelope Island	Stone Corral Lurline Headwaters Antelope Island	Stone Corral Peninsula Hills

<sup>a</sup> Primary season for filling Sites Reservoir is November through March; winter fill operations are constrained to diversion operating criteria.

<sup>b</sup> Delevan Pipeline can be operated June through March (April and May are reserved for maintenance).

<sup>c</sup> A pump station, intake, and fish screens are not included for the Delevan Pipeline for Alternative B. For this alternative, the Delevan Pipeline would only be operated for year-round releases from Sites Reservoir to the Sacramento River.

- cfs = cubic feet per second
- M&I = municipal and industrial
- MAF = million acre-feet
- PG&E = Pacific Gas and Electric Company
- TAF = thousand acre-feet
- TRR = Terminal Regulating Reservoir
- WAPA = Western Area Power Administration

- **Alternative D** – Alternative D has been developed by the Sites Project Authority. This alternative includes a 1.8 MAF reservoir with a new intake (2,000 cfs) on the Sacramento River (Delevan Intake). Alternative D operations would deliver water for agricultural and M&I supply (with approximately 45 percent of the deliveries to agriculture in the Sacramento Valley and remainder exported), incremental Level 4 refuge water supply, and Delta environmental water quality. The alternative would be operated cooperatively with the CVP and SWP to provide benefits to anadromous fish. This alternative provides less water for Delta environmental water quality, but increased benefits to anadromous fish between Keswick Dam and Red Bluff.

All of the action alternatives must be operated in a mutually beneficial and cooperative manner with the CVP and SWP to achieve the project objectives. The section titled “Evaluation of Physical Accomplishments” in Chapter 7, Alternative Evaluation, describes project operations and water rights. The Authority has formed an Operations Work Group, including representatives from Reclamation and DWR, to develop Principles of Agreement and an operations plan. The operations presented in this chapter can only be achieved if the Principles of Agreement are finalized and accepted by all involved parties as a basis for cooperatively operating the CVP, SWP, and Sites Reservoir.

### **No Action Alternative (NEPA)/No Project Alternative (CEQA)**

The terms “No Action Alternative” (as described by NEPA), “No Project Alternative” (as described by CEQA), and “Without Project Future Conditions” are considered synonymous throughout this report. No Action Alternative is used as the basis for comparison of the potential benefits and effects of the action alternatives, consistent with the Federal P&Gs (WRC 1983) and NEPA Guidelines. Under the No Action Alternative, no actions would be taken to provide storage north of the Delta to achieve the project objectives.

For the surface storage investigations, the planning horizon for the future conditions is assumed to be 100 years. Future conditions include facilities, policies, regulations, programs, and operational assumptions included in the existing conditions, plus future actions, projects, and programs that can reasonably be expected to take place. Climate change was subsequently evaluated through sensitivity analysis (see Chapter 7, Alternative Evaluation,).

The modeling effort to evaluate the NODOS project alternative plans began in 2010, and relied on assumptions that were finalized on July 5, 2010. The assumptions for the No Action Alternative include reasonably foreseeable projects, including projects under construction, and continuation of existing policy and management decisions. Altering these assumptions would change the conclusions in this report.

Key assumptions regarding the No Action Alternative include the following:

- Operations of the CVP and SWP by Reclamation and DWR, respectively, are described in the *Long-Term Coordinated Operation of the CVP and SWP: Biological Assessment*, published in August 2008 (Reclamation 2008a). These operations include operations of the CVP under the Central Valley Project Improvement Act (P.L. 102-575), including fish and wildlife restoration activities in accordance with Section 3406(b)(2); coordinated

operations of the CVP and SWP under SWRCB Decision-1641 (D-1641)<sup>1</sup> and the SWRCB Water Quality Control Plan adopted in 2006; and use of Joint Points of Diversion (which allows Reclamation and DWR to use both the CVP and SWP diversion capacity capabilities in accordance with D-1641).

- CVP and SWP operational assumptions also include continued operations under the COA, which was approved by the United States Congress and the California State Legislature in 1986, to share responsibilities between the CVP and SWP for providing water for in-basin uses in the Delta watershed, sharing of responsibilities to meet water quality criteria established by the SWRCB, and sharing of surplus water flows in the Delta.
- Operations of the CVP and SWP also include assumptions for operations in accordance with the 2008 USFWS Biological Opinion (BiOp) (USFWS 2008a) and the 2009 NMFS BiOp (NMFS 2009).
- Operations at the diversion from the Sacramento River into the T-C Canal and the Corning Canal were modified under the No Action Alternative to improve fish passage. Under the Existing Conditions, the radial gates were lowered into the Sacramento River to create Lake Red Bluff between June 15 and August 31, based on the 2009 NMFS (BiOp) Action I.3.2. However, under the No Action Alternative, the radial gate operations were replaced with a new 3,000 cfs intake and pumping plant along the bank of the Sacramento River with a flat-plate fish screen to divert water from the Sacramento River into the T-C and Corning Canals.
- Operations of the Freeport Regional Water Authority pumping plant along the Sacramento River serve Sacramento County and the East Bay Municipal Utility District and are included in the No Action Alternative assumptions.
- The final operational criteria for the interim operations of the San Joaquin River Restoration were undergoing NEPA evaluation at the time of model development; therefore, the criteria were not available for inclusion in the No Action Alternative assumptions.
- Enlargement of Los Vaqueros Reservoir from 100 TAF to 160 TAF is included in the No Action Alternative assumptions. The reservoir expansion to 260 TAF is not included in the No Action Alternative assumptions.
- The SWP Banks Pumping Plant capacity is assumed to be 10,300 cfs. However, diversions from Old River into Clifton Court Forebay are assumed to be limited by USACE agreement to generally 6,680 cfs, except during high-flow events (Section 10 of the Rivers and Harbors Appropriation Act of 1899 [33 U.S.C. 403]).
- The No Action Alternative includes water-use efficiency to conserve and recycle water throughout California.
- The assumptions in the 2009 Memorandum of Understanding between Reclamation, DWR, and SWRCB for implementing the CALFED Water Transfer Program are included.
- All hydropower facilities of the CVP, SWP, and other waters tributary to the Sacramento River and the Delta are assumed to be operated in accordance with existing agreements and other regulatory operating agreements. Operations of these facilities are dependent on

---

<sup>1</sup> Water Rights Decision 1641 Revised (State Water Resources Control Board, March 2000).

the hydrology and water supply allocations. It is assumed that these facilities operate in the same manner they have historically.

- The No Action Alternative does not include modifications to Folsom Dam to increase releases during lower pool stages, or to revise the surcharge storage space in the reservoir. These projects were under evaluation at the time of development of the modeling assumptions.
- The No Action Alternative does not include potential enlargement of Shasta Lake or construction of Temperance Flat Reservoir because these projects were under evaluation at the time of development of the modeling assumptions.
- The No Action Alternative and Future Conditions do not include assumptions for climate change related to sea level rise and changes in precipitation patterns, including changes in ratios between snow and rainfall. The analysis supporting the estimation of benefits does not include the effects of climate change. The resulting uncertainty is described in Chapter 9, Risk and Uncertainty.
- The No Action Alternative does not assume new Delta conveyance facilities to be in place, including proposed construction of intakes in the North Delta to convey CVP and SWP water supplies.

The bulleted assumptions were also included in the future with-project conditions.

### Action Alternatives

Alternatives A, B, C, and D are described in this section. Each alternative is described, and then the individual facilities that constitute each alternative are described. This discussion of alternatives and individual facilities is followed by a description of the operations associated with the alternatives. More detailed descriptions of the facilities are provided in Appendix B, Engineering. Alternative C1 was evaluated in the EIR/EIS to assess the impacts that would result from Alternative C without hydropower generation; however, that alternative was not considered in this Draft Feasibility Report because it does not meet the secondary objective for hydropower generation.

#### **Alternative A (1.3 MAF Sites Reservoir, 2,000 cfs Delevan Pipeline for Intake and Release)**

Under Alternative A, Sites Reservoir would have a 1.3 MAF storage capacity (it is the smallest of the four action alternatives). The Sites Pumping/Generating Plant has a reduced capacity due to the shorter dams that would be needed for the smaller reservoir. Under this alternative, water released from Sites Reservoir would generate up to 100 megawatts (MW), as compared to 125 MW under Alternatives B, C, and D. The facilities for Alternative A are depicted on Figure 6-1.

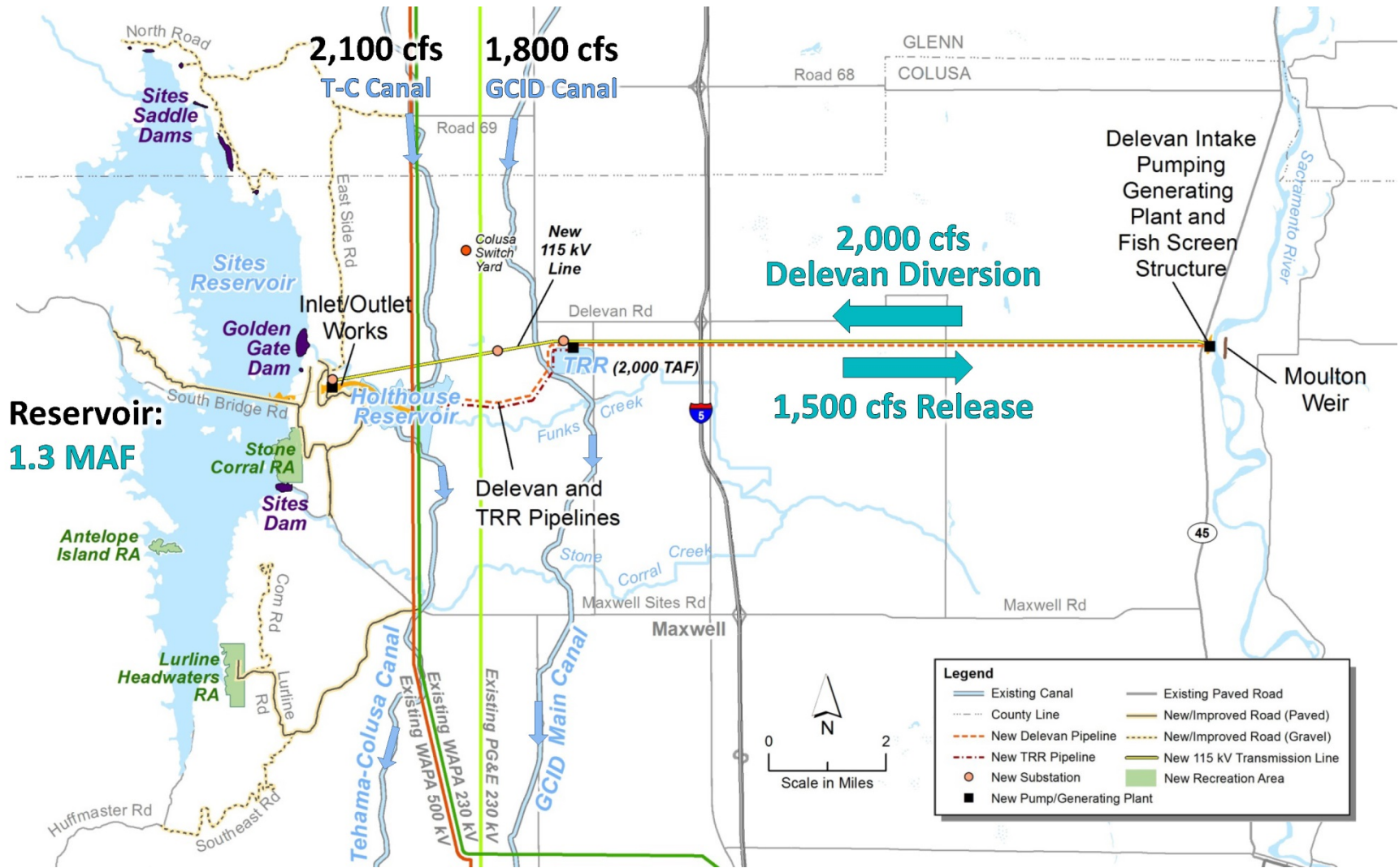


Figure 6-1. Features of NODOS Alternative A

On the eastern side of the project, Alternative A includes the Delevan Intake Pumping/Generating Plant and adjoining fish screen structure at the Sacramento River. The new intake would have a 2,000 cfs capacity, and this flow would be conveyed across the valley by the Delevan Pipeline to Holthouse Reservoir. Releases could also be made from the Sites Reservoir to the Sacramento River through the Delevan Pipeline through the fish screen at the Delevan Intake Pumping/Generating Plant. The power transmission lines would run from the vicinity of Holthouse Reservoir to the Delevan Intake Pumping/Generating Plant parallel to the Delevan Pipeline.

In addition to the Delevan Pipeline, water would be conveyed into the reservoir by the T-C and GCID Canals. Water intended for providing public benefits and supplying the CVP and SWP service areas would be stored in Sites Reservoir for future delivery. The following releases would be possible:

- Releases from Holthouse Reservoir to the southern portion of the TCCA service area
- Releases from the Terminal Regulating Reservoir (TRR) to the southern portion of the GCID service area
- Releases from the Delevan Pipeline to the Sacramento River for downstream water users, incremental Level 4 refuge water supply, and Delta environmental water quality

Reclamation and DWR may modify existing contracts or execute contracts for conveyance (i.e., export) using CVP or SWP facilities at the contractor's request. Conveyance contracts would be required for all water moved through the T-C Canal.

Contracts would be required for water stored in CVP reservoirs.

Releases made from the Holthouse Reservoir Forebay/Afterbay would generate power at the TRR and Delevan Intake Pumping/Generating Plants.

Alternative A has three recreation areas (Stone Corral, Lurline Headwaters, and Antelope Island).

### **Alternative B (1.8 MAF Sites Reservoir, 1,500 cfs Delevan Pipeline for Release Only)**

Under Alternative B, Sites Reservoir would have a 1.8 MAF storage capacity. Under this alternative, water released from Sites Reservoir would generate up to 125 MW. The facilities for Alternative B are depicted on Figure 6-2.

On the eastern side of the project, Alternative B does not include the Delevan Intake Pumping/Generating Plant or adjoining fish screen structure at the Sacramento River. Instead, this alternative includes a reinforced-concrete structure housing a flow meter and cone valve to dissipate releases of up to 1,500 cfs into the Sacramento River. There would be no pumping at this location. The Delevan Pipeline would only be used to release water from Holthouse Reservoir to the Sacramento River through the dissipating structure. As a result, there would be no new power transmission lines running from Holthouse Reservoir to the Delevan Release Structure across the valley.



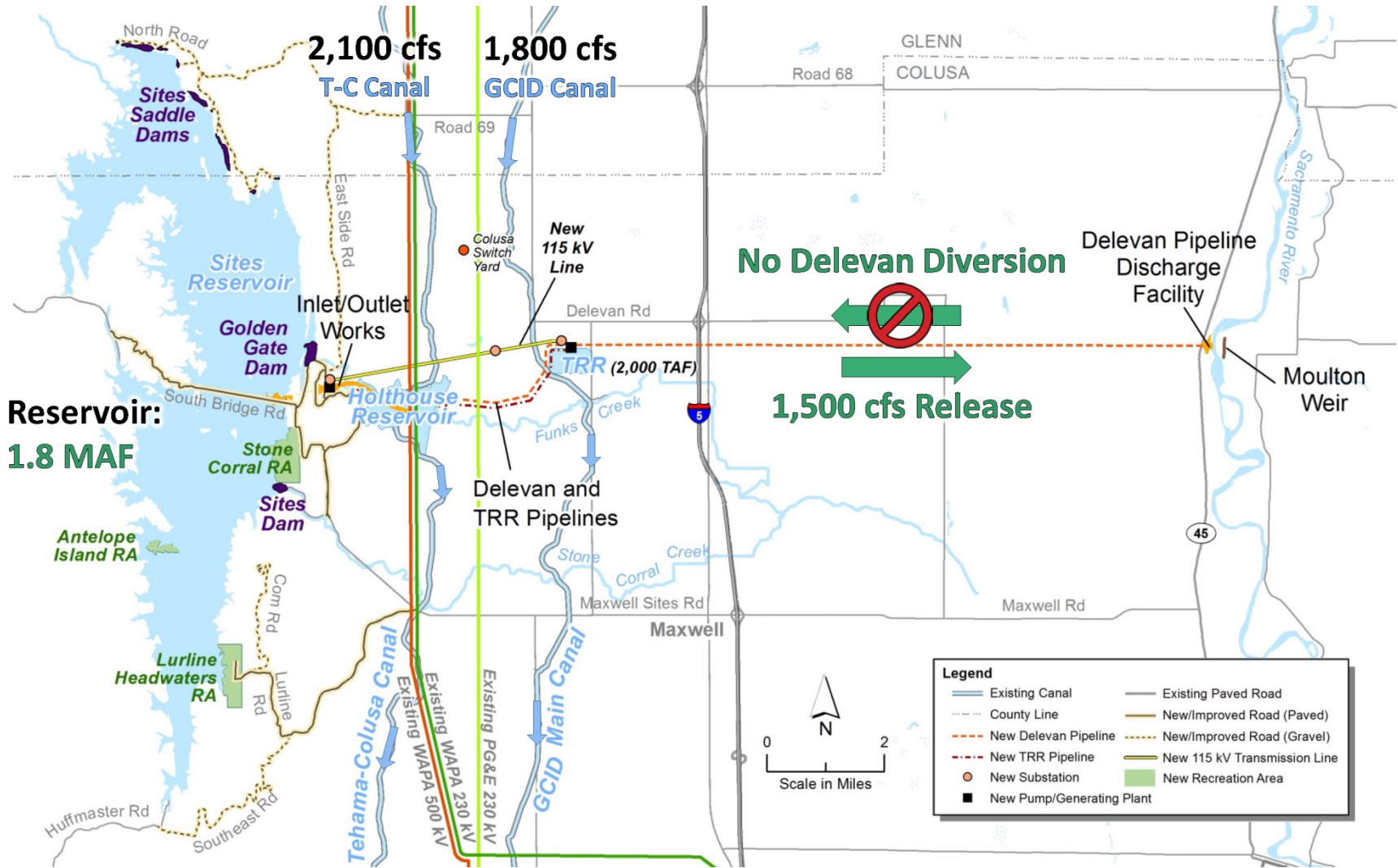


Figure 6-2. Features of NODOS Alternative B

## Chapter 6 Alternative Development

For Alternative B, water would be conveyed to the reservoir solely by the T-C and GCID Canals. Water intended for providing public benefits and supplying the CVP and SWP service areas would be stored in Sites Reservoir for future delivery. The following releases would be possible:

- Releases from Holthouse Reservoir to the southern portion of the TCCA service area
- Releases from the TRR to the southern portion of the GCID service area
- Releases from the Delevan Pipeline to the Sacramento River for downstream water users, incremental Level 4 refuge water supply, and Delta environmental water quality

Reclamation and DWR may modify existing contracts or execute contracts for conveyance (i.e., export) using CVP or SWP facilities at the contractor's request. Conveyance contracts would be required for all water moved through the T-C Canal.

Contracts would be required for water stored in CVP reservoirs.

Releases made from the Holthouse Reservoir Forebay/Afterbay would generate power at the TRR Pumping/Generating Plant.

Alternative B has three recreation areas (Stone Corral, Lurline Headwaters, and Antelope Island).

### **Alternative C (1.8 MAF Sites Reservoir, 2,000 cfs Delevan Pipeline for Intake and Release)**

Under Alternative C, Sites Reservoir would have a 1.8 MAF storage capacity. The Sites Pumping/Generating Plant has a 125 MW capacity. The facilities for Alternative C are depicted on Figure 6-3.

On the eastern side of the project, Alternative C includes the Delevan Intake Pumping/Generating Plant and adjoining fish screen structure at the Sacramento River. The new intake would have a 2,000 cfs capacity, and this flow would be conveyed across the valley by the Delevan Pipeline to Holthouse Reservoir. Releases could also be made from the Sites Reservoir to the Sacramento River through the Delevan Pipeline through the fish screen at the Delevan Intake. The power transmission lines would run from the vicinity of Holthouse Reservoir to the Delevan Intake Pumping/Generating Plant parallel to the Delevan Pipeline.

In addition to the Delevan Pipeline, water would be conveyed to the reservoir by the T-C and GCID Canals. Water intended for providing public benefits and supplying the CVP and SWP service areas would be stored in Sites Reservoir for future delivery. The following releases would be possible:

- Releases from Holthouse Reservoir to the southern portion of the TCCA service area
- Releases from the TRR to the southern portion of the GCID service area
- Releases from the Delevan Pipeline to the Sacramento River for downstream water users, incremental Level 4 refuge water supply, and Delta environmental water quality

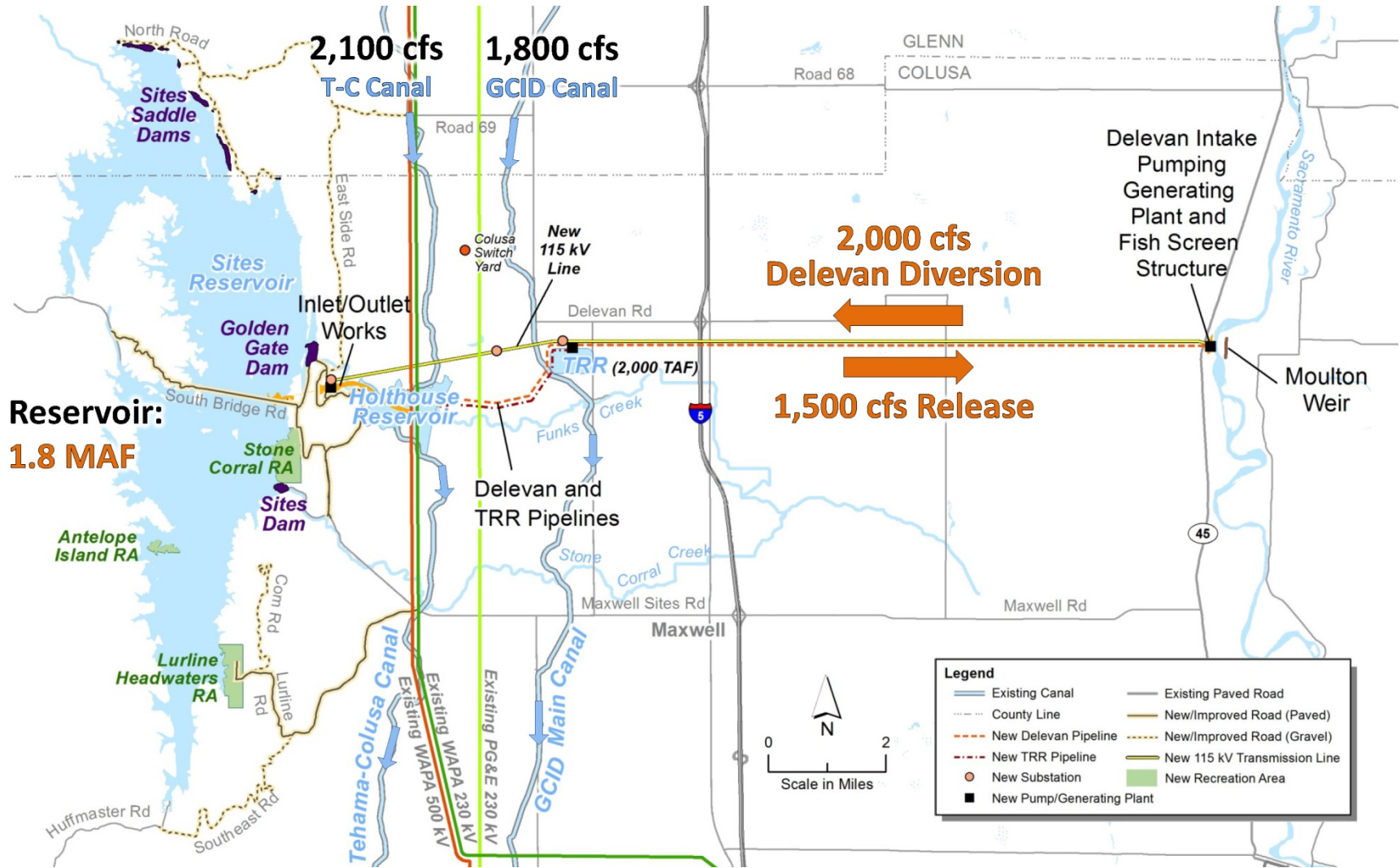


Figure 6-3. Features of NODOS Alternative C

## Chapter 6 Alternative Development

Reclamation and DWR may modify existing contracts or execute contracts for conveyance (i.e., export) using CVP or SWP facilities at the contractor's request. Conveyance contracts would be required for all water moved through the T-C Canal.

Contracts would be required for water stored in CVP reservoirs.

Releases made from the Holthouse Reservoir Forebay/Afterbay would generate power at the TRR and Delevan Intake Pumping/Generating Plants.

Alternative C has three recreation areas (Stone Corral, Lurline Headwaters, and Antelope Island).

### **Alternative D (1.8 MAF Sites Reservoir, 2,000 cfs Delevan Pipeline for Intake and Release, Local Considerations)**

Under Alternative D, Sites Reservoir would have a 1.8 MAF storage capacity. The Sites Pumping/Generating Plant has a 125 MW capacity. The facilities for Alternative D are depicted on Figure 6-4.

On the eastern side of the project, Alternative D includes the Delevan Intake Pumping/Generating Plant and adjoining fish screen structure at the Sacramento River. The new intake would have a 2,000 cfs capacity, and this flow would be conveyed across the valley by the Delevan Pipeline to Holthouse Reservoir. The power transmission lines for the Delevan Intake would run north from a new substation in Colusa rather than across the valley from the west.

In addition to the Delevan Pipeline, water would be conveyed to the reservoir by the T-C and GCID Canals. Water intended to provide public benefits and to supply the GCID and TCCA service areas would be stored in Sites Reservoir for future delivery. The following releases would be possible:

- Releases from Holthouse Reservoir to the southern portion of the TCCA service area
- Releases from the TRR to the southern portion of the GCID service area
- Releases from the Delevan Pipeline to the Sacramento River for downstream water users, incremental Level 4 refuge water supply, and Delta environmental water quality
- Releases from Holthouse Dam to Funks Creek and the Colusa Basin Drain

Reclamation and DWR may modify existing contracts or execute contracts for conveyance (i.e., export) using CVP or SWP facilities at the contractor's request. Conveyance contracts would be required for all water moved through the T-C Canal.

Contracts with Reclamation would be required for water stored in CVP reservoirs.

The Authority would also need to enter into contracts with Reclamation to store water in Shasta Lake and Folsom Lake.

Releases made from the Holthouse Reservoir Forebay/Afterbay would generate power at the TRR and Delevan Intake Pumping/Generating Plants.

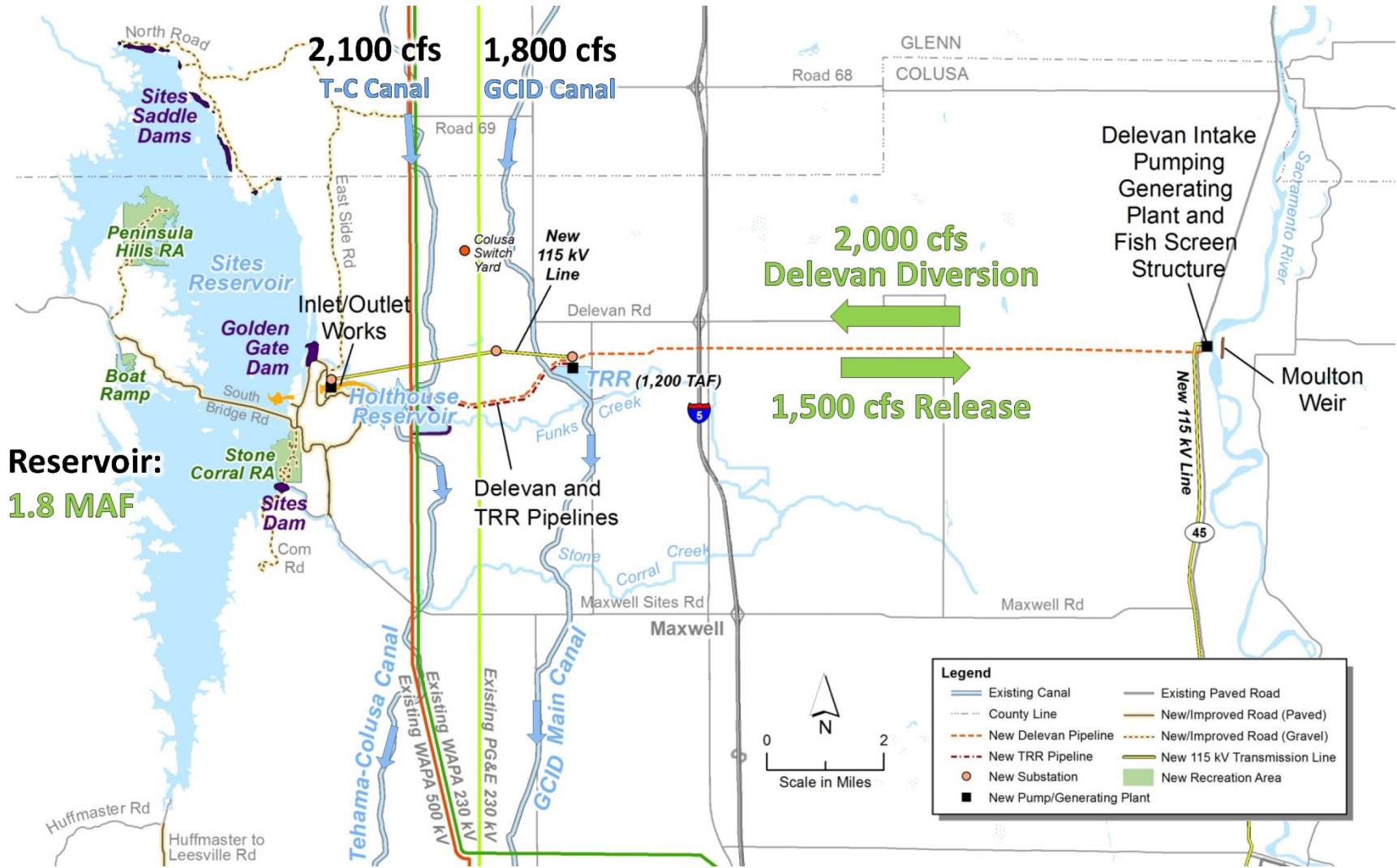


Figure 6-4. Features of NODOS Alternative D



Alternative D has two recreation areas (Stone Corral and Peninsula Hills).

## Facility Descriptions

Detailed information on all project facilities is provided in the section titled “Design Considerations” in Appendix B, Engineering.

### Sites Reservoir

Two reservoir storage capacity options are under consideration for the action alternative plans:

- 1.3 MAF for Alternative A
- 1.8 MAF for each of Alternative B, Alternative C, and Alternative D

#### **1.3 MAF Storage Capacity (Alternative A)**

For the 1.3 MAF storage reservoir, the maximum WSE of the reservoir would be 480 feet mean sea level (msl), with an inundation area of approximately 12,400 acres. The minimum operating water surface would be at elevation 340 feet. The reservoir would require construction of the Golden Gate Dam on Funks Creek, Sites Dam on Stone Corral Creek, and six saddle dams on the northern end of the reservoir (see Figure 6-1). All of these dams would be zoned earth rockfill embankment-type dams, which previous investigations indicate would be the most economical. However, a study of dam types would be conducted in the preliminary design phase to ensure the selection of the most economical and technically feasible dam types for all of the Sites Reservoir dams.

The embankment for Golden Gate Dam would have a crest elevation of 500 feet, a crest length of 1,450 feet, a maximum height of 266 feet above the streambed, and a total embankment volume of 6.0 million cubic yards. Sites Dam would be constructed on Stone Corral Creek. The dam embankment would have a crest elevation of 500 feet, a crest length of 725 feet, a maximum height of 250 feet above the streambed, and a total embankment volume of 2.9 million cubic yards.

Six saddle dams would be required at the northern end of Sites Reservoir, between the Funks Creek and the Hunter Creek watersheds, roughly along the Glenn-Colusa County line. Total embankment volume of the saddle dams would be 2.2 million cubic yards.

Total embankment volume required for the Golden Gate Dam, Sites Dam, and the six saddle dams would be approximately 11.0 million cubic yards.

#### **1.8 MAF Storage Capacity (Alternatives B, C, and D)**

For the 1.8 MAF storage reservoir, the maximum WSE of the reservoir would be 520 feet msl, with an inundation area of approximately 14,000 acres. The minimum operating water surface would be at elevation 340 feet. The reservoir would require construction of Golden Gate Dam on Funks Creek, Sites Dam on Stone Corral Creek, and nine saddle dams on the northern end of the reservoir, between the Funks Creek and the Hunter Creek watersheds (see Figure 6-2, Figure 6-3, and Figure 6-4). The current design for the larger reservoir also uses zoned earth rockfill embankment-type dams.

Golden Gate Dam would be constructed on Funks Creek, approximately 1 mile west of Holthouse Reservoir. The proposed dam embankment would have a crest elevation of 540 feet, a crest length of 2,250 feet, a maximum height of 310 feet above the streambed, and a total embankment volume of 10.6 million cubic yards. Sites Dam would be constructed on Stone Corral Creek, approximately 0.25 mile east of the town of Sites and 8 miles west of the town of Maxwell. The dam embankment would have a crest elevation of 540 feet, a crest length of 850 feet, a maximum height of 290 feet above the streambed, and a total embankment volume of 3.8 million cubic yards.

Nine saddle dams would be required at the northern end of Sites Reservoir, between the Funks Creek and the Hunter Creek watersheds, roughly along the Glenn-Colusa County line.

The total embankment volume required for the Golden Gate Dam, Sites Dam, and the nine saddle dams is approximately 21.0 million cubic yards.

### **Sites Reservoir Inlet/Outlet Structure (All Alternatives)**

Water would be diverted into and released from Sites Reservoir to Holthouse Reservoir, which would serve as a forebay/afterbay. Water would be pumped out of Holthouse Reservoir at the Sites Pumping/Generating Plant through a connecting tunnel and then passed into the reservoir through a vertical inlet/outlet structure standing in the reservoir. Releases would be made using these same facilities.

The purpose of the reservoir inlet/outlet structures would be to regulate reservoir releases through the connecting tunnel to the Sites Pumping/Generating Plant. The reservoir inlet/outlet structure would be at the western end of the tunnel and southwest of the proposed Golden Gate Dam. The reservoir inlet/outlet structure would consist of a low-level inlet/outlet structure for emergency drawdown releases.

For the 1.8 MAF reservoir, the tower would be approximately 260 feet high and have nine tiers of port valves. For the 1.3 MAF reservoir, the tower would be approximately 220 feet high and have seven tiers of port valves. The main tower shaft would have an inner diameter of 32 feet and an outer diameter of 39 feet.

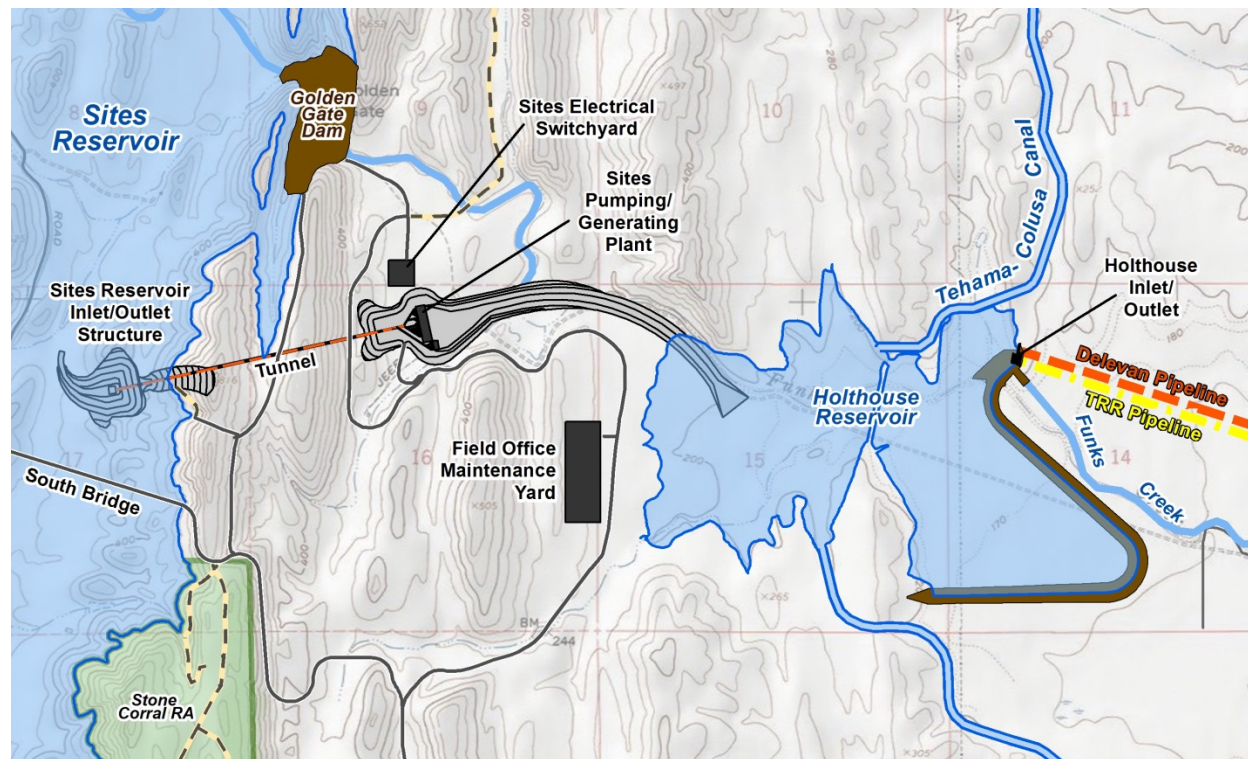
### **Tunnel Connecting Inlet/Outlet Structure to Sites Pumping/Generating Plant (All Alternatives)**

The purpose of the connecting tunnel is to convey water between Sites Reservoir and the Sites Pumping/Generating Plant. The tunnel would be approximately 4,500 feet long. The proposed 30-foot-diameter finished tunnel size was developed to meet DWR's Division of Safety of Dams emergency drawdown release criteria. The proposed tunnel has a design capacity of approximately 23,000 cfs.

### **Sites Pumping/Generating Plant (All Alternatives)**

Hydroelectric generating capability has been incorporated into the Sites Pumping/Generating Plant (see graphic below). In general, the addition of ancillary hydroelectric power generation to the grid would help mitigate some of the power consumption costs associated with this offstream water storage facility. Water would be pumped into Sites Reservoir primarily in the winter and spring months during off-peak periods, and water would be released primarily during the

summer and fall, thereby producing hydropower when power demands and costs are typically higher. Although every alternative includes the Sites Pumping/Generating Plant, the sizing of the plant varies based on the release capacity and maximum water surface elevation in Sites Reservoir.



Source: DWR 2007.

### Sites Pumping/Generating Plant

The design capacity of the Sites Pumping/Generating Plant would be approximately 5,900 cfs for Alternatives A, C, and D; and 3,900 cfs for Alternative B.

The Sites Pumping/Generating Plant would be connected to Holthouse Reservoir by an unlined approach channel approximately 8,300 feet long. An electrical switchyard would be required adjacent to the Sites Pumping/Generating Plant to provide power to and from the plant. The switchyard would step down the electrical voltage from the high-voltage lines used to transmit electricity over long distances to a lower voltage that can be used by the pumps and other machinery in the plant in pump mode. Power could be provided to the switchyard from the nearby Pacific Gas and Electric Company (PG&E) or WAPA 230-kV transmission lines.

### Holthouse Reservoir (All Alternatives)

It would be necessary to enlarge Funks Reservoir to provide the storage capacity to operate the conveyance systems supplying water; to regulate flows for the proposed Sites Pumping/Generating Plant; and to store water for on-call power generation for up to 6 hours per day. Funks Reservoir is an existing reservoir on Funks Creek, approximately 7 miles northwest of Maxwell, in Colusa County. It was constructed in 1975 by Reclamation and has a design capacity of 2,250 AF, with a surface area of 232 acres. An earthfill dam with a crest elevation of



214 feet impounds the reservoir on the east. The spillway overflow discharge capacity is 25,000 cfs with all gates fully open.

Funks Reservoir would be expanded to create Holthouse Reservoir by excavating the adjacent area. Preliminary studies indicate that the active storage should be approximately 6,500 AF to satisfy seasonal water balance needs and simultaneously permit pump-back power generation for up to 6 hours per day on a daily basis.

Holthouse Reservoir would regulate inflows and releases to minimize power usage and maximize power generation; it would also serve as a regulatory reservoir for the T-C Canal.

An existing WAPA transmission line current crosses through the footprint of Holthouse Reservoir. Currently, the preferred relocation option is to move the segment of the line in the reservoir footprint area to the west and cross the Holthouse Reservoir at the site of the existing Funks Dam.

### **Red Bluff Pump Installation at the Pumping Plant (All Alternatives)**

Water entering Holthouse Reservoir from the T-C Canal would be diverted into the canal from the Sacramento River at Red Bluff. Facilities associated with the Red Bluff Pumping Plant were extensively upgraded as part of the RBDD Fish Passage Improvement Project, completed by Reclamation in 2012. Additional capacity would be needed at the pumping plant to provide diversions into Sites Reservoir. The plant has two empty bays where additional pumps can be added. Two additional pumps would be installed as part of the NODOS project.

### **Terminal Regulating Reservoir (All Alternatives)**

Water conveyed down the GCID Canal would be conveyed into a future TRR. The TRR would be required to provide operational storage to balance out normal and emergency flow variations between the upstream GCID Canal Pump Station, a new TRR Pumping/Generating Plant, and the downstream canal. The TRR Pumping/Generating Plant would convey water from the TRR up to Holthouse Reservoir via a new pipeline.

The TRR would be created on the valley floor next to the GCID Canal by a combination of excavation and embankment. The reservoir would be composed of an earth embankment dam. The reservoir would be approximately 16 feet deep, with a maximum water depth of 12 feet, leaving 4 feet of freeboard. Two configurations were considered for the TRR. Alternatives A, B, and C use a larger, 2,000 AF reservoir. Alternative D proposes a smaller 1,200 AF reservoir to reduce impacts to landowners.

The TRR Pumping/Generating Plant would pump 1,800 cfs of water from the TRR to Holthouse Reservoir. The TRR Pumping/Generating Plant would generate power from flows released through the TRR Pumping/Generating Plant, with a maximum return flow of 900 cfs (the return flow is constrained by the downstream capacity of the GCID Canal).

### **TRR Pipeline (All Alternatives)**

The 3.5-mile-long TRR Pipeline would convey water from the TRR to Holthouse Reservoir. The TRR Pipeline would be bi-directional, allowing water to be pumped from the TRR to Holthouse Reservoir for storage, and allowing water to flow by gravity from Holthouse Reservoir for release to the TRR/GCID Canal. The TRR Pipeline would consist of two 12-foot-diameter

reinforced-concrete pipes with capacity to convey 1,800 cfs from the TRR to Holthouse Reservoir, and 900 cfs from Holthouse Reservoir to the TRR. The pipeline would be buried a minimum of 8 feet (to top of pipe) below ground surface.

### **Delevan Pipeline (All Alternatives)**

The Delevan Pipeline would consist of two buried 12-foot-diameter reinforced-concrete pipes that would provide water conveyance capability between the Sacramento River and Holthouse Reservoir. The pipeline would be about 13.5 miles in length, with an elevation difference of approximately 150 feet. Under Alternatives A, C, and D, the Delevan Pipeline would be used to both convey water to Holthouse Reservoir using the pumps at the Delevan Intake Pumping/Generating Plant, and to release water back to the river under gravity conditions. Under Alternative B, the Delevan Pipeline would only release water by gravity from Holthouse Reservoir to the Sacramento River through a new outlet structure. To construct pipelines under major infrastructure facilities, bore/jack construction methods would be used at road crossings (Interstate [I]-5, I-99, and SR 45); railroad crossings, the crossing under the Colusa Basin Drain, gas transmission line crossings, and the crossing under the GCID Canal.

The alignment for the pipeline is the same under Alternatives A, B, and C, but it is slightly farther south under Alternative D to take advantage of an existing easement held by the Maxwell Irrigation District.

### **Delevan Intake Pumping/Generating Plant (Alternatives A, C, and D)**

The Delevan Intake Pumping/Generating Plant would pump water from the Sacramento River to Holthouse Reservoir. The plant would pump 2,000 cfs of water from the Sacramento River to Holthouse Reservoir, and the design return flow is 1,500 cfs.

The Delevan Intake Pumping/Generating Plant would be on the right bank of the Sacramento River across the river from the Moulton Weir. The proposed pumping/generating plant would involve the construction of:

- A pumping/generating plant
- Forebay/afterbay pond
- Two air chambers
- Manifold piping to connect the pumping and generating units to the Delevan Pipeline
- A control building
- An electrical switchyard
- Fish-screening facilities on the Sacramento River

The fish-screening facilities would be on the western side of the Sacramento River, slightly downstream of River Mile 158.5, and on the eastern side of SR 45. Based on the fish screen design and constructability, the proposed location of the plant is considered the best for hydraulics for fish-screening operations.

### **Delevan Pipeline Discharge Facility (Alternative B)**

Alternative B would not include the Delevan Intake Pumping/Generating Plant. It would instead include the Delevan Pipeline Discharge Facility. This facility would control releases from Holthouse Reservoir to the Sacramento River through the Delevan Pipeline. This structure would be on the waterside bank of the Sacramento River and would have a flowmeter and cone-valves for each of the two pipes of the Delevan Pipeline. A concrete-lined discharge channel would carry the released flows from the valves down the concrete channel into a concrete spillway and into the Sacramento River. A positive barrier bar rack would cover the spillway at expected operating river levels to prevent fish from entering the structure.

### **Road Relocations and South Bridge (All Alternatives)**

Sites Reservoir would inundate portions of Maxwell-Sites Road and Sites-Lodoga Road, and would therefore block travel between the towns of Maxwell and Lodoga. These roads are in Colusa County's jurisdiction. Approximately 6 miles of Huffmaster Road and Peterson Road (gravel roads) would be inundated. Therefore, this project would reroute existing roads or provide alternate access.

The proposed public roads and South Bridge would provide vehicle access to allow for travel between Maxwell and areas west of the proposed reservoir, including the town of Lodoga and East Park Reservoir. The proposed primary route from Maxwell to Lodoga would be a paved two-lane road, and would use portions of the existing Maxwell-Sites Road and Sites-Lodoga Road alignments. This route would also provide access to the proposed Stone Corral Recreation Area. The proposed South Bridge would be a two-lane concrete bridge. The bridge would be 35.5 feet wide and approximately 1.6 miles long.

Gravel roads would provide access to the dams and operations facilities in the vicinity of Sites Reservoir. Alternatives A, B, and C include more extensive roads to allow access to the southern end of the reservoir. Alternative D includes a new road that would connect property at the southern end of the reservoir to Leesville Road.

### **Transmission Lines, Electrical Substations, and Switchyards (All Alternatives)**

Proposed dedicated transmission lines would carry electricity from an existing power source (grid) to the individual pumping/generating plants. The substation and transmission lines would also allow the pumping/generating plants to reverse the flow of electricity, and feed electricity back into the electrical grid for use by other customers during generation activities.

The Sites and TRR Pumping/Generating Plants would be connected to the existing electrical grid by a new 230-kilovolt (kV) or 115 kV overhead transmission line in the vicinity of Holthouse Reservoir. Near the Sites Pumping/Generating Plant, the existing WAPA and PG&E 230-kV lines are the most probable power sources large enough for project use (see Figure 6-1 through Figure 6-4). To reach the Sites Pumping/Generating Plant, a short transmission line (length of 1 to 4 miles) may be required from the substation to the pumping plant. A similar transmission line from the same substation would be required for the TRR Pumping/Generating Plant.

In Alternatives A and C, new transmission lines would parallel the proposed route of the Delevan Pipeline from the Sacramento River to the Delevan Intake Pumping/Generating Plant, and would be constructed primarily within a 150-foot-wide permanent transmission line easement.

Alternative B does not include the Delevan Intake Pumping/Generating Plant, and no new transmission line would be required. Under Alternative D, the transmission lines would be routed north-south along SR 45 instead of across the valley. Under this alternative, power would be supplied from a new substation west of the city of Colusa.

Transmission costs for the NODOS project will be affected by whether transmission is through WAPA or the California Independent System Operator (CAISO).

### Recreation Facilities (All Alternatives)

New recreational facilities adjacent to Sites Reservoir are included in each of the project alternatives (see Appendix E, Recreation). Alternatives A, B, and C have three recreation areas, and two are proposed under Alternative D.

- **Stone Corral Recreation Area (All Alternatives)** – The Stone Corral Recreation Area would be on the eastern side of the reservoir, north of the existing Maxwell-Sites Road and the proposed Sites Dam. The maximum proposed size of the Stone Corral Recreation Area is 235 acres.
- **Antelope Island Recreation Area (Alternatives A, B, and C)** – The Antelope Island Recreation Area would be in the southwestern portion of the reservoir. The maximum proposed size of the Antelope Island Recreation Area is 49 acres.
- **Lurline Headwaters Recreation Area (Alternatives A, B, and C)** – The proposed Lurline Headwaters Recreation Area is a 219-acre site on the southeastern end of Sites Reservoir in an open meadow surrounded by oak grassland along steep mountains with excellent views.
- **Peninsula Hills Recreation Area (Alternative D)** – Peninsula Hills Recreation Area, proposed by Colusa County, would occupy approximately 516 acres on the northwestern side of Sites Reservoir. The Authority is considering the installation of a separate boat launch facility approximately 2 miles south of this recreation area, with access to the reservoir south of Sites-Lodoga Road.

These recreation areas could potentially be developed and commissioned in a phased approach to match recreation interest at Sites Reservoir. Under Alternatives A, B, and C, the Stone Corral Recreation Area would be the first to be developed, followed by the Lurline Headwaters Recreation Area, and then the Antelope Island Recreation Area. Should recreational use remain low, only the Stone Corral Recreation Area would be constructed. For Alternative D, the Stone Corral Recreation Area and the west-side Boat Ramp would be constructed initially, followed by the remainder of Peninsula Hills Recreation Area, if warranted. The facilities for each recreation area are summarized in Table 6-2.

## Proposed Operations

The proposed reservoir would be filled by diversions from the Sacramento River. Sites Reservoir would be operated in cooperation with CVP and SWP facilities to maximize the potential benefits and to comply with existing operations requirements (e.g., COA, CVPIA, BiOps, D-1641).

Implementing cooperative operations would require an agreement between Reclamation, the Authority, and DWR that would define the responsibilities of each party for coordination and facility operations. The Sites Authority formed and is coordinating an Operations Work Group, including participation from CVP and SWP operators. A framework for cooperative operations still needs to be developed. The framework will include the following elements.

The Authority has developed a draft Water Rights Strategy.

The working group will develop operational Principles of Agreement.

The Authority will complete an operations plan with review and input from the Operations Work Group.

Table 6-2. Summary of Recreation Facilities

Feature	Lurline Headwaters	Stone Corral	Antelope Island	Peninsula Hills
Alternative	A, B, and C	A, B, C, and D	A, B, and C	D
Size	219 acres	235 acres	49 acres	516 acres
Access	Sulphur Gap Road to Lurline Road	New Stone Corral Road	Boat-in only	Existing Sites-Lodoga Road and new bridge and new Peninsula Road
Camp sites	50 (car and recreational vehicle) and 3 group camp area (each group camp area can accommodate up to 24 people)	50 (car and recreational vehicle)	12 (boat-in)	100 (car and recreational vehicle) and 1 group camp area (group camp area can accommodate up to 24 people)
Picnic sites	10 (with parking at each site)	10 (with parking at each site)	None	10 (with parking at each site)
Hiking trails	Yes	Yes	Yes	Yes
Vault toilets	8	10	1	10
Kiosk	1	1	None	1
Boat launch	None	Two-lane ramp and parking area	Off-shore	Nearby two-lane ramp and parking area approximately 2 miles from recreation area
Utilities	None	Electricity and water	None	Electricity and water
Other	Fishing access parking (10 stalls); vista point/sightseeing; additional parking areas	35-acre overlook/interpretive (sightseeing) and additional parking areas	None	Equestrian trails and horse trailer parking area; vista point/sightseeing; additional parking areas

The Operations Work Group will identify agreements and contracts (e.g., Warren Act) to convey or store water for cooperative operations and deliveries to participating agencies.

The operations for all of the action alternatives are designed to provide water for the following purposes:

- Improve the reliability and the system flexibility for water supplies throughout the CVP and SWP service areas for agricultural, urban, and environmental uses

## Chapter 6 Alternative Development

- Increase incremental Level 4 refuge water supply for optimum habitat management in the Central Valley refuges
- Improve Sacramento and American River water temperatures and flow conditions for salmon and other native fish
- Improve Delta outflows and the X2 position to provide better conditions for Delta smelt and other aquatic species in the Delta.

Cooperative operations of Sites Reservoir with the existing CVP and SWP reservoirs would increase the benefits of the project. Additional water could be stored in the existing reservoirs (Shasta, Trinity, Oroville, and Folsom) through the following operations:

- Releasing water from Sites Reservoir to meet existing Sacramento Valley CVP contract requirements, instead of taking this water out of Shasta (including exchange of Sites Project water between contractors for needs upstream of Sites Reservoir)
- Releasing water from Sites Reservoir to meet CVP and SWP south-of-the-Delta needs, instead of releasing water from the CVP and SWP reservoirs
- Releasing water from Sites Reservoir instead of from the CVP and SWP reservoirs to meet a portion of the CVP commitment for Delta outflow to maintain the position of X2

The Sites Reservoir alternatives would be adaptively managed to provide water for the highest beneficial use, consistent with the objectives of this report.

Sites Reservoir would provide water through the following mechanisms.

- Water stored in Sites Reservoir could be released to the T-C Canal for distribution to water users south of Holthouse Reservoir.
- Water could be released from Holthouse Reservoir to the TRR, where it could be released to either the GCID Canal or Funks Creek to meet local water supply needs.
- Water could be released through the Delevan Pipeline to the Sacramento River, where it could be picked up by downstream users or used for Delta export. Releases would also be provided for incremental Level 4 refuge water supply and for Delta environmental water quality.
- Water stored in Sites Reservoir could be exchanged for water stored in Shasta Lake or other CVP and SWP system reservoirs. This mechanism would appreciably increase upstream storage and operational flexibility to support multiple water supply and ecosystem benefits.
- Implementation considerations associated with project operations are discussed in Chapter 8, National Economic Development and Locally Preferred Alternative.

All operations of the Sites Reservoir Project would be provided by the non-Federal Sponsor (the Authority). The Authority would be responsible for managing releases for all deliveries of water north of the Delta, and releases of water intended for export. For the conveyance of water for export, water users may use the provisions of their existing CVP and SWP contracts and/or enter

into contracts for the conveyance of Sites water across the Delta to their place of use. Contracts would be required for all water moved through the T-C Canal. The Authority would also need to obtain wheeling agreements with GCID and TCCA to move water through the GCID Canal and the T-C Canal, respectively.

The Authority would need to enter into agreements with Reclamation to store water in Shasta Reservoir and Folsom Lake per the Warren Act. Agreements would be needed with DWR for storage in Lake Oroville.

### **Water Rights**

Water rights would need to be obtained from the SWRCB for diversions, storage, and regulation of Sites Reservoir, and delivery of that water for beneficial use (see Chapter 8, National Economic Development and Locally Preferred Alternative for discussion of implementation requirements). Implementation of the NODOS project would include:

- Assignment of the State Filing (A025517), as it will be updated
- Possible additional water right filings as may be needed for the operation of Sites Reservoir
- Obtaining a water right permit from the SWRCB for the operation of Sites Reservoir
- Other water rights water

This will be expanded upon in the draft Water Rights Strategy. Other water rights are associated with diversions from Stone Corral and Funks Creeks outside of the Sites Reservoir inundation area, including appropriative water rights permits issued to GCID. However, those water rights are limited to use on specific properties and do not include large amounts of water due to their place-of-use limitations.

**Department of Water Resources Application for Water Rights for “Colusa Reservoir”:** In February 1975, DWR, Northern District, published *Major Surface Water Development Opportunities in the Sacramento Valley: A Progress Report (DWR 1975)*. This report considered the results of previous Reclamation and DWR reports, and provided in-depth analyses of four reservoir locations in the Sacramento Valley, including the “Colusa Reservoir Complex” (which included the currently proposed Sites Reservoir) and the “Glenn Reservoir Complex” (which included a potential Newville Reservoir). The analysis considered the timing and volume of available surplus water in the Sacramento River with respect to riparian and senior appropriative water rights holders. For the Colusa Reservoir proposal, the report acknowledged that water from local water rights would be included in the operation of the originally proposed Colusa Reservoir; however, the study focused primarily on using surplus Sacramento River and associated tributary water supplies to provide up to 3,164,000 AF of storage.

Subsequently, on September 30, 1977, the Department of Water Resources submitted a water right application under Water Code 10500 for diversions that would provide water to the Colusa and Glenn Reservoir Complexes. Water Right Application A025517 was filed for the Colusa Reservoir Complex; it included the following five diversion locations, with a collective direct diversion rate to use of 4,200 cfs:

- Sacramento River at Red Bluff Diversion Dam (adjacent to the current Red Bluff Diversion Pumping Plant) (Latitude N40°15'21.5240" / Longitude W122°20'30.4725")
- Sacramento River at the existing GCID Pumping Plant (Latitude N39°78'95.7266" / Longitude W122°05'01.9941")
- Middle South Fork of Willow Creek along Road 302 (Latitude N39°54'24.0015" / Longitude W122°39'04.4006")
- Funks Creek to the northwest of Funks Reservoir in 1977 (Latitude N39°34'27.3539" / Longitude W122°32'07.3568")
- Stone Corral Creek along Maxwell-Sites Road east of Huffmaster Road (Latitude N39°30'75.6840" / Longitude W122°32'90.5778")

This resulted in a State filing, which is now held by the SWRCB. The Face Value Amount<sup>2</sup> of this was for 3,164,000 acre-feet/year. The stated water uses under this State filing included irrigation, municipal, domestic, industrial, recreational, fish and wildlife, water quality control, incidental power, and other without any seasonal restrictions (i.e., proposed application requested diversion from January 1 through December 31). The water right application will need to be updated to reflect the details of the Sites Reservoir Project, including all of the points of diversion, service areas, and adjustment of the storage amount down to 1.81 MAF.

The State filing did not include the proposed Delevan Pipeline intake diversion from Sacramento River near the existing Maxwell Irrigation District diversion. This diversion would need to be added as a point of diversion under the State filing or require a new water right.

### ***Diversions into Sites Reservoir***

The proposed Sites Reservoir would be filled through the diversion of water diverted from the Sacramento River pursuant to State issued water rights. Water would be diverted at two (Alternative B) to three locations (Alternatives A, C, and D) on the river. Diversions would only occur during periods when flow is in excess of the following:

- Existing CVP and SWP and other water rights diversions, including SWP Article 21 (interruptible supply) and other more senior flow priorities (diversions associated with Freepoint Regional Water Project and the existing Los Vaqueros Reservoir)
- Existing regulatory requirements, including SWRCB D-1641, CVPIA 3406(b)(2) (Reclamation and USFWS 2003), the 2008 USFWS BiOp (USFWS 2008), the 2009 NMFS BiOp (NMFS 2009), and other instream flow requirements
- Future regulatory or other requirements that may be placed on the United States or the State of California

---

<sup>2</sup> SWRCB defines Face Value Amount as the maximum amount of water that can be appropriated for water rights issued after 1914 (Title 23 California Code of Regulations Section 731). The Face Value Amount, as shown on each water right application and permit, includes the total amount of water to be diverted for consumptive uses plus water not consumed by the water rights holder that may be used by other users (e.g., conveyance losses to percolation or surface runoff) (SWRCB 2016). For appropriative water rights, the total Face Value Amount is only available after flows are provided to senior water rights, instream flow criteria, and other senior water regulatory requirements as specified in the actual water right permit.



The Authority is committed to the concept of only diverting water when the system is declared to be in "true" Excess Conditions under the COA. This prevents the operations of Sites Reservoir from having an effect on SWP and CVP operations. If the Water Right conditions or the BiOp provisions on the SWP and CVP become more restrictive on CVP/SWP operations, then this will likely decrease the times that the system is in Excess Conditions and this will therefore limit the times that Sites will be able to divert water and will decrease the water delivery capability of Sites.

The original priority date of Application 25517 (9/30/1977) may be retained. Any new application for a water right would have a present-day priority date as of date of filing. State Water Board Decision 1594 states that Standard Permit Term 91 has been placed in permits issued on applications for diversions within the Delta watershed filed after August 16, 1978. The operations modeling performed in support of this Draft Feasibility Report was more restrictive than Term 91 limitations on diversions. The studies used "balanced conditions" to control diversions that protect stored water releases of the CVP and SWP, and also maximize CVP and SWP diversions prior to allowing diversions for Sites Reservoir. The Authority intends to demonstrate to the State Water Board that for every application involved, whether State filed or new, there is a reasonable likelihood that unappropriated water is available for the proposed appropriations.

#### ***Developing Cooperative Operations with Reclamation and DWR***

The Authority is discussing operational principles for cooperative operations with Reclamation and DWR. As the Federal Feasibility Investigation proceeds, these principles will be refined and eventually used to develop a more detailed operations agreement that outlines the cooperative operations of the Sites Reservoir and the Federal and State facilities.

One key principle is that the operation of the Sites Project will cause no negative impacts to the CVP, SWP, or their contractors. Avoiding these impacts includes, but is not limited to, no negative operational, financial, or compliance impacts to CVP and SWP. The filling of Sites Reservoir will be restricted to when the regulatory-required bypass requirements at the diversion points and other key locations are met and the Delta is declared to be in "excess conditions."

#### ***Potential Cooperative Operations with Central Valley Project and State Water Project***

There are several ways that Sites Reservoir could be operated in cooperation with CVP and SWP operations. Releases from Sites Reservoir could be made such that releases from other reservoirs could be reduced while still meeting requirements for minimum instream flow objectives, Sacramento River temperature requirements, and Delta salinity control. Through this reduction in releases, storage could be conserved in Trinity Lake, Shasta Lake, Lake Oroville, and Folsom Lake to appreciably increase operational flexibility to improve fish survival (including water temperature and flow stabilization), and other ecological benefits.

The following operations would require cooperation between agencies, including Reclamation, DWR, the Authority, the TCCA, and GCID.

- Water pursuant to Water Right Application A025517 would be diverted from the Sacramento River at the RBPP and conveyed through the T-C Canal under a new conveyance agreement and a new water right. This water would be stored in Sites

Reservoir. Funks Reservoir would be expanded and re-configured into Holthouse Reservoir without losing current functions.

- Water pursuant to Water Right Application A025517 would be diverted from the Sacramento River at the GCID pumping plant in Hamilton City under a new agreement between the Authority and GCID. This water would be conveyed to the TRR, pumped into Holthouse Reservoir (would be part of the new conveyance agreement in the prior bullet), and then stored in Sites Reservoir.
- Water pursuant to Water Right Application A025517 would be diverted from the Sacramento River at the Delevan Intake Pumping/Generating Plant and pumped into Holthouse Reservoir (would be part of the new Conveyance agreement in the first bullet) and then stored in Sites Reservoir.
- Water stored in Sites Reservoir for ecosystem benefits could be exchanged for an equal quantity of water in Shasta Lake, Folsom Lake, or Lake Oroville which could be for coldwater pool, instream flows, or other public benefit.
- Supplemental water (i.e., water purchased from the Authority) could be released from Sites Reservoir via the T-C Canal and GCID Canal to provide an additional water supply to CVP and SWP contractors in the Sacramento Valley.
- Water stored in Sites Reservoir for ecosystem benefits could be released via the new Delevan Pipeline to improve Delta environmental water quality. This water would most likely be funded and owned by the State.
- Water could be released from Sites Reservoir via the new Delevan Pipeline to provide supplemental water supply (i.e., water purchased from the Authority) in the CVP and SWP service areas south of the Delta. This water would be acquired from the Authority, but the agencies receiving this water would have to execute new agreements with the CVP or agreements with the SWP to convey the water south of the Delta.
- Water stored in Sites Reservoir for ecosystem and water quality benefits could be released via the T-C Canal, GCID Canal, CBD, and/or Sacramento River for the benefit of fish and wildlife (public benefits under the California WSIP). This water would include water supply delivered to refuges, and it could be owned by Reclamation or the State.

### ***Operations for Anadromous Fish and Delta Environmental Water Quality***

Operations to benefit anadromous fish and environmental water quality were informed by prior CALFED studies and recommendations. As part of CALFED, several systemwide operational strategies were considered for reversing the fundamental causes of decline in fish and wildlife populations. CALFED recommended a series of actions to improve ecological processes and increase the amount and quality of habitat.

The CALFED Environmental Restoration Program identified more than 600 programmatic actions to improve ecological health. Eight of these (EI-1 through EI-8) were identified by the NODOS project planning team, with input from the Sacramento River Flow Regime Technical Advisory Group (which included environmental advocacy groups, academics, and representatives from Federal and State water resource and fish and wildlife agencies), and

incorporated into the NODOS project alternatives. These actions are described in Table 6-3. CALFED advocated an adaptive management implementation strategy that supports the flexible use of environmental water. This adaptive approach has been accommodated in NODOS project planning by dedicating a NODOS project storage allocation to benefit anadromous fish and Delta environmental water quality.

Proposed operations, including the proposed actions for fish enhancement, are summarized in Table 6-3. This table shows the types of beneficiary operations under drought and other hydrologic conditions and the priorities assumed for various seasonal operations. The proposed actions for fish enhancement are described below.

#### ***Shasta Lake Coldwater Pool and Sacramento River Temperature Control***

The benefits from Sites Reservoir would be appreciably enhanced through cooperative operations with Shasta Lake to increase the volume of Shasta Lake coldwater pool storage and improve the ability to maintain appropriate water temperatures in the Sacramento River during summer months and in drought years. This would be accomplished by exchanging water dedicated to public benefits stored in Sites Reservoir for additional storage in Lake Shasta to provide benefits to anadromous fish. The exchanged water from Sites Reservoir would then be released to meet Shasta's environmental obligations and meet CVP contract obligations (Reclamation would be reimbursed by the CVP contractors in accordance with their existing contracts). This would allow the coldwater pool at Shasta Lake to be maintained at higher levels than are currently achievable. Shasta Lake release patterns could be shifted in season and between adjacent years to improve coldwater storage and flow management for salmon that use the Sacramento River between Keswick Dam and Red Bluff as habitat.

#### ***Stabilize Upper Sacramento River Fall Flows***

Additional storage in Shasta Lake could be used to stabilize fall flows between Keswick Dam and Red Bluff to avoid abrupt reductions in flow that strand juvenile fish. Stabilized flows would reduce adverse conditions for spawning fall-run Chinook salmon (such as, dewatering of redds and scour damage).

#### ***Folsom Lake Coldwater Pool Improvement and Supply Reliability***

Coordinated operations between Sites Reservoir and Folsom Lake would improve the reliability of coldwater carryover storage at Folsom Lake, stabilize flows in the American River, and help maintain suitable water temperatures in the lower American River. Additional summer releases from Sites Reservoir could reduce the need for releases from Folsom Lake, resulting in increased carryover storage. Sites Reservoir releases could also provide additional Delta outflow to reduce the reliance on Folsom Lake for releases to maintain Delta water quality.

#### ***Delta Outflow Improvement and Delta Water Quality***

Sites Reservoir releases could provide supplemental Delta outflow during summer and fall months to improve Delta X2 salinity gradient conditions, and increase estuarine habitat, reduce entrainment, and improve food availability for anadromous fishes and other estuarine-dependent species. Increasing Delta outflow could help maintain the X2 position closer to Collinsville, and increase Delta smelt spawning habitat and improve food availability.

This page left intentionally blank.

Table 6-3. Description of Proposed Seasonal Schedule for Project Operations

Measure	Detail of Operation	Alternative(s)	Priority of Operation <sup>a</sup>	Year-Type Suitable <sup>b</sup>	Suitable Months for Operation <sup>c</sup>												
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
<b>General Operation</b>					The darker shading indicates months where there is <b>heavy use</b> of operations to attain the stated objective. Lighter shading indicates months where operations for the objective are <b>light to moderate</b> (i.e., operations occur when supplies are available and conditions favor the operation). No shading indicates <b>no use to light use</b> for the indicated objective.												
Diversions	Conduct diversions to T-C Canal, GCID Canal, and the proposed Delevan Pipeline (diversions could occur in any month). Diversions would only occur once the D-1641, CVPIA 3406(b)(2), 2008 USFWS BiOp, and 2009 NMFS BiOp requirements have been met and existing authorized Delta diversions have been satisfied. Diversions to Sites Reservoir would be restricted by Sacramento River bypass criteria at Red Bluff, Hamilton City, Wilkins Slough, and Freeport, and the restrictions for protecting fish outmigration-related pulse flows (7 to 10 days once a month when flow conditions provide). Shading indicates the period in which diversion operations would occur, with the highest diversions during November through March. Diversions could also be limited by future regulatory requirements which may be placed on the United States.	A, B, C, and D	N/A	N/A	■	■	■	■	■	■	■	■	■	■	■	■	■
Seasonal Reservoir Operations	Fill Sites Reservoir by pumping water diverted and stored pursuant to Water Right Application A025517 throughout the winter and spring and drain during peak release periods throughout the summer and fall.	A, B, C, and D	N/A	N/A	Fill Cycle			Drain Cycle						Fill Cycle			
<b>Water Supply Operations (modeled results are provided in Error! Reference source not found.)</b>																	
Authority	Provide average annual deliveries of 225 TAF for agricultural and municipal water supply. Approximately 98 TAF would be delivered to the Sacramento River Valley, and the remainder would be exported. Export would require new contracts for conveyance with Reclamation and DWR.	D	SPA-1	AN, BN, D, C	■	■	■	■	■	■	■	■	■	■	■	■	■
SWP Contractors	Increase water supply reliability up to SWP Table A contract amounts in years when SWP delivery allocation is below 85 percent. Shading highlights period in which Delta exports would be increased. Table A represents the maximum annual contract amount of water delivery that SWP contractors can receive.	A, B, C	DP-1	BN, D, C	■	■	■	■	■	■	■	■	■	■	■	■	■
CVP Contractors	Increase CVP water supply reliability up to contract amounts (total increase up to 55 TAF in Dry and Critical years) in any year when water supply availability limits water made available by the CVP. There would be little effect if Delta export capacity is limiting water made available by the CVP. Reliability increase would mostly affect agricultural water service contractors. Shading indicates the typical agricultural diversion pattern.	A, B, C	AVG-4	AN, BN, D	■	■	■	■	■	■	■	■	■	■	■	■	■
<b>Incremental Level 4 Water Supply to Refuges</b>																	
Incremental Level 4 water supply for wildlife refuges	Provide (3.35 TAF per year maximum for refuges north of the Delta and up to a maximum of 101.09 TAF per year for refuges south of the Delta to supplement refuges' supplies up to the full Level 4 water supplies (CVPIA).	All	AVG-3	AN, BN, D	■	■	■	■	■	■	■	■	■	■	■	■	■
<b>Delta Environmental Water Quality Operation</b>																	
Delta environmental water quality	Augment Delta outflow above base D-1641 operations for up to 6 months, with monthly rates varying within 750 cfs, 1,000 cfs, and 1,500 cfs tiers (maximum augmentation of 450 TAF per period).	All	AVG-1	AN, BN, D	■	■	■	■	■	■	■	■	■	■	■	■	■
EI-5: Delta Outflow for Delta Smelt Habitat Improvement (Summer/Fall)	Augment Delta outflow during summer and fall months (i.e., May through December) to improve X2 (if possible, west of Collinsville 81 km), and increase estuarine habitat, reduce entrainment, and improve food availability for anadromous fishes and other estuarine-dependent species (e.g., Delta smelt, longfin smelt, Sacramento splittail, starry flounder, and <i>Crangon franciscorum</i> ). Shading highlights period in which Delta outflow would be augmented (operation coordinated with Delta environmental water quality action).	All	AVG-2	ALL	■	■	■	■	■	■	■	■	■	■	■	■	■
<b>Hydropower Operation</b>																	
Dispatchable hydropower generation	Provide more than 30 hours per week of uninterrupted operation, with dedicated afterbay/forebay (Holthouse Reservoir) with 6,500-acre-foot capacity.	All	N/A	ALL	■	■	■	■	■	■	■	■	■	■	■	■	■
<b>Ecosystem Improvements</b>																	
EI-1: Shasta Coldwater Pool	Increase Shasta Lake storage levels to provide additional coldwater pool storage. This action would have particular emphasis in Below Normal, Dry, and Critical water-year types. This benefit would be achieved by (1) exchanging environmental water from Sites Reservoir for environmental water storage in Shasta, and then releasing water from Sites Reservoir to meet CVP contract requirements for GCID, Reclamation District 108, and the Member Units of the TCCA; (2) releasing water from Sites Reservoir to meet CVP south-of-the-Delta needs instead of releasing water from Shasta; and (3) releasing water from Sites Reservoir to meet a portion of the CVP commitment for Delta outflow.	All	DP-1	BN, D, C	■	■	■	■	■	■	■	■	■	■	■	■	■

Table 6-3. Description of Proposed Seasonal Schedule for Project Operations

Measure	Detail of Operation	Alternative(s)	Priority of Operation <sup>a</sup>	Year-Type Suitable <sup>b</sup>	Suitable Months for Operation <sup>c</sup>											
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EI-2: Sacramento River Flows for Temperature Control	Maintain water temperatures year-round at levels suitable for all species and life stages of anadromous salmonids in the Sacramento River between Keswick Dam and Red Bluff Pumping Plant, and during the July through November period for Below Normal, Dry, and Critical water-year types. This objective would be achieved by using the increase in storage at Shasta.	All	DP-2	BN, D, C												
EI-3: Folsom Lake Coldwater Pool	Increase Folsom Lake storage levels to provide additional coldwater pool to achieve temperatures that are more suitable for juvenile steelhead summer rearing and fall-run Chinook salmon spawning in the lower American River from May through November during all water-year types. The additional storage would be achieved by relying on Sites Reservoir to respond to some of the Delta objectives that are currently met through releases from Folsom, particularly from January through August.	All	DP-2	D, C												
EI-4: Stabilize American River Flows	Augment flows in the lower American River to reduce dewatering of fall-run Chinook salmon redds (i.e., October through March) and steelhead redds (i.e., January through May). This action would also reduce juvenile anadromous salmonid isolation events (through avoiding extreme fluctuations in flow), particularly from October through June. This objective would be accomplished by releasing a portion of the additional water stored at Folsom Reservoir resulting from reliance on Sites Reservoir to meet Delta objectives.	All	DP-2	ALL												
EI-6: Lake Oroville Coldwater Pool	Improve the reliability of coldwater pool storage in Lake Oroville to improve water temperature suitability for juvenile steelhead and spring-run Chinook salmon over-summer rearing and fall-run Chinook salmon spawning in the lower Feather River from May through November during all water-year types. Additional storage would be accomplished through releases from Sites Reservoir to meet Lake Oroville compliance obligations. Provide releases from Oroville Dam to maintain mean daily water temperatures at levels suitable for juvenile steelhead and spring-run Chinook salmon over-summer rearing and fall-run Chinook salmon spawning in the lower Feather River. Stabilize flows in the lower Feather River to minimize redd dewatering, juvenile stranding, and isolation of anadromous salmonids.	All	DP-2	BN, D, C												
EI-7: Stabilize Sacramento River Fall Flows	Stabilize flows in the Sacramento River between Keswick Dam and the Red Bluff Diversion Dam to minimize dewatering of fall-run Chinook salmon redds (for the spawning and embryo incubation life-stage periods extending from October through March), particularly during fall months. Avoid abrupt changes. Operations would avoid adverse impacts to coldwater pool operations in Dry and Critical water-year types.	All	AVG-1	AN,BN,D												
EI-8: Sacramento River Diversion Reduction at Red Bluff and Hamilton City	Provide increased flows from spring through fall in the lower Sacramento River by reducing diversions at Red Bluff Pumping Plant and Hamilton City and by providing supplemental flows at the proposed Delevan Pipeline Intake / Pipeline Discharge facilities.	All	N/A	ALL												

<sup>a</sup> Priority of operation: "DP" indicates that the operational priority has a driest period's emphasis, and "AVG" indicates an average-to-wet hydrologic emphasis. The numbers 1-4 indicate priority within the associated hydrologic emphasis; "N/A" indicates that operations are not or cannot be easily defined within the priority structure of the scenario.

<sup>b</sup> Year-type most suitable for operation is the D-1641 40-30-30 year-types that are reflected in operations studies; operations in these year-types occur when supplies would be available in Sites Reservoir to support the operation, when the operations criteria in the scenario allow for prioritization of the operations, and when conditions are suitable for developing the benefit associated with the operation.

<sup>c</sup> The heavier shaded parts of each bar highlight the months in which conditions would be most suitable to the operations; the lighter shaded parts of each bar highlight the months that would be less suitable to the operations; operations in these months would occur when supplies are available in Sites Reservoir to support the operation, when the operations criteria in the scenario allow for prioritization of the operations, and when conditions are suitable for developing the benefit associated with the operation.

- AN = Above Normal
- Authority = Sites Project Authority
- AVG = Average
- BiOp = Biological Opinion
- BN = Below Normal
- C = Critical
- cfs = cubic feet per second
- CVP = Central Valley Project
- CVPIA = Central Valley Project Improvement Act
- D = Dry
- D-1641 = Water Rights Decision 1641 Revised (SWRCB 2000)
- Delta = Sacramento-San Joaquin River Delta
- DP = driest periods
- GCID = Glenn-Colusa Irrigation District
- km = kilometers
- N/A = not applicable
- NMFS = National Marine Fisheries Service
- SWP = State Water Project
- T-C Canal = Tehama-Colusa Canal
- TAF = thousand acre-feet
- TCCA = Tehama-Colusa Canal Authority
- USFWS = United States Fish and Wildlife Service

***Lake Oroville Coldwater Pool Improvement***

Sites Reservoir releases could increase the reliability of coldwater pool storage in Oroville Reservoir to reduce water temperatures in the lower Feather River for the benefit of juvenile steelhead and spring-run Chinook salmon over-summer rearing and fall-run Chinook salmon.

This page intentionally left blank.