Sites Project Value Planning Alternatives Appraisal Report

April 2020

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Executive Summary

Ongoing planning efforts to develop the Sites Reservoir Project (Project) continue to inform expectations on diversion permits and water rights, as well as shape investor participation. In October 2019, representatives from the Authority Board and Reservoir Committee began undertaking a "value planning" process: an effort to identify and evaluate additional alternatives that could make the Project more affordable for the Project's participants. This decision was based on ongoing discussions with permitting agencies, expected project cost and cost per acre foot, and existing participation levels. An Ad Hoc Value Planning Workgroup was formed in late 2019 and continued to meet through early 2020. The Workgroup directed the efforts of Authority staff and the consultant team to formulate and evaluate Project alternatives that would be more affordable, and to identify a recommended Project.

For the purpose of this value planning effort, project objectives were limited to the interests of the Authority's participants and the anticipated benefits to be funded through the Water Storage Investment Program (WSIP) by the State of California. The primary and secondary Project objectives are provided in Table E-1.

TABLE E-1. PROJECT OBJECTIVES.

Primary Objectives	Secondary Objectives
Improve Water Supply and Water Supply Reliability	Provide Opportunities for Recreation
Provide Incremental Level 4 Water Supply for Refuges	Provide Opportunities for Flood Damage Reduction
Improve the Survival of Anadromous Fish	
Enhance the Delta Ecosystem	

Overview of Project Components

The Project includes many facilities. Most of the Project costs are associated with four primary functions: diversions for filling, conveyance for releases, storage, and roads and bridges.

- Diversion Facilities for Filling – Diversion facilities include pipelines, canals, and pumping plants required to fill Sites Reservoir. To reduce costs, the value planning alternatives focused on using existing facilities for filling Sites Reservoir rather than constructing new facilities.
- Conveyance for Releases – The value planning alternatives focused on using the existing Tehama-Colusa Canal (T-C Canal) to deliver water to the southern terminus of the canal. Releases could then be conveyed from the southern end of the T-C Canal to either the Colusa Basin Drain (CBD) or the Sacramento River.
- Storage – Smaller reservoir sizes, focusing on reservoir sizes of 1.5, 1.3, and 1.0 million acre-feet (MAF) were evaluated to reduce the number and size of the dams and saddle dams along with related gates, towers, tunnels, and pumping facilities needed to fill Sites Reservoir.
- Roads and Bridges – The value planning effort considered a number of road and bridge combinations, ultimately focusing on lower costs options for a new bridge to maintain emergency and public access from Maxwell to Lodoga along with roads (paved and unpaved) to maintain access for residents and provide for construction traffic.

Value Planning Alternatives

Value planning alternatives that combine different types and sizes of diversion, release, reservoir, and road and bridge facilities were developed. Initial alternatives were developed following the October 2, 2019 kickoff meeting. These initial alternatives were then refined in the following months and additional alternatives were also added. Over this time period, analyses were completed to assess the operational, environmental, and permitting considerations for different alternatives. Staff also performed a repayment analyses for the alternatives. These analyses are summarized below.

Operational Assessment

The value planning alternatives evaluated the ability of several reservoir sizes and conveyance capacities to meet current participant subscriptions of approximately 230,000 acre-feet (AF), comprised of 192,892 AF of public water agency participation and approximately 40,000 AF of participation by the State of California through the Water Storage Investment Program (WSIP). A sensitivity analysis for a range of reservoir sizes and release capacities for Sites Reservoir was conducted to evaluate the quantity of water that could be released under different conveyance capacities assuming diversion criteria based on current discussions with regulatory agencies. Table 5-2 shows the estimated average annual releases under different combinations of potential Sites storage and release capacities.

TABLE E-2. SITES RESERVOIR RELEASES UNDER VARYING STORAGE AND RELEASE CAPACITIES

	Long-term Average		
Storage Capacity (MAF)	**1,500 cfs Release Capacity (TAF)**	**1,000 cfs Release Capacity (TAF)**	**750 cfs Release Capacity (TAF)**
1.5	253	243	236
1.3	243	234	230
1.0	207	195	191

Based on the preliminary analysis performed, the value planning alternatives with reservoir sizes of 1.3 to 1.5 MAF including assumed diversion criteria would be able to provide enough water to meet current participant demands. In addition, the use of the T-C Canal and the CBD as the conveyance systems appears possible based on preliminary analysis. Additional hydraulic analyses will be needed to confirm downstream conveyance conditions in the CBD, and the available capacity of the T-C Canal downstream of Funks Reservoir should be confirmed. Discussions with Reclamation on non-investment exchanges with Shasta Lake are ongoing. Annual Shasta Lake exchanges including assumed diversion criteria are estimated to be about 60 TAF. While field verification and additional analysis are required, the value planning alternatives with reservoir sizes of 1.3 to 1.5 MAF appear feasible from an operations standpoint.

Environmental and Permitting

The analysis of the value planning alternatives determined that obtaining permits from regulatory resource agencies for some of the alternatives would be relatively easier because of the (1) reduced inundation areas (within reservoir footprint), (2) lack of a pipeline easement to the Sacramento River, (3) removal of the northern regulating reservoir facilities, and (4) shorter conveyance off the T-C Canal (to CBD).

Repayment Analyses

A repayment analysis was conducted to estimate the annual repayment costs per AF of release from Sites Reservoir for both with and without a Water Infrastructure Finance and Innovation Act (WIFIA) loan. The analysis was based upon the estimated construction, operation and maintenance costs, and the estimated releases. Key assumptions included using 2019 as the base year, the U.S. Department of Agriculture loan for the Maxwell Intertie at 3.85%, a revenue bond interest rate of 5%, and a 30-year repayment. Including the USDA loan reduces the overall project cost by approximately $20 per acre-foot. The range in repayment costs are summarized in Table E-3.

TABLE E-3. ANNUAL REPAYMENT COSTS PER ACRE-FOOT OF RELEASE

	VP1			VP2			VP3		VP4		VP5	VP6	VP7
Reservoir Size (MAF)	1.0	1.3	1.5	1.0	1.3	1.5	1.3	1.5	1.3	1.5	1.3	1.3	1.5
Release Capacity (cfs)	750			750			1,500		1,000		1,000	1,000	1,000
Project Cost (2019 $, billions)	3.2	3.4	3.6	2.7	2.9	3.1	3.4	3.6	2.9	3.1	2.9	3.0	3.0
Annualized acre-feet/year Release (TAF)	191	230	236	191	230	236	243	253	234	243	234	234	243
PWA Annual Costs During Repayment Without WIFIA[a] Loan (2020 $, $/acre-feet)	862	776	805	730	667	693	738	754	660	678	644	674	661
PWA Annual Costs During Repayment With WIFIA Loan (2020 $, $/acre-feet)	799	724	755	665	614	641	689	708	608	628	592	621	611

[a] Water Infrastructure Finance and Innovation Act

Recommended Project

The recommended Project was developed by the Ad Hoc Value Planning Workgroup through a sequential process that included initial and refined alternatives. Important considerations included total project cost, impacts on landowners, impacts on traffic and public safety, ability to meet participant demands, ability to provide public benefits to the State, relative magnitude of environmental impacts, and the estimated cost per acre-foot of water delivered. The recommended Project and two options for consideration are shown in Table E-4.

TABLE E-4. VALUE PLANNING GROUP RECOMMENDED PROJECTS

	VP5	VP6	VP7
	Option 1	Option 2	Recommended
Reservoir Size	1.3 MAF	1.3 MAF	1.5 MAF
Dunnigan Release Capacity (cfs)	1,000	1,000	1,000
Estimated Cost (2019 dollars)	$2,855,000,000	$2,988,000,000	$3,037,000,000
Estimated Cost per Acre-Foot with WIFIA[a] (2020)	$592	$621	$611
Estimated Deliveries (Long-Term Average in TAF)	234	234	243

[a] Water Infrastructure Finance and Innovation Act

The recommended project (Alternative VP7) includes a 1.5 MAF reservoir to provide additional storage for dry and critical years. All options include a bridge to minimize travel times and provide emergency access for communities on the west side of the reservoir. The bridge for all options was sized based on the maximum water surface elevation for a 1.5 MAF facility to avoid future traffic impacts that could arise if climate change or other factors necessitated expanding a smaller reservoir. All alternatives also include a new unpaved road to maintain access for residents along the southern portion of the reservoir.

All options for consideration, including the recommended alternative, would release water through the T-C Canal. A 1,000 cfs release near the end of the canal would deliver water to either the CBD (Alternatives VP5 and VP7) or to the Sacramento River (Alternative VP6).

The Value Planning Workgroup recommends the Project proceed as Alternative VP7. Although Alternative VP5 had the lowest overall cost and lower cost per acre-foot, the Value Planning Workgroup recommends VP7 based on higher deliveries at a comparable cost and improved operational flexibility with a 1.5 MAF reservoir. The proposed facility locations associated with VP7 are shown in Figure E-1.

The Value Planning Workgroup also recommends the subsequent analyses of the Project include a 1.3 MAF reservoir (per VP5) and a Dunnigan to Sacramento River 1000 cfs release pipeline (per VP6) in order to provide flexibility to respond to any future condition changes that might result in such facilities becoming preferable.

The Recommended Project results in the following significant changes to the Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) Alternative D 1.8 MAF Project:

- Reduced project size and footprint
- Reduced Sacramento River diversions
- Elimination of Delevan Sacramento River diversion and release facility
- Elimination of Delevan Pipeline and associated impacts to landowners and wildlife refuges along that alignment
- Reduced costs and improved affordability to the Project's funding participants

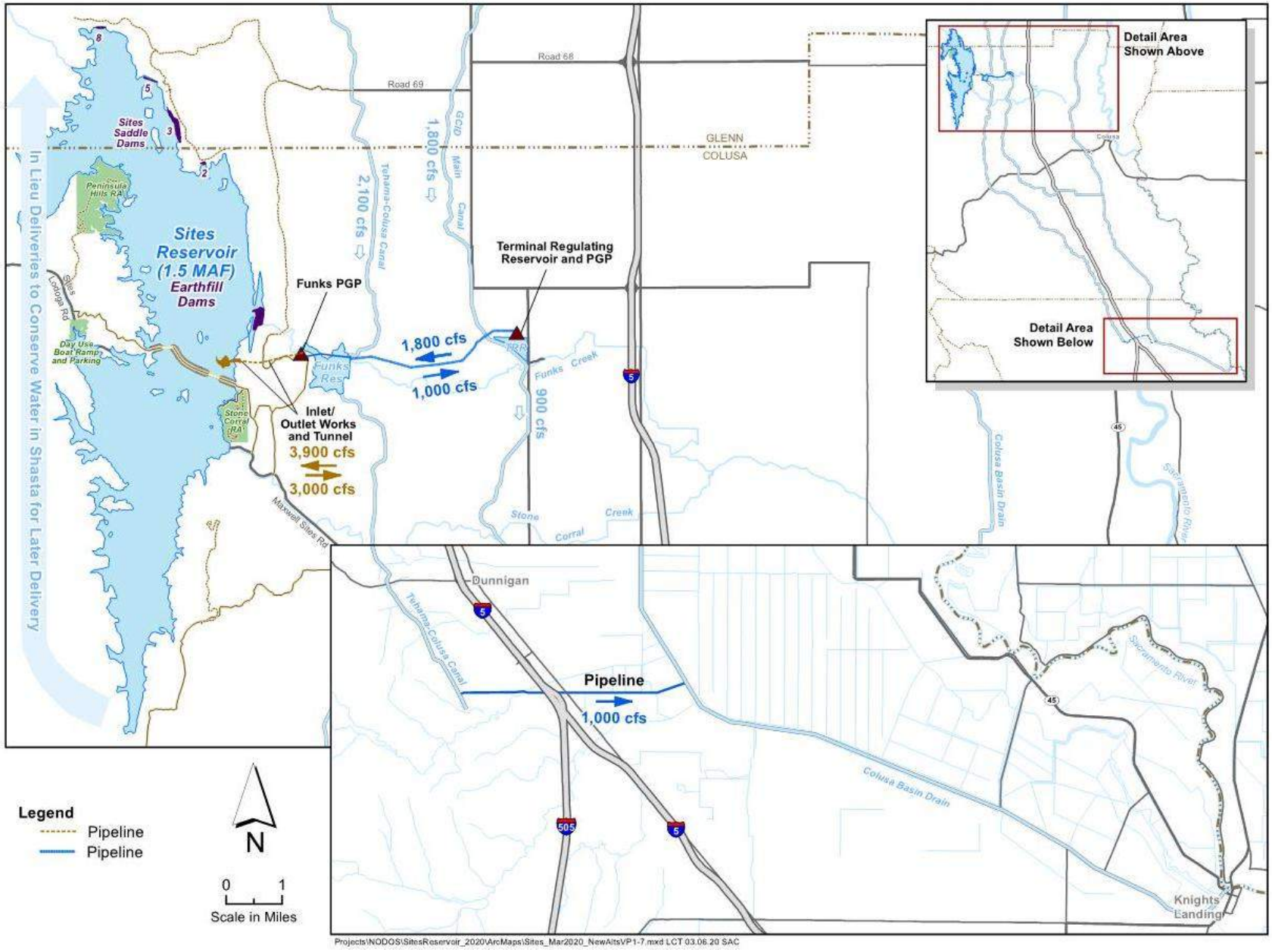

FIGURE E-1. RECOMMENDED VALUE PLANNING ALTERNATIVE (VP7)

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1. Introduction

1.1 Background

Ongoing planning efforts to develop the Sites Reservoir Project (Project) continue to inform expectations on diversion permits and water rights, as well as shape investor participation. In October 2019, representatives from the Authority Board and Reservoir Committee began undertaking a "value planning" process: an effort to identify and evaluate additional alternatives that could make the Project more affordable for the Project's participants. This decision was based on ongoing discussions with permitting agencies, expected project cost and cost per acre foot, and existing participation levels. An Ad Hoc Value Planning Workgroup was formed in late 2019 and continued to meet through early 2020. The Workgroup directed the efforts of Authority staff and the consultant team to formulate and evaluate Project alternatives that would be more affordable, and to identify a recommended Project.

1.2 Purpose

The purpose of this report is to present the methodology and findings of the value planning process and to summarize the overall Project status from a permitting, operations, and repayment perspective. The intent is that the Participants will find this information useful in assessing their level of ongoing Project participation.

2. Project Objectives and Participants

2.1 Objectives

A wide variety of Project objectives have been proposed in previous planning efforts by the Authority, the California Department of Water Resources (DWR), the Bureau of Reclamation (Reclamation), and others. For the purpose of this value planning effort, project objectives were limited to the interests of the Authority's participants and the anticipated benefits to be funded through the Water Storage Investment Program (WSIP) by the State of California.

Prior to the initiation of the value planning effort, the estimated Project cost for participants for a presumed 1.8 million acre-feet (MAF) reservoir exceeded the average annual cost per acre-foot subscription that was acceptable (i.e. affordable for the agricultural participants) for their continued participation. The primary purpose of value planning was to provide enough water for current Project subscription while reducing the overall cost and the cost per acre-foot to an affordable level, which varies by participants. It was also essential that the alternatives selected meet the overall Project objectives:

- **Improve Water Supply and Water Supply Reliability.** The assumed total Project demand is approximately 230 thousand acre-feet per year (TAFY) in releases from Sites Reservoir, including a water agency demand of approximately 193 TAFY (see Table 5.1 for additional details).
- **Provide Incremental Level 4 Water Supply for Refuges.** Through the WSIP, the State committed to invest in Incremental Level 4 water supply for refuges at an undetermined level. The estimated level of commitment is an average delivery of 26 TAFY. Level 4 refuge demand is located primarily south of the Sacramento-San Joaquin Delta (Delta).
- **Improve the Survival of Anadromous Fish.** Participants are supportive of actions that benefit salmon, steelhead, and other anadromous fish species of concern in the Sacramento River watershed. The ability of Sites Reservoir to benefit salmon largely depends on the ability to use Sites Reservoir for in-lieu deliveries to Central Valley Project (CVP) contractors or to meet other CVP requirements. This enables the conservation of the coldwater pool in Shasta and Folsom Lakes. The species benefit from improved coldwater pool management, lower river water temperatures and supplemental flows to prevent the dewatering of redds. Negotiations are ongoing with Reclamation to establish a mutually agreeable operation.
- **Enhance the Delta Ecosystem.** Water released from Sites Reservoir would be conveyed to the Yolo Bypass toe drain to convey biomass to the Delta to help supply food for Delta smelt.

Alternatives include opportunities to achieve the following secondary objectives:

- **Provide Opportunities for Recreation**. This benefit is being funded through WSIP. The WSIP funding will support the construction of new recreation facilities, including Stone Corral Recreation Area on the east side of the reservoir, a boat ramp on the west side of the reservoir, and the Peninsula Hills Recreation Area on the west side of the reservoir.
- **Provide Flood Damage Reduction**. This benefit is being funded through WSIP. The WSIP application focused on flood-damage reduction resulting from the construction of Sites Dam on Stone Corral Creek. Once completed, Sites Dam will reduce the likelihood of flooding in the Stone Corral Creek watershed, and Golden Gate Dam will improve flood damage reduction for extreme events on Funks Creek.

Previously published benefits included hydropower production. The Value Planning Workgroup decided not to require facilities for pumpback generation in the value planning alternatives. Most costs associated with pumpback hydropower are attributable to Fletcher Reservoir. If pumpback generation is not required, then there is no requirement for a forebay/afterbay arrangement and Fletcher Reservoir can be eliminated, resulting in significant cost savings.

Although hydropower is not a Project objective, the cost estimates for the value planning alternatives include turbines in the pumping plants for generation on release. These turbines are not a major cost driver for the Project and are likely to significantly reduce operations, maintenance, and replacement (OM&R) costs by offsetting the costs for power to pump water into Sites. The benefit derived from retaining turbines can be reassessed to optimize the design as the Project progresses and energy markets fluctuate.

2.2 Participants

The Project facilities are to be limited to those that directly benefit the current participants (WSIP and local entity participants). Reclamation and the State of California, through the CVP and the State Water Project (SWP), were assumed to be cooperating partners not investors. The State may contract for WSIP benefits through the California Water Commission, the California Department of Fish and Wildlife, DWR, or the State Water Resources Control Board; nevertheless, the WSIP participation level is currently capped at $816 million (some of which is allocated to recreation and flood control benefits), and deliveries were constrained to correspond to this level. Beyond the State, current financial participants include the following:

- City of American Canyon
- Antelope Valley-East Kern Water Agency
- Carter Mutual Water Company
- Coachella Valley Water District
- Colusa County
- Colusa County Water Agency
- Cortina Water District
- Davis Water District
- Desert Water Agency
- Dunnigan Water District
- Glenn-Colusa Irrigation District (GCID)
- LaGrande Water District
- Metropolitan Water District of Southern California
- Reclamation District 108
- San Bernardino Valley Municipal Water District
- San Gorgonio Pass Water Agency
- Santa Clara Valley Water District
- Santa Clarita Valley Water District
- Westside Water District
- Wheeler Ridge-Maricopa Water Storage District
- Zone 7 Water Agency

3. Overview of Project Components

The Project includes many facilities. Most of the Project costs are associated with four essential Project functions: diversions, conveyance for releases, storage, and roads and bridges. The following sections provide an overview of the overall Project components, with focus on those that were closely evaluated during the value planning process.

3.1 Diversions

At the October 2, 2019 meeting of the Ad Hoc Value Planning Workgroup, it was decided to focus alternatives on the use of existing diversions (Red Bluff and Hamilton City pumping plants) rather than constructing a new pumping plant on the Sacramento River.

Diversion facilities include pipelines, canals, and pumping plants required to fill Sites Reservoir. Alternative D (1.8 MAF reservoir) relied on three diversions, including the existing Tehama-Colusa (T-C) Canal diversion at Red Bluff, the existing GCID Main Canal diversion at Hamilton City, and a new diversion on the Sacramento River for the Delevan pipeline. The lowest cost options use the existing pumping plants and canals. Together, the T-C and GCID Main Canals can deliver approximately 3,900 cubic feet per second (cfs). Eliminating the new Delevan pumping plant provides substantial cost savings (approximately $260 million). Although this reduces the ability to fill Sites Reservoir, the workshop participants believed that two diversions would provide adequate conveyance capacity consistent with the likely permittable diversion capacity.

3.1.1 Diversion Criteria

Sites Reservoir would be filled through the diversion of excess Sacramento River flows that originate primarily from unregulated tributaries to the Sacramento River downstream from Keswick Dam. Diversions would be allowed when operational criteria are met, which would be set by permitting requirements. Based on current permitting discussions, the diversion criteria included in Table 3-1 were assumed for the value planning analysis. These criteria are often referred to as “Scenario B.”

TABLE 3-1. ASSUMED DIVERSION AND OPERATIONS CRITERIA (SCENARIO B)

Location	Criteria
Wilkins Slough Bypass Flow	8,000 cfs April/May 5,000 cfs all other times
Fremont Weir Notch	Prioritize the Fremont Weir Notch, Yolo Bypass preferred alternative, flow over weir within 5%
Flows into the Sutter Bypass System	No restriction due to flow over Moulton, Colusa, and Tisdale Weirs
Freeport Bypass Flow	Modeled WaterFix Criteria (applied on a daily basis) Post-Pulse Protection (applied on a moving 7-day average) Post-Pulse (3 levels) = January–March Level 2 starts January 1 Level 1 is initiated by the pulse trigger
Net Delta Outflow Index (NDOI) Prior to Project Diversions	44,500 cfs between March 1 and May 31

For more information on the assumed diversion and operations criteria, refer to Appendix B.

3.1.2 Pumping Facilities

Once water is diverted from the Sacramento River, it must be pumped into Sites Reservoir. This requires pumping plants with regulating reservoirs at the existing T-C and GCID Main Canals.

Pumping from T-C Canal to Sites Reservoir

The Tehama-Colusa Canal Authority (TCCA) diversion facility is located on the Sacramento River near Red Bluff. The Red Bluff Pumping Plant has an existing pumping capacity of 2,000 cfs, which is used to meet current agricultural water demand. The Project would include installation of one additional pump (250 cfs) and

one backup pump to the existing pump grouping, which would increase the overall pumping capacity to 2,250 cfs to fully use the 2,100 cfs capacity for diversion through the T-C Canal to Sites Reservoir.

For value planning, two regulating reservoir options were considered for the T-C Canal: the existing Funks Reservoir and a new Tehama-Colusa Regulating Reservoir (TCRR). The primary advantages of a new northern regulating reservoir (TCRR) are that it would eliminate almost all impacts on T-C Canal operations, and it would allow for early filling of Sites Reservoir. Two locations were considered, with one near Road 68 and a second to the northwest near Hunters Creek. Preliminary cost estimates indicate that both locations would have comparable cost for implementation. The Hunters Creek location reduces the length of pipeline needed to lift water into Sites Reservoir by approximately 2 miles, but it is less accessible for construction and maintenance and has greater environmental impacts because of streambed impacts. Using the existing Funks Reservoir minimizes the length of pipeline and does not require constructing a new regulating reservoir into Sites Reservoir and, therefore, has the lowest cost.

Pumping from GCID Main Canal to Sites Reservoir

Under proposed Project operations, the GCID Main Canal would convey water pumped from the existing Hamilton City pumping facility to Sites Reservoir. The Hamilton City pumping facility has a 3,000 cfs diversion capacity at the Sacramento River intake, and the capacity of the GCID Main Canal is 1,800 cfs. Table 3-2 shows the flows that are assumed to occupy capacity in the canal during existing winter operations. A dedicated annual 2-week maintenance shutdown period is assumed in the last week of January through the first week of February.

TABLE 3-2. OCCUPIED CAPACITY IN THE GCID MAIN CANAL DURING EXISTING WINTER OPERATIONS

Month	October	November	December	January	February	March
Occupied Capacity (cfs)	513	534	389	235	56	48

Conveying water from the GCID Main Canal requires the construction of the Terminal Regulating Reservoir (TRR) to regulate levels in the canal with the operation of the new pumping plant to convey water to Sites Reservoir. Therefore, construction of the TRR was included in each alternative.

Forebay/Afterbay and Sites Pumping/Generating Plants

Alternative D of the Draft EIR/EIS (1.8 MAF reservoir) included a forebay/afterbay (Fletcher Reservoir) where all diversions collected were then lifted into Sites Reservoir using the Sites Pumping/Generating Plant. This arrangement maximized the potential for pumpback generation (cycling between the upper and lower reservoir to provide dispatchable power). The Value Planning Workshop participants decided to eliminate pumpback generation from the Project at this time. This enables the elimination of Fletcher Reservoir (approximately $190 million). It also allows consideration of eliminating the Sites Pumping/Generating Plant (the most expensive single Project facility, at $800 million), provided some additional investment is made to the other pumping plants to compensate for increased head to pump directly into Sites Reservoir.

3.2 Conveyance for Releases

Shasta Exchange for Project Demands: It is possible to release water from Sites Reservoir to meet CVP Sacramento Valley agricultural water service and Settlement contractor CVP demands. Meeting CVP needs from Sites Reservoir in the T-C Canal and GCID Canal service areas south of Funks Reservoir allows water to be conserved in Shasta Lake for subsequent delivery to meet Project demands. This could include refuge water supply or South of Delta participant needs. The amount of additional conveyance (for example, Delevan conveyance or Dunnigan conveyance) that must be constructed to release water directly from Sites Reservoir to the Sacramento River depends on the amount and timing of water that could be cooperatively exchanged through Shasta for Project demands.

Delevan Pipeline or Canal: Alternative D (1.8 MAF Reservoir) included two pipelines with a combined capacity of 1,500 cfs back to the Sacramento River for releasing water directly to the Sacramento River. The value planning effort considered a reduced capacity of 750 cfs using a canal in place of a pipeline where

possible to reduce costs. Constructing a canal is less costly but increases environmental impacts by introducing potential flooding issues and creating a barrier to terrestrial species migration.

Dunnigan Release: A new option introduced by the Value Planning Workgroup is the use of the existing T-C Canal to deliver water to the southern terminus of the canal. Water could be conveyed from the southern end of the T-C Canal to either the Colusa Basin Drain (CBD) or the Sacramento River. Three conveyance approaches were considered:

- Conveyance through existing drainage channels to the CBD
- Conveyance through a new canal to the CBD
- Conveyance through a pipeline to the CBD or river

Gravity releases through existing drainage channels to the CBD are possible but would result in significant water loss attributable to seepage and evaporation and, therefore, were eliminated. The environmental team has recommended pipeline release versus a canal as the preferred option to minimize environmental impacts. Conveyance through a pipeline to the CBD or river can be done by gravity without a pump station. The ability of the T-C Canal to operate using a gravity pipeline to the CBD or river was evaluated, with results summarized in Section 5.

3.2.1 Release Criteria

Sites Reservoir would be operated in cooperation with CVP and SWP operations to coordinate releases from Shasta Lake, Lake Oroville, and Folsom Lake. Sites releases could allow reduced releases from other reservoirs while maintaining minimum instream flow objectives, Sacramento River temperature requirements, and Delta salinity control requirements assigned to CVP and SWP. Through reduction in releases from CVP and SWP reservoirs, storage could be conserved in Shasta Lake, Lake Oroville, and Folsom Lake to increase operational flexibility.

Releases from Sites Reservoir to the Sacramento River would be operated to achieve multiple benefits associated with the Project's primary objectives in specific water year types and months of the year. Most releases are likely to occur in dry and critical water years when members request releases from storage, and when state water (WSIP) is likely to be released for environmental benefits. Priority operations would include the following:

- Provide water to Project participants north and south of the Delta.
- Provide water to the Cache Slough area via the Yolo Bypass.
- Provide water for Incremental Level 4 refuge deliveries.
- Support Reclamation goals through exchange. Goals could include improved Shasta Lake temperature management and Sacramento River fall flow stabilization to improve spawning and rearing success of anadromous fish.

Sites releases to Sacramento Valley members include deliveries to TCCA members, GCID, Reclamation District 108 (RD 108), Colusa County, and other members. Most of these deliveries are conveyed through the T-C Canal.

TCCA historical monthly diversion data for 1999 through 2013 were reviewed to assess seasonal diversion patterns and variations in water use for a range of hydrologic conditions and CVP allocations. The historical data were used to verify that the total irrigation demands and diversion patterns generally represented actual water operations. TCCA's CVP Agricultural Water Service Contracts are subject to shortage allocations based on CVP storage and annual hydrologic conditions. Sites deliveries to TCCA participants will be used to supplement existing CVP contract supplies.

GCID and RD 108 are CVP Sacramento River Settlement Contractors and are subject to a 25 percent contract reduction in severe drought years under specific shortage criteria in their contracts. Sites water will be used to supplement existing CVP settlement contract supplies.

It is assumed that South of Delta SWP Contractors will take delivery of Sites water to supplement SWP Table A allocations in dry and critical water years. Sites Reservoir releases to SWP contractors are assumed to be initiated when the SWP allocation is less than 85 percent of Table A values. If the SWP allocation is less than

65 percent of Table A values, releases to SWP members are assumed to become more aggressive to supplement decreased supplies.

3.3 Dams and Reservoir

Alternative D of the EIR/EIS proposed a 1.8 MAF reservoir for Sites. The capacity of the reservoir depends on the size of the dams. The height of Golden Gate and Sites Dams is reduced for a 1.5, 1.3, or 1.0 MAF reservoir, and some of the saddle dams are eliminated with the smaller reservoir.

Reducing the capacity of the reservoir would also reduce the height and number of gates required for the inlet/outlet tower. Dam safety regulations also require the ability to rapidly reduce the amount of water stored behind a dam in the event of imminent failure. The reservoir inlet/outlet tunnels are designed to meet this rapid drawdown requirement, instead of normal service levels. Smaller reservoirs require smaller-diameter tunnels, further reducing the cost.

Finally, reducing the reservoir size also reduces the head on the pumping facilities needed to fill Sites Reservoir. The value planning effort focused on 1.5, 1.3, and 1.0 MAF facilities to reduce construction costs.

Three alternative construction methods for dams were considered. The original DWR concept was for a zoned rockfill dam. Reduced cost is likely with an earthfill dam or a hardfill dam; however, the variance in cost based on the dam construction method is much less than the potential savings associated with reducing the size of the reservoir.

3.4 Roads and Bridge

Alternative D (1.8 MAF reservoir) included a new bridge approximately 1.5 miles in length to maintain emergency and public access from Maxwell to Lodoga. Other alternatives considered included a pair of shorter-span bridges along with the use of constructed fill (causeways) between the sections and a combination of a shorter bridge with a tunnel for the smaller reservoir.

A new road around the southern end of Sites Reservoir that would connect over to Lodoga was considered as an alternative to building a bridge.

All alternatives include a road to the southern end of Sites Reservoir to provide access for residents who would otherwise be stranded by the new reservoir.

The road and bridge options are described more fully in Appendix A.

4. Value Planning Alternatives

4.1 Alternative Development

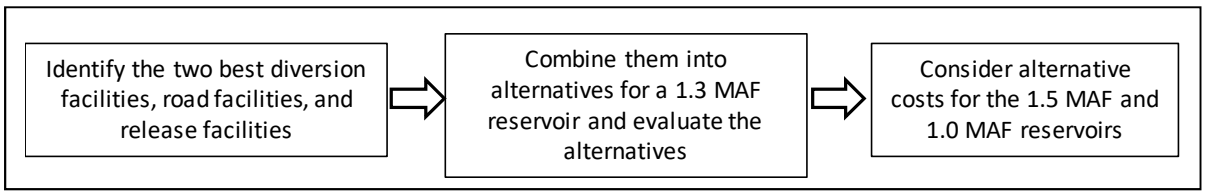
Project alternatives were developed that combine different types and sizes of diversion, release, reservoir, and road and bridge facilities described in Section 3. Initial alternatives were developed following the October 2, 2019 kickoff meeting and then refined in the following months to develop a recommended alternative. Initial alternatives are described in Appendix A. The refined alternatives are described in this section, with the preferred alternative discussed in Section 8. Figures for the refined alternatives are provided in Appendix A.

4.2 Initial Alternatives

Representatives from the Reservoir Committee and Authority Board met on October 2, 2019, to discuss approaches that could potentially lower the Project cost. Several facility modifications were identified, and appraisal-level costs are provided in this analysis to allow a comparison of alternatives. The Value Planning Analysis Technical Memorandum is in Appendix A of this report; however, additional alternatives were identified in subsequent meetings on November 15 and December 16, 2019, and during the value planning alternatives field trip on January 14, 2020. The costs for the refined alternatives are provided in Appendix A.

4.3 Evaluation of Alternatives Selected for Further Study

The following approach was used to develop and evaluate the initial alternatives (VP1 through VP4).



4.3.1 Evaluation of Facilities

Diversion Facilities: Diversion facilities considered are described in Section 3.1 and are evaluated in Table 4-1**.**

TABLE 4-1. INITIAL SCREENING OF DIVERSION FACILITIES (750 cfs)

Option	Initial Cost	Advantages	Disadvantages	Rank
Delevan Pipeline and Pumping Plant	$859M	Direct release to river	Requires new intake Impact on landowners Giant garter snake habitat High cost	Low
TCRR, Pipeline, and Pumping Plant	$634M	Existing Red Bluff pumping Independent regulation for TCCA Early fill (2-3 years earlier)	Impacts additional real estate Cost of new regulating reservoir Pipeline distance	Medium
TRR, Pipeline, and Pumping Plant	$474M	Existing Hamilton City pumping	—	Best
Funks, Channel, and Pumping Plant	$256M	Closest to Sites Reservoir No additional regulating reservoir required	Must avoid T-C Canal impacts	Best

Roads and Bridges: Options for roads and bridges at Sites Reservoir are discussed in Section 3.4 and are evaluated in Table 4-2.

TABLE 4-2. ROADS AND BRIDGES

Option	Initial Cost	Advantages	Disadvantages	Rank
South Road to Residents	$41M	Provide access to stranded property	—	Required
North Construction Bypass – construction traffic only (paved)	$30M	Avoid traffic through Maxwell	—	Required
Bridge	Varies	Shortest travel time Lower maintenance cost Less environmental impact	—	Best
South Road	$224M	Avoids bridge	Higher maintenance More acres affected	Medium

Release Facilities: Options for conveyance for releases from Sites Reservoir are discussed in Section 3.2 and are evaluated in Table 4-3.

TABLE 4-3. INITIAL SCREENING OF RELEASE FACILITIES (750 CFS)

Option	Initial Cost	Advantages	Disadvantages	Rank
Delevan Pipeline	$389M	Direct release to river	Impact on landowners Giant garter snake habitat High cost	Low
Delevan Canal	$360M	Direct release to river	Impact on landowners Giant garter snake habitat Complicates local drainage Additional pump station at CBD High cost	Low
Dunnigan to CBD[a]	$54M	Less acreage affected May avoid a 408 permit	Potential losses in CBD	Best
Dunnigan to River	$173M	Avoid loss in CBD	Impact additional acreage	Medium

[a] CBD – Colusa Basin Drain

An evaluation of conveyance facility sizing was performed, with results provided in Section 5.

4.3.2 Refined Alternatives

Four alternatives were developed for the 1.3 MAF reservoir with combinations of the highest ranked facilities to bookend the value planning options for the March 2, 2020 review meeting. An additional three alternatives were developed during the review meeting:

- Alternative VP 5 – This alternative includes a 1.3 MAF reservoir and uses the Funks Reservoir and the TRR to fill Sites Reservoir with releases (1,000 cfs) from the southern end of the T-C Canal through a pipeline that would go to the CBD.
- Alternative VP 6 – This alternative includes a 1.3 MAF reservoir and uses the Funks Reservoir and the TRR to fill Sites Reservoir with releases (1,000 cfs) from the southern end of the T-C Canal through a pipeline that would extend to the Sacramento River.
- Alternative VP 7 – This alternative This alternative includes a 1.5 MAF reservoir and uses the Funks Reservoir and the TRR to fill Sites Reservoir with releases (1,000 cfs) from the southern end of the T-C Canal through a pipeline that would go to the CBD.

The refined alternatives are shown in Table 4-4.

TABLE 4-4. RECOMMENDED ALTERNATIVE AND ALTERNATES

Major Facilities	VP5	VP6	VP7
	Alternate 1	Alternate 1A	**Recommended**
Reservoir Size	1.3 MAF	1.3 MAF	1.5 MAF
Bridge Size (avoids future traffic Interruption)	1.5 MAF	1.5 MAF	1.5 MAF
South Road to Local Residents	Included	Included	Included
Misc. Local and Project Roads	Included	Included	Included
Diversion Locations	Funks and TRR	Funks and TRR	Funks and TRR
Dunnigan Release	1,000 cfs to CBD	1,000 cfs to River	1,000 cfs to CBD
Direct Cost	$1,787,000,000	$1,870,000,000	$1,902,000,000
Non-Contract Costs	$485.000,000	$508,000,000	$516,000,000
Contingency	$557,000,000	$583,000,000	$592,000,000
Total Estimated Cost (2019 dollars)	$2,855,000,000	$2,988,000,000	$3,037,000,000

Cost estimating details are provided in Appendix A-4.

The availability of site data and design information to support preparing cost estimates varies between the facilities that constitute the Sites Reservoir project. Some facilities (like the main dams) are advanced enough to support a lower-bound Class 3 estimate as defined by the Association for Advancement of Cost Engineering, International. Other facilities, like the Dunnigan conveyance from the T-C Canal to the CBD have no supporting geotechnical evaluation and only a preliminary screening of potential utility conflicts. These estimates are at a Class 5 level.

A contingency of 10% was first applied for design, followed by a 15% contingency for construction. The compounded contingency is approximately 30% of the direct cost for construction. Non-contract costs were estimated at 17% of the total estimated cost.

5. Operational Assessment of Sites Release Capacity for Value Planning

5.1 Participant Subscriptions

The value planning alternatives evaluated the ability of several reservoir sizes and conveyance capacities to meet participant subscriptions. Table 5-1 shows the current member participation for the Sites Reservoir Project by region and delivery type. WSIP deliveries for Refuge Incremental Level 4 and Yolo Bypass are estimated to be about 40 TAFY.

TABLE 5-1. CURRENT SITES RESERVOIR PARTICIPATION

Member	Reservoir Participation (AFY)
Public Water Agencies	
North of Delta	52,142
South of Delta	140,750
Subtotal Public Water Agencies	192,892
State of California (WSIP)	
Refuge Incremental Level 4 and Yolo Bypass	~40,000
Total Requirement	~230,000

5.2 Evaluation of Reservoir Size and Release Capacity

A sensitivity analysis for a range of reservoir sizes and release capacities for Sites Reservoir was conducted to evaluate the quantity of water that could be released under different conveyance capacities. The analysis included a surrogate approximation of the potential to exchange water between Sites Reservoir and Shasta Lake based on the analysis presented in Section 5.3. This exchange would be implemented through the release of Sites water to meet Sacramento Valley CVP contract demands and Delta regulatory obligations. The exchange assumes a corresponding reduction in Shasta Lake releases that preserves storage in the lake and contributes to water temperature management and Sacramento River flow stability benefits. Based on Scenario B diversion criteria (see Table 3-1), it is assumed that approximately 60 TAF could be exchanged on an average annual basis, with most of these exchanges occurring in dry and critical water year types. This also assumes integration with the SWP to facilitate operations and deliveries to South of Delta members.

Three conveyance capacities for Sites Reservoir releases were evaluated: 750, 1,000, and 1,500 cfs. Each conveyance capacity was assessed using three storage capacities for the reservoir: 1.5, 1.3, and 1.0 MAF, with assumed reservoir dead storage of 120 TAF. All nine combinations of these capacities were run under Scenario B. For each scenario, releases from Sites Reservoir were quantified using monthly releases, as reported by CalSim II modeling. Deliveries include releases for TCCA, GCID, RD 108, Colusa County, Sacramento Valley members, South of Delta members, Refuge Level 4, and Yolo Bypass.

Table 5-2 shows average annual releases under different combinations of potential Sites storage and release capacities. -Releases highlighted in green meet current participant demand, while releases highlighted in orange do not meet current participant demands.

TABLE 5-2. SITES RESERVOIR RELEASES UNDER VARYING STORAGE AND RELEASE CAPACITIES

Storage Capacity (MAF)	Long-term Average		
	1,500 cfs Release Capacity (TAF)	1,000 cfs Release Capacity (TAF)	750 cfs Release Capacity (TAF)
1.5	253	243	236
1.3	243	234	230
1.0	207	195	191

Meets participant demand (193+40=233)

Does not meet participant demand

Table 5-3 shows average annual releases for Sacramento Valley Index water year types. Maximum Sites releases generally occur in dry water years, as highlighted yellow, because there is increased water demand and available Delta export capacity. Overall, decreasing Sites' release capacity from 1,000 to 750 cfs reduces average annual releases by 1.6 to 2.7 percent, depending on reservoir size.

Overall, decreasing Sites' release capacity from 1,500 to 1,000 cfs reduces average annual releases by 4.0 to 6.2 percent. Further reducing the release capacity to 750 cfs reduces average annual deliveries by an additional 1.6 to 2.7 percent.

Releases from Sites are greatest during dry years. Consequently, dry years are more critical to the conveyance capacity of Sites releases than any other year type. For example, the average annual delivery of a 1.5 MAF reservoir decreases by 13.5 percent when its release capacity is reduced from 1,500 to 750 cfs.

Based on this sensitivity analysis, the combination of a 1.5 MAF reservoir and a 1,000 cfs release capacity provides about a 243 TAF average annual release for Sites Reservoir, which meets current participation and provides additional operational flexibility.

TABLE 5-3. SITES RESERVOIR RELEASES UNDER VARYING STORAGE AND RELEASE CAPACITIES, BY WATER YEAR TYPE

Year Type	Storage Capacity (MAF)	1,500 cfs Release Capacity (TAF)	1,000 cfs Release Capacity (TAF)	750 cfs Release Capacity (TAF)
Wet	1.5	115	116	112
	1.3	122	115	113
	1.0	118	112	109
Above Normal	1.5	275	286	280
	1.3	287	299	303
	1.0	185	186	194
Below Normal	1.5	285	273	277
	1.3	278	263	266
	1.0	237	217	213
Dry	1.5	422	382	365
	1.3	392	364	345
	1.0	343	309	301
Critically Dry	1.5	243	237	225
	1.3	205	204	204
	1.0	185	184	177

Note: Recommended range to account for uncertainty is simulated values less 30,000 acre-feet.

5.3 Evaluation of Potential for Shasta Lake Exchange

The Ad Hoc Value Planning Workgroup wanted to evaluate the proposed alternatives without Reclamation investing in the Project financially. In this scenario, water stored in Sites Reservoir could be exchanged with Shasta Lake to meet CVP TCCA agricultural water service and Settlement Contractor obligations as well as downstream flow and Delta water quality requirements. Therefore, a portion of the water demand within the CVP service area along the T-C Canal and GCID Main Canal south of Sites Reservoir could be met from releases from Sites Reservoir in the spring and allow an equal amount of water to be retained in Shasta Lake (via exchange) to improve summer cold water pool management.

The exchange could occur when Sacramento River flows at Keswick and temperatures at Clear Creek are within a specific range and not compromised by reduced Shasta Lake releases into the Sacramento River. This exchange would likely occur in April through May (and possibly June) in dry and critically dry years.

Shasta Lake releases of exchange water are proposed to be scheduled to benefit downstream temperatures in the Sacramento River, which would likely occur in September, October, or November. Withdrawals from Shasta would be coordinated with Reclamation. Based on conversations with Reclamation, this analysis assumes that no carryover storage of exchange water would be allowed between years.

The exchange operation would likely be subject to the following constraints provided by Reclamation to protect the interests of the CVP and to comply with State and federal laws and regulations:

- All water stored in Shasta would be subject to spill at any date and would be the first water in Shasta to spill.
- All operations associated with this exchange would be subject to river temperature constraints. This ensures there is no impact by reducing releases to store, and ensures a benefit when water is released later in the year.
- All operations are subject to approval by the State Water Resources Control Board and must comply with any applicable State or federal laws, regulations, or guidelines.

A post-processing analysis was performed for the 82-year simulation period of CalSim II to evaluate Shasta exchanges under a series of criteria that were assumed for the Sacramento River at Clear Creek, Keswick flow, Shasta storage, and water year types.

Figure 5-1 shows the exceedance probability of the annual volume of exchangeable water (TAF) for the nine scenarios evaluated. Overall, the annual exchange with Shasta ranges from 0 to 300 TAF for the scenarios with no Delevan Pipeline.

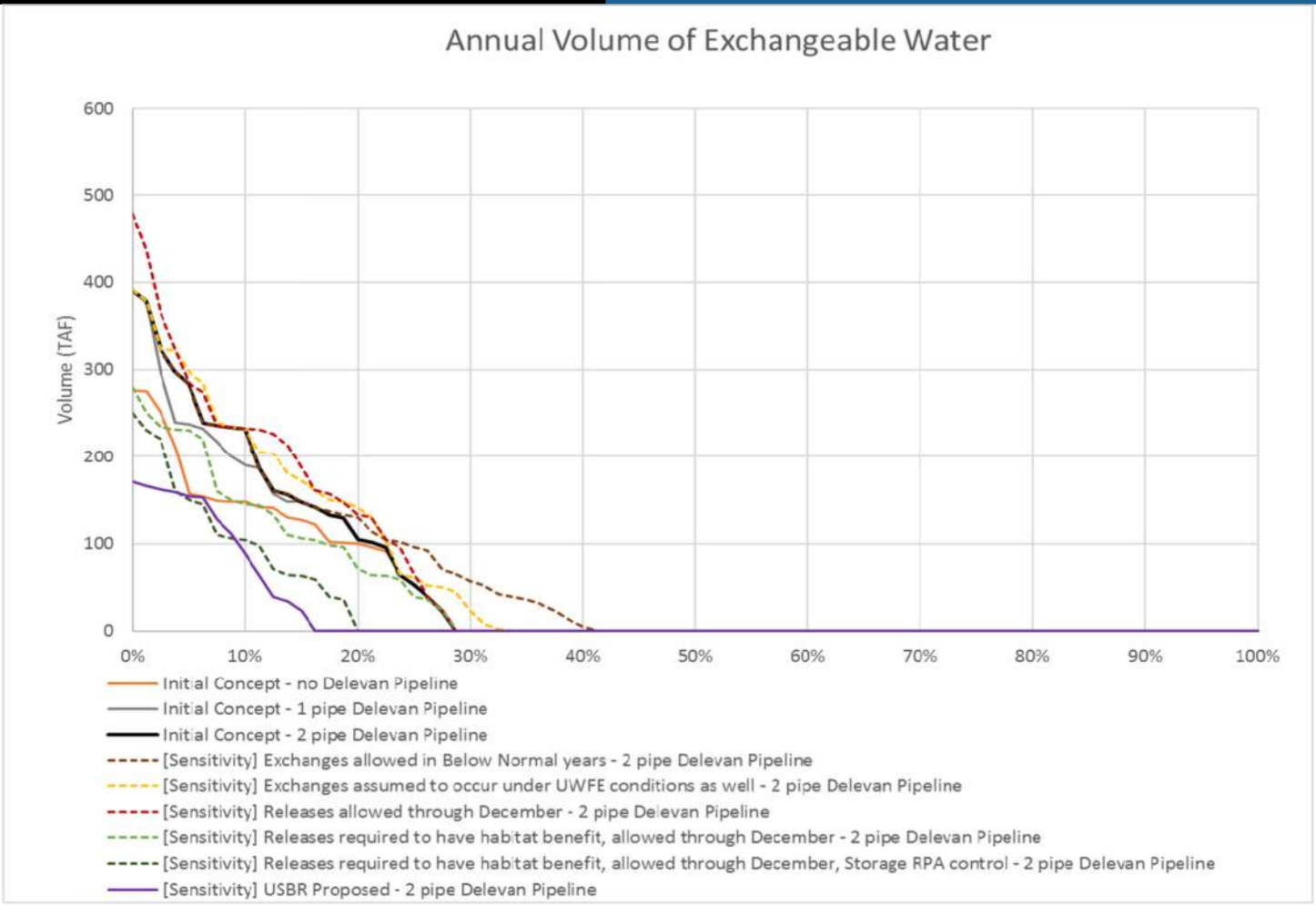


FIGURE 5-1. ANNUAL VOLUME OF EXCHANGEABLE WATER WITH SHASTA LAKE

5.4 Evaluation of T-C Canal Available Capacity

A screening analysis of historical daily diversion data was completed to estimate available capacity in the lower T-C Canal below Funks Reservoir for conveyance of releases from Sites Reservoir. Based on an approximation of the proportion of total T-C Canal diversions that were conveyed in the canal below Funks Reservoir, it appears the lower T-C Canal may have up to 1,000 cfs of available capacity for Project releases on an average monthly basis, during the peak summer diversion season when TCCA contractors receive a 100 percent contract allocation.

A check was then conducted to verify that the T-C Canal had enough available capacity to convey Sites releases to TCCA members, plus additional Sites releases to the Sacramento River. An analysis was conducted of Sites Reservoir monthly releases through the T-C Canal to the TCCA members using a 1,000 cfs conveyance capacity and three different storage capacities (1.0, 1.3, and 1.5 MAF). For this particular analysis, the releases assume no exchange with Shasta Lake. The results of this analysis indicate that simulated monthly Sites deliveries to T-C Canal members along the canal never exceed more than 500 cfs, while total deliveries through the T-C Canal, including South of Delta releases, rarely exceed 1,100 cfs. Based on this preliminary analysis, the lower T-C Canal appears to have sufficient capacity to convey CVP TCCA contractor deliveries, Sites releases to TCCA members, plus additional Sites releases to the Sacramento River, during the peak summer diversion season.

5.5 Evaluation of Colusa Basin Drain Available Capacity

The rate of flow from the Colusa Basin Drain into the Sacramento River through the Knight's Landing Outfall Gates (KLOG) depends on the differential stage in the Sacramento River and in the CBD at KLOG. The stage

in the CBD at KLOG is dependent upon the operation of both KLOG and the Wallace Weir. The flow in the CBD has historically been difficult to measure due to backwater effects.

RD 108 completed an appraisal level assessment of historical flows through KLOG to estimate a range of flows that generally result in flooding of adjacent agricultural fields. Flooding was estimated to occur with flows ranging from 1,370 cfs to 2,220 cfs indicating that flows of 1,000 cfs from Sites are possible, though further analysis should be conducted.

Using the CBD for conveyance of Sites Reservoir water will include coordination with the local landowners regarding the project operation and timing of the additional flows. In order to understand how water released from Sites Reservoir could be moved through the CBD and into the Sacramento River at Knights Landing, the hydraulics between the CBD, KLOG, and Wallace Weir need to be investigated.

5.6 Operations Conclusions

Based on the preliminary analysis performed, the value planning alternatives with reservoir sizes of 1.3 to 1.5 MAF, including Scenario B Diversion Criteria, would be able to provide enough water to meet current participant demands. In addition, the use of the T-C Canal and the CBD as the conveyance systems appears possible based on preliminary analysis. Additional hydraulic analyses will be needed to confirm downstream conveyance conditions in the CBD, and the capacity of the T-C Canal downstream of Funks Reservoir should be confirmed. Discussions with Reclamation on non-investment exchanges with Shasta Lake are ongoing. Annual average Shasta Lake exchanges included with Scenario B analyses are estimated at about 60 TAF. While field verification and additional analysis are required, the value planning alternatives with reservoir sizes of 1.3 to 1.5 MAF appear feasible from an operations standpoint.

6. Environmental and Permitting Assessment of Alternatives

Appendix C summarizes considerations for the value planning effort from the environmental planning and permitting perspective and includes the following:

- Key differences between the value planning alternatives when compared with Alternative D, as described in the Draft EIR/EIS
- Species within the alternative's footprint that could potentially be affected through construction and operation of the Project
- Key permits and approvals required to construct and operate the Project, including any additional regulatory requirements beyond those identified in the Draft EIR/EIS
- Environmental planning considerations related to California Environmental Quality Act/National Environmental Policy Act (CEQA/NEPA) analysis
- Qualitative change in mitigation cost as compared with Alternative D
- A relative weighting associated with environmentally related criteria (and associated metrics) compared with Alternative D.

6.1 Environmental Permitting Assessment

The analysis of the value planning alternatives determined that the alternatives considered (Alternatives 1 through VP7) would result in little, if any, substantial change in timing or cost of key permits because of the same relative magnitude of impacts associated with the Project footprint and operations when compared with Alternative D. However, using the scoring methodology provided in Table 4 of Appendix C, obtaining permits from regulatory resource agencies for Alternatives 5a, 6a, VP1, VP2, VP5, and VP7 would be relatively easier because of the (1) reduced inundation areas (within reservoir footprint), (2) lack of a pipeline easement to the Sacramento River, (3) removal of the northern regulating reservoir facilities, and (4) shorter conveyance off the T-C Canal (to CBD).

6.2 Environmental Planning Assessment

The Draft EIR/EIS identified potentially significant environmental effects on aquatic, botanical, and terrestrial biological resources. However, with the exception of golden eagles, mitigation was identified to reduce effects to less than significant levels. Similarly, effects on wetlands and other jurisdictional waters were considered less than significant after implementation of proposed mitigation. However, the Draft EIR/EIS determined that Alternative D (as well as the other build alternatives) would result in potentially significant and unavoidable direct and indirect effects to (1) terrestrial biological resources (golden eagle), (2) paleontological resources, (3) cultural resources (historical and tribal resources, human remains), (4) land use (community of Sites and existing land uses), (5) air quality, (6) climate change and greenhouse gas emissions, and (7) growth-inducing impacts.

Appendix C provides CEQA/NEPA considerations for each alternative vetted during the value planning process. As with permitting, considerations were developed in a screening-level comparison to Alternative D. Table 6-1 briefly discusses the CEQA/NEPA considerations associated with each of the refined value planning alternatives identified on March 2, 2020. It should be noted that each of the value planning alternatives addressed below rely substantially on the use of existing conveyance facilities and minimize the need for new construction and associated ground disturbance, thereby reducing overall environmental effects.

TABLE 6-1. VALUE PLANNING CEQA/NEPA CONSIDERATIONS

Alternative	CEQA/NEPA Key Considerations
VP5 Alternate 1	Reduction in reservoir size may reduce effects on cultural, biological, and land use (agriculture) resources, but not to less-than-significant levels. Elimination of the Delevan pipeline or canal would potentially reduce land use (agricultural) effects, but effects would likely still be considered significant and unavoidable for the overall Project. Earthfill dam rather than rockfill dam would need to be analyzed for potential changes in environmental effects. Release from the southern terminus of the T-C Canal to the CBD would require additional study.
VP6 Alternate 1A	Similar to Alternative VP5, reduction in reservoir size may reduce effects on cultural, biological, and land use (agriculture) resources, but not to less-than-significant levels. Elimination of Delevan pipeline or canal would potentially reduce agricultural effects, but effects would likely still be considered significant and unavoidable for the overall Project. Release from the southern terminus of the T-C Canal would require additional study; the proposed Dunnigan pipeline to Sacramento River may affect federal project levees (though likely less than Alternative D). Earthfill dam rather than rockfill dam would need to be analyzed for potential changes in environmental effects.
VP7 Recommended	Similar to VP5 and VP6, reduction in reservoir size may reduce effects on cultural, biological, and land use (agriculture) resources, but not to less-than-significant levels. Elimination of Delevan pipeline or canal would potentially reduce agricultural effects, but effects would likely still be considered significant and unavoidable for the overall Project. Earthfill dam rather than rockfill dam would need to be analyzed for potential changes in environmental effects. Release from the southern terminus of the T-C Canal to the CBD would require additional study.

7. Costs and Repayment

7.1 Cost Estimates

Construction cost estimates were derived from detailed appraisal-level estimates for a 1.3 MAF reservoir (Alternative A in the EIR/EIS and feasibility report) and for a 1.8 MAF reservoir (Alternative D in the EIR/EIS and feasibility report). These estimates reflect the current Project concepts and conceptual level of Project design, with appropriate allowances for contingencies, non-contracts costs, and forward escalation. Other project-related costs are also provided, including environmental mitigation and temporary and permanent easement acquisition. Estimated prices were developed in October 2015 dollars in support of the Authority's

WSIP application and have been escalated in this estimate. Additional details on the estimate are provided in Appendix A.

7.2 Repayment Analyses

7.2.1 Methodology

A repayment analysis based on the estimated construction, operations, and maintenance costs, and the estimated releases, was conducted to estimate the annual repayment costs per AF of releases from Sites Reservoir. The analysis was conducted both with and without a Water Infrastructure Finance and Innovation Act (WIFIA) loan. The methodology was very similar to prior value planning analysis conducted in late 2019 and as described in the full financial model technical memorandum in Appendix D. One item of significant note is that the reporting base year has changed versus that analysis, resulting in an increase of cost per acre-feet due to inflation. Participants' annual costs are provided in 2020 dollars. When comparing with the prior metric of using 2018 dollars, a $600/AF cost at a 2% inflation rate will add approximately $25 by reporting in 2020 dollars.

7.3 Key Assumptions

The analysis was conducted using the full amount of the U.S. Department of Agriculture (USDA) loan available to construct the Maxwell Intertie. This loan of $439 million is at a lower interest rate (3.85 percent) than the revenue bond assumed interest rate (5.00 percent). This analysis assumes that Project changes would not affect the terms of the USDA loan. The use of the USDA loan results in an overall reduction in the cost by approximately $20 per acre-foot. A full table of assumptions is provided in Appendix D.

7.4 Repayment Results

The ability to reduce project costs to approximately $3 billion while still constructing a 1.5 MAF reservoir and thereby maintaining higher releases (ranging from 230 to 243 TAF of average annual releases) results in a reduction in the dollar per acre-feet repayment down to the $600 range in 2020 dollars. This range of payments – which is lower than the VP1 through VP4 alternatives - can be seen in the VP5, VP6, and VP7 scenarios (Table 7-1). A cash flow tool, including operations and maintenance costs and annualized debt service, is included as Attachment D-2.

TABLE 7-1. ANNUAL REPAYMENT COSTS PER ACRE-FOOT OF RELEASE

	VP1			VP2			VP3		VP4		VP5	VP6	VP7
Reservoir Size (MAF)	1.0	1.3	1.5	1.0	1.3	1.5	1.3	1.5	1.3	1.5	1.3	1.3	1.5
Release Capacity (cfs)	750			750			1,500		1,000		1,000	1,000	1,000
Project Cost (2019 $, billions)	3.2	3.4	3.6	2.7	2.9	3.1	3.4	3.6	2.9	3.1	2.9	3.0	3.0
Annualized acre-feet/year Release (TAF)	191	230	236	191	230	236	243	253	234	243	234	234	243
PWA Annual Costs During Repayment Without WIFIA[a] Loan (2020 $, $/acre-feet)	862	776	805	730	667	693	738	754	660	678	644	674	661
PWA Annual Costs During Repayment With WIFIA Loan (2020 $, $/acre-feet)	799	724	755	665	614	641	689	708	608	628	592	621	611

[a] Water Infrastructure Finance and Innovation Act

8. Recommended Project

The recommended Project was developed by the Ad Hoc Value Planning Workgroup through a sequential process that included initial and refined alternatives. Important considerations included total project cost, impacts on landowners, impacts on traffic and public safety, ability to meet participant demands, ability to provide public benefits to the State, relative magnitude of environmental impacts, and the estimated cost per acre-foot of water delivered. The recommended Project and two options for consideration are shown in Table 8-1.

TABLE 8-1. VALUE PLANNING GROUP RECOMMENDED PROJECTS

	VP5	VP6	VP7
	Option 1	Option 2	Recommended
Reservoir Size	1.3 MAF	1.3 MAF	1.5 MAF
Dunnigan Release Capacity (cfs)	1,000 cfs to CBD	1,000 cfs to River	1,000 cfs to CBD
Estimated Cost (2019 dollars)	$2,855,000,000	$2,988,000,000	$3,037,000,000
Estimated Cost per Acre-Foot with WIFIA[a] (2020)	$592	$621	$611
Estimated Deliveries (Long-Term Average in TAF)	234	234	243

[a] Water Infrastructure Finance and Innovation Act

The recommended project (Alternative VP7) includes a 1.5 MAF reservoir to provide additional storage for dry and critical years. All options include a bridge to minimize travel times and provide emergency access for communities on the west side of the reservoir. The bridge for all options was sized based on the maximum water surface elevation for a 1.5 MAF facility to avoid future traffic impacts that could arise if climate change or other factors necessitated expanding a smaller reservoir. All alternatives also include a new unpaved road to maintain access for residents along the southern portion of the reservoir.

All options, including the recommended alternative, would release water through the T-C Canal. A 1,000 cfs release near the end of the canal would deliver water to either the CBD (Alternatives VP5 and VP7) or to the Sacramento River (Alternative VP6).

The Value Planning Workgroup recommends the Project proceed as Alternative VP7. Although Alternative VP5 had the lowest overall cost and lower cost per acre-foot, the Value Planning Workgroup recommends VP7 based on higher deliveries at a comparable cost and improved operational flexibility with a 1.5 MAF reservoir. The proposed facility locations associated with VP7 are shown in Figure 8-1.

The Value Planning Workgroup also recommends the subsequent analyses of the Project include a 1.3 MAF reservoir (per VP5) and a Dunnigan to Sacramento River 1000 cfs release pipeline (per VP6) in order to provide flexibility to respond to any future condition changes that might result in such facilities becoming preferable.

The Recommended Project results in the following significant changes to the original Alternative D 1.8 MAF Project:

- Reduced project size and footprint
- Reduced Sacramento River diversions
- Elimination of Delevan Sacramento River diversion and release facility
- Elimination of Delevan Pipeline and associated impacts to landowners and wildlife refuges along that alignment
- Reduced costs and improved affordability to the Project's funding participants.

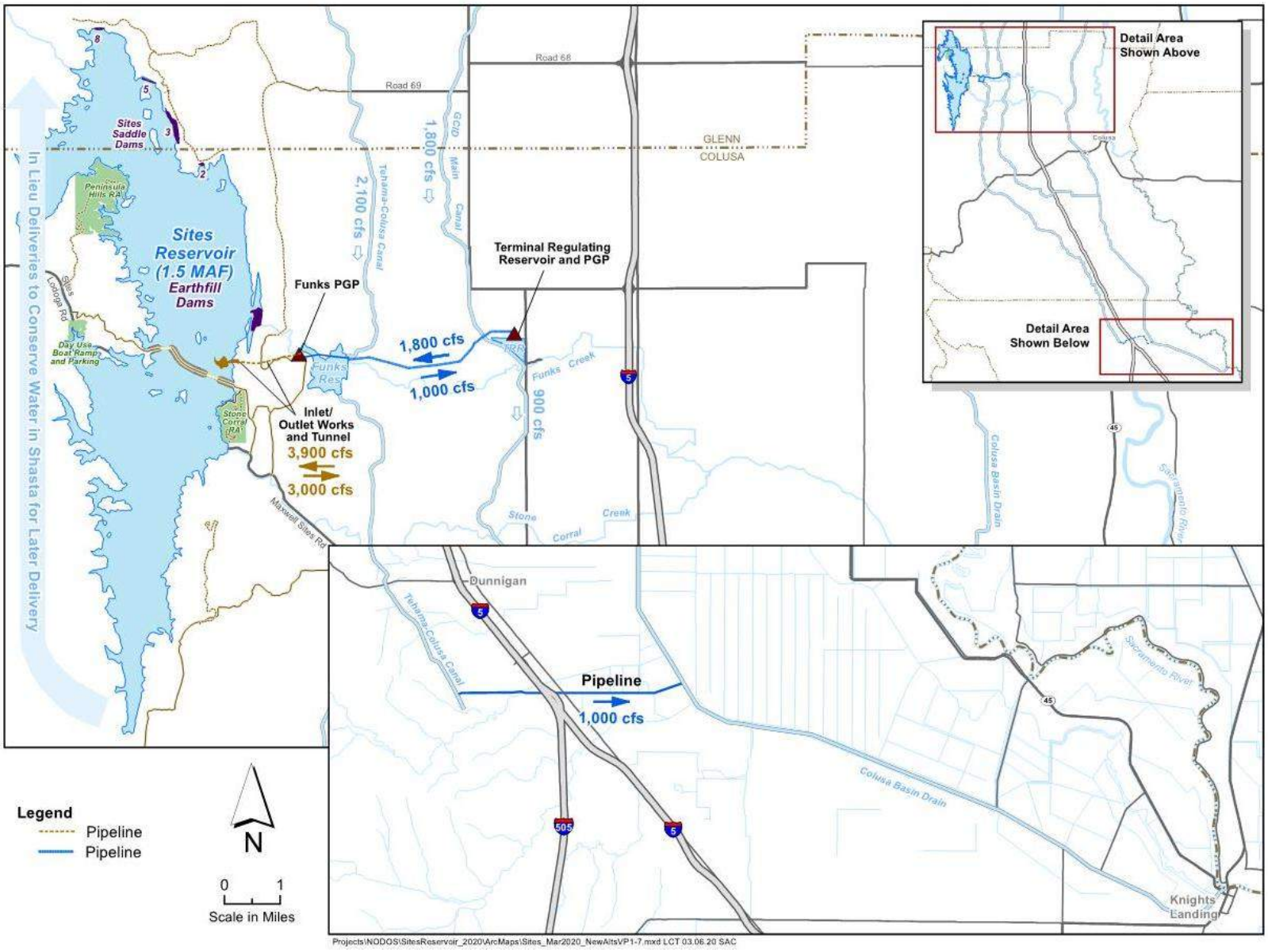


FIGURE 8-1. RECOMMENDED VALUE PLANNING ALTERNATIVE (VP7)

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Appendix A – Value Planning Alternatives and Costs

Value Planning Analysis Technical Memorandum

Sites Program Management Team

To:	Mike Azevedo, Lewis Bair, Thad Bettner, Gary Evans, Rob Kunde, Shelly Murphy, Randall Neudeck, Dan Ruiz, Jeff Sutton, Jamie Traynham, Bill Vanderwaal
CC:	Rob Tull
Date:	November 13, 2019
From:	Joe Barnes, Jeff Herrin, Pete Rude (Jacobs), Jeff Smith (Jacobs)

1.0 Value Planning Effort

Representatives from the Reservoir Committee and Authority Board met on October 2, 2019 to discuss approaches that could potentially lower the cost of the project. Several facility modifications were identified, and appraisal level costs are provided in this analysis to allow a comparison of alternatives.

At this level of evaluation, the analysis is useful for identifying alternatives that merit further evaluation. The analysis is not sufficiently refined to distinguish between two alternatives of similar cost (e.g., + 10 to 15%).

Construction cost estimates for many of the facilities were derived from appraisal-level estimates for a 1.3 million acre feet (MAF) reservoir (Alternative A in the Environmental Impact Report/Environmental Impact Statement [EIR/S] and feasibility report) and for a 1.8 MAF reservoir (Alternative D in the EIR/S and feasibility report). Several new facilities were estimated, where possible using the unit rates from similar facilities in the existing estimates. Estimated prices were developed in October 2015 dollars and have been escalated in this estimate.

The actual project construction cost ultimately would depend on the final design details of the preferred project alternative and the labor and material costs, market conditions, and other variable factors existing at the time of bid. Accordingly, the final project cost is expected to vary from the preliminary estimates presented in this section.

2.0 General Limitations

AECOM represents that our services were conducted in a manner consistent with the standard of care ordinarily applied as the state of practice in the profession within the limits prescribed by our client. No other warranties, either expressed or implied, are included or intended in this brief appraisal-level cost estimate.

We have used background information, conceptual designs, and data by others to prepare this appraisal-level cost estimate. We have relied on this information, as furnished, and is neither responsible for nor has confirmed the accuracy of this information.

The appraisal-level cost estimate presented herein is for the current study only and should not be extended or used for any other purposes.

3.0 Value Planning Facility Options and Alternatives

The meeting on October 2, 2019 identified both modifications to previously evaluated facilities and alternative facilities to reduce cost. A comprehensive table showing approximately 59 facility options that were considered in this analysis, along with their respective costs, is provided in Attachment 2.

There are numerous ways of combining the individual facility options into alternatives. To speed the analysis, we have looked at nine complete alternatives. There are many other ways of combining the facilities that can be further evaluated at the direction of the Value Planning working group.

The initial alternatives are shown in Table 1.

Table 1. Initial Alternatives for consideration.

Features	Initial Alternatives								
	1	2	3	4a	4b	5a	5b	6a	6b
1.5 MAF Reservoir	•	•	•	•	•	•	•	•	
1.3 MAF Reservoir									•
Funks/Sites PGP	•	•		•	•	•	•		
TCRR and Upgraded TRR PGP			•					•	•
Delevan Canal/Pipeline Release	•	•	•	•	•				
Dunnigan Canal to CBD Release						•		•	
Dunnigan to River Release							•		•
Multi-Span Bridge	•		•	•	•	•	•	•	•
South Road to Lodoga		•							
South Road to Residents	•		•	•	•	•	•	•	•
Rockfill Embankment Dam	•	•	•			•	•		
Earthfill Dam				•				•	•
Hardfill Dam					•				

MAF = million acre feet
PGP = Pumping/Generating Plant
TCRR = Tehama-Colusa Regulating Reservoir
TRR = Terminal Regulating Reservoir

For purposes of comparison, we have included Alternative D, the alternative presented in the WSIP application in the comparison of alternatives. The new alternatives include the following:

- Alternative 1 – Refer to Figure 1. This alternative reduces the size of the reservoir to 1.5 MAF and uses a multi-span bridge to reduce costs. The other features are generally consistent with Alternative D.

- Alternative 2 – Refer to Figure 2. This alternative is very similar to Alternative 1 but uses the southern road with the more direct route to Lodoga in place of the bridge.

- Alternative 3 – Refer to Figure 3. This alternative eliminates the Sites Pumping/Generating Plant and replaces it with the Tehama-Colusa Regulating Reservoir (TCRR) and Pumping Plant near Road 69 in combination with an upgraded Terminal Regulating Reservoir (TRR) to fill Sites Reservoir. Water would be released to the Sacramento River through a canal/pipeline to the Delevan release structure. The canal portion would begin at the TRR and continue east to the Colusa Basin Drain (CBD). It would be necessary to siphon under the CBD and pump the water to the river. The two-span bridge is used in this alternative.

- Alternatives 4a and 4b – Refer to Figures 4a and 4b. These alternatives include the single Sites Pumping/Generating Plant (PGP) with releases through the Delevan Canal/Pipeline. Alternative 4a uses an earthfill dam and Alternative 4b uses a hardfill dam in place of the zoned rockfill dam.

- Alternatives 5a and 5b – Refer to Figures 5a and 5b. These alternatives replace the Delevan Canal/Pipeline with a southern release near the southern terminous of the Tehama-Colusa (T-C) Canal. Alternative 5a releases water to the CBD. Water released to the CBD would be conveyed through the lower portion of the CBD to the Sacramento River. Alternative 5b conveys water by canal to the CBD, then uses a siphon and pumping plant to convey water on to the river.

- Alternatives 6a and 6b – Refer to Figures 6a and 6b. These alternatives combine the TCRR and upgraded TRR with the southern release structure and an earthfill dam. Alternative 6a appears to have the lowest construction cost.

A summary of alternative costs, including a cost comparison with Alternative D, is included in Table 2.

Table 2. Summary of Estimated Costs

Alternative	Estimated Costs ($2018) (financing cost not included)	Cost Reduction from Alternative D
Alternative D	$5,235 million	0%
Alternative 1	$3,970 million	24%
Alternative 2	$3,988 million	24%
Alternative 3	$3,868 million	26%
Alternative 4a	$3,828 million	27%
Alternative 4b	$3,861 million	26%
Alternative 5a	$3,548 million	32%
Alternative 5b	$3,876 million	26%
Alternative 6a	$3,417 million	35%
Alternative 6b	$3,584 million	32%

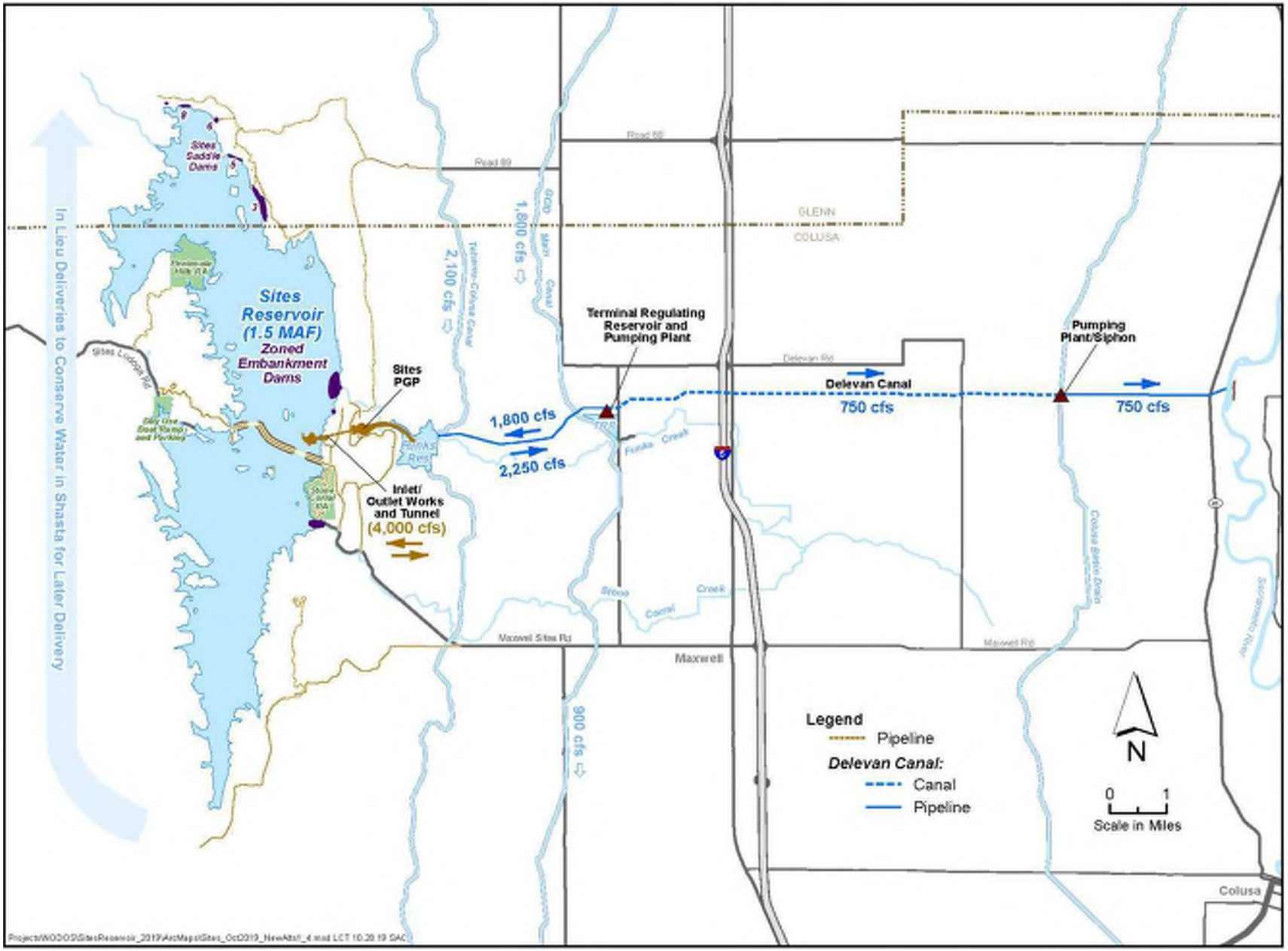


Figure 1. Alternative 1 (Estimated cost - $3,970 million)

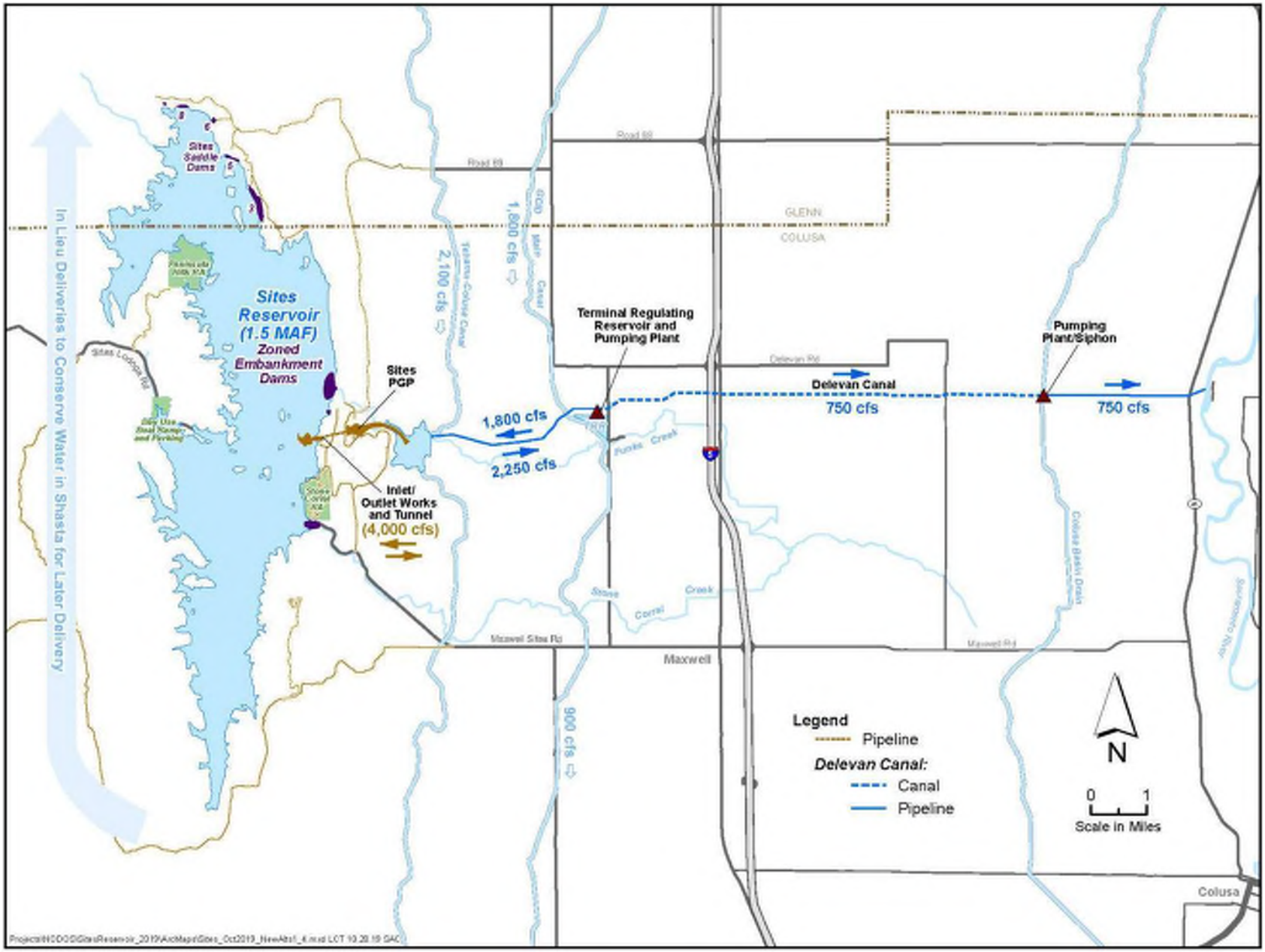


Figure 2. Alternative 2 (Estimated cost - $3,988 million)

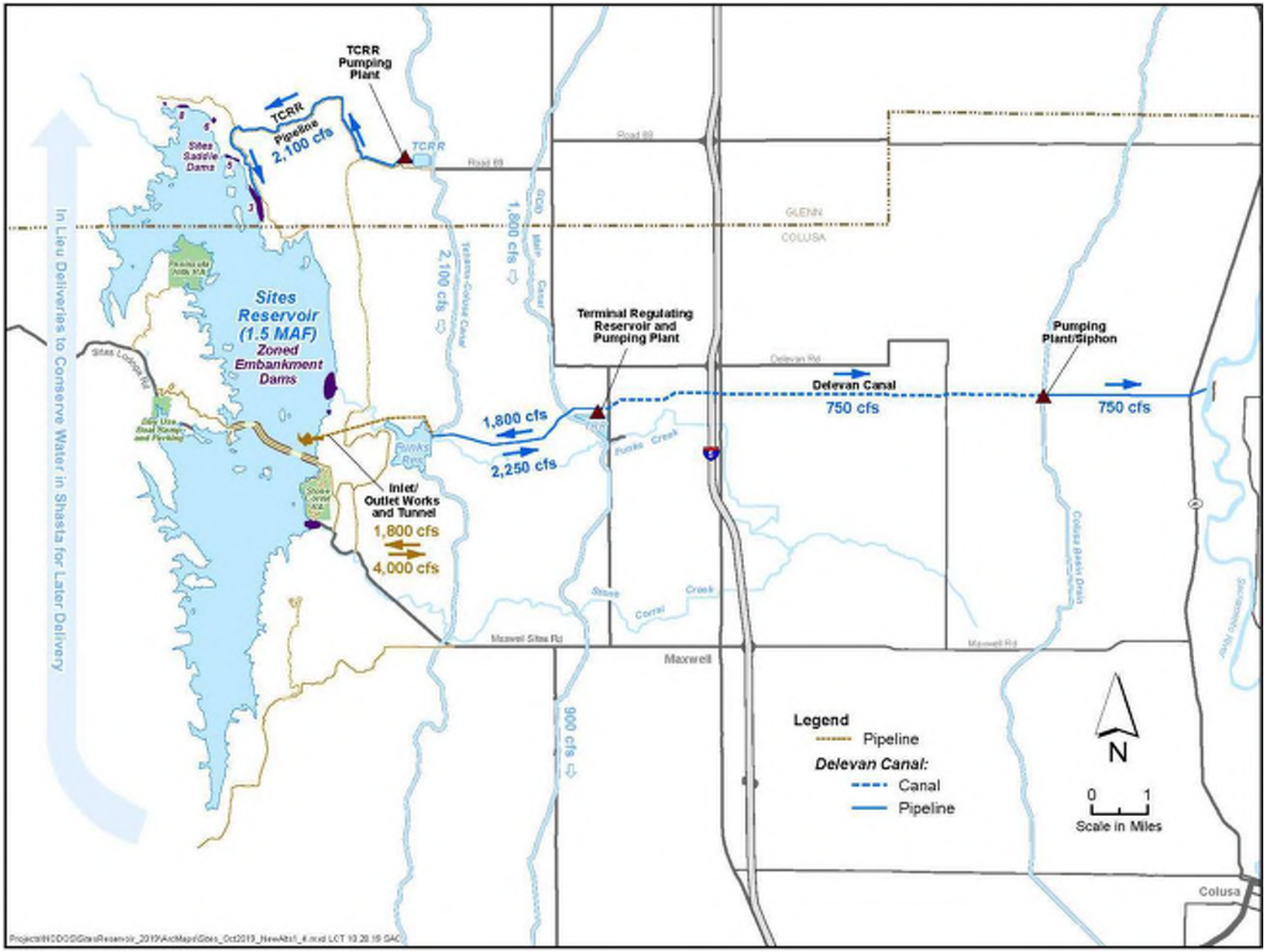


Figure 3. Alternative 3 (Estimated cost - $3,868 million)

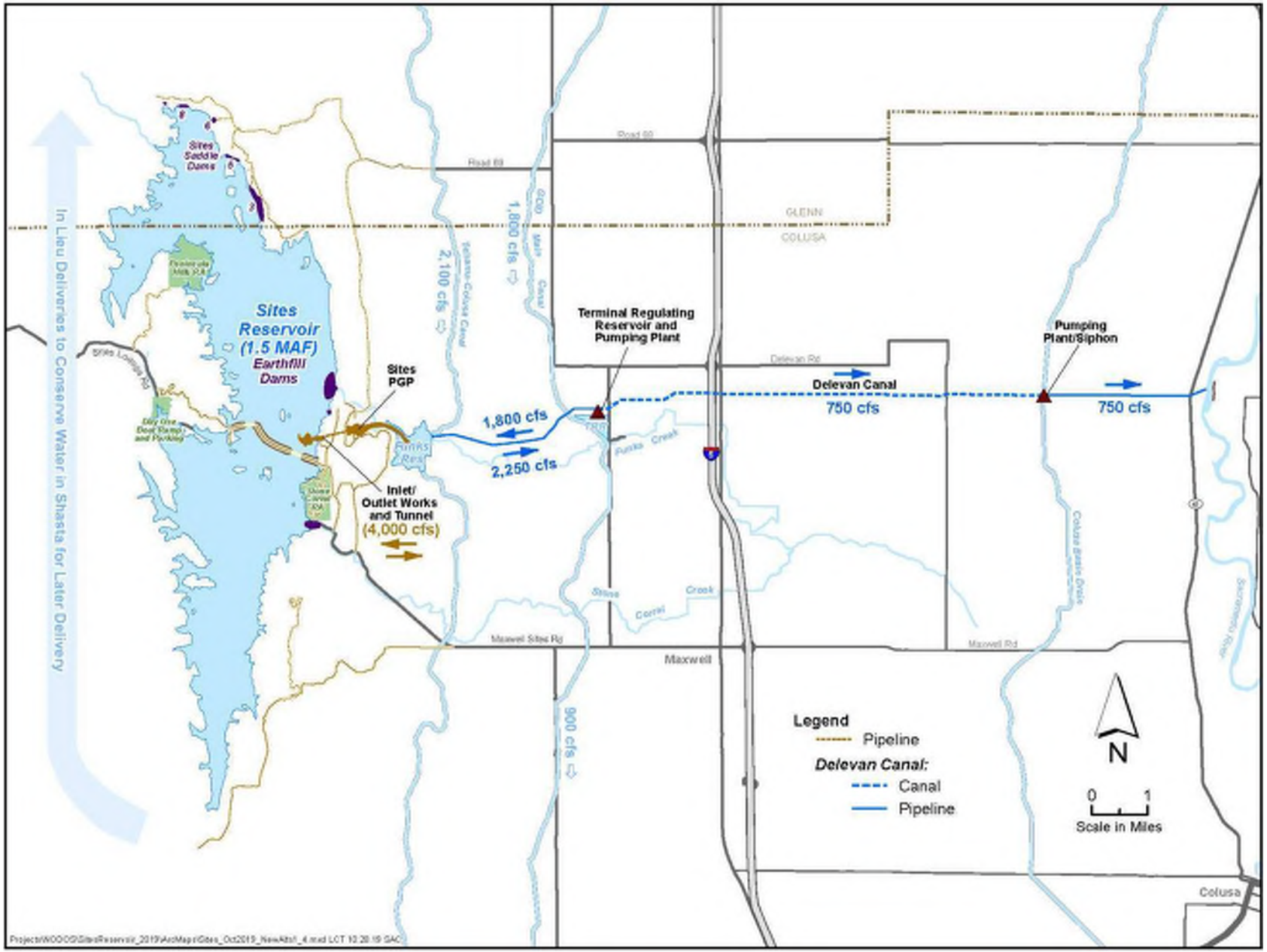


Figure 4a. Alternative 4a (Estimated cost - $3,828 million)

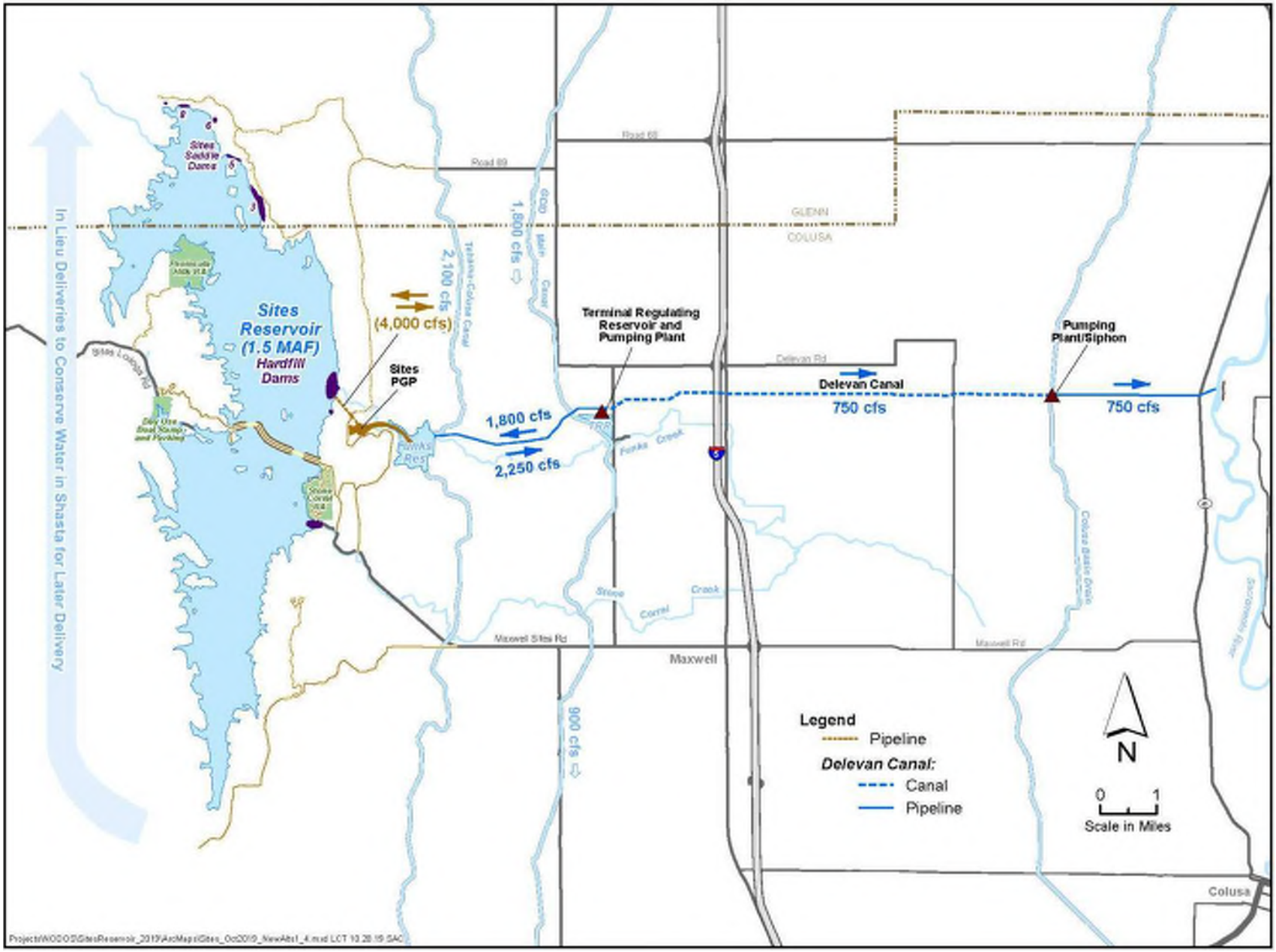


Figure 4b. Alternative 4b (Estimated cost - $3,861 million)

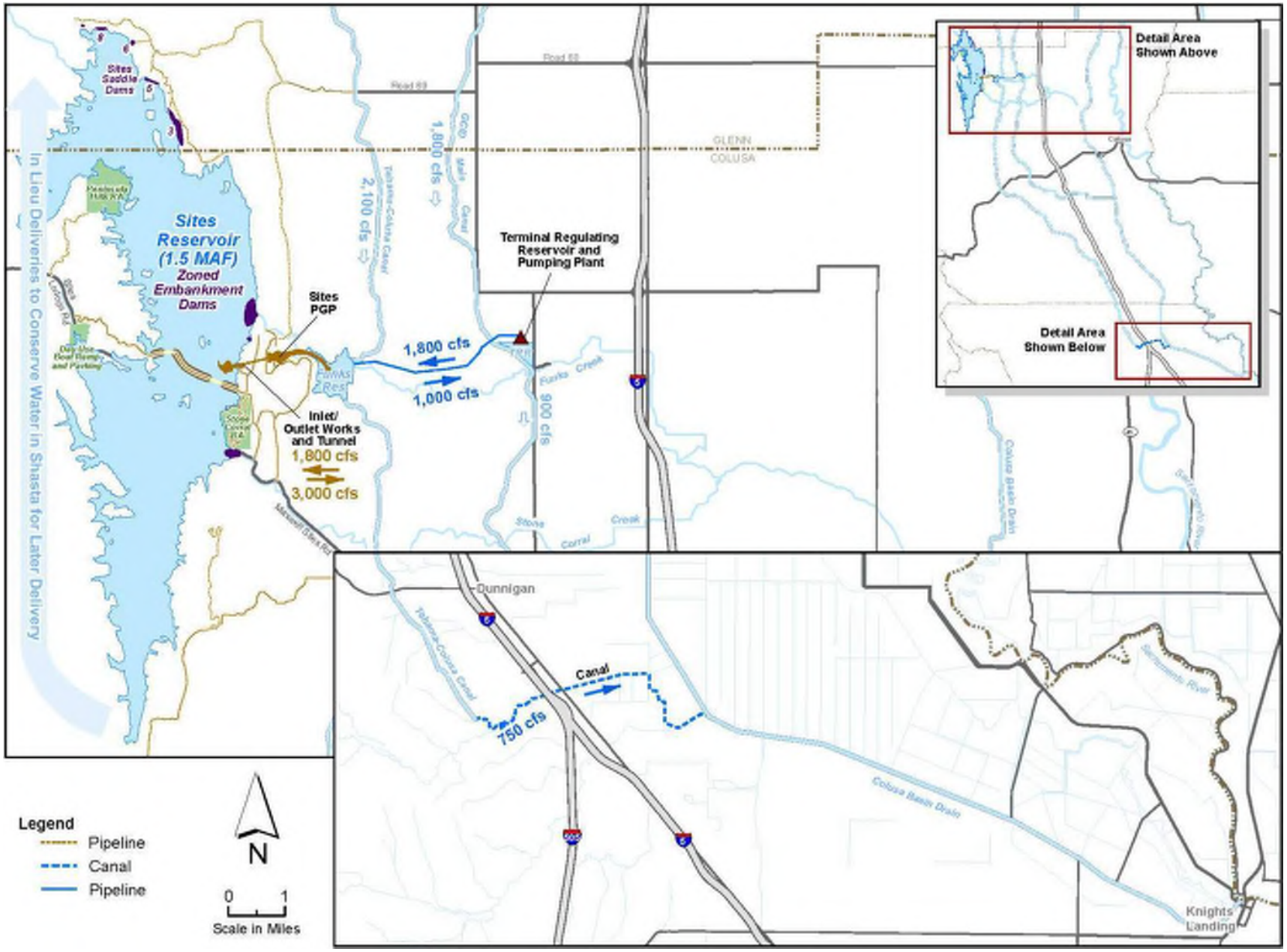


Figure 5a. Alternative 5a (Estimated cost - $3,548 million)

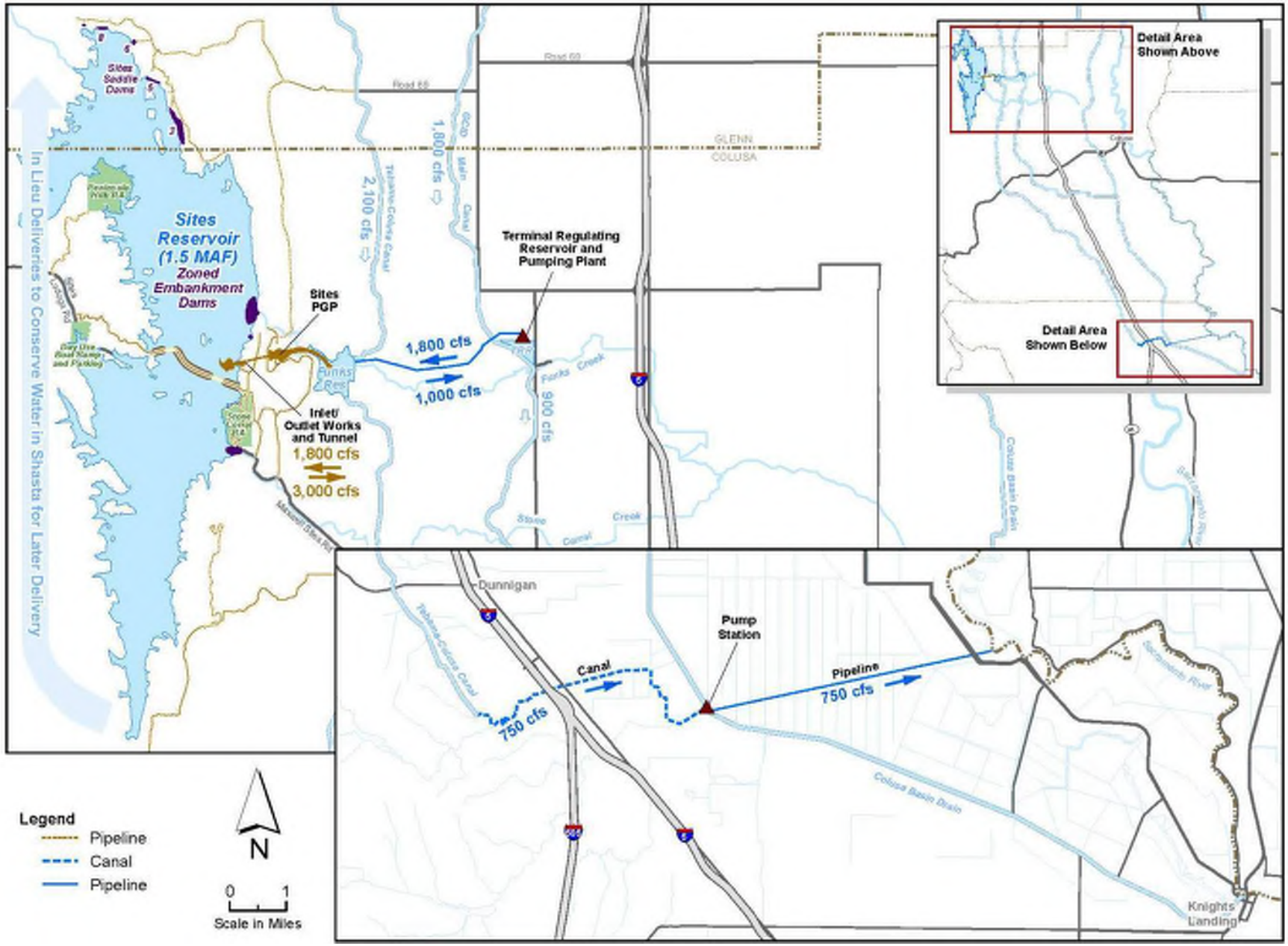


Figure 5b. Alternative 5b (Estimated cost - $3,876 million)

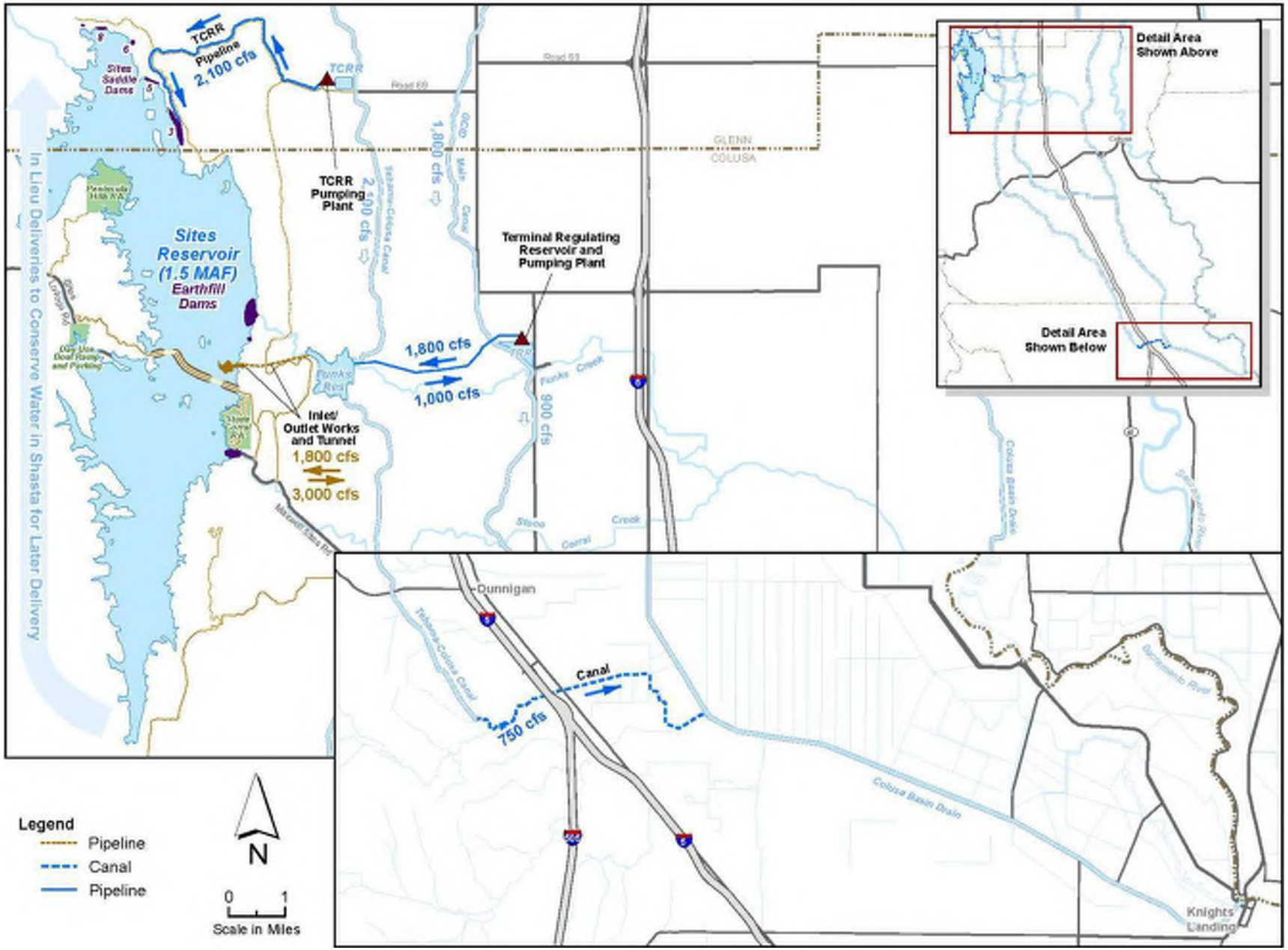


Figure 6a. Alternative 6a (Estimated cost - $3,417 million)

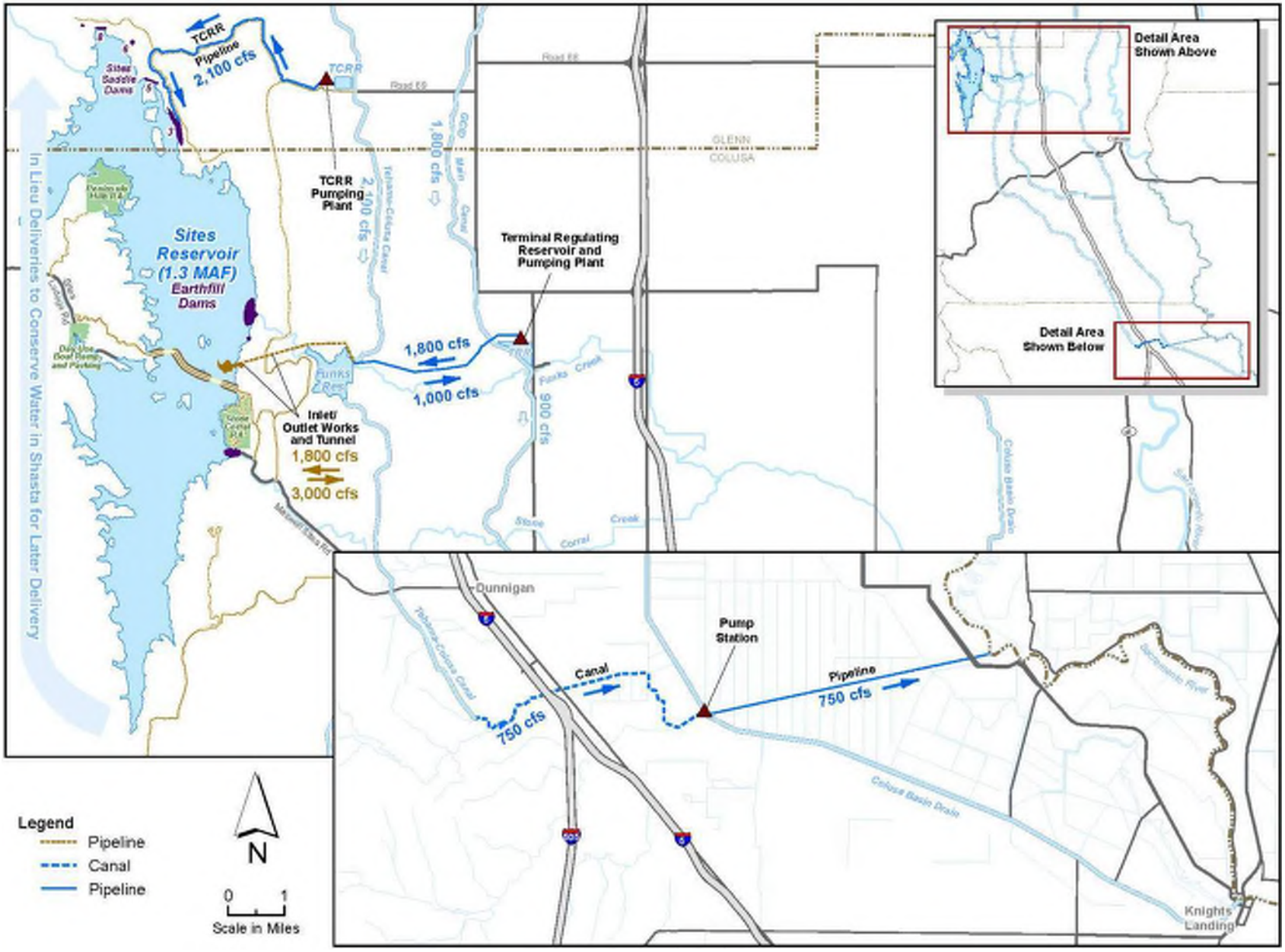


Figure 6b. Alternative 6b (Estimated cost - $3,584 million)

4.0 Environmental Mitigation

HDR reviewed the existing mitigation cost estimates currently being used and found that when applied to the Value Planning Alternatives, the estimated mitigation costs do not result in any significant changes in estimated mitigation costs (>$50M). Their October 11, 2019 memorandum concluded that until additional analysis can be performed on a specific project description, the existing $500M estimate should be retained.

5.0 Emergency Reservoir Drawdown

It is proposed to distribute the emergency reservoir release flow required by the State of California Department of Water Resources, Division of Safety of Dams (DSOD) to different locations around Sites Reservoir. For the alternative project evaluation, it is assumed that these release points would include Hunters Creek, Stone Corral Creek, Funks Creek, the Glenn-Colusa Irrigation District (GCID) and T-C Canals, and an open channel that would connect the TRR with the CBD. For the channel, it is assumed that emergency release water would be conveyed to TRR through the TRR Pipeline.

The emergency release flow required is a function of the size of Sites Reservoir. DSOD requires that 10-percent of the height of the reservoir must be reduced over a period of seven days. Table 3 provides an estimate of the average 7-day emergency release flow required for various reservoir sizes to meet the criteria. Also shown in the table is AECOM's assumed distribution of the required release to the creeks and canals listed above. Additional evaluation of the downstream watersheds and the downstream impacts will be needed to refine the distribution of releases between the candidate release points.

Regarding the canal to the CBD, AECOM assumes that the capacity would be between 750 and 1,000 cubic feet per second (cfs), which would be the equivalent release for one of the two 12-foot-diameter Delevan Pipes. A flow of 1,000 cfs is used in the table. In distributing the remaining flows as shown in the table, the following assumption were made:

1. The flows allocated to Stone Corral Creek and Funks Creek are approximately equivalent to 50-year flows estimated from published regression curves for Coastal Range areas. These flows are estimated at the Sites and Golden Gate Dams.

2. The flows allocated to the GCID and TC Canals represent minimum spare capacity that could be available to convey emergency releases. Capacity could be higher during certain time of the year.

3. After accounting for the releases described above, the balance of the required release was assigned to Hunters Creek at the north end of the valley. This release could be distributed to two or three of the larger saddle dams at the north end of Sites Reservoir, which are adjacent to Hunters Creek, or are on tributaries. At each release point, an outlet works pipeline would be provided at the base of the dam with energy dissipation valve(s) at the downstream end.

4. The release to Hunters Creek is sizeable. One feasible approach to reduce impacts would be to provide a dry dam on the creek with sized outlet works that would use storage routing to reduce the flow released to the creek downstream. There is at least one suitable site for such a dam on the creek where it passes out of the eastern ridge into the valley. This is not included with this cost estimate.

Also shown on the Table 3 is the estimated size of the twin outlet works tunnels required to pass the water being released to Funks Creek, the GCID and T-C canals, and the canal to the CBD. Tunnel size is based on the assumed distribution of the required emergency release to the various discharge points.

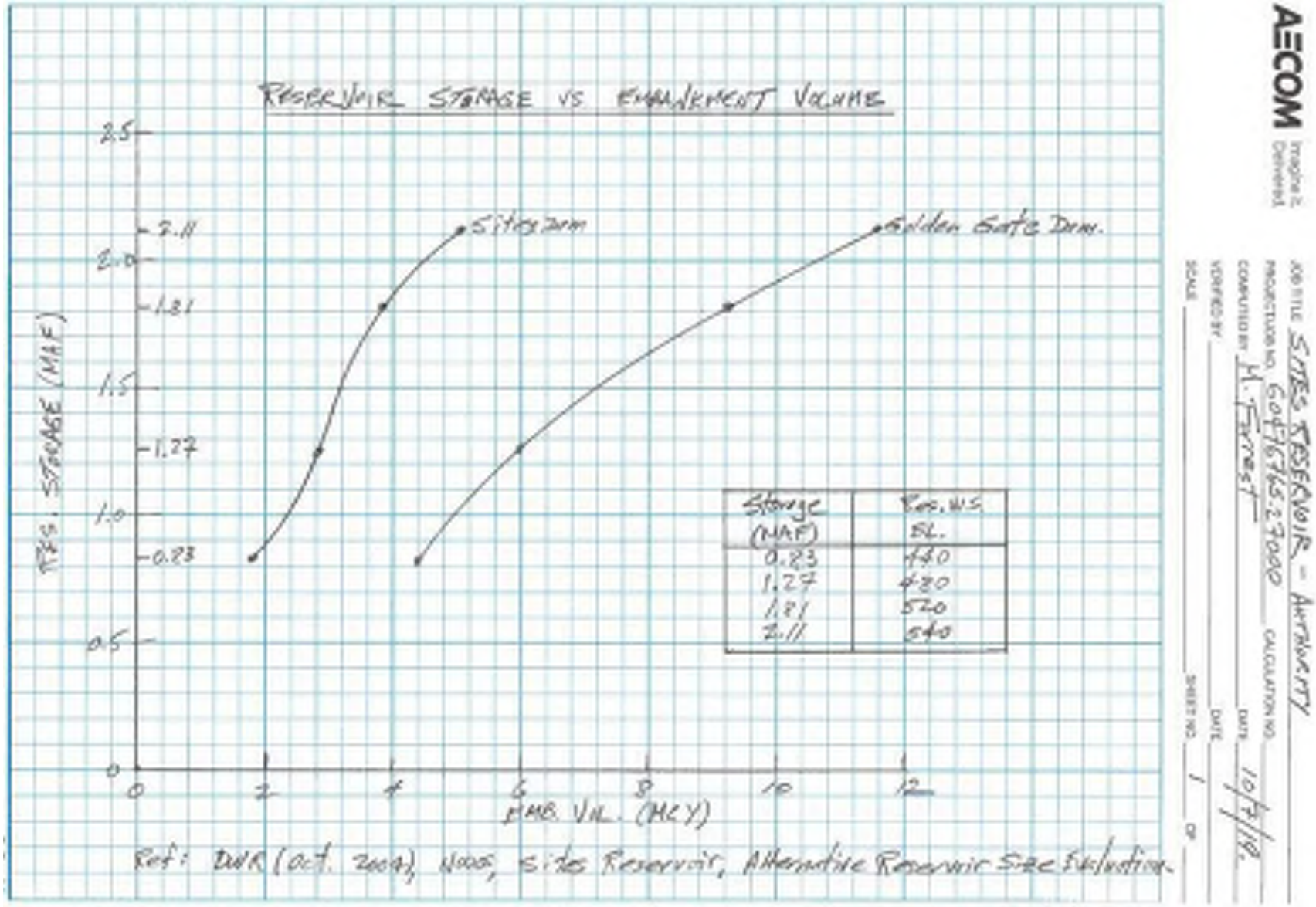
Table 3. Emergency Release – Assumed Distribution of Flows

Reservoir Size	1.8 MAF	1.5 MAF	1.3 MAF	1.0 MAF	0.8 MAF
Emergency Release Required (cfs)	21,700	17,950	15,450	12,000	9,650
Stream Releases (cfs)					
Hunters Creek Release Structure	11,250	7,500	5,000	4,500	3,000
Stone Corral Creek	3,500	3,500	3,500	3,500	3,500
Total =	14,750	11,000	8,500	8,000	6,500
Remaining Release Required =	**6,950**	**6,950**	**6,950**	**4,000**	**3,150**
I/O Tower and Tunnel Releases					
Funks Creek	4,500	4,500	4,500	2,550	3,150
GCID Main Canal	700	700	700	700	0
T-C Canal	750	750	750	750	0
Canal Conveyance to Colusa Basin Drain	1,000	1,000	1,000	0	0
Total =	6,950	6,950	6,950	4,000	3,150
I/O Tunnel Required Release (cfs) =	**6,950**	**6,950**	**6,950**	**4,000**	**3,150**
Estimated Twin I/O Tunnel Sizes (feet) for 20 feet per second (fps) maximum velocity (ft) =	**15**	**15**	**15**	**11**	**10**

6.0 Attachments

	Component Cost	Alternative D	Alternative 1	Alternative 2	Alternative 3	Alternative 4a	Alternative 4b	Alternative 5a	Alternative 5b	Alternative 6a	Alternative 6b
Total ($2018) w/o financing cost		$5,234,596,920	$3,969,916,920	$3,988,276,920	$3,868,396,920	$3,828,436,920	$3,860,836,920	$3,547,636,920	$3,875,956,920	$3,416,956,920	$3,584,356,920
% cost reduction		0%	24%	24%	26%	27%	26%	32%	26%	35%	32%
Total ($2015)		$4,846,849,000	$3,675,849,000	$3,692,849,000	$3,581,849,000	$3,544,849,000	$3,574,849,000	$3,284,849,000	$3,588,849,000	$3,163,849,000	$3,318,849,000
RESERVOIRS AND DAMS											
Develop Sites Reservoir Area	$255,000,000	$255,000,000	$255,000,000	$255,000,000	$255,000,000	$255,000,000	$255,000,000	$255,000,000	$255,000,000	$255,000,000	$255,000,000
Single Span Bridge	$215,000,000	$215,000,000									
Short Span Bridges	$125,000,000		$125,000,000		$125,000,000	$125,000,000	$125,000,000	$125,000,000	$125,000,000	$125,000,000	$125,000,000
Lodoga Road (Long Route)	$114,000,000										
Lodoga Road (Direct Route)	$180,000,000			$180,000,000							
South Road Property Access	$38,000,000		$38,000,000		$38,000,000	$38,000,000	$38,000,000	$38,000,000	$38,000,000	$38,000,000	$38,000,000
Construct Main Dams (1.8 MAF) - Zoned Embankment	$610,000,000	$610,000,000									
Construct Main Dams (1.5 MAF) - Zoned Embankment	$511,000,000		$511,000,000	$511,000,000	$511,000,000			$511,000,000	$511,000,000		
Construct Main Dams (1.5 MAF) - Earthfill	$380,000,000					$380,000,000				$380,000,000	
Construct Main Dams (1.5 MAF) - Hardfill	$690,000,000						$690,000,000				
Construct Main Dams (1.3 MAF) - Zoned Embankment	$400,000,000										
Construct Main Dams (1.3 MAF) - Earthfill	$320,000,000										$320,000,000
Construct Saddle Dams (1.8 MAF)	$270,000,000	$270,000,000									
Construct Saddle Dams (1.5 MAF)	$183,000,000		$183,000,000	$183,000,000	$183,000,000	$183,000,000	$183,000,000	$183,000,000	$183,000,000	$183,000,000	
Construct Saddle Dams (1.3 MAF)	$94,000,000										$94,000,000
Construct Forebay/Afterbay (Fletcher/Holthouse)	$190,000,000	$190,000,000									
Funks Reservoir Structures/Dredging	$22,000,000		$22,000,000	$22,000,000		$22,000,000	$22,000,000	$22,000,000	$22,000,000		
Construct TRR Reservoir	$39,000,000	$39,000,000	$39,000,000	$39,000,000	$39,000,000	$39,000,000	$39,000,000	$39,000,000	$39,000,000	$39,000,000	$39,000,000
North T-C Regualting Reservoir	$39,000,000				$39,000,000					$39,000,000	$39,000,000
Hunters Creek Release Structures (at 3 Saddle Dams)	$84,000,000		$84,000,000	$84,000,000	$84,000,000	$84,000,000	$84,000,000	$84,000,000	$84,000,000	$84,000,000	$84,000,000
PUMPING AND GENERATING PLANTS											
Construct I/O Structure and Single 30' Diameter Tunnel	$210,000,000	$210,000,000					$0				
Construct I/O Struture and Twin 15" Diameter Tunnels	$280,000,000		$280,000,000	$280,000,000	$280,000,000	$280,000,000	$0	$280,000,000	$280,000,000	$280,000,000	$280,000,000
Sites Pumping-Generating Plant (5,900 cfs) - with Delevan	$800,000,000	$800,000,000									
Sites Pumping-Generating Plant (4,000 cfs) - w/o Delevan	$634,000,000		$634,000,000	$634,000,000		$634,000,000	$634,000,000	$634,000,000	$634,000,000		
T-C North Pumping Plant - 2100 cfs	$185,000,000				$185,000,000					$185,000,000	$185,000,000
TRR Pumping-Generating Plant - 1800 cfs	$160,000,000	$160,000,000	$160,000,000	$160,000,000		$160,000,000	$160,000,000	$160,000,000	$160,000,000		
Increased Head TRR PumpGen Plant - 1800 cfs	$185,000,000				$185,000,000					$185,000,000	$185,000,000
CBD Pumping Plant for Delevan Release (750 cfs)	$34,000,000		$34,000,000	$34,000,000		$34,000,000	$34,000,000				
Sacramento River Pumping-Generating Plant (2000 cfs)	$260,000,000	$260,000,000									
Sacramento River Release Structure - 1500 cfs	$16,000,000										
Sacramento River Release Structure - 750 cfs	$8,000,000		$8,000,000	$8,000,000	$8,000,000	$8,000,000	$8,000,000				
Sacramento River Fish Screen Structure	$55,000,000	$55,000,000									
Red Bluff Pump Addition	$3,849,000	$3,849,000	$3,849,000	$3,849,000	$3,849,000	$3,849,000	$3,849,000	$3,849,000	$3,849,000	$3,849,000	$3,849,000
CBD Pumping Plant for T-C Extension (750 cfs)	$34,000,000								$34,000,000		$34,000,000
Canals and Conduits											
Construct Channel to Holthouse	$49,000,000	$49,000,000									
Reduced Channel with Hunters Creek Discharge	$31,000,000		$31,000,000	$31,000,000	$31,000,000	$31,000,000	$31,000,000	$31,000,000	$31,000,000	$31,000,000	$31,000,000
Construct Delevan Pipeline - Two Pipeline	$660,000,000	$660,000,000									
Construct Delevan Pipeline - One Pipeline	$389,400,000										
Delevan Canal to CBD (750 cfs)	$150,000,000		$150,000,000	$150,000,000	$150,000,000	$150,000,000	$150,000,000				
CBD Siphon and Pipeline to River (750 cfs)	$210,000,000		$210,000,000	$210,000,000	$210,000,000	$210,000,000	$210,000,000				
TCRR Pipeline to Sites Reservoir (2100 cfs)	$410,000,000				$410,000,000					$410,000,000	$410,000,000
Construct TRR Pipeline - Four Pipelines (with Afterbay)	$350,000,000	$350,000,000									
Construct TRR Pipeline - Three Pipelines	$280,000,000		$280,000,000	$280,000,000		$280,000,000	$280,000,000				
Construct TRR Pipeline - Two Pipelines	$210,000,000				$210,000,000			$210,000,000	$210,000,000	$210,000,000	$210,000,000
T-C Canal Extension to CBD	$73,000,000							$73,000,000	$73,000,000	$73,000,000	$73,000,000
Siphon, Turnout, and Pipeline from CBD to River	$270,000,000								$270,000,000		$270,000,000
Release Structure - 750 cfs for South Outfall	$8,000,000							$8,000,000	$8,000,000	$8,000,000	$8,000,000
Stony Creek Diversion to TC	$37,000,000										
Transmission Lines, Switchyards and Substations											
Sites PGP and Colusa Substations,Switchyards, Transmission	190,000,000	190,000,000									
Sites PGP Substation, Switchyard, Transmission	98,000,000		98,000,000	98,000,000		98,000,000	98,000,000	98,000,000	98,000,000		
TRR and T-C from Cogen Substation	105,000,000				$105,000,000					$105,000,000	$105,000,000
General Property											
Recreation and O&M Facility	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000
Mitigation ($350M construction + $150M operation)											
Construction Impacts	350,000,000	350,000,000	350,000,000	350,000,000	350,000,000	350,000,000	350,000,000	350,000,000	350,000,000	350,000,000	350,000,000
Operation Impacts	150,000,000	150,000,000	150,000,000	150,000,000	150,000,000	150,000,000	150,000,000	150,000,000	150,000,000	150,000,000	150,000,000

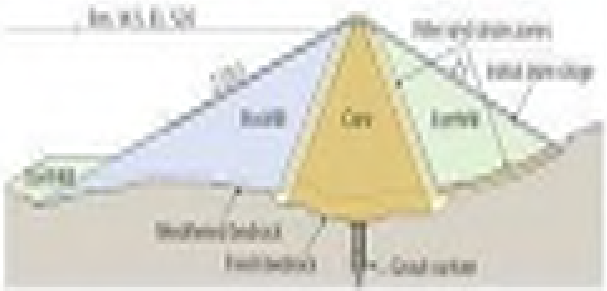
Attachment 2. Res Storage vs Embank Vol Plot.pdf and Alt Dam ROM Costs



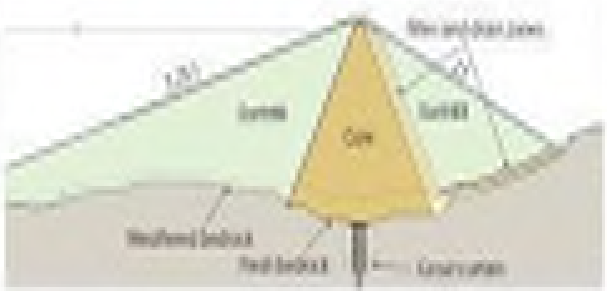
Attachment 3. Alternative-section_dams

Dam Types Drive Affordability

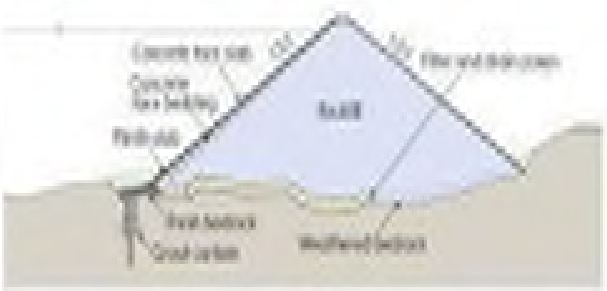
Option #1 Zoned Earth- and Rockfill Dams



Option #2 Zoned Earthfill Dams

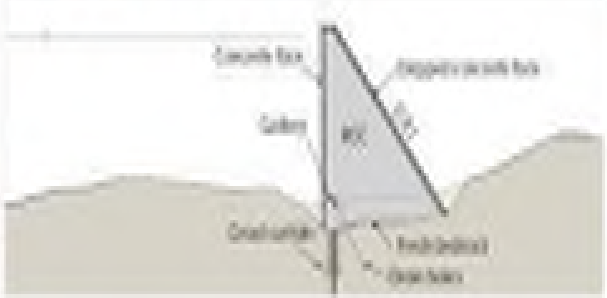


Option #3 Concrete Faced Rockfill Dams

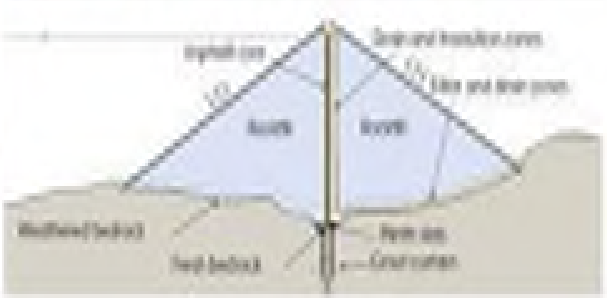


Option #4 RCC Hardfill Dams

Option #5 RCC Dams



Option #6 Asphalt Core Rockfill Dams



Value Planning Analysis Authority Staff Review Comments

Date: October 22, 2019

Subject: Value Planning Analysis Authority Staff Review Comments

1.0 Purpose

On October 18, 2019, representatives from the Reservoir Committee requested staff to identify potential issues with the Sites Reservoir Project Alternatives presented three Technical Memorandums. The memorandums that were reviewed included the following:

1. Value Planning: Mitigation Cost Estimate Update of 2016 Technical Memorandum, October 11, 2019.
2. Value Planning Analysis Technical Memorandum, October 14, 2019.
3. Value Planning Effort Technical Memorandum, October 15, 2019.

2.0 Review Comments

In their review, staff did not identify anything that would be considered a "fatal flaw". Staff review comments are presented below:

General

1. The value planning effort included development of appraisal level costs. The draft Sites Authority Principles and Requirements for Feasibility Study and the Technical Reference for the Water Storage Investment Program (WSIP) reference their cost estimates to the Association for the Advancement of Cost Engineering (AACE) International classifications. The AACE classifications correspond to the percent that project design has been completed and the associated expected range in accuracy of the cost estimate. It is recommended that the value planning cost estimates and contingencies follow the AACE classifications and guidelines.
2. The I/O structure changes from a single 30 foot diameter tunnel in Alternative D to twin 15 foot diameter tunnels. Because this change increases costs by around $70 million, it would be beneficial to explain the reasoning.
3. It is recognized that many of the staff comments would be addressed after the value planning effort is complete and the alternatives are being further evaluated to screen them down to identify a preferred plan. Examples are as follows:
    a. Incorporate an emergency spillway and revise the freeboard and dam crest elevation, if appropriate.
    b. Finalize the emergency drawdown facilities and associated flowage easements, if appropriate.
    c. Further evaluate the compatibility of the portion of the Delevan Canal that will be located in the right overbank floodplain of the CBD, as well as potential upstream hydraulic impacts.
4. The CEQA Guidelines, Section 15088.5 (a) addresses the requirements associated with changes in a project and the need for recirculation of an EIR prior to certification. Specifically:

    "A lead agency is required to recirculate an EIR when significant new information is added to the EIR after public notice is given of the availability of the draft EIR for public review under Section 15087 but

before certification. As used in this section, the term “information” can include changes in the project or environmental setting as well as additional data or other information. New information added to an EIR is not “significant” unless the EIR is changed in a way that deprives the public of a meaningful opportunity to comment upon a substantial adverse environmental effect of the project or a feasible way to mitigate or avoid such an effect (including a feasible project alternative) that the project's proponents have declined to implement.”

Each alternative should be reviewed for potential changes in the significance of an impact and/or inability to implement mitigation previously identified in the EIR.

5. According to CEQA, an EIR must describe a reasonable range of alternatives to a proposed project that could feasibly attain most of the basic project objectives, and would avoid or substantially lessen any of the proposed project's significant effects. Any new alternative should be reviewed in light of comments received on the Draft EIR/EIS and in consideration of reducing significant adverse effects.

Specific

1. The EIR/EIS found that the Project’s conversion of Prime Farmland, Unique Farmland or Farmland of Statewide importance to non-agricultural use would result in significant and unavoidable impacts. In all alternatives, replacement of the Delevan pipeline with open canal may result in additional environmental effects associated with agricultural land conversion as it may render additional land unsuitable for agricultural production; while this may not substantially increase an already significant and unavoidable effect, it would increase costs for mitigation at the 1:1 ratio currently proposed.
2. Alternative 2 proposes the use of a roadway around the southern end of the reservoir rather than a bridge crossing. This may result in additional vehicle miles traveled and associated air quality and greenhouse gas effects as well as affect emergency response times. Other effects that may be in excess of those associated with Alternative D would be ground disturbing effects to cultural and/or biological resources; however, it is likely that the roadway could be designed to avoid significant resources.

   Alternatives 5a, 5b, 6a and 6b would be implemented outside of the previously analyzed project footprint and would be most likely to trigger recirculation of the Draft EIR/EIS due to the change in environmental setting and potential for previously undisclosed environmental effects.

Feature	Potential Major Permitting Effect Compared to Alt D
1.5 MAF Reservoir	• Reduce effect to grassland threatened and endangered (T&E) species • Reduced effect to streams, wetlands and cultural resources
1.3 MAF Reservoir	• Reduce effect to grassland T&E species • Reduced effect to streams, wetlands and cultural resources
Funks/Sites PGP	• Reduce impact to grassland T&E species • Reduced effect to streams, wetlands and cultural resources
TCRR and Upgraded TRR PGP	• No major change in effects anticipated • Unknown effects to cultural resources
Delevan Canal/Pipeline Release	• Reduced effect to river channel • Reduced effect to riparian vegetation • Reduced effect to riverine species (aquatic and terrestrial)
Dunnigan Canal to CBD Release	• Reduced effect to riverine species (aquatic and terrestrial • Increased (new) effect to CA tiger salamander • Reduced effect to Giant Garter Snake • New water quality effect • New in-river flow reduction effect • Unknown effects to cultural resources
Dunnigan to River Release	• Reduced effect to riparian vegetation • Reduced effect to riverine species (aquatic and terrestrial • Increased (new) effect to CA tiger salamander • New in-river flow reduction effect • Unknown effects to cultural resources
Multi-Span Bridge	• No major change in effects anticipated
South Road to Lodoga	• No major change in effects anticipated • Unknown effects to cultural resources
South Road to Residents	• Minor change in impacts/mitigation for grassland T&E species • Unknown effects to cultural resources
Rockfill Embankment Dam	• Assuming fill comes from within the current project footprint, no major change in effects anticipated; If fill sites outside of the current project footprint are necessary, additional analysis would be needed
Earthfill Dam	• Assuming fill comes from within the current project footprint, no major change in effects anticipated; If fill sites outside of the current project footprint are necessary, additional analysis would be needed
Hardfill Dam	• Assuming fill comes from within the current project footprint, no major change in effects anticipated; If fill sites outside of the current project footprint are necessary, additional analysis would be needed

Alternative 1

1. No issues to consider.

Alternative 2

1. The community's "preferred" road connection is the bridge. The South Road will require extensive local community engagement to get "acceptance" of the road.
2. South Road affects landowners who are not currently impacted by the project – will require extensive outreach to "newly" impacted landowners.
3. South Road increases the amount of property that would be needed to acquire…increases land that would need TROE agreements for studies.

Alternative 3

1. TCRR and pumping plant affects landowners who are not currently impacted by the project – will require extensive outreach to "newly" impacted landowners.
2. Any revisions to the GCID TRR (size/footprint) could create landowner issues.
3. Depending on the sizing and location of the Delevan Canal…could be an increase in land needed for acquisition, would move us to permanent take rather than easements over the buried pipeline, could cause the created of bifurcated/remnant parcels, could be a bigger impact to existing farming operations.

Alternative 4a

1. Same issues as Alternative 3 – Delevan Canal.

Alternative 4b

1. Same issues as Alternative 3 – Delevan Canal.

Alternative 5a

1. TC Canal Southern Release affects landowners who are not currently impacted by the project – will require extensive outreach to "newly" impacted landowners – as well as Yolo County.

Alternative 5b

1. TC Canal Southern Release affects landowners who are not currently impacted by the project – will require extensive outreach to "newly" impacted landowners – as well as Yolo County.

Alternative 6a

1. TCRR and pumping plant affects landowners who are not currently impacted by the project – will require extensive outreach to "newly" impacted landowners.

2. TC Canal Southern Release affects landowners who are not currently impacted by the project – will require extensive outreach to “newly” impacted landowners – as well as Yolo County.

Alternative 6b

1. TCRR and pumping plant affects landowners who are not currently impacted by the project – will require extensive outreach to “newly” impacted landowners.
2. TC Canal Southern Release affects landowners who are not currently impacted by the project – will require extensive outreach to “newly” impacted landowners – as well as Yolo County.

Appendix A-2 Road and Bridge Analysis
Technical Memorandum

To:	Value Planning Work Group
CC:	Lee Frederiksen
Date:	February 28, 2020
From:	AECOM
Subject:	Road and Bridge Analysis

1.0 Introduction

Several alternatives for realigning Sites-Ladoga Road across and around the planned reservoir have been considered. These alternatives were discussed with Colusa and Glenn Counties on January 28, 2020. Important considerations include the following:

- Avoid comingling construction traffic with the general public
- An access road is required for residents at the southern end of Sites Reservoir
- Consider travel time and maintenance costs in the development of alternatives
- Consider public safety in developing the designs, including high winds and potential jumping hazards/nuisance

It is proposed to bring construction traffic in from the north via Road 68 onto a paved construction bypass. The general public would continue to travel on the existing Sites-Lodoga Road until either a new road/bridge across the reservoir or southern bypass road is constructed and opened for use, at which point the existing Sites-Lodoga Road could be closed and construction on Sites Dam could begin.

Four realignment alternatives for the Sites-Ladoga Road are being considered. Three road/bridge realignment alternatives (A, B, and C) and one fully road realignment alternative (D) are depicted in Figure F-1 below. The combination of roadway fill and bridge is being considered for access across the reservoir to reduce the project cost associated with a full-length bridge. Approximate travel times for these alternatives are provided in Table A2-1.

Table A2-1. Approximate Travel Times for Road Options (1.8 MAF Reservoir)

	SQUAW CREEK TO COLUSA CANAL			
Alternative	**A - BLUE**	**B - ORANGE**	**C - GREEN**	**D - PINK**
Align. Length (mi)	16.5	18.3	21.3	18.9
Assumed Ave Travel Speed (mph)	35	30	30	30
Time of Travel (min)	28	37	43	38
Relative Travel Time (min)	-	(8)	(14)	(10)

Alternative A, the South Road/Bridge alignment, is the most direct route with the shortest travel time.

2.0 South Road/Bridge Alignment (Alternative A – Blue)

Recently, three varying sizes of reservoir have been considered – 1.0 MAF, 1.3 MAF, and 1.8 MAF. As the size of the reservoir increases, the water surface elevation also increases, which elevates the road/bridge crossing. Larger reservoirs require longer bridges with taller piers and taller roadway fill prisms. When considering various size reservoirs and possibly phasing the reservoir to increase water storage over time, Table F-2 shows how road and bridge costs vary for different reservoir sizes. The table includes a least cost 1 MAF, non-phasable alternative with a tunnel; A least cost 1 MAF, non-phasable alternative without a tunnel; A least cost 1.3 MAF, non-phasable alternative; And phaseable options from 1 MAF to 1.8 MAF, plus 1.3 MAF to 1.8 MAF.

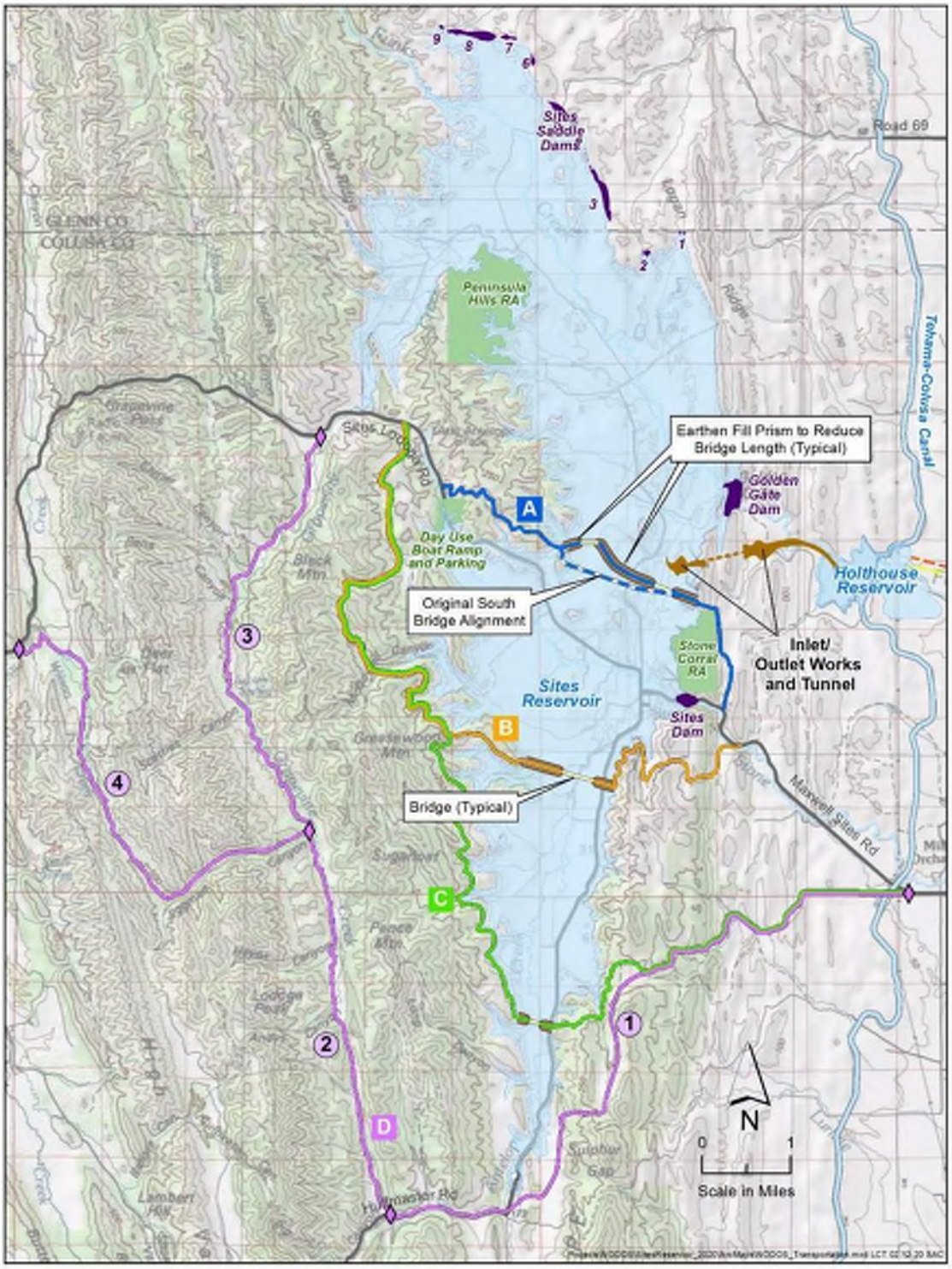


Figure A2-1. Public Transportation Route Alternatives

Table A2-2. Approximate Cost for South Bridge Options (Option A in Figure F-1)

Reservoir Data				Blue Alternative - Planning-Level Construction Cost Estimate ($M)								
MAF	Storage WSE	Max Flood Δ in WSE + Wave Ht. (ft') =	10	Road	Reservoir Crossing			Tunnel	Phase 1 Total	Phase 2 (to 1.8 MAF)	Total Phase 1 & 2	Total Blue Alternative
		= Roadway Hinge Point Elevation			Bridge		Road					
					L (ft)	Cost	Fill					
1	457	467		$43	748	$23	$30	$95	$191	Not Phasable	$191	$191
1	457	467		$47	748	$23	$30	$0	$99	Not Phasable	$99	$99
1	457	467		$47	748	$23	$79	$0	$149	$65	$213	$213
1.3	481	491		$47	844	$26	$53	$0	$126	Not Phasable	$126	$126
1.3	481	491		$47	844	$26	$97	$0	$170	$35	$205	$205
1.5	498	508		$46	1106	$25	$47	$0	$118	Not Phasable	$118	$118
1.8	520	530		$45	1500	$46	$105	$0	$196	NA	$196	$196

Page is intentionally blank.

3.0 Southern Road Alignment (Alternative D – Pink)

The alternative to avoid constructing a bridge is the southern road alignment. As noted in Section F.1, an access road to properties at the southern end of Sites Reservoir is required regardless of which alternative is selected. If a bridge were not constructed, it would be necessary to construct a paved road to the southern end of the reservoir that would continue north and west on the west side of the reservoir to maintain access to Lodoga and other communities to the west.

Table A2-3 provides an approximate cost for a paved road for each of the four numbered road segments depicted in Figure F-1.

Table A2-3. Conceptual Cost for Road Segments

Southern Road (Pink Alternative in Figure F-1)		
Road Segment	**Segment Length (mi)**	**Construction Cost Est. ($M)**
1	7.4	$85.3
2	6.0	$69.7
3	5.6	$64.4
4	5.9	$68.7
Total Cost of Seg. 1, 2, & 4		$224
Total Cost of Seg. 1, 2, & 3		$219

4.0 Other Roads

Additional public and project roads are included in all alternatives. These include access to the communication towers on the east side of the reservoir; access to Stone Corral, Peninsula Hills, and boat ramps; roads internal to the recreation areas, and roads to access all project facilities for maintenance. Costs budgeted for public roads include the following:

Construction Bypass Road - $30M
Stone Corral Eastside Access and Boat Ramp - $9.7M
Westside Boat Ramp Access and Access to Peninsula Hills Recreation - $5.2M
Eastside Road to Communication Tower - $6.3M
Peninsula Hills Park Roads - $2.7M (excludes parking lots)

Appendix A-3 Conveyance System Technical Memorandum

To:	Value Planning Work Group
CC:	Lee Frederiksen
Date:	April 9, 2020
From:	Jacobs
Subject:	Conveyance System

1.0 Background

In October 2019, a Value Planning analysis draft technical memorandum was completed with the objective of looking at alternative project components to reduce the cost of the Sites reservoir project. This technical memorandum provided several viable alternatives that reduced the overall project costs from the original $5.2B to a new range of $3.4 to $4.0B. The lowest cost alternative, known as Alternative 6A, includes a 1.5 million acre-foot reservoir, a pump station on the Tehama-Colusa (T-C) Canal to lift water to the reservoir, and use of the Tehama-Colusa Canal to discharge water from the Reservoir to the Sacramento River. Specifically, water would be discharged from the reservoir into the T-C canal, conveyed down the T-C canal near the end in Dunnigan and then new facilities built to convey it from T-C canal to either the Colusa Basin Drain (CBD) or the Sacramento River.

2.0 Purpose

The purpose of this TM is to look at various alternatives to convey water from the end of T-C canal to the CBD or Sacramento River for flows of 750 cfs and 1,000 cfs. Members of the Reservoir Committee visited the area on January 14, 2020 to look at conveyance alternatives to be analyzed.

3.0 Alternatives Development

The alternatives developed by members of the Reservoir Committee are as follows and provided as exhibits at the end of this Technical Memorandum:

3.1 Alternative 6A-1

This alternative is sized for a flow of 750 cfs and includes a turnout on the T-C canal located about 1,500 feet upstream of the end of T-C canal, then a pipeline east until it intercepts Bird Creek and then flow is discharge into Bird Creek where it flows to the Colusa basin Drain. Total length of this alternative is 20,000 feet with 6,600 feet of pipeline and 13,400 feet of open channel (Bird Creek).

3.2 Alternative 6A-2 CBD

This alternative is sized for a flow of 750 cfs and includes a turnout on the T-C canal located about 1,500 feet upstream of the end of T-C canal, then a pipeline east all the way to the Colusa basin Drain, and ends with a flow control/pressure reducing valve to discharge to the CBD. This pipeline follows roughly the same alignment as Alt 6A-1. Total length of this alternative is 20,000 feet.

3.3 Alternative 6A-2 Sac Riv

This alternative is sized for a flow of 750 cfs and includes a turnout on the T-C canal located about 1,500 feet upstream of the end of T-C canal, then a pipeline east all the way to the Sacramento River, and ends with a flow control/pressure reducing valve to discharge to the Sacramento River. This pipeline follows roughly the same alignment as Alt 6A-1, but then continues east across farmland to the Sacramento River. Total length of this alternative is 51,000 feet.

3.4 Alternative 6A-3

This alternative is sized for a flow of 750 cfs and includes a turnout on the end of the T-C canal that discharges to a small, winding ditch (created by discharges from T-C Canal), then intercepts Bird Creek and continues to flow in Bird Creek where it ends by flowing into the Colusa basin Drain. Total length of this alternative is 24,600 feet with 4,000 feet of small ditch and 20,600 feet of open channel (Bird Creek).

3.5 Alternative 6A-4

This alternative is sized for a flow of 750 cfs and includes a turnout on the T-C canal located about 27,000 feet upstream of the end of T-C canal where it crosses Hunter Creek. Flow is discharge to Hunter Creek where it ends by flowing into the Colusa basin Drain. Total length of this alternative is about 32,500 feet of open channel (Hunter Creek).

3.6 Alternative 6A-5 CBD

This alternative is essentially the same layout as Alterative 6A-2 CBD except the flow is increased from 750 cfs to 1,000 cfs.

3.7 Alternative 6A-5 Sac River

This alternative is essentially the same layout as Alterative 6A-2 Sac River except the flow is increased from 750 cfs to 1,000 cfs.

4.0 Initial Screening of Alternatives

Based on a field visit on February 11, 2020, it was determined that discharging flow directly to the existing open channels would result in significant water loss due to seepage and evaporation. This is based on the visual evidence of the existing creek beds showing sandy and gravels that have high infiltration rates. In addition, these creeks have significant debris to impede flow and would require high maintenance to reshape. Lastly, these creeks are wide and the 750 cfs flow would be very shallow, contributing to an increase in evaporation and seepage. As a result, it was determined that all open channels will need to be lined. Given that Hunter Creek is significantly longer than the other open ditch options, it was decided to eliminate Alternative 6A-4 from further consideration.

A second criteria used to evaluate these alternatives includes an assumption that Bird Creek needs to maintain their current shape to accommodate storm runoff flows that created them. Calculations were performed using topographic data to determine the canal cross required for the 750 cfs flow for the different segments. The existing ditch has depth that varies from 7-10 feet. Using a water depth of 5 feet, a 2:1 side slope, frictional coefficient of 0.02, calculations showed the bottom width of a trapezoidal channel to be about 12 feet. The existing channel has a bottom width that ranges from 20-25 feet and a top width of about 50 feet. Lining the existing channel to accommodate stormwater flows (as a criteria), would be very expensive and unnecessary given that the channel needs to accommodate the 750 cfs is less than half of the channel width. If this channel was lined, then significant maintenance would be required to remove all the debris accumulated from stormwater runoff. As a result, it was decided to eliminate using the existing creeks for conveying the water. Therefore, alternatives 6A-1 and 6-A3 were eliminated, leaving only the piping alternatives.

5.0 Evaluation of Alternative 6A-2 and 6A-5 Alternatives

Calculations were performed to determine the pipeline sizes required for the two remaining options. An assumption was made to have both pipelines sized to allow for gravity flow. Following are the assumptions used in these calculations:

- Water Surface elevation in T-C Canal =175 feet
- Water surface elevation in Colusa Basin Drain = 32 feet
- Water surface elevation at Sacramento river = 40 feet (typically lower, but required to go high in levee per Army Corps Standards)
- Hazen-Williams Friction Factor C-value = 130

The results of these calculations resulted in the following:

5.1 Alternative 6A-2 CBD

The pipeline will carry 750 cfs and be 7.5-foot (90-inch) internal diameter with two tunneled crossings (I-5 and 99W/RR) that require 9-foot (108") casings. The total length of pipeline is 20,000 feet with 300-foot and 250-foot tunneled crossings. A 72-inch flow control/pressure reducing valve will be placed at the discharge to dissipate energy and adjust the flow.

5.2 Alternative 6A-2 Sac Riv

The pipeline will be 9.5-foot (114-inch) internal diameter with three tunneled crossings (I-5 and 99W/RR and CBD) that require 11-foot (132") casings. The total length of pipeline is 51,600 feet with 300-, 250-, and 250-foot tunneled crossings. A 72-inch flow control/pressure reducing valve will be placed at the discharge to dissipate energy and adjust the flow.

5.3 Alternative 6A-5 CBD

The pipeline will carry a flow of 1,000 cfs and be 9-foot (108-inch) internal diameter with three tunneled crossings (I-5 and 99W/RR and CBD) that require 10.5-foot (126") casings. The total length of pipeline is 20,000 feet with 300-foot and 250-foot tunneled crossings. A 78-inch flow control/pressure reducing valve will be placed at the discharge to dissipate energy and adjust the flow.

5.4 Alternative 6A-5 Sac River

The pipeline will carry a flow of 1,000 cfs and be 10.5-foot (126-inch) internal diameter with three tunneled crossings (I-5 and 99W/RR and CBD) that require 12-foot (144") casings. The total length of pipeline is 51,600 feet with 300-, 250-, and 250-foot tunneled crossings. A 78-inch flow control/pressure reducing valve will be placed at the discharge to dissipate energy and adjust the flow.

6.0 Cost Analysis

A Class 5 cost estimate was prepared based on limited information, where little more than proposed plant type, its location, and the capacity are known. Strategic planning purposes include but are not limited to, market studies, assessment of viability, evaluation of alternate schemes, project screening, location and evaluation of resource needs and budgeting, and long-range capital planning. Examples of estimating methods used would include cost/capacity curves and factors, scale-up factors, and parametric and modeling techniques. Typically, little time is expended in the development of this estimate. The expected accuracy ranges for this class estimate are –20 to –50 percent on the low side and +30 to +100 percent on the high side. These estimate includes a Contractors overhead and profit, a 10% contingency, and 17% for soft costs (admin, design, construction management). These estimates include costs for real estate acquisition based on a 100-foot wide corridor at $15,000 per acre.

Cost for Alt 6A-2 750 cfs to Colusa Basin Drain = **$54.8M ($30/di-lf)**

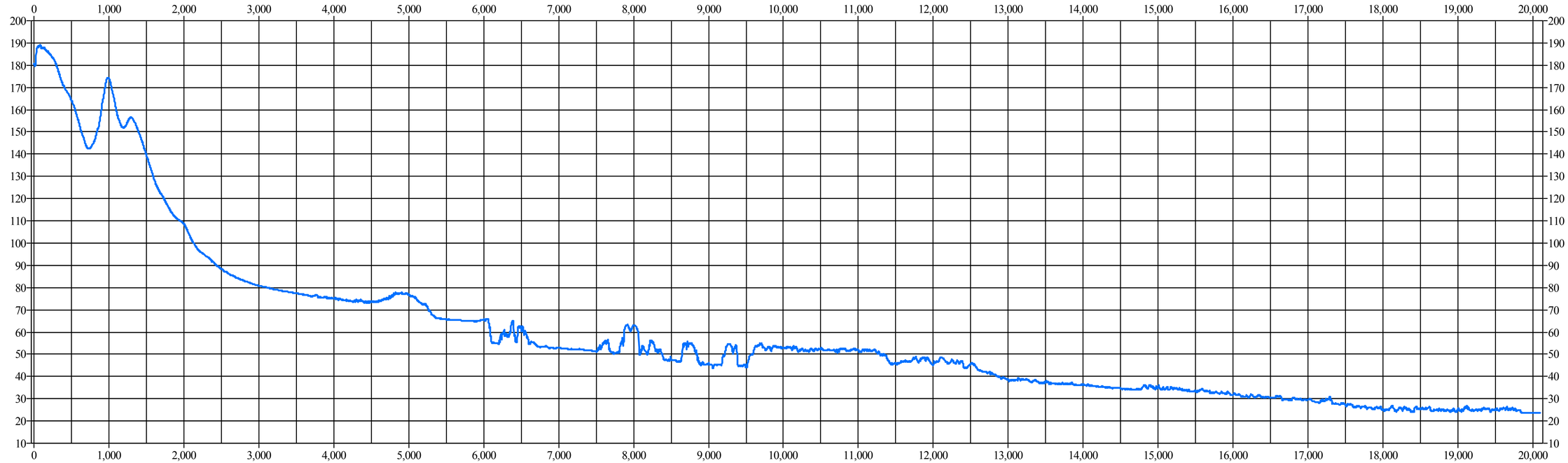
Cost for Alt 6A-2 750 cfs to Sacramento River = **$175.2M ($30/di-lf)**

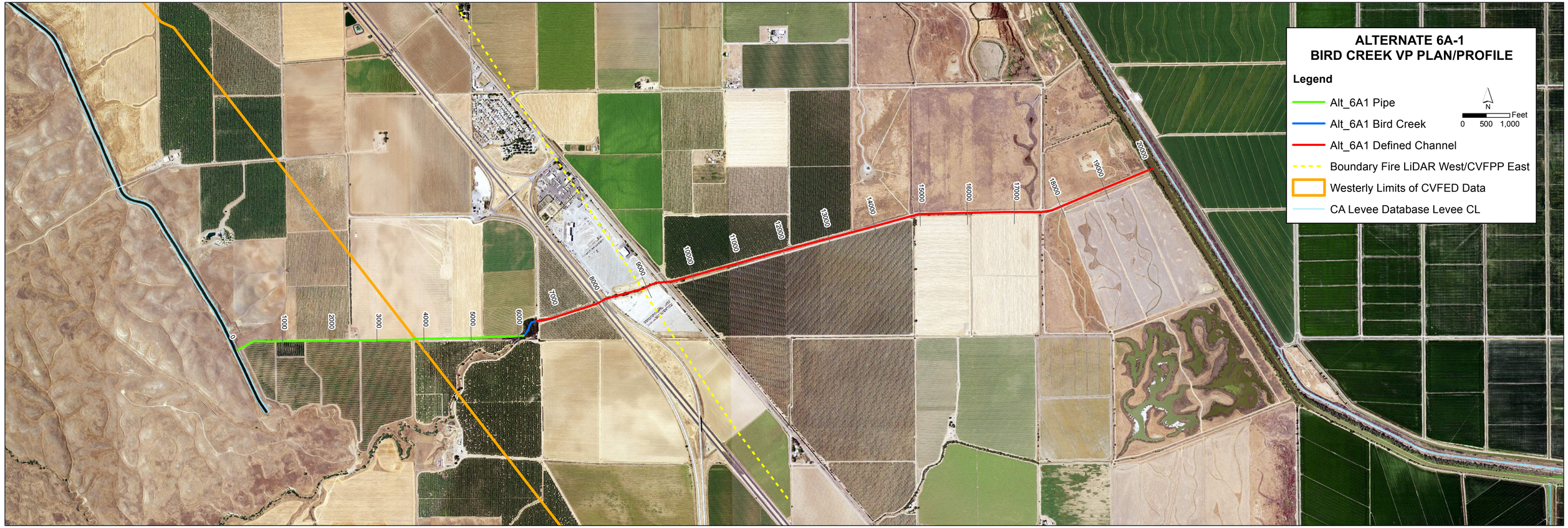
Cost for Alt 6A-5 1,000 cfs to Colusa Basin Drain = **$65.2M ($30/di-lf)**

Cost for Alt 6A-5 1,000 cfs to Sacramento River = **$192.5M ($30/di-lf)**

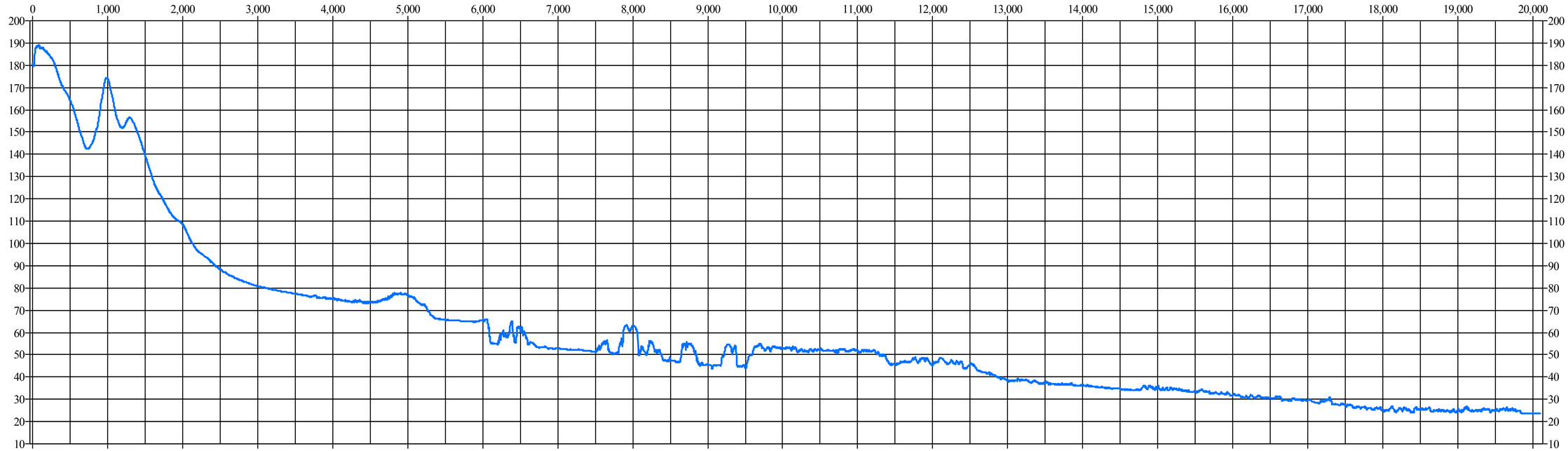
The comparison of costs shows extending the pipeline to the Sacramento River will cost an additional $120M for the 750 cfs flow and $130M for the 1,000 cfs flow. These differences are primarily due to the added length and the additional tunnel to get under the Colusa Basin Drain, as well as the larger diameter pipes for the 1,000 cfs case.

ALTERNATE 6A-1 BIRD CREEK

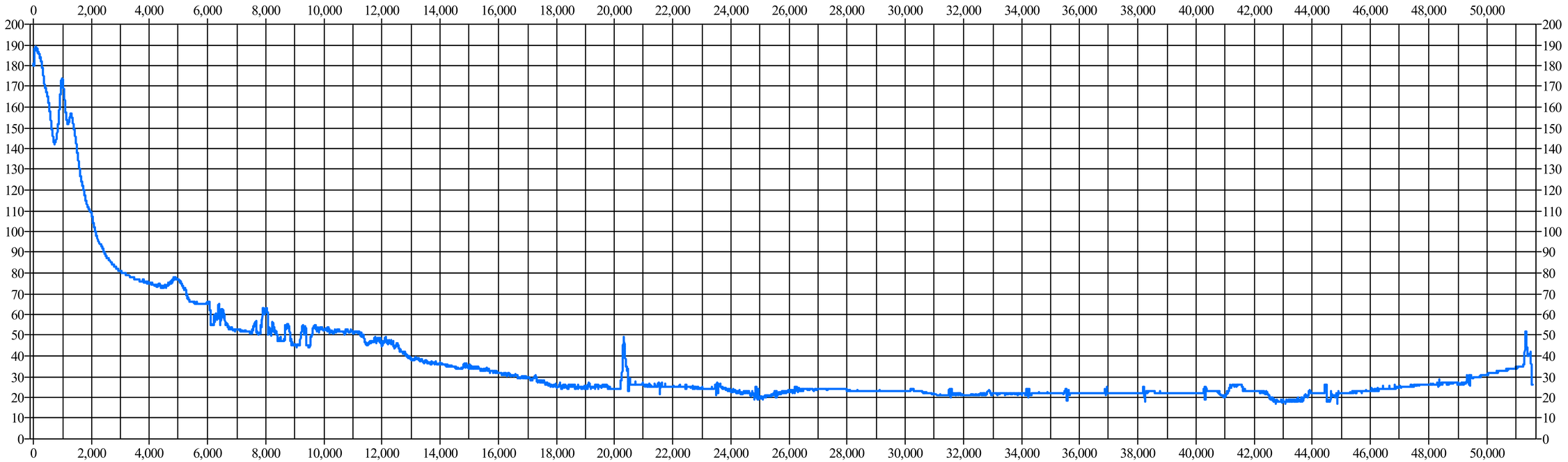




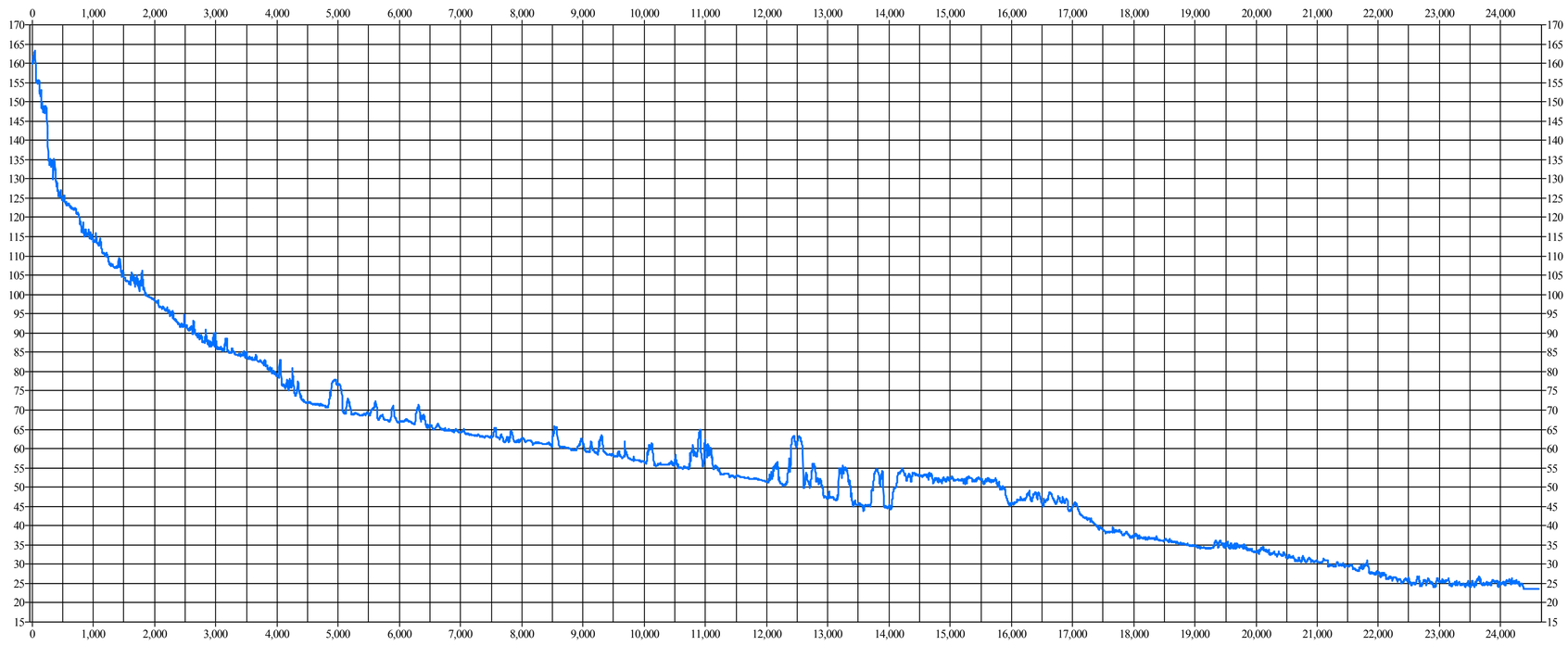
ALTERNATE 6A-2-CBD

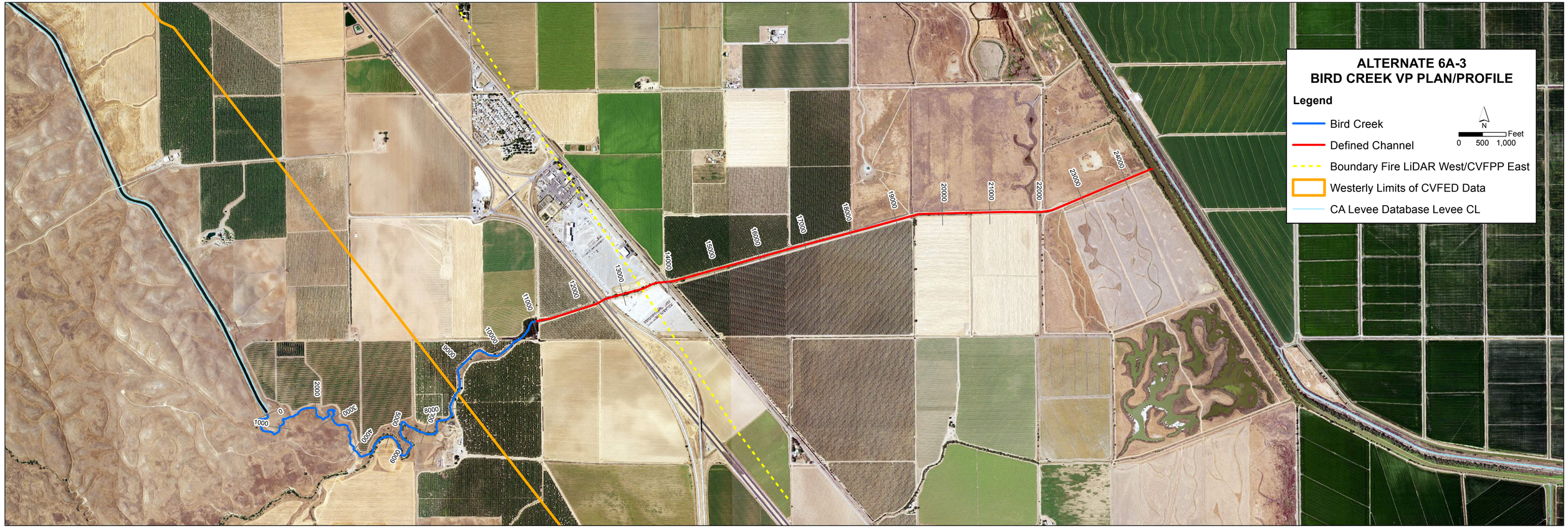


Alternate 6A-2, Tehama Colusa Canal to Sacramento River

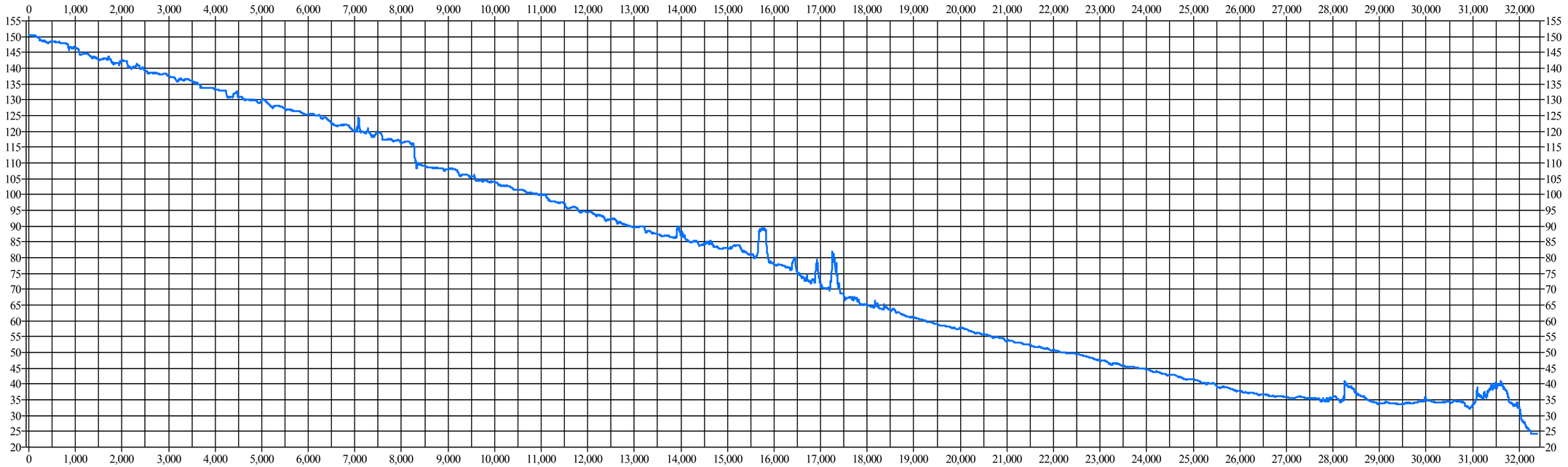


ALTERNATE 6A-3 BIRD CREEK





ALTERNATE 6A-4 HUNTER CREEK



Appendix A-4 Cost Estimate Technical Memorandum

To:	Sites Value Planning Group
CC:	Lee Frederiksen
Date:	January 28, 2020
From:	AECOM
Subject:	Cost Estimate

Construction cost estimates were derived from detailed appraisal-level estimates for a 1.3 MAF reservoir (Alternative A in the EIR/S and feasibility report) and for a 1.8 MAF reservoir (Alternative D in the EIR/S and feasibility report). These estimates reflect the current project concepts and conceptual level of project design, with appropriate allowances for contingencies, non-contracts costs, and forward escalation. Other project-related costs are also provided, including environmental mitigation, and temporary and permanent easement acquisition. The Alternative D estimate was used to support the Authority's WSIP application. Estimated prices were developed in October 2015 dollars and have been escalated in this estimate.

The actual project construction cost ultimately would depend on the final design details of the preferred project alternative and the labor and material costs, market conditions, and other variable factors existing at the time of bid. Accordingly, the final project cost would vary from the preliminary estimates presented in this section.

Major assumptions made to prepare the preliminary feasibility cost estimates include:

- Competitive market conditions would prevail at the time of bid tender.
- Work would be packaged for bidding so that the magnitude of the contract would not unduly restrict competition.
- The construction schedule assumes a start of field construction activities in the second quarter of 2022 for all scenarios.
- Environmental mitigation and ecosystem enhancement measures would be consistent with those currently used in practice and would be the same for each alternative.
- Builder's Risk Insurance would be available to the contractor.
- Materials such as sand, gravel, and cement would remain available within the haul distances used to prepare the estimates.

1.0 Level and Classification of Cost Estimates

The availability of site data and design information to support preparing cost estimates varies between the facilities that constitute the Sites Reservoir project. Some facilities (like the main dams) are advanced enough to support a lower-bound Class 3 estimate as defined by the Association for Advancement of Cost Engineering, International. Other facilities, like the Dunnigan conveyance from the T-C Canal to the CBD have no supporting geotechnical evaluation and only a preliminary screening of potential utility conflicts. These estimates are considered to be at a Class 5 level.

The estimate for the 1.8, 1.3, and 0.8 MAF reservoir dams used dimensions, quantities, and cost ratios previously developed by DWR (DWR DOE. 2004. Sites Reservoir Engineering Feasibility Study – Sites

Reservoir Alternative Reservoir Size Evaluation. October.). The estimate for the 1.0 MAF reservoir was interpolated from the 0.8 MAF and 1.3 MAF facilities.

1.1 Estimate Base and Escalation

The contract, field, and construction cost estimates presented in this section were compiled using individual-estimate worksheets for each NODOS/Sites Reservoir Project feature. All costs are provided in October 2015 dollars. Escalation of construction costs to a notice to proceed date in mid-2022 has been included. Escalation was evaluated using various sources, including the USACE Civil Works Construction Cost Index and the Consumer Price Index. Results varied from 15.3 percent to 15.8 percent over the escalation period. For the project alternatives, 15 percent over 7 years has been applied for each alternative.

1.2 Allowances and Contingency

Construction contingency is a percentage allowance added to develop the field cost. Contingencies are funds for use after construction starts to compensate the contractor for such issues as unforeseen or changed site conditions, owner-directed orders for change, and differences between estimated and actual quantities. Contingency allowances are generally higher for appraisal-level estimates than for feasibility-level estimates.

For a Class 4 estimate, the overall cost variability can range per AACE from negative 15% to 30% on the low range to positive 20% to 50% on the high range, depending on the level of design information available to support the estimate. This report uses a construction contingency of 15 percent to establish for all features, but also applies a higher contingency to high risk and new facilities developed during the value planning effort where less supporting information is available.

- A 30% contingency was applied for an upper end estimate for the new Funks pumping facilities. Although these were not previously studied, they are in the footprint where geotechnical investigations have been performed in the past.
- A 65% contingency was applied to establish the upper range of costs for the Dunnigan release facilities. There is no information from prior investigations or topography for these facilities. These facilities are at a Class 5 level.
- A 40% contingency was applied to establish the upper range of costs for the TRR. Geotechnical information is limited and there is a potential liquefaction concern.

Table A4-1 presents the allowances and average contingency percentages adopted and applied to the feasibility-level cost estimate for the alternative projects.

Table A4-1. Allowances and Contingencies for Estimating

Allowances and Contingencies	Percentages
Mobilization/Demobilization	5 percent
Design Contingency	10 percent
Construction Contingency	15 to 65 percent
Non-Contract Costs	17 percent

The mobilization/demobilization allowance and design and construction contingencies were applied to the contractor costs to develop the contract cost. The construction contingency was applied to the contract cost to arrive at the field cost.

1.3 Non-Contract Costs

Non-contract costs include Authority staff, engineering and design, surveying, geotechnical investigation, construction management and inspection, project close-out, administration, legal services, permitting, etc. For the estimates presented in this section, the non-contract costs were estimated to be 17 percent of the total field costs (contract cost plus contingency). Actual non-contract costs would vary from facility to facility; however, 17 percent is assumed to represent the average value.

1.4 Environmental Mitigation

Many environmental laws affect the State's major water supply programs, and environmental concerns play a major role in water policy and planning. Mitigation costs for the original alternatives were based on *Sites Reservoir Feasibility Study Technical Memorandum: Mitigation Measure Evaluation and Cost Estimate* (AECOM 2016).

2.0 Estimates

Estimate summaries are provided for Alternatives VP1 through VP 3 in Tables A4-2 through A4-4, respectively.

The Value Planning Work Group subsequently selected three alternatives for further analysis. These are shown in Table A4-5.

Table A4-2. Estimate Summary for Alternative VP 1

Facility	1.0 MAF ($ Millions)	1.3 MAF ($ Millions)	1.5 MAF ($ Millions)
Develop Sites Reservoir, including Land and Project Roads, Clearing and Demolition	$143,000,000	$143,000,000	$143,000,000
Other Roads (Project and Recreation)	$79,000,000	$79,000,000	$79,000,000
South Road to Residents (Unpaved)	$41,000,000	$41,000,000	$41,000,000
Bridge	$99,000,000 To $116,000,000	$126,000,000 To $147,000,000	$154,000,000 To $180,000,000
North Construction Access Road (Paved)	$30,000,000	$30,000,000	$30,000,000
Construct Sites Dam and Golden Gate Dam	$255,000,000	$345,000,000	$410,000,000
Construct Saddle Dams	$92,000,000	$101,000,000	$197,000,000
Construct TRR	$42,000,000 To $51,000,000	$42,000,000 To $51,000,000	$42,000,000 To $51,000,000
Construct TCRR	$42,000,000 To $51,000,000	$42,000,000 To $51,000,000	$42,000,000 To $51,000,000
Funks Reservoir Dredging/Structures	$24,000,000	$24,000,000	$24,000,000
Hunters Creek Release Structures	$91,000,000	$91,000,000	$91,000,000
Construct I/O Structure and Tunnels for Reservoir	$183,000,000	$280,000,000	$302,000,000
Construct TCRR Pumping/Generating Plant	$200,000,000	$200,000,000	$200,000,000
Construct TRR Pumping/Generating Plant	$200,000,000	$200,000,000	$200,000,000
Red Bluff Pump Addition	$4,000,000	$4,000,000	$4,000,000
Construct Funks Release Channel	$34,000,000	$34,000,000	$34,000,000
Construct TCRR Pipeline	$443,000,000 To $508,000,000	$443,000,000 To $508,000,000	$443,000,000 To $508,000,000
Construct TRR Pipeline	$227,000,000	$227,000,000	$227,000,000
Construct Dunnigan Pipeline to River	$177,000,000 To $292,000,000	$177,000,000 To $292,000,000	$177,000,000 To $292,000,000
River Release Structure	$9,000,000	$9,000,000	$9,000,000
Transmission Lines, Substations, Switchyards	$113,000,000	$113,000,000	$113,000,000
General Property, including Recreation Areas and OM&R Facilities	$32,000,000	$32,000,000	$32,000,000
Mitigation	$540,000,000	$540,000,000	$540,000,000
Construction Cost (2019)	$3,057,000,000 To $3,262,000,000	$3,281,000,000 To $3,490,000,000	$3,493,000,000 To $3,707,000,000

Key:
I/O = inlet/outlet
OM&R = operation, maintenance, and replacement
TCRR = Regulating Reservoir for T-C Canal
TRR = Terminal Regulating Reservoir for GCID Main Canal

Table A4-3. Estimate Summary for Alternative VP 2

Facility	1.0 MAF ($ Millions)	1.3 MAF ($ Millions)	1.5 MAF ($ Millions)
Develop Sites Reservoir, including Land and Project Roads, Clearing and Demolition	$143,000,000	$143,000,000	$143,000,000
Other Roads (Project and Recreation)	$79,000,000	$79,000,000	$79,000,000
South Road to Residents (Unpaved)	$41,000,000	$41,000,000	$41,000,000
Bridge	$99,000,000 To $116,000,000	$126,000,000 To $147,000,000	$154,000,000 To $180,000,000
North Construction Access Road (Paved)	$30,000,000	$30,000,000	$30,000,000
Construct Sites Dam and Golden Gate Dam	$255,000,000	$345,000,000	$410,000,000
Construct Saddle Dams	$92,000,000	$101,000,000	$197,000,000
Construct TRR	$42,000,000 To $51,000,000	$42,000,000 To $51,000,000	$42,000,000 To $51,000,000
Funks Reservoir Dredging/Structures	$24,000,000	$24,000,000	$24,000,000
Hunters Creek Release Structures	$91,000,000	$91,000,000	$91,000,000
Construct I/O Structure and Tunnels for Reservoir	$183,000,000	$280,000,000	$302,000,000
Construct TRR Pumping/Generating Plant	$200,000,000	$200,000,000	$200,000,000
Construct Funks Pumping/Generating Plant	$200,000,000	$200,000,000	$200,000,000
Construct Funks Release Channel	$34,000,000	$34,000,000	$34,000,000
Red Bluff Pump Addition	$4,000,000	$4,000,000	$4,000,000
Construct Funks Release Channel	$31,000,000	$31,000,000	$31,000,000
Construct TRR Pipeline	$227,000,000	$227,000,000	$227,000,000
Construct Dunnigan Pipeline to CBD	$56,000,000 To $90,000,000	$56,000,000 To $90,000,000	$56,000,000 To $90,000,000
Transmission Lines, Substations, Switchyards	$113,000,000	$113,000,000	$113,000,000
General Property, including Recreation Areas and OM&R Facilities	$32,000,000	$32,000,000	$32,000,000
Mitigation	$540,000,000	$540,000,000	$540,000,000
Construction Cost (2019)	$2,613,000,000 To $2,754,000,000	$2,837,000,000 To $2,982,000,000	$2,996,000,000 To $3,199,000,000

Key:
I/O = inlet/outlet
OM&R = operation, maintenance, and replacement
TRR = Terminal Regulating Reservoir

Table A4-4. Estimate Summary for Alternative VP 3

Facility	1.3 MAF ($ Millions)	1.5 MAF ($ Millions)
Develop Sites Reservoir, including Land and Project Roads, Clearing and Demolition	$143,000,000	$143,000,000
Other Roads (Project and Recreation)	$79,000,000	$79,000,000
South Road to Residents (Unpaved)	$41,000,000	$41,000,000
Bridge	$126,000,000 To $147,000,000	$154,000,000 To $180,000,000
North Construction Access Road (Paved)	$30,000,000	$30,000,000
Construct Sites Dam and Golden Gate Dam	$345,000,000	$410,000,000
Construct Saddle Dams	$101,000,000	$197,000,000
Construct TRR	$42,000,000 To $51,000,000	$42,000,000 To $51,000,000
Funks Reservoir Dredging/Structures	$24,000,000	$24,000,000
Hunters Creek Release Structures	$91,000,000	$91,000,000
Construct I/O Structure and Tunnels for Reservoir	$280,000,000	$302,000,000
Construct TRR Pumping/Generating Plant	$200,000,000	$200,000,000
Construct Funks Pumping/Generating Plant	$200,000,000	$200,000,000
Construct Funks Release Channel	$34,000,000	$34,000,000
Red Bluff Pump Addition	$4,000,000	$4,000,000
Construct Funks Release Channel	$31,000,000	$31,000,000
Construct TRR Pipeline	$227,000,000	$227,000,000
Construct Delevan Pipeline	$713,000,000	$713,000,000
Transmission Lines, Substations, Switchyards	$113,000,000	$113,000,000
General Property, including Recreation Areas and OM&R Facilities	$32,000,000	$32,000,000
Mitigation	$540,000,000	$540,000,000
Construction Cost (2019)	$3,373,000,000 To $3,402,000,000	$3,585,000,000 To $3,619,000,000

Key:
I/O = inlet/outlet
OM&R = operation, maintenance, and replacement
TRR = Terminal Regulating Reservoir

The estimated costs for Alternatives VP1 through VP 3 were determined for the 1.0 MAF, 1.3 MAF, and 1.5 MAF reservoir sizes. Estimated costs are presented in Table A4-5.

Table A4-5. Alternative Costs ($millions)

Reservoir Size	Alternative VP 1 TCRR, TRR, 750 cfs Release to Sacramento River	Alternative VP 2 Funks Reservoir, TRR, 750 cfs Release to CBD	Alternative VP 3 Funks Reservoir, TRR, 1,500 cfs Delevan Release
1.0 MAF	$3,057 to $3,262	$2,613 to $2,754	NA
1.3 MAF	$3,281 to $3,490	$2,837 to $2,982	$3,373 to $3,402
1.5 MAF	$3,493 to $3,707	$2,996 to $3,199	$3,585 to $3,619

The Value Planning Work Group subsequently selected three alternatives for consideration as the Authority's proposed project description. These are shown in Table A4-6. Alternative VP7 was chosen as the recommended project.

Table A4-6. Estimate Summary for Recommended Alternative and Alternates

Facility	VP-5 ($ Millions)	VP-6 ($ Millions)	VP-7 ($ Millions)
Develop Sites Reservoir, including Land and Project Roads, Clearing and Demolition	$143,000,000	$143,000,000	$143,000,000
Other Roads (Project and Recreation)	$79,000,000	$79,000,000	$79,000,000
South Road to Residents (Unpaved)	$41,000,000	$41,000,000	$41,000,000
Bridge (Corresponds to 1.5 MAF reservoir for all alternatives)	$180,000,000	$180,000,000	$180,000,000
North Construction Access Road (Paved)	$30,000,000	$30,000,000	$30,000,000
Construct Sites Dam and Golden Gate Dam (1.5 MAF)			$450,000,000
Construct Sites Dam and Golden Gate Dam (1.3 MAF)	$386,000,000	$386,000,000	
Construct Saddle Dams (1.5 MAF)			$198,000,000
Construct Saddle Dams (1.3 MAF)	$102,000,000	$102,000,000	
Construct TRR	$51,000,000	$51,000,000	$51,000,000
Funks Reservoir Dredging/Structures	$24,000,000	$24,000,000	$24,000,000
Hunters Creek Release Structures	$91,000,000	$91,000,000	$91,000,000
Construct I/O Structure and Tunnels for Reservoir (1.5 MAF)			$302,000,000
Construct I/O Structure and Tunnels for Reservoir (1.3 MAF)	$280,000,000	$280,000,000	
Construct TRR Pumping/Generating Plant	$200,000,000	$200,000,000	$200,000,000
Construct Funks Pumping/Generating Plant	$200,000,000	$200,000,000	$200,000,000
Construct Funks Release Channel	$34,000,000	$34,000,000	$34,000,000
Red Bluff Pump Addition	$4,000,000	$4,000,000	$4,000,000
Construct TRR Pipeline	$227,000,000	$227,000,000	$227,000,000
Construct Dunnigan Pipeline to CBD (1,000 cfs)	$66,000,000		$66,000,000
Construct Dunnigan Pipeline to River (1,000 cfs)		$194,000,000	
Release Structure	$8,600,000	$8,600,000	$8,600,000
Transmission Lines, Substations, Switchyards	$136,000,000	$136,000,000	$136,000,000
General Property, including Recreation Areas and OM&R Facilities	$32,000,000	$32,000,000	$32,000,000
Mitigation	$540,000,000	$540,000,000	$540,000,000
Construction Cost (2019)	$2,855,000,000	$2,988,000,000	$3,037,000,000

Key:
I/O = inlet/outlet
OM&R = operation, maintenance, and replacement
TRR = Terminal Regulating Reservoir

3.0 Operations, Maintenance, and Replacement Costs

The financial model requires estimated costs for OM&R. Many long-term OM&R costs are proportional to diversions (e.g., energy for pumping and wheeling costs for GCID and Reclamation facilities). Variable and fixed repair and replacement costs were estimated using INEL Guidelines (Estimation of Economic Parameters of U.S. Hydropower Resources for estimating O&M, 2003) and through comparison to costs for the Central Utah and Animas La Plata Projects. Estimated OM&R costs are summarized in Table A4-7 Wheeling costs are conservatively estimated at $22/AF. Power costs were derived from modeling by PARO (DWR, 2016).

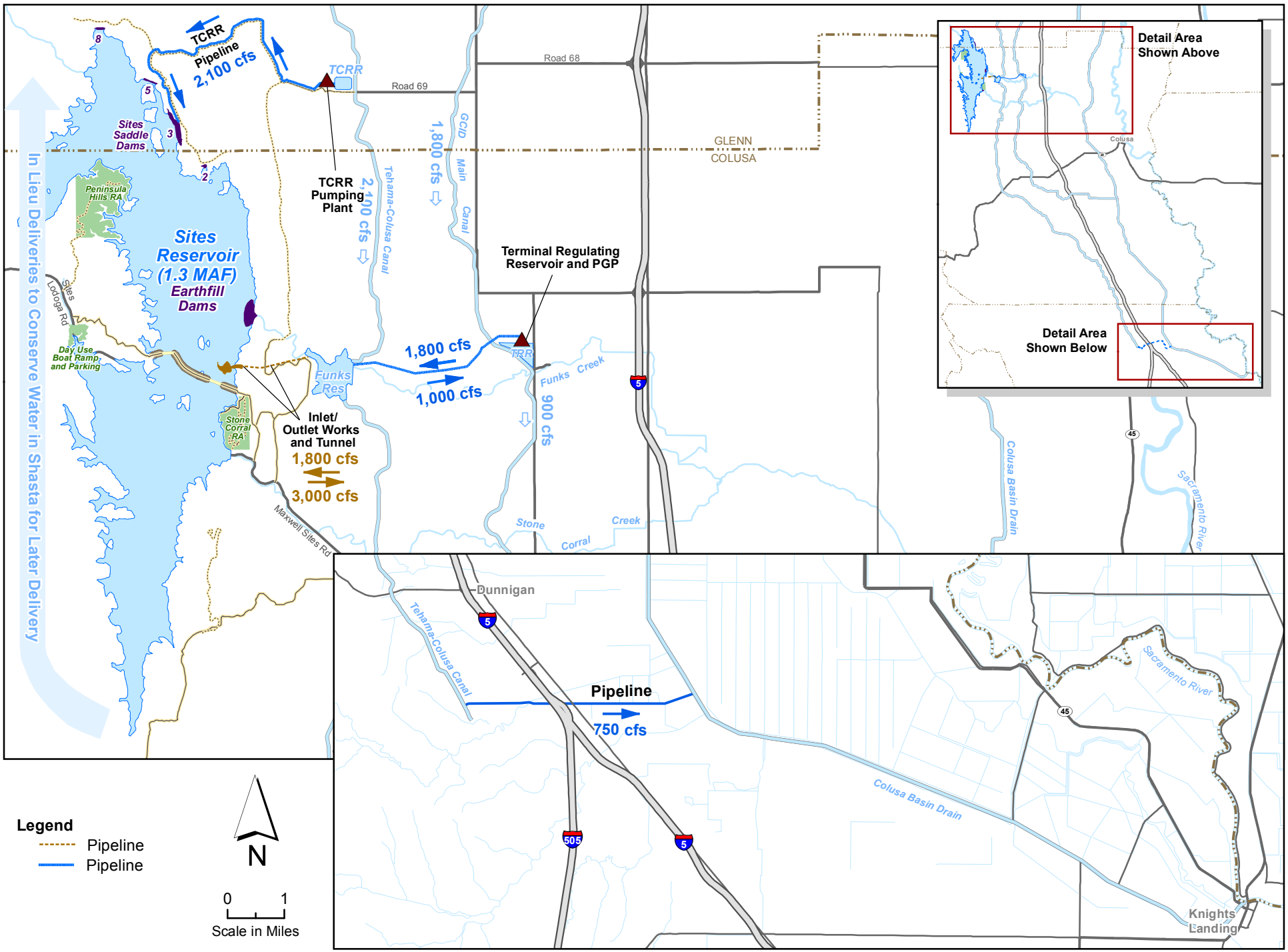
The resulting cost per acre foot was used to adjust the cost estimate to correspond to modeling results.

Table A4-7. OM&R Costs (2016)

Size	Total Flow	Est. Div	SOD Flow	Pump ($1000s)	Wheeling ($1000s)	Variable ($1000s)	Var/AF	Fixed/ AF	$/AF	Total without Generation ($M/yr)	Gen/AF	Potential Savings
1.5	375	394	98	$8,679	$10,819	$19,498	$50	$20	$70	$26,064	$11	$4,052
1.3	359	377	88	$8,309	$10,229	$18,538	$49	$21	$70	$25,149	$10	$3,713
1.0	317	333	60	$7,337	$8,643	$15,980	$48	$24	$72	$22,713	$9	$2,895

Attachment A-4-1

Value Planning Alternatives



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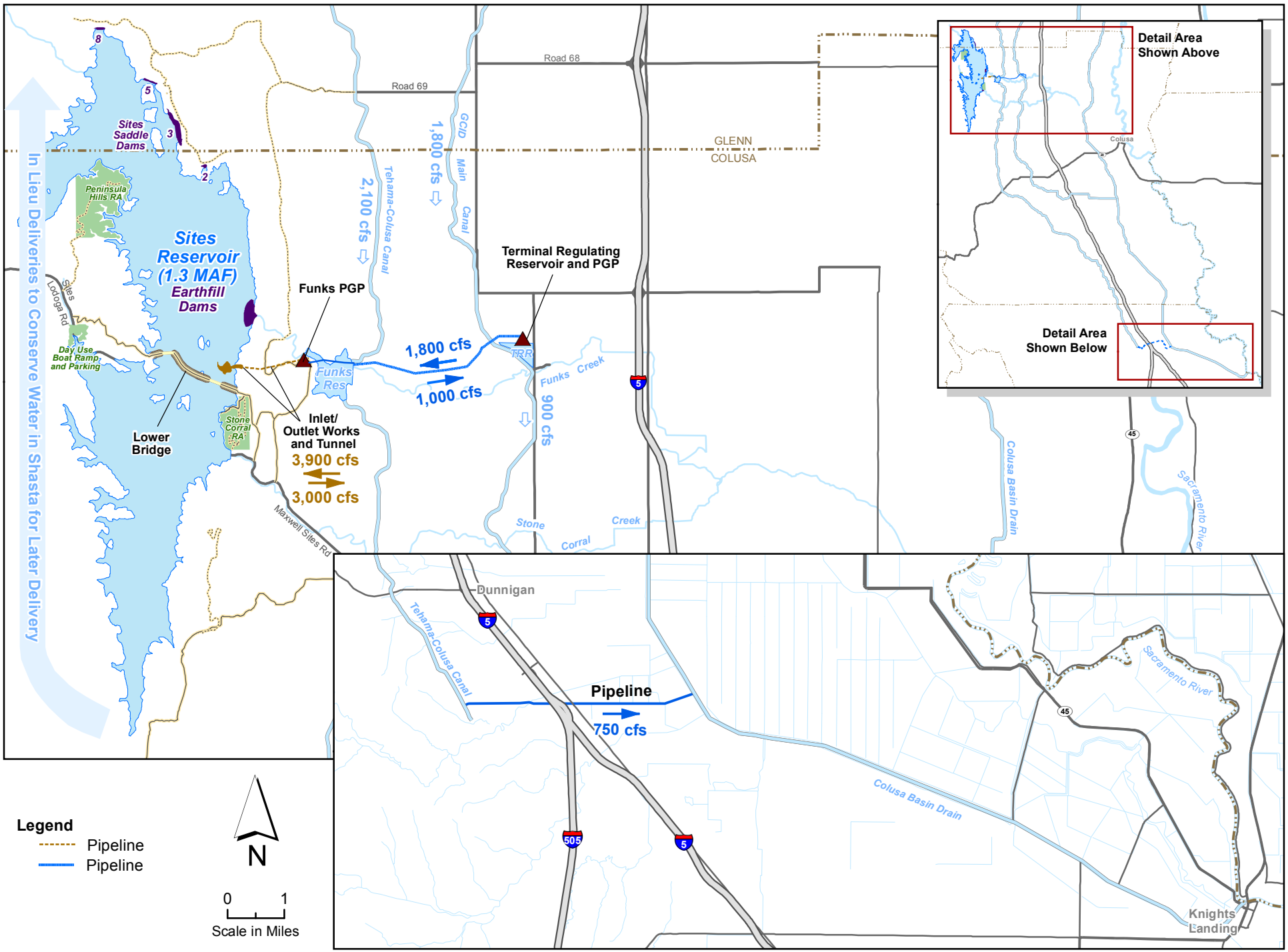
VP1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Sites Reservoir (1.3 MAF) Earthfill Dams
Sites Saddle Dams
Peninsula Hills RA
Day Use Boat Ramp and Parking
Stone Corral RA
Lower Bridge
Inlet/ Outlet Works and Tunnel
3,900 cfs
3,000 cfs
Funks PGP
Funks Res
1,800 cfs
1,000 cfs
Terminal Regulating Reservoir and PGP
TRR
900 cfs
2,100 cfs
1,800 cfs
Tehama-Colusa Canal
GCID Main Canal
Road 68
Road 69
GLENN
COLUSA
Maxwell Sites Rd
Sites Lodoga Rd
Funks Creek
Stone Corral Creek
Colusa Basin Drain
Sacramento River
Detail Area Shown Above
Detail Area Shown Below
Colusa
Dunnigan
Pipeline
750 cfs
Knights Landing
Legend
Pipeline
Pipeline
N
0
1
Scale in Miles
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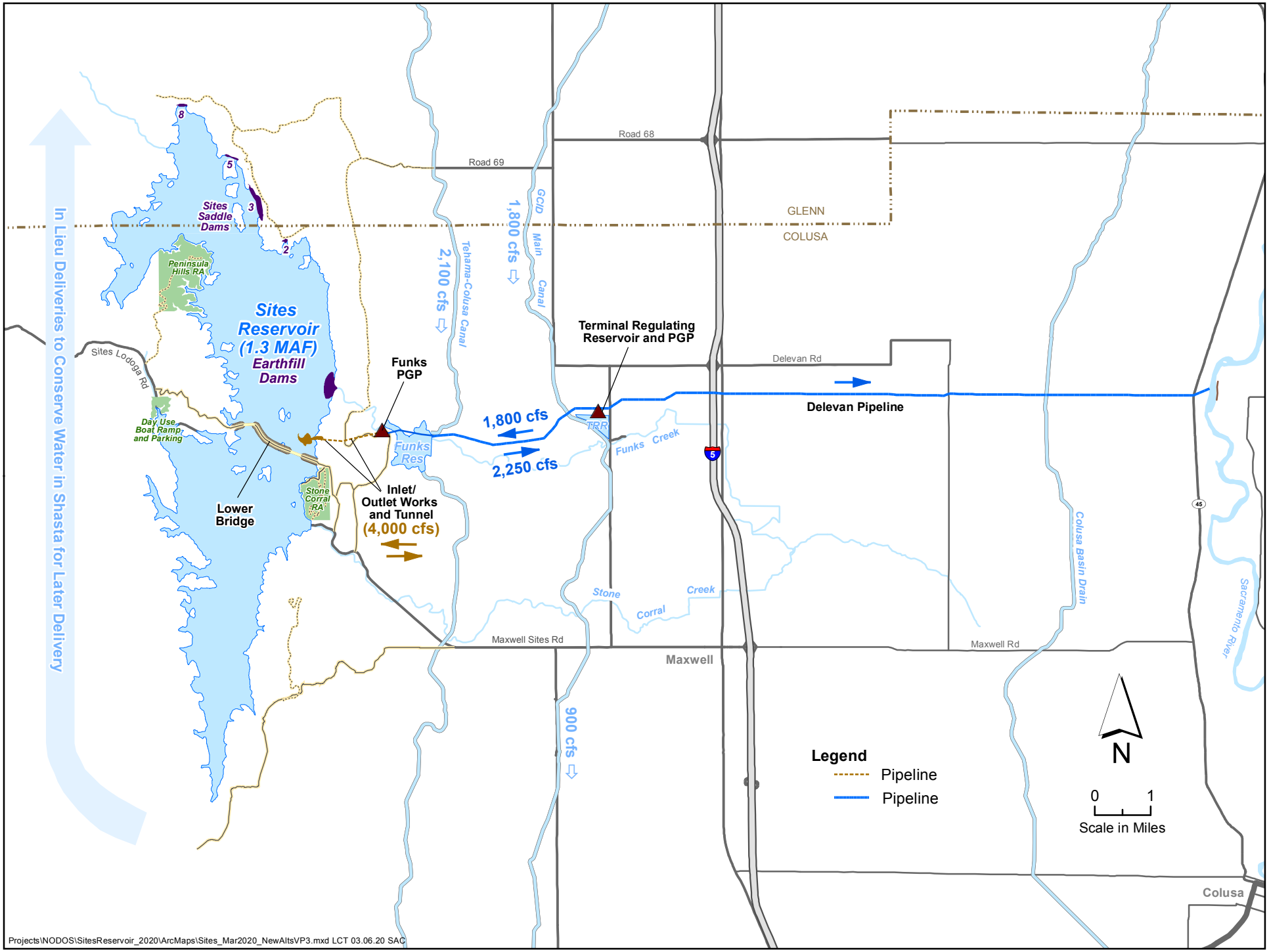
VP2


In Lieu Deliveries to Conserve Water in Shasta for Later Delivery
Sites Saddle Dams
8
5
3
2
Peninsula Hills RA
Sites Reservoir (1.3 MAF) Earthfill Dams
Sites Lodoga Rd
Day Use Boat Ramp and Parking
Stone Corral RA
Lower Bridge
Inlet/ Outlet Works and Tunnel (4,000 cfs)
Funks PGP
Funks Res
1,800 cfs
2,250 cfs
2,100 cfs
Tehama-Colusa Canal
1,800 cfs
GCID Main Canal
Terminal Regulating Reservoir and PGP
TRR
Delevan Pipeline
Road 68
Road 69
GLENN
COLUSA
Delevan Rd
Funks Creek
Stone Corral Creek
Maxwell Sites Rd
Maxwell
Maxwell Rd
900 cfs
Colusa Basin Drain
Sacramento River
Colusa
Legend
Pipeline
Pipeline
N
0 1
Scale in Miles
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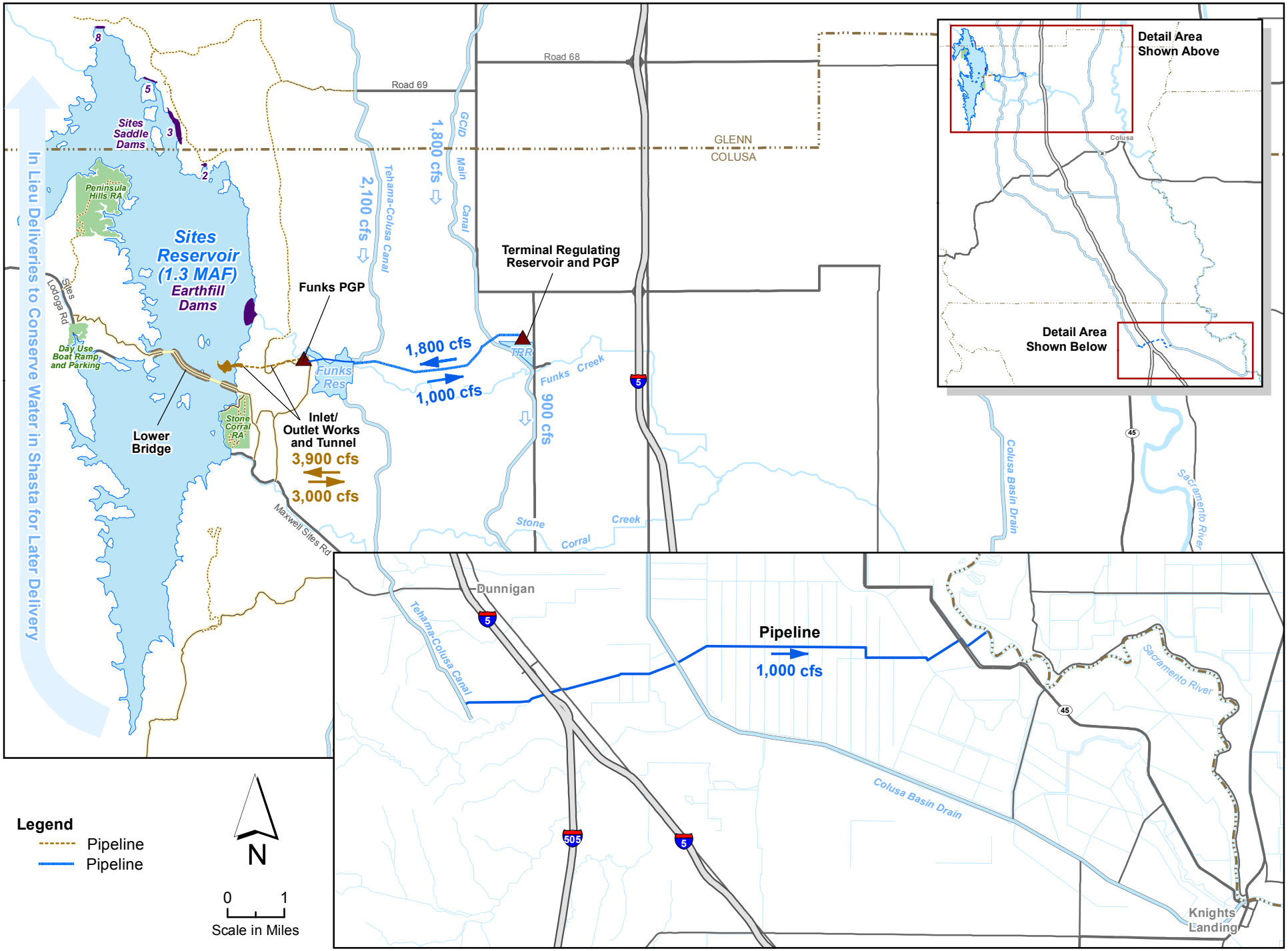
VP3


In Lieu Deliveries to Conserve Water in Shasta for Later Delivery
Sites Reservoir (1.3 MAF) Earthfill Dams
Sites Saddle Dams
Peninsula Hills RA
Day Use Boat Ramp and Parking
Stone Corral RA
Lower Bridge
Inlet/ Outlet Works and Tunnel
3,900 cfs
3,000 cfs
Funks PGP
Funks Res
1,800 cfs
1,000 cfs
Terminal Regulating Reservoir and PGP
TRR
900 cfs
2,100 cfs
1,800 cfs
Tehama-Colusa Canal
GCID Main Canal
Road 68
Road 69
GLENN
COLUSA
Funks Creek
Stone Corral Creek
Colusa Basin Drain
Sacramento River
Maxwell Sites Rd
Sites Lodoga Rd
Detail Area Shown Above
Detail Area Shown Below
Colusa
Dunnigan
Pipeline
1,000 cfs
Knights Landing
Legend
Pipeline
Pipeline
N
0
1
Scale in Miles
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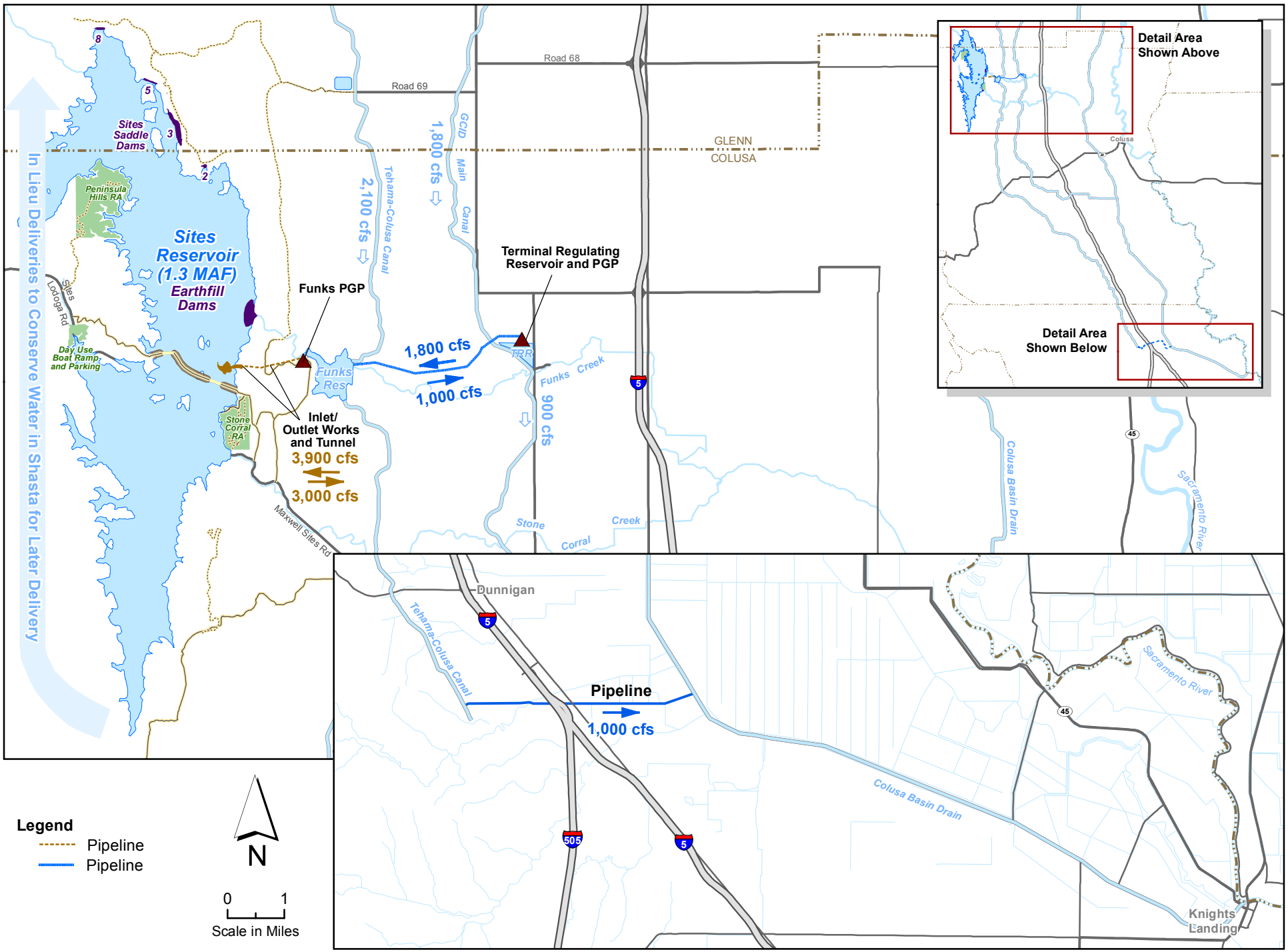
VP4



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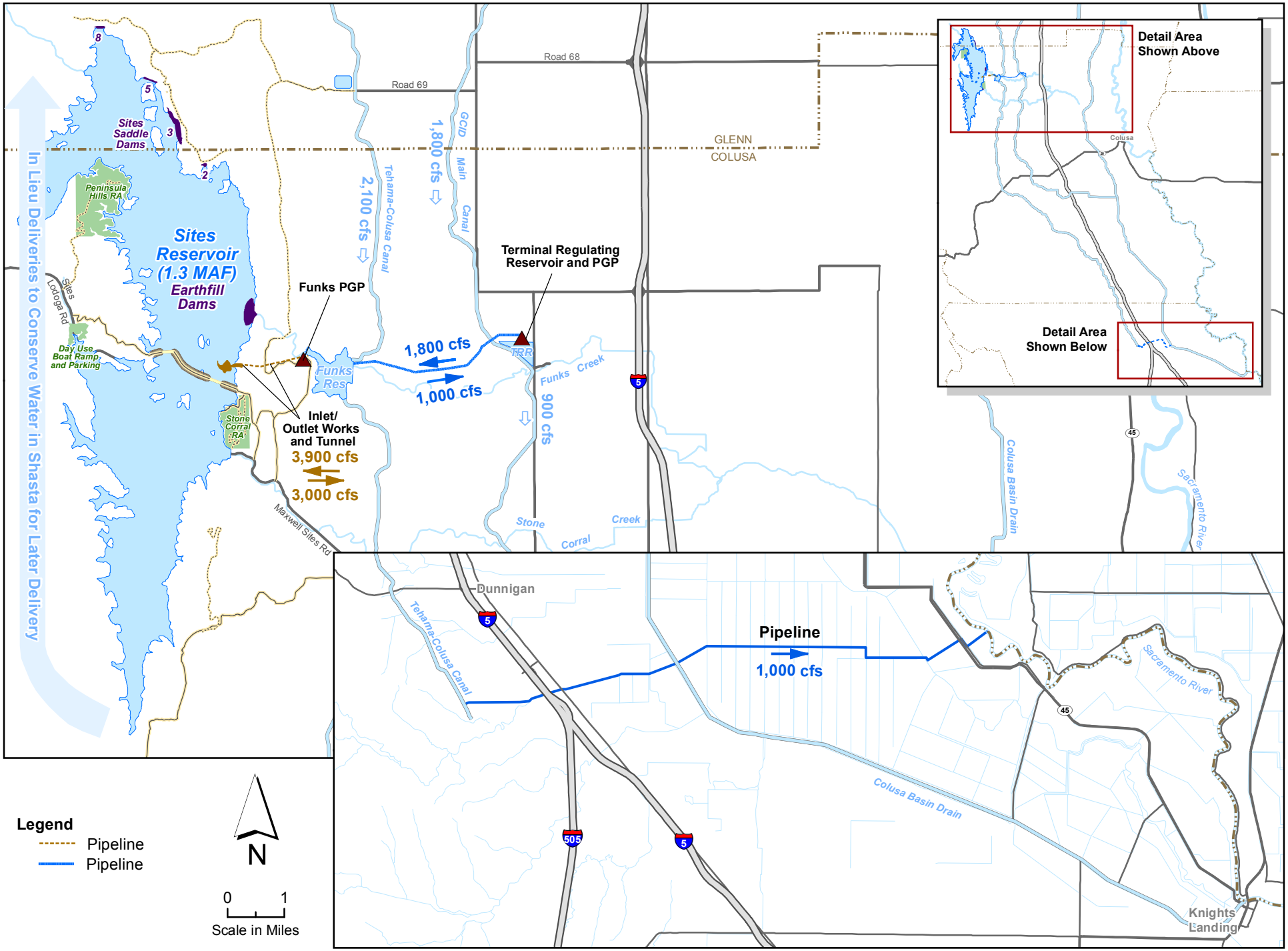
VP5



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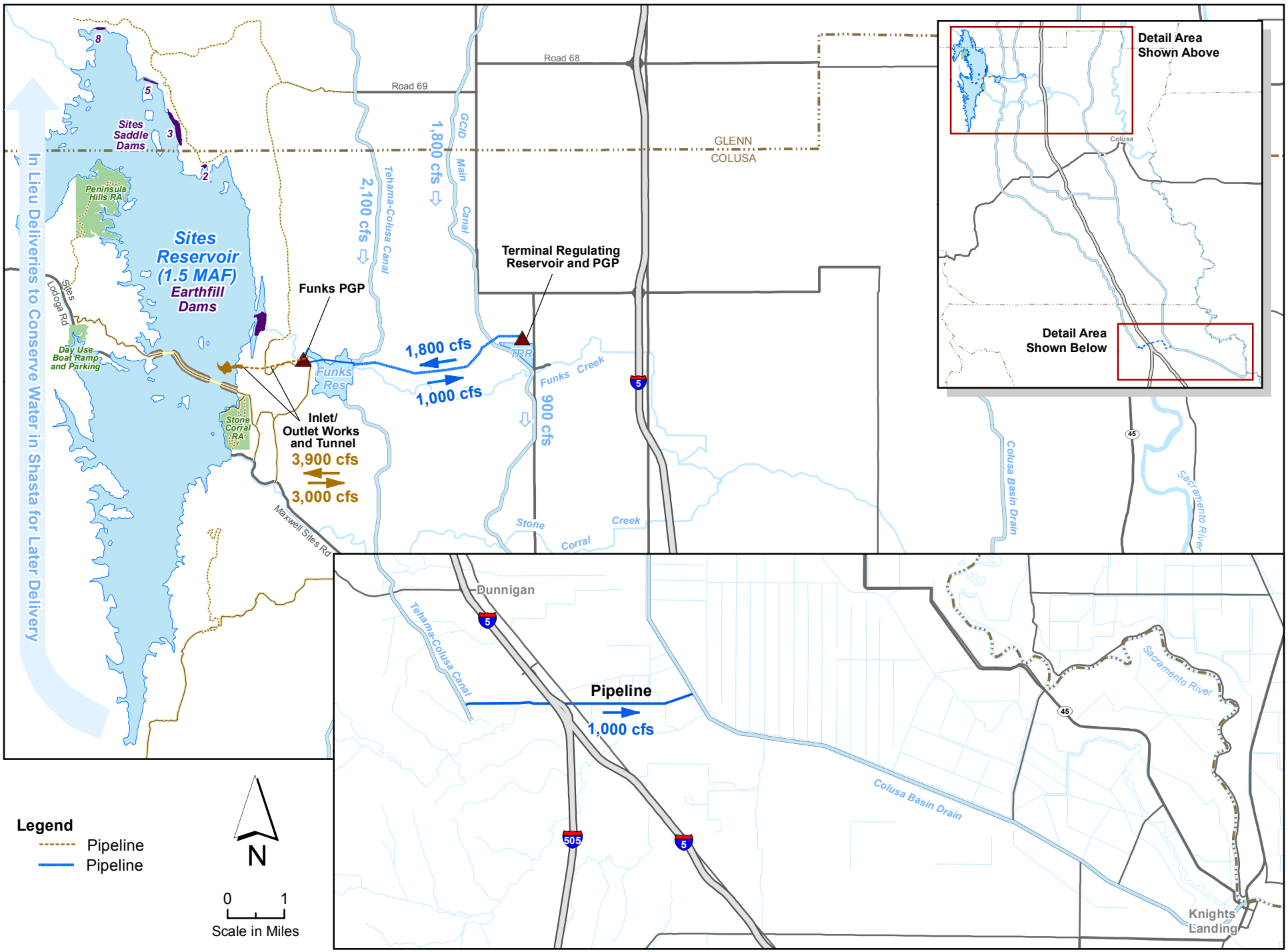
VP6


In Lieu Deliveries to Conserve Water in Shasta for Later Delivery
Sites Reservoir (1.5 MAF) Earthfill Dams
Sites Saddle Dams
Peninsula Hills RA
Day Use Boat Ramp and Parking
Stone Corral RA
Sites Lodoga Rd
Maxwell Sites Rd
Funks PGP
Inlet/ Outlet Works and Tunnel
3,900 cfs
3,000 cfs
Terminal Regulating Reservoir and PGP
1,800 cfs
1,000 cfs
900 cfs
2,100 cfs
1,800 cfs
Funks Res
Funks Creek
Stone Corral Creek
Tehama-Colusa Canal
GCID Main Canal
Road 68
Road 69
GLENN
COLUSA
Colusa
Colusa Basin Drain
Sacramento River
Detail Area Shown Above
Detail Area Shown Below
Dunnigan
Pipeline
1,000 cfs
Knights Landing
Legend
Pipeline
Pipeline
N
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Scale in Miles
Projects\NODOS\SitesReservoir_2020\ArcMaps\Sites_Mar2020_NewAltsVP1-7.mxd LCT 03.06.20 SAC

VP7

Appendix B – Operations

Appendix B-1 Release Capacity and Reservoir Size Technical Memorandum

To:	Value Planning Work Group
CC:	Lee Frederiksen
Date:	March 12, 2020
From:	Rob Tull, CH2M
Quality Review by:	Erin Heydinger
Authority Agent Review by:	Ali Forsythe
Subject:	Release Capacity and Reservoir Size

This memorandum includes a sensitivity analysis for a range of reservoir sizes and release capacities for Sites Reservoir. The purpose of this analysis is to evaluate the quantity of water from Sites Reservoir that could be released under different conveyance capacities.

1.0 Assumptions

Three conveyance capacities for Sites Reservoir releases were evaluated: 750 cubic feet per second (cfs), 1,000 cfs, and 1,500 cfs. Each conveyance capacity was assessed using three storage capacities for the reservoir: 1.5 million acre-feet (MAF), 1.3 MAF, and 1.0 MAF. All nine combinations were run under Scenario B, an operations scenario that was developed through previous discussions with the California Department of Fish and Wildlife (CDFW). Assumptions and diversion criteria for Scenario B operations are detailed in Attachment 1.

The following scenarios were evaluated:

1. Scenario B – 750 cfs conveyance capacity & 1.5 MAF storage capacity
2. Scenario B – 750 cfs conveyance capacity & 1.3 MAF storage capacity
3. Scenario B – 750 cfs conveyance capacity & 1.0 MAF storage capacity
4. Scenario B – 1,000 cfs conveyance capacity & 1.5 MAF storage capacity
5. Scenario B – 1,000 cfs conveyance capacity & 1.3 MAF storage capacity
6. Scenario B – 1,000 cfs conveyance capacity & 1.0 MAF storage capacity
7. Scenario B – 1,500 cfs conveyance capacity & 1.5 MAF storage capacity
8. Scenario B – 1,500 cfs conveyance capacity & 1.3 MAF storage capacity
9. Scenario B – 1,500 cfs conveyance capacity & 1.0 MAF storage capacity

For each scenario, releases from Sites Reservoir were quantified using monthly releases, as reported by CalSim II modeling. Deliveries include releases for Phase 2 project participants including members along the Tehema-Colusa Canal (T-C Canal), Glenn-Colusa Irrigation District, Reclamation District 108, Colusa County, other Sacramento Valley participants, South of Delta participants, plus Proposition 1 deliveries for Incremental Level 4 refuge water supply (Refuge Level 4) and Yolo Bypass.

The type of facility selected to convey Sites Reservoir releases is yet to be determined (at the time the analysis was conducted). Releases may be through a canal, creek, or pipe. The results of this sensitivity analysis are unaffected by facility choice and additional analysis to account for seepage losses and downstream hydraulic conditions will be needed in the future.

These sensitivity analyses include a surrogate approximation of the potential to exchange water between Sites Reservoir and Shasta Lake. This exchange would be implemented through the release of Sites water to meet Sacramento Valley Central Valley Project (CVP) contract demands and Delta regulatory obligations. There would be a corresponding reduction in Shasta Lake releases that preserves storage in the lake and contributes to water temperature management and Sacramento River flow stability benefits. Based on previous analyses it is assumed that about 60 thousand acre-feet (TAF) could be exchanged on an average annual basis with the majority of these exchanges occurring in dry and critical water year types. This also assumes integration with the State Water Project (SWP) to facilitate operations and deliveries to South-of-Delta members. Work is on-going to develop the capability to simulate the Reclamation no investment exchange and integration of operations with the SWP.

2.0 Release Results

Table B1-1 shows the reservoir releases for Scenario B under all nine combinations of Sites storage and release capacities. The table includes average annual deliveries for the full 82-year simulation period and each water year type, as classified by DWR's Sacramento Valley Water Year Hydrologic Index.

Overall, decreasing Sites' release capacity from 1,500 cfs to 1,000 cfs reduces average annual releases by 4.0% to 6.2%. Bringing the release capacity down to 750 cfs reduces average annual deliveries by another 1.6% to 2.7%.

Releases from Sites are greatest during Dry years. Consequently, dry years are more critical to the conveyance capacity of Sites releases than any other year type. For example, the average annual delivery of a 1.5 MAF reservoir decreases by 13.5% when its' release capacity is reduced from 1,500 cfs to 750 cfs.

Based on this sensitivity analysis, the combination of a 1.3 MAF reservoir and a 750 cfs release capacity provides about a 230 TAF average annual release for Sites Reservoir.

It is recommended that a lower range estimate also be considered, to account for uncertainty, that is 30 TAF less than the simulated values shown in Table B1-1.

Table B1-1. Sites Reservoir Releases under Varying Storage and Release Capacities

Preliminary - Sensitivity			
Conveyance Release Analysis – Scenario B			
Reservoir Release (TAF)			
Long-term Average			
Storage Capacity (MAF)	Scenario B – 1,500 cfs Release Capacity	Scenario B – 1,000 cfs Release Capacity	Scenario B – 750 cfs Release Capacity
1.5	253	243	236
1.3	243	234	230
1.0	207	195	191
Wet Years			
Storage Capacity (MAF)	Scenario B – 1,500 cfs Release Capacity	Scenario B – 1,000 cfs Release Capacity	Scenario B – 750 cfs Release Capacity
1.5	115	116	112
1.3	122	115	113
1.0	118	112	109
Above Normal Years			
Storage Capacity (MAF)	Scenario B – 1,500 cfs Release Capacity	Scenario B – 1,000 cfs Release Capacity	Scenario B – 750 cfs Release Capacity
1.5	275	286	280
1.3	287	299	303
1.0	185	186	194
Below Normal Years			
Storage Capacity (MAF)	Scenario B – 1,500 cfs Release Capacity	Scenario B – 1,000 cfs Release Capacity	Scenario B – 750 cfs Release Capacity
1.5	285	273	277
1.3	278	263	266
1.0	237	217	213
Dry Years			
Storage Capacity (MAF)	Scenario B – 1,500 cfs Release Capacity	Scenario B – 1,000 cfs Release Capacity	Scenario B – 750 cfs Release Capacity
1.5	422	382	365
1.3	392	364	345
1.0	343	309	301
Critically Dry Years			
Storage Capacity (MAF)	Scenario B – 1,500 cfs Release Capacity	Scenario B – 1,000 cfs Release Capacity	Scenario B – 750 cfs Release Capacity
1.5	243	237	225
1.3	205	204	204
1.0	185	184	177

3.0 T-C Canal Capacity Analysis

It is necessary to determine whether there is enough capacity in the T-C Canal to accommodate Sites releases to the Sacramento River in addition to releases for Tehama-Colusa Canal Authority (TCCA) members. It is assumed there is 750 cfs of available capacity through the canal.

To confirm the available capacity in the T-C Canal, historical daily diversion data were obtained. Figure B1-1 shows historical daily diversions through the T-C Canal for the period from January 2014 to February 2020. CVP TCCA contractors received a 100 percent contract allocation for 2016 through 2019. The total recorded diversions at Red Bluff Pumping Plant were reduced by one-third to approximate the level of flow in the reach of the TCC below Funks Reservoir. As shown, the estimated daily canal flows never exceed 800 cfs. Assuming the T-C Canal has a capacity of 1,900 cfs below Funks Reservoir, there would be at least 1,000 cfs capacity available for Sites releases even under 100 percent allocation years. Figure B1-2 shows the average monthly approximation for historical diversions through the lower T-C Canal. The figure shows that with some smoothing of the daily values that could be accomplished by forecasting, the lower T-C Canal may have up to 1,000 cfs capacity for Project releases on an average monthly basis, during the peak summer diversion season when TCCA contractors receive a 100 percent contract allocation.

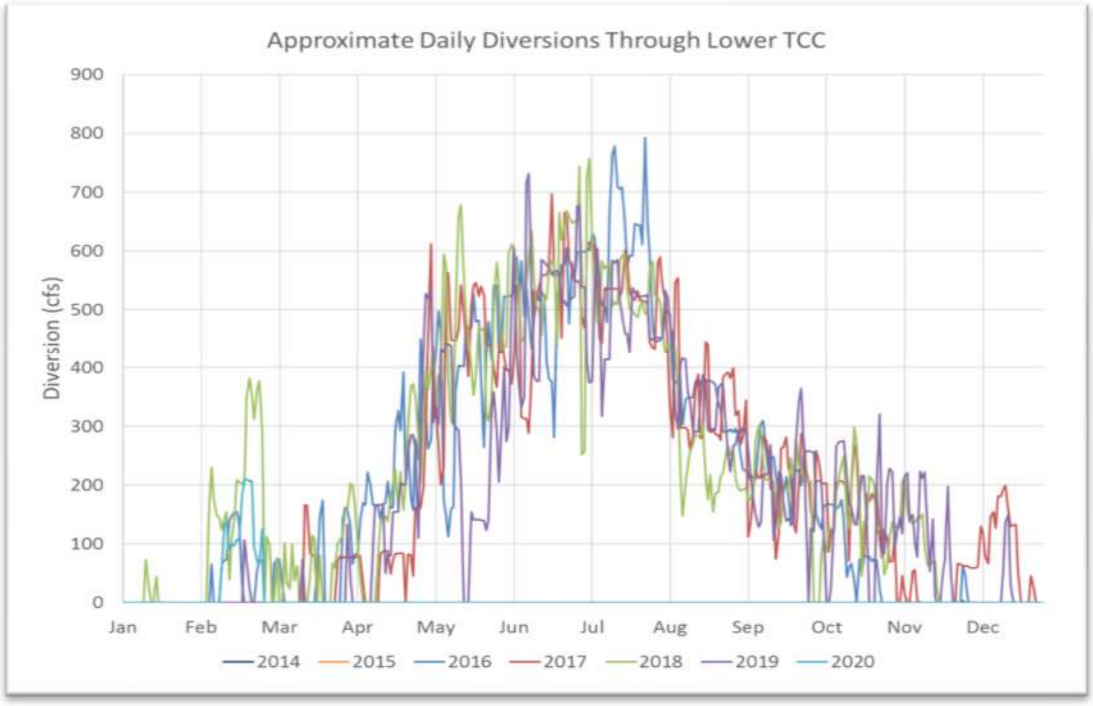


Figure B1-1. Approximated Daily Diversions through the Lower T-C Canal for 2014 to 2020

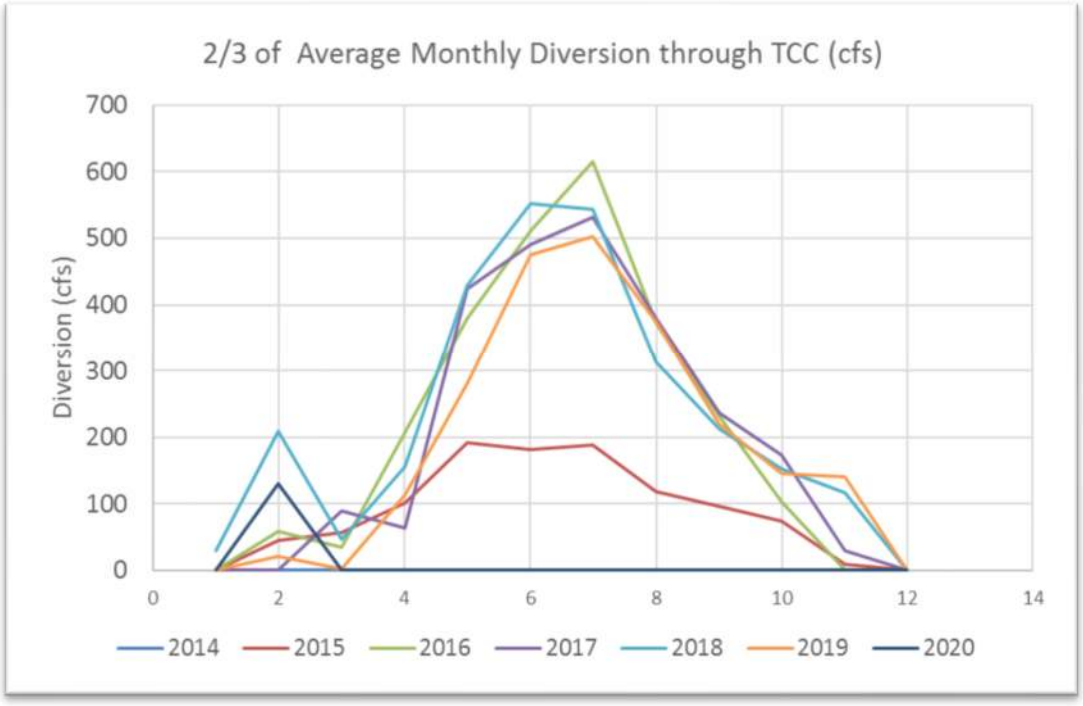


Figure B1-2. Approximated Average Monthly Diversion through the lower T-C Canal for 2014 to 2020

Figure B1-3 shows Sites Reservoir releases through the T-C Canal to the TCCA members under Scenario B using a 1,000 cfs conveyance capacity and three different storage capacities (1.0 MAF, 1.3 MAF, and 1.5 MAF). The releases assume no exchange with Shasta Lake. Figure B1-4 shows total release through the T-C Canal under the assumption that the T-C Canal is the only option for release conveyance. This release includes CVP deliveries to TCCA members and releases from Sites Reservoir under the assumption of no exchange with Shasta Lake. It also includes Sites releases for Colusa County, other Sacramento Valley members, South-of-Delta members, and state deliveries for Level 4 Refuges and Yolo Bypass objectives. As shown, simulated monthly Sites deliveries through T-C Canal to members along the canal never exceed much more than 500 cfs, while total deliveries through T-C Canal including South of Delta releases rarely exceeds 1,100 cfs. Based on this preliminary analysis, the lower T-C Canal appears to have sufficient capacity to convey CVP TCCA contractor deliveries, Sites releases to TCCA members, plus additional Sites releases to the Sacramento River, during the peak summer diversion season.

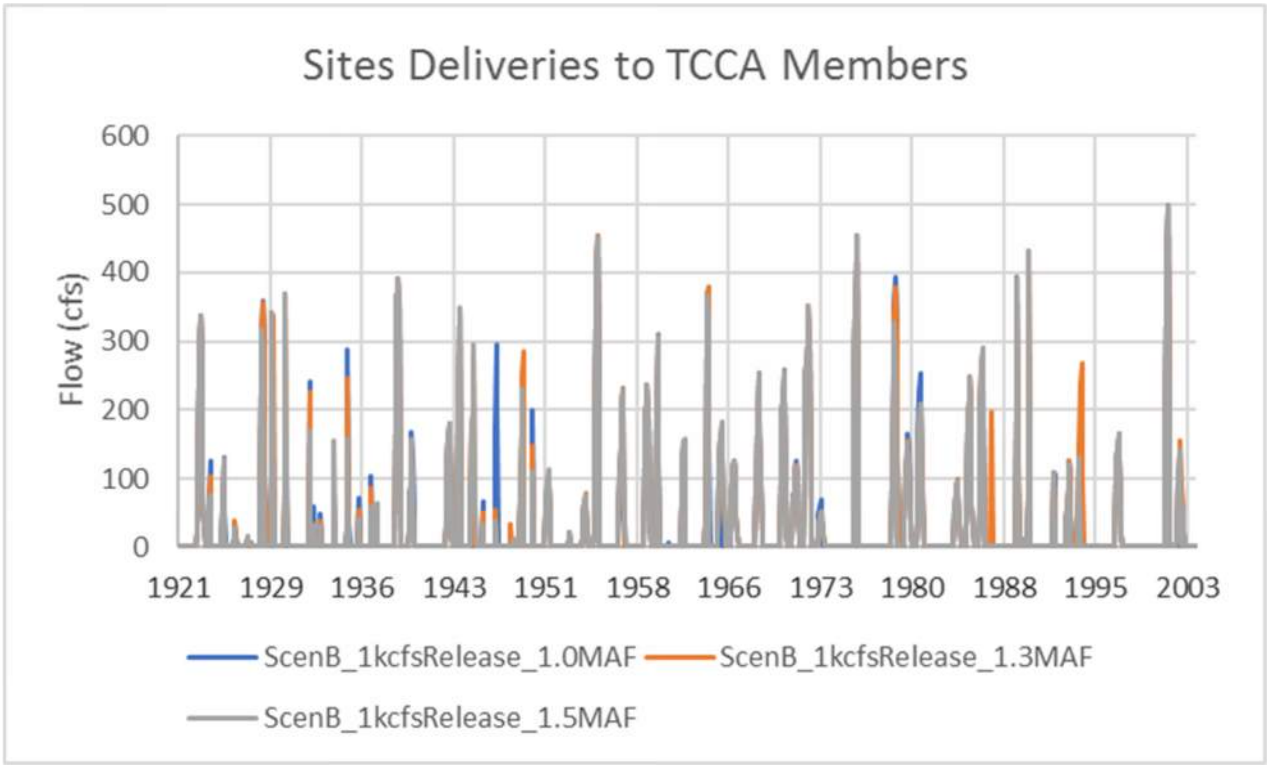


Figure B1-3. Sites Deliveries to TCCA Members under Scenario B

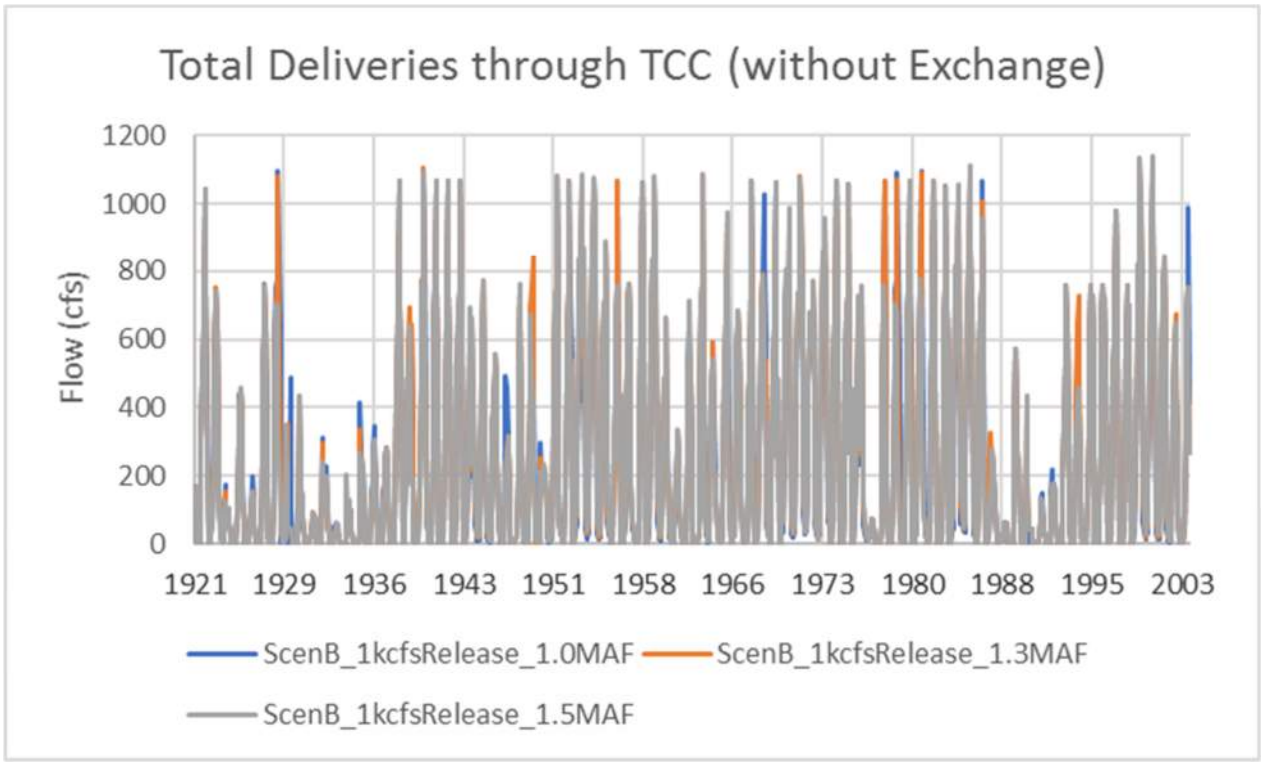


Figure B1-4. Total Deliveries through the T-C Canal under Scenario B

4.0 Limitations

This evaluation was conducted as a sensitivity analysis to support the value planning process and there are a number of limitations that need to be taken into consideration.

- This analysis evaluates conveyance sizing under assumed Scenario B diversion criteria.
- Monthly model time step is appropriate for value planning purposes. More detailed modeling analysis will be needed to confirm these results.
- Estimates of conveyance release capability presented in Table B1-1 are upper range estimates based on model simulated results and do not account for uncertainty.
- It is recommended that a lower range estimate also be considered to account for uncertainty. The lower range estimate values would be 30 TAF below the Table B1-1 values to account for uncertainty associated with 1) interpretation of Scenario B diversion criteria, 2) need to preserve functional spills into the Sutter and Yolo bypasses, 3) river flow routing and real-time operational controls and decisions, 4) need to further refine assumptions and model simulation of CVP no investment exchange and SWP operations integration.

Attachment B-1-1

Sites Operations Scenario B

Attachment 1. Operations Scenario B

This attachment provides modeling assumptions for Sites Project operations Scenario B used to evaluate the release capacity of Sites Reservoir. Scenario B was developed based on previous discussions with CDFW in December of 2019.

Criteria	Scenario B
Reservoir Size	1.0 MAF, 1.3 MAF, or 1.5 MAF
GCC Maintenance Window	2 weeks (Jan/Feb)
Upstream Pulse Flow Protection	Bypass the first pulse flow event in October – May for up to 7 days during pulse of 15,000 to 25,000 cfs as measured at Bend Bridge
Wilkins Slough Bypass Flow	8,000 cfs April/May; 5,000 cfs all other times
Fremont Weir Notch	Prioritize the Fremont Weir Notch, Yolo Bypass preferred alternative, flow over weir within 5%
Flows into the Sutter Bypass System	No restriction due to flow over Moulton, Colusa, and Tisdale Weirs
Freeport Bypass Flow	Modeled WaterFix Criteria (applied on a daily basis) Post-Pulse Protection (applied on a moving 7-day average) Post-Pulse (3 levels) = Jan-Mar Level 2 starts Jan 1 Level 1 is initiated by the pulse trigger
Net Delta Outflow Index (NDOI) Prior to Project Diversions	44,500 cfs between March 1 and May 31

Appendix B-2 Shasta Lake Exchanges with No Reclamation Investment Technical Memorandum

To:	Value Planning Work Group
CC:	Lee Frederiksen
Date:	March 9, 2020
From:	CH2M
Subject:	Shasta Lake Exchanges with No Reclamation Investment

1.0 Purpose

- Conduct a preliminary evaluation of the potential for exchanging Sites Project water with Shasta Lake without dedicated Bureau of Reclamation (Reclamation) investment in the Sites Project (Project).
- Implement feedback on exchange criteria provided by Reclamation.
- Investigate the potential temperature benefits of the operation.

2.0 Background

With Reclamation participation to the Project, but no investment, water stored in Sites Reservoir could be exchanged with Shasta Lake to meet Central Valley Project (CVP) Tehama Colusa Canal Authority (TCCA) Agricultural water Service and Settlement Contractor obligations and downstream flow and Delta water quality requirements. Therefore, a portion of the water demand within the CVP service area along the Tehama Colusa Canal (TCC) and the Glenn Colusa Canal (GCC) south of Sites Reservoir could be met from releases from Sites Reservoir in the spring and allow an equal amount of water to be retained in Lake Shasta (via exchange) to improve summer cold water pool management.

The exchange could occur when Sacramento River flows at Keswick and temperatures at Clear Creek are within a specific range and not compromised by reduced Lake Shasta releases into the Sacramento River. This exchange could likely occur in April through May (and possibly June) in Dry and Critical years.

Lake Shasta releases of exchange water would be scheduled to benefit downstream temperatures in the Sacramento River, which would likely occur in September, October, or November. Withdrawals from Shasta would be coordinated with Reclamation and no carry over storage of exchange water would be allowed between years.
The exchange operation would likely be subject to the following constraints provided by Reclamation to protect the interests of the CVP and to comply with State and Federal laws and regulations:

- All water stored in Shasta would be subject to spill at any date and would be the first water in Shasta to spill.
- All operations associated with this operation would be subject to river temperature constraints to ensure that there is not an impact by reducing releases to store and to ensure a benefit when released later in the year.

- All operations are subject to approval by the State Water Resources Control Board (SWRCB), and any applicable state or federal laws, regulations, or guidelines.

3.0 Operations Analysis

3.1 Approach

- A post-processing approach was used for this preliminary analysis due to extensive code changes that will be needed to implement this operation in the CalSim II model.
- All calculations were performed using results from the CalSim II DCR 2015 Merged Model No Action Alternative (NAA).
- The post-processing analysis was performed for the years 1922 through 2002, consistent with the time period modeled in CalSim II.
- A series of criteria was established, as defined in the attached table, for each scenario. If all criteria were met, the operation was permitted for that year. Criteria included Sacramento River temperature at Clear Creek, Keswick flow, Shasta storage, and water year types. Additional criteria were provided by Reclamation for analysis.
- In all scenarios, Keswick outflow and Sacramento River at Clear Creek temperature requirements between April and June were protected to maintain NAA conditions.
- Nine scenarios were evaluated to assess the volume and frequency of water that could be exchanged between Sites and Shasta Lake.

    1) The “Initial Concept”, based on Thad Bettner’s Aug 8 email, allows for exchanges with Shasta Lake between April and July and releases between August and November 15 during Dry and Critical years. Releases from Shasta storage were based on available Banks Pumping Plant capacity. The exchange operation is only permitted when the Sacramento Valley is in “In-basin Use” (IBU) conditions. Under the “Initial Concept”, three scenarios were evaluated:
        a. No Delevan Pipeline, assuming that the exchange operation is not facilitated through the Delevan Pipeline.
        b. One-pipe Delevan Pipeline.
        c. Two-pipe Delevan Pipeline.
    2) Additionally, several sensitivity analyses were performed on the “Initial Concept” with a two-pipe Delevan Pipeline:
        a. Includes the exchange operation in Below Normal water years.
        b. Exchanges assumed to occur under UWFE conditions as well.
        c. Shasta Lake releases allowed through December.
    3) Two scenarios were designed to maximize Delta export and habitat benefits from the exchange operation with the release of the stored water:
        a. Releases are delayed to improve river temperatures and provide fall flow stability habitat benefits in August through December.
        b. The same criteria as above, with the additional requirement that Shasta Lake storage be above 1,900 TAF in September, consistent with the RPA.
    4) Reclamation provided additional criteria for the exchange operation on January 16, 2020:
        a. The exchange period is limited to April and May. This reflects Reclamation’s comments on what is needed to meet estimated targets for Sacramento River temperatures at Clear Creek, Keswick flows above minimum, and deliveries to the Sacramento River Settlement Contractors.

b. Withdrawals of Sites water stored in Shasta would most likely occur in September, October, and November.

c. The exchange is limited to Dry and Critically Dry water years.

d. Sacramento River Temperature at Clear Creek must be below the following targets for the exchange to occur:

Table B2-1. Temperatures (°F) on the Sacramento River at Clear Creek, from ROC on LTO Proposed Action

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
Wet (32%)	53.3	54.6	51.4	47.5	46.3	47.1	49.2	50.2	51.5	52.0	52.8	52.9
Above Normal (16%)	53.1	53.9	50.8	47.7	46.4	47.4	49.9	50.3	51.0	51.4	52.8	53.7
Below Normal (13%)	54.3	54.7	51.5	48.2	47.4	49.0	51.1	50.6	51.2	52.1	53.0	54.2
Dry (24%)	54.0	54.6	51.1	48.4	48.0	49.0	51.2	51.1	51.5	52.7	53.6	54.4
Critical (15%)	59.5	56.3	51.4	48.6	48.2	49.6	51.6	52.2	53.4	55.0	57.4	60.5

	Within 1 °F of Tier 1 limit (52.5 °F – 53.5 °F)
	53.6 °F – 55.9 °F
	Tier 4 (> 56 °F)

3.2 General Assumptions

- The exchange concept with Shasta Lake is permissible by the Bureau of Reclamation.
- Water year types are based on the Sacramento Valley D-1641 index and are assigned on a January-December calendar-year basis.
- It is assumed that no Sites Project water is carried over in Shasta Lake between calendar years.
- It is assumed that there is sufficient water in Sites Reservoir to facilitate the operation.
- It is assumed that all active storage in Sites Reservoir is available for exchange.
- The exchange operation is based on the replacement of both CVP agricultural deliveries and water released from Shasta to meet Delta requirements.

3.3 Results

Results are summarized in the attached time series, bar chart, and exceedance figures. A summary of the results is provided below.

Table B2-2. Summary of Average Annual Exchange Volumes by Water Year (TAF)

WYT	Initial Concept - no Delevan Pipeline Exchange	Initial Concept - 1 pipe Delevan Pipeline	Initial Concept - 2 pipe Delevan Pipeline	[Sensitivity] Exchanges allowed in Below Normal years - 2 pipe Delevan Pipeline	[Sensitivity] Exchanges assumed to occur under UWFE conditions as well - 2 pipe Delevan Pipeline	[Sensitivity] Releases allowed through December - 2 pipe Delevan Pipeline	[Sensitivity] Releases required to have habitat benefit, allowed through December - 2 pipe Delevan Pipeline	[Sensitivity] Releases required to have habitat benefit, allowed through December, Storage RPA control - 2 pipe Delevan Pipeline	[Sensitivity] USBR Proposed - 2 pipe Delevan Pipeline
W	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
AN	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
BN	n/a	n/a	n/a	43	n/a	n/a	n/a	n/a	n/a
D	119	141	144	144	156	177	100	100	43
C	80	114	130	130	149	133	104	9	56

Depending on the scenario considered, Sites Reservoir storage may not be available for this type of operation due to constraints on diversions-to-fill and other constraints of the scenario. When compared against storage volumes for a simulated 1.3 MAF reservoir using CDFW Scenario B, in 10 of the 21 years that the exchange occurs, there is not sufficient water in Sites Reservoir to facilitate the exchange operation.

3.4 Recommendations

- This preliminary evaluation demonstrates there is enough volume and frequency of water available for exchange to warrant further evaluation of these potential operations in more detail in a systemwide CVP/SWP context.
- Based on comments, use the post-processing spreadsheet to evaluate additional combinations of operational exchange criteria.

Sites Project with no Reclamation Investment

Sites-Shasta Exchange Operation

Alternatives
Initial Concept - no Delevan Pipeline
Initial Concept - 1 pipe Delevan Pipeline
Initial Concept - 2 pipe Delevan Pipeline
[Sensitivity] Exchanges allowed in Below Normal years - 2 pipe Delevan Pipeline
[Sensitivity] Exchanges assumed to occur under UWFE conditions as well - 2 pipe Delevan Pipeline
[Sensitivity] Releases allowed through December - 2 pipe Delevan Pipeline
[Sensitivity] Releases required to have habitat benefit, allowed through December - 2 pipe Delevan Pipeline
[Sensitivity] Releases required to have habitat benefit, allowed through December, Storage RPA control - 2 pipe Delevan Pipeline
[Sensitivity] USBR Proposed- 2 pipe Delevan Pipeline

	Export required			
	Initial Concept - no Delevan Pipeline	Initial Concept - 1 pipe Delevan Pipeline	Initial Concept - 2 pipe Delevan Pipeline	[Sensitivity] Exchanges allowed in Below Normal years
	Exchange limited to conditions with limited flow/temperature impact potential			
	Storage accrued in Shasta by exchange			
	Banks export capacity must be available			
	Storage released from Shasta for export starting in August			
	No Delevan Pipeline	1-pipe Delevan Pipeline	2-pipe Delevan Pipeline	2-pipe Delevan Pipeline
	Storage must be released from Shasta by Nov 15	Storage must be released from Shasta by Nov 15	Storage must be released from Shasta by Nov 15	Storage must be released from Shasta by Nov 15
	Only Dry and Critically Dry years considered	Only Dry and Critically Dry years considered	Only Dry and Critically Dry years considered	Below Normal, Dry, and Critically Dry years considered
Exchange Operation Sac Flow check Prior to Summer - All scenarios	Keswick Flow (cfs)	Keswick Flow (cfs)	Keswick Flow (cfs)	Keswick Flow (cfs)
	April 6,000	April 6,000	April 6,000	April 6,000
	May 6,000	May 6,000	May 6,000	May 6,000
	Jun 10,000	Jun 10,000	Jun 10,000	Jun 10,000
	Jul 12,000	Jul 12,000	Jul 12,000	Jul 12,000
Exchange Operation Sac Temperature check Prior to Summer - All scenarios	Sac R blw Clear Creek Temp (F)	Sac R blw Clear Creek Temp (F)	Sac R blw Clear Creek Temp (F)	Sac R blw Clear Creek Temp (F)
	April No Rule	April No Rule	April No Rule	April No Rule
	May 56	May 56	May 56	May 56
	Jun 56	Jun 56	Jun 56	Jun 56
	Jul 53.5	Jul 53.5	Jul 53.5	Jul 53.5
Hold Operation Storage over Summer - Habitat scenarios	Shasta Storage (TAF)	Shasta Storage (TAF)	Shasta Storage (TAF)	Shasta Storage (TAF)
	April No Rule	April No Rule	April No Rule	April No Rule
	May No Rule	May No Rule	May No Rule	May No Rule
	Jun No Rule	Jun No Rule	Jun No Rule	Jun No Rule
	Jul No Rule	Jul No Rule	Jul No Rule	Jul No Rule
	Sep - low No Rule	Sep - low No Rule	Sep - low No Rule	Sep - low No Rule
	Sep - high No Rule	Sep - high No Rule	Sep - high No Rule	Sep - high No Rule
Release Operation - Habitat scenarios delayed release - other scenarios release starts in Aug	Maximum Keswick Flow (cfs)	Maximum Keswick Flow (cfs)	Maximum Keswick Flow (cfs)	Maximum Keswick Flow (cfs)
	Aug 10,000	Aug 10,000	Aug 10,000	Aug 10,000
	Sep 12,000	Sep 12,000	Sep 12,000	Sep 12,000
	Oct No Rule	Oct No Rule	Oct No Rule	Oct No Rule
	Nov No Rule	Nov No Rule	Nov No Rule	Nov No Rule
	Dec No Rule	Dec No Rule	Dec No Rule	Dec No Rule
Release Operation various	Release Schedule	Release Schedule	Release Schedule	Release Schedule
	Aug All month	Aug All month	Aug All month	Aug All month
	Sep All month	Sep All month	Sep All month	Sep All month
	Oct All month	Oct All month	Oct All month	Oct All month
	Nov Through Nov 15	Nov Through Nov 15	Nov Through Nov 15	Nov Through Nov 15
	Dec No Release	Dec No Release	Dec No Release	Dec No Release

Year Types
various

WYT Control	
W	0
AN	0
BN	0
D	1
C	1

WYT Control	
W	0
AN	0
BN	0
D	1
C	1

WYT Control	
W	0
AN	0
BN	0
D	1
C	1

WYT Control	
W	0
AN	0
BN	1
D	1
C	1

COA Conditions Permitted	
IBU UWFE	Yes No

COA Conditions Permitted	
IBU UWFE	Yes No

COA Conditions Permitted	
IBU UWFE	Yes No

COA Conditions Permitted	
IBU UWFE	Yes No

Export required		Habitat benefit and export required	
[Sensitivity] Exchanges assumed to occur under UWFE conditions as well	[Sensitivity] Releases allowed through December	[Sensitivity] Releases required to have habitat benefit, allowed through December	[Sensitivity] Releases required to have habitat benefit, allowed through December, Storage RPA control
Exchange limited to conditions with limited flow/temperature impact potential			
Storage accrued in Shasta by exchange			
Banks export capacity must be available			
Storage released from Shasta for export starting in August			
2-pipe Delevan Pipeline	2-pipe Delevan Pipeline	2-pipe Delevan Pipeline	2-pipe Delevan Pipeline
Storage must be released from Shasta by Nov 15	Storage must be released from Shasta by Nov 15	Storage is carried into December at risk of spill	Storage is carried into December at risk of spill
Only Dry and Critically Dry years considered	Only Dry and Critically Dry years considered	Only Dry and Critically Dry years considered	Only Dry and Critically Dry years considered

Exchange Operation
Sac Flow check
Prior to Summer
- All scenarios

Keswick Flow (cfs)	
April	6,000
May	6,000
Jun	10,000
Jul	12,000

Keswick Flow (cfs)	
April	6,000
May	6,000
Jun	10,000
Jul	12,000

Keswick Flow (cfs)	
April	6,000
May	6,000
Jun	10,000
Jul	12,000

Keswick Flow (cfs)	
April	6,000
May	6,000
Jun	10,000
Jul	12,000

Exchange Operation
Sac Temperature check
Prior to Summer
- All scenarios

Sac R blw Clear Creek Temp (F)	
April	No Rule
May	56
Jun	56
Jul	53.5

Sac R blw Clear Creek Temp (F)	
April	No Rule
May	56
Jun	56
Jul	53.5

Sac R blw Clear Creek Temp (F)	
April	No Rule
May	56
Jun	56
Jul	53.5

Sac R blw Clear Creek Temp (F)	
April	No Rule
May	56
Jun	56
Jul	53.5

Hold Operation
Storage over Summer
- Habitat scenarios

Shasta Storage (TAF)	
April	No Rule
May	No Rule
Jun	No Rule
Jul	No Rule
Sep - low	No Rule
Sep - high	No Rule

Shasta Storage (TAF)	
April	No Rule
May	No Rule
Jun	No Rule
Jul	No Rule
Sep - low	No Rule
Sep - high	No Rule

Shasta Storage (TAF)	
April	No Rule
May	No Rule
Jun	No Rule
Jul	No Rule
Sep - low	No Rule
Sep - high	No Rule

Shasta Storage (TAF)	
April	No Rule
May	No Rule
Jun	No Rule
Jul	No Rule
Sep - low	1,900
Sep - high	No Rule

Release Operation
- Habitat scenarios
  delayed release
- other scenarios
  release starts in Aug

Maximum Keswick Flow (cfs)	
Aug	10,000
Sep	12,000
Oct	No Rule
Nov	No Rule
Dec	No Rule

Maximum Keswick Flow (cfs)	
Aug	10,000
Sep	12,000
Oct	No Rule
Nov	No Rule
Dec	No Rule

Maximum Keswick Flow (cfs)	
Aug	10,000
Sep	12,000
Oct	12,000
Nov	6,000
Dec	5,000

Maximum Keswick Flow (cfs)	
Aug	10,000
Sep	12,000
Oct	12,000
Nov	6,000
Dec	5,000

Release Operation
various

Release Schedule	
Aug	All month
Sep	All month
Oct	All month

Release Schedule	
Aug	All month
Sep	All month
Oct	All month

Release Schedule	
Aug	All month
Sep	All month
Oct	All month

Release Schedule	
Aug	All month
Sep	All month
Oct	All month

Nov	Through Nov 15	Nov	All month	Nov	All month	Nov	All month
Dec	No Release	Dec	All month	Dec	All month	Dec	All month

Year Types
various

WYT Control		WYT Control		WYT Control		WYT Control	
W	0	W	0	W	0	W	0
AN	0	AN	0	AN	0	AN	0
BN	0	BN	0	BN	0	BN	0
D	1	D	1	D	1	D	1
C	1	C	1	C	1	C	1

COA Conditions Permitted		COA Conditions Permitted		COA Conditions Permitted		COA Conditions Permitted	
IBU	Yes	IBU	Yes	IBU	Yes	IBU	Yes
UWFE	Yes	UWFE	No	UWFE	No	UWFE	No

[Sensitivity] USBR Proposed
Exchange limited to conditions with limited flow/temperature impact potential
Storage accrued in Shasta by exchange
Banks export capacity must be available
Storage released from Shasta for export starting in September
2-pipe Delevan Pipeline
Storage must be released from Shasta by Nov 15
Only Dry and Critically Dry years considered

Exchange Operation
Sac Flow check
Prior to Summer

Keswick Flow (cfs)	
April	6,000
May	6,000

Exchange Operation
Sac Temperature check
Prior to Summer
- All scenarios

Sac R blw Clear Creek Temp (F)		
Month	D	C
April	51.2	51.6
May	51.1	52.2
Jun	51.5	53.4
Jul	52.7	55.0

Hold Operation
Storage over Summer
- Habitat scenarios

Shasta Storage (TAF)	
April	No Rule
May	No Rule
Jun	No Rule
Jul	No Rule
Sep - low	No Rule
Sep - high	No Rule

Release Operation
- Habitat scenarios
  delayed release
- other scenarios
  release starts in Aug

Maximum Keswick Flow (cfs)	
Aug	No Rule
Sep	No Rule
Oct	No Rule
Nov	No Rule
Dec	No Rule

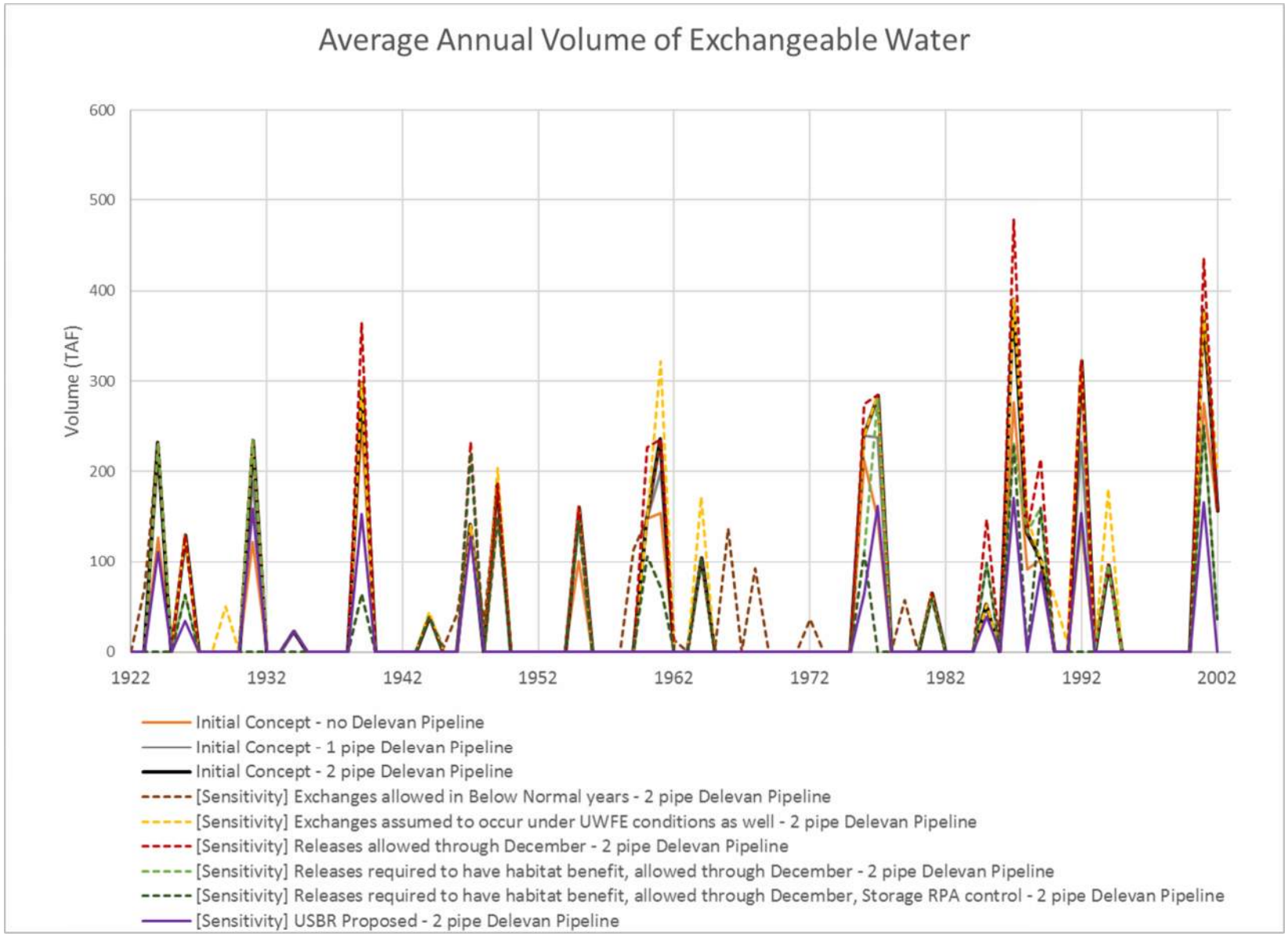
Release Operation
various

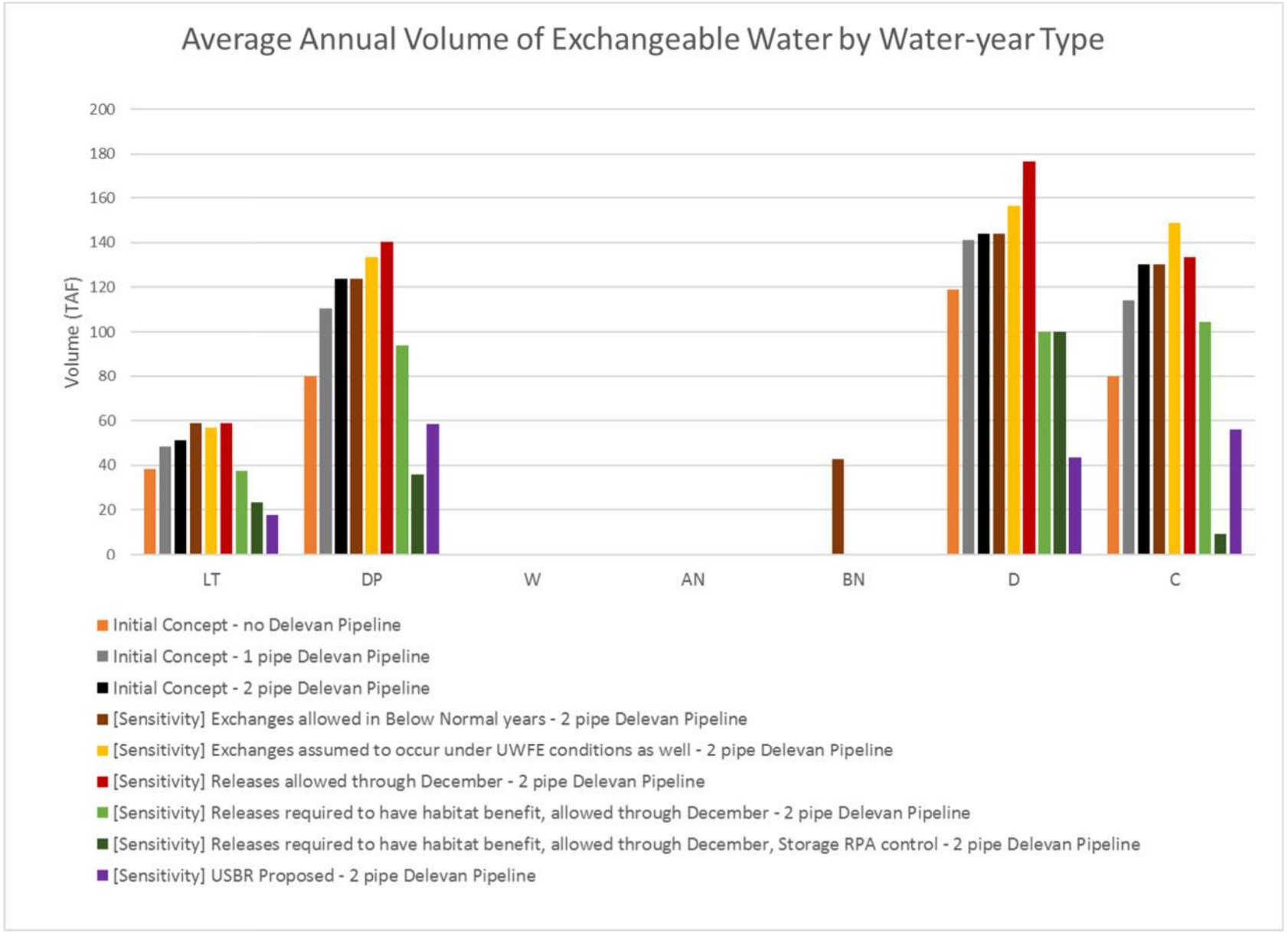
Release Schedule	
Aug	No Release
Sep	All month
Oct	All month
Nov	All Month
Dec	No Release

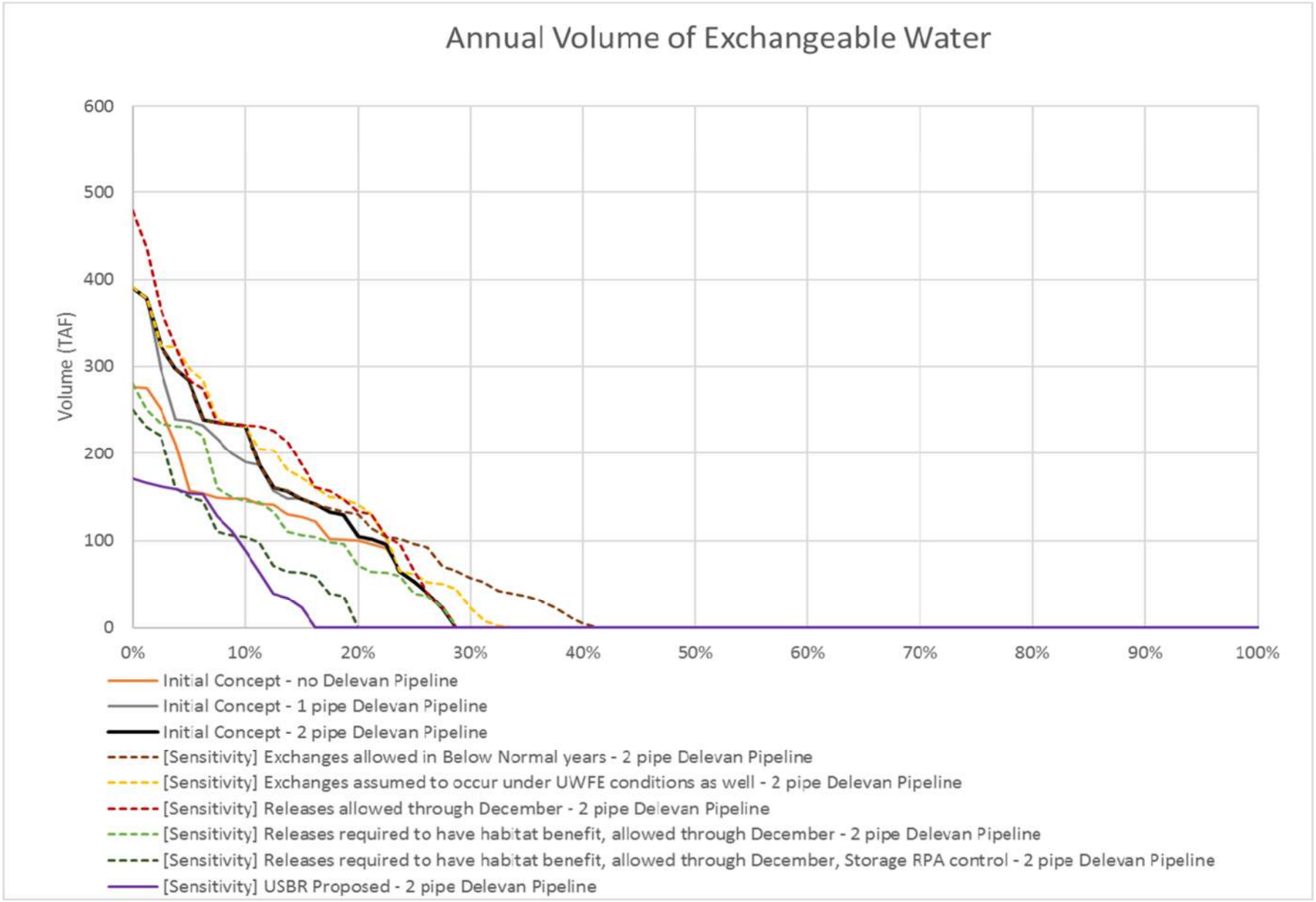
Year Types
various

WYT Control	
W	0
AN	0
BN	0
D	1
C	1

COA Conditions Permitted	
IBU	Yes
UWFE	No


Average Annual Volume of Exchangeable Water
Volume (TAF)
600
500
400
300
200
100
0
1922
1932
1942
1952
1962
1972
1982
1992
2002
Initial Concept - no Delevan Pipeline
Initial Concept - 1 pipe Delevan Pipeline
Initial Concept - 2 pipe Delevan Pipeline
[Sensitivity] Exchanges allowed in Below Normal years - 2 pipe Delevan Pipeline
[Sensitivity] Exchanges assumed to occur under UWFE conditions as well - 2 pipe Delevan Pipeline
[Sensitivity] Releases allowed through December - 2 pipe Delevan Pipeline
[Sensitivity] Releases required to have habitat benefit, allowed through December - 2 pipe Delevan Pipeline
[Sensitivity] Releases required to have habitat benefit, allowed through December, Storage RPA control - 2 pipe Delevan Pipeline
[Sensitivity] USBR Proposed - 2 pipe Delevan Pipeline


Average Annual Volume of Exchangeable Water by Water-year Type
Volume (TAF)
200
180
160
140
120
100
80
60
40
20
0
LT
DP
W
AN
BN
D
C
Initial Concept - no Delevan Pipeline
Initial Concept - 1 pipe Delevan Pipeline
Initial Concept - 2 pipe Delevan Pipeline
[Sensitivity] Exchanges allowed in Below Normal years - 2 pipe Delevan Pipeline
[Sensitivity] Exchanges assumed to occur under UWFE conditions as well - 2 pipe Delevan Pipeline
[Sensitivity] Releases allowed through December - 2 pipe Delevan Pipeline
[Sensitivity] Releases required to have habitat benefit, allowed through December - 2 pipe Delevan Pipeline
[Sensitivity] Releases required to have habitat benefit, allowed through December, Storage RPA control - 2 pipe Delevan Pipeline
[Sensitivity] USBR Proposed - 2 pipe Delevan Pipeline


Annual Volume of Exchangeable Water
Volume (TAF)
600
500
400
300
200
100
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Initial Concept - no Delevan Pipeline
Initial Concept - 1 pipe Delevan Pipeline
Initial Concept - 2 pipe Delevan Pipeline
[Sensitivity] Exchanges allowed in Below Normal years - 2 pipe Delevan Pipeline
[Sensitivity] Exchanges assumed to occur under UWFE conditions as well - 2 pipe Delevan Pipeline
[Sensitivity] Releases allowed through December - 2 pipe Delevan Pipeline
[Sensitivity] Releases required to have habitat benefit, allowed through December - 2 pipe Delevan Pipeline
[Sensitivity] Releases required to have habitat benefit, allowed through December, Storage RPA control - 2 pipe Delevan Pipeline
[Sensitivity] USBR Proposed - 2 pipe Delevan Pipeline

4.0 Temperature Post-processing Analysis

Several scenarios were further evaluated for temperature benefits to assess the viability of the exchange. The “Initial Concept - 2 pipe Delevan Pipeline” and “USBR Proposed” scenarios were evaluated as follows:

4.1 Approach

- A post-processing exercise was conducted using the estimated exchange volumes calculated in the previous section.
- Shasta Lake releases were adjusted in the CalSim II output for the DCR 2015 Merged Model No Action Alternative (NAA). This was performed for two scenarios:

1) “Releases Limited by Delivery Capacity”: From April through July, releases are reduced to match the exchange operation developed in the post-processing. From August through November, exchanged water is released at a rate no greater than the delivery capacity calculated in the post-processing until there is no exchanged water left to release. In November, any water remaining is released.
2) “Scheduled Releases”: This scenario assumes that the system can be re-operated to deliver any water released. In this scenario, from April through July, releases are reduced to match the exchange operation developed in the post-processing. In August, 40% of the exchanged water is released. In September, an additional 40% is released. In September, the final 20% is released. In the “USBR – Proposed” scenario, 40% is released in September, 40% is released in October, and 20% is released in November.
3) Since the operation only occurs in dry and critically dry water years, the averages for only those water year types are presented. Within those water year types, only years where the action is greater than 50 TAF are included. This includes 14 of the 18 dry years and 7 of the 12 critically dry years. In dry years with an exchange greater than 50 TAF, the average exchange operation was 182 TAF when releases were limited by delivery capacity and 311 TAF when releases were scheduled. In critically dry years with an exchange greater than 50 TAF, the average exchange was 220 TAF when releases were limited by delivery capacity and 225 TAF when releases were scheduled.
4) Under the USBR Proposed scenario, the exchange only occurred in 5 of the 18 dry years and 5 of the 12 critically dry years. In dry years with an exchange greater than 50 TAF, the average exchange operation was 141 TAF when releases were limited by delivery capacity and 167 TAF when releases were scheduled. In critically dry years with an exchange greater than 50 TAF, the average exchange was 130 TAF when releases were limited by delivery capacity and 130 TAF when releases were scheduled.
5) The Upper Sacramento River Water Quality Model (USRWQM) in HEC-5Q was run using the revised CalSim II outputs.

4.2 Results

Temperature results are in the tables below. Our preliminary screening analysis shows that there is some potential for temperature reduction below the targets specified by Reclamation, but further analysis will be needed to further evaluate the benefits of the exchange operation.

Temperature changes (ºF) between No Project and Project with no Reclamation Investment Initial Concept - 2-pipe Delevan Pipeline									
Releases Limited by Delivery Capacity Dry Year Averages (with action >50 TAF)									
		APR	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**
Sacramento River below Keswick	No Action	48.2	48.7	49.5	50.9	52.6	52.9	54.7	54.3
	With Project	48.2	49.0	49.6	50.8	52.1	52.6	54.0	53.9
	Difference	0.0	0.2	0.1	-0.1	-0.5	-0.4	-0.7	-0.4
Sacramento River below Clear Creek	No Action	49.7	50.3	51.0	52.2	54.0	54.6	55.2	54.1
	With Project	49.7	50.7	51.3	52.2	53.4	54.1	54.5	53.8
	Difference	0.0	0.4	0.3	0.1	-0.6	-0.5	-0.7	-0.3
Critically Dry Year Averages (with action >50 TAF)									
		APR	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**
Sacramento River below Keswick	No Action	48.9	50.6	51.8	53.0	55.5	58.1	57.9	55.4
	With Project	48.8	50.4	51.8	52.9	54.2	57.7	57.9	55.5
	Difference	0.0	-0.3	-0.1	-0.2	-1.3	-0.4	0.1	0.1
Sacramento River below Clear Creek	No Action	50.2	52.2	53.2	54.4	56.8	59.4	58.2	55.2
	With Project	50.3	52.2	53.3	54.3	55.4	58.9	58.3	55.2
	Difference	0.1	0.0	0.1	-0.1	-1.4	-0.5	0.0	0.1
Initial Concept - 2-pipe Delevan Pipeline									
Scheduled Releases (40% Aug, 40% Sep, 20% Oct) Dry Year Averages (with action >50 TAF)									
		APR	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**
Sacramento River below Keswick	No Action	48.2	48.7	49.5	50.9	52.6	52.9	54.7	54.3
	With Project	48.2	49.0	49.7	50.8	51.9	52.1	54.5	54.3
	Difference	0.0	0.2	0.1	-0.1	-0.6	-0.9	-0.1	0.0
Sacramento River below Clear Creek	No Action	49.7	50.3	51.0	52.2	54.0	54.6	55.2	54.1
	With Project	49.8	50.7	51.3	52.3	53.2	53.4	55.0	54.1
	Difference	0.0	0.4	0.3	0.1	-0.8	-1.2	-0.2	0.0
Critically Dry Year Averages (with action >50 TAF)									
		APR	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**
Sacramento River below Keswick	No Action	48.9	50.6	51.8	53.0	55.5	58.1	57.9	55.4
	With Project	48.9	50.4	51.8	52.9	54.3	57.3	58.0	55.6
	Difference	0.0	-0.2	0.0	-0.1	-1.2	-0.8	0.1	0.1
Sacramento River below Clear Creek	No Action	50.2	52.2	53.2	54.4	56.8	59.4	58.2	55.2
	With Project	50.3	52.2	53.3	54.3	55.5	58.4	58.3	55.3
	Difference	0.1	0.0	0.1	-0.1	-1.3	-1.0	0.1	0.1

Temperature changes (ºF) between No Project and Project with no Reclamation Investment USBR Proposed- 2-pipe Delevan Pipeline									
Releases Limited by Delivery Capacity Dry Year Averages (with action >50 TAF)									
		APR	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**
Sacramento River below Keswick	No Action	48.5	48.9	50.0	51.5	53.4	53.8	55.4	55.2
	With Project	48.5	49.4	49.8	51.2	53.2	53.2	55.3	55.1
	Difference	0.0	0.5	-0.2	-0.3	-0.2	-0.6	-0.1	-0.1
Sacramento River below Clear Creek	No Action	50.2	50.3	51.3	52.7	54.7	55.5	56.0	55.0
	With Project	50.2	51.3	51.2	52.4	54.6	54.7	55.8	54.9
	Difference	0.0	1.0	-0.1	-0.3	-0.2	-0.8	-0.2	-0.1
Critically Dry Year Averages (with action >50 TAF)									
		APR	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**
Sacramento River below Keswick	No Action	49.0	51.0	52.4	53.2	56.3	59.5	58.3	55.3
	With Project	49.0	50.9	52.3	53.1	55.3	58.7	58.5	55.4
	Difference	0.0	-0.1	-0.1	-0.1	-1.0	-0.9	0.2	0.1
Sacramento River below Clear Creek	No Action	50.3	52.5	53.8	54.6	57.6	60.6	58.7	55.1
	With Project	50.5	52.6	53.7	54.5	56.6	59.6	58.8	55.2
	Difference	0.2	0.1	-0.1	-0.1	-1.0	-1.0	0.1	0.1
USBR Proposed- 2-pipe Delevan Pipeline									
Scheduled Releases (40% Sep, 40% Oct, 20% Nov) Dry Year Averages (with action >50 TAF)									
		APR	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**
Sacramento River below Keswick	No Action	48.5	48.8	49.9	51.5	53.3	53.6	55.4	55.2
	With Project	48.5	49.4	49.8	51.2	53.1	53.1	55.3	55.0
	Difference	0.0	0.5	-0.2	-0.3	-0.2	-0.5	-0.1	-0.1
Sacramento River below Clear Creek	No Action	50.1	50.2	51.3	52.8	54.7	55.3	55.9	54.9
	With Project	50.1	51.2	51.2	52.5	54.5	54.6	55.8	54.8
	Difference	0.0	1.0	-0.1	-0.3	-0.2	-0.7	-0.2	-0.1
Critically Dry Year Averages (with action >50 TAF)									
		APR	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**
Sacramento River below Keswick	No Action	49.0	51.0	52.4	53.2	56.3	59.5	58.3	55.3
	With Project	49.0	50.9	52.3	53.0	55.3	58.5	58.4	55.5
	Difference	0.0	-0.1	-0.1	-0.1	-1.0	-1.0	0.0	0.1
Sacramento River below Clear Creek	No Action	50.3	52.5	53.8	54.6	57.6	60.6	58.7	55.1
	With Project	50.5	52.6	53.7	54.5	56.6	59.6	58.7	55.3
	Difference	0.2	0.1	-0.1	-0.1	-1.0	-1.0	0.0	0.2

Appendix B-3 Colusa Basin Drain Value Planning Evaluation Technical Memorandum

To:	Value Planning Work Group
CC:	Lee Frederiksen
Date:	April 7, 2020
From:	Anne Williams - MBK
Subject:	Colusa Basin Drain Value Planning Alternative

The Sites Reservoir Project is currently undergoing a value planning process to investigate various potential alternatives of the Sites Reservoir Project operations. As part of this process, one alternative proposes that water released from Sites Reservoir is conveyed through the Tehama Colusa Canal (TC Canal) to its terminus, and then to the Colusa Basin Drain (CBD) through Bird Creek or a pipeline near the same location. The alternative proposes to move up to 1,000 cfs of water during May through October through the CBD, and either through the Knights Landing Outfall Gates (KLOG) and into the Sacramento River near Knights Landing, or through the Knights Landing Ridge Cut (Ridge Cut) to the Yolo Bypass and then to the Sacramento River near Rio Vista. The purpose of this memorandum is to provide background information and MBK Engineer's (MBK) knowledge based on experience about the CBD, and to identify potential considerations or risks associated with this proposed alternative to the Sites Reservoir Project Value Planning Work Group (Work Group).

This memorandum is organized by topic, based on a list of questions provided by the Work Group. It is intended to identify initial considerations at a high level, based on MBK's experience and information that was readily available. Attached to this memorandum is a brief presentation with background information and key facilities along the CBD, which was provided and discussed with the Work Group at a meeting on February 13, 2020.

1.0 Flow

In order to understand how water released from Sites Reservoir could be moved through the CBD and into the Sacramento River at Knights Landing, the hydraulics between the CBD, KLOG, and Wallace Weir need to be investigated. MBK has requested any available analyses from Reclamation District 108 (RD 108), which may have been conducted for the KLOG and/or Wallace Weir rehabilitation projects.

The rate of flow from the CBD into the Sacramento River through KLOG, depends on the differential stage in the Sacramento River and in the CBD at KLOG. The stage in the CBD at KLOG is dependent upon the operation of both KLOG and the Wallace Weir. The flow in the CBD has historically been difficult to measure due to backwater effects. To fully understand how far upstream backwater may extend from KLOG, a hydraulic analysis would need to be conducted. Based on the experience of MBK and the landowners, it is estimated that water levels can be affected by the KLOG and Wallace Weir operation to County Line Road, approximately 15 miles upstream of the Ridge Cut and approximately 4 miles upstream of Bird Creek.

Currently, MBK is aware of measurements at the following locations, generally identified from upstream to downstream.

- Colusa Drain near Sidds Rd (Glenn-Colusa Irrigation District [GCID]: Flow, Stage, Water Temperature, pH, Specific Conductance, Salinity, Dissolved Solids, and Dissolved O2)
- Colusa Drain near Road 68 (GCID: Flow, Stage, Water Temperature, pH, Specific Conductance, Salinity, Dissolved Solids, and Dissolved O2)
- Colusa Drain at Lurline Road (GCID: Flow, Stage, Water Temperature, pH, Specific Conductance, Salinity, Dissolved Solids, and Dissolved O2)
- Colusa Drain near Highway 20 (CDEC – CDR: Flow & Stage)
- Colusa Drain at Davis Weir (GCID: Flow, Stage, Water Temperature, pH, Specific Conductance, Salinity, Dissolved Solids, and Dissolved O2)
- Colusa Basin Drain at Knights Landing (CDEC – KLG: Stage & Gate Openings)
- Sacramento River at Knights Landing (CDEC – KNL: Stage)
- Ridge Cut Slough at Knights Landing (CDEC – RCS: Flow, Stage, Velocity, and Water Temperature[1])
- Ridge Cut at Wallace Weir (RD 108 & the California Department of Water Resources [DWR] – RD 108 with approval by DWR: Flow & Stage)
- Yolo Bypass near Woodland (CDEC – YBY: Flow & Stage)

Pursuant to the 1937 Hershey Agreement, DWR limits water levels at KLOG during the irrigation season to no greater than 25.5 ft United States Engineering Datum (USED, also known as the U.S. Army Corps of Engineers Datum). During this period DWR also attempts to maintain a water level of no less than 24.5 ft USED. These elevations are identified to prevent localized flooding and impacts to the ability to drain fields in the lower portion of the CBD and the Ridge Cut (which may occur at levels greater than 25.5 ft) and avoid limiting the ability of diverters to pump water for irrigation purposes (which may occur at levels lower than 24.5 ft).

In July 2016, state and federal agencies and local water users and landowners coordinated an Emergency Action for Delta Smelt. The goal of the program was to generate a pulse flow in the Yolo Bypass, using about 400 cfs of water pumped from the Sacramento River into the CBD by GCID and RD 108 over a two-week period in July[2]. The approximate 400 cfs pulse flow was in addition to existing flows in the CBD at the time, about 200 cfs measured at Davis Weir. The resulting maximum flow in the CBD below Davis Weir during the effort was about 850 cfs. The pulse flow was conveyed to the Yolo Bypass using the CBD, Wallace Weir, and the Tule Canal. The action generated a total flow pulse of 12,700 acre-feet in the Yolo Bypass.

Additional Delta Smelt experiments occurred in the fall of 2018 and 2019, planned to generate estimated pulses of 24,000 acre-feet in the Yolo Bypass. These more recent experiments involved the rerouting of agricultural return flow/rice drain water (not the addition of Sacramento River water) from the CBD into the Yolo Bypass via the Ridge Cut (rather than discharging the water to the Sacramento River at KLOG). The 2018 flow action occurred for about one month, late August to late September, and water levels in the CBD at KLOG were raised to 27.0 ft. Measured CBD flows at the Davis Weir during the peak of the 2018 action were about 3,000 cfs. The actual pulse generated in the Yolo Bypass is estimated to have been about 20,000 acre-feet. Similarly, the 2019 flow action raised water levels in the CBD at KLOG to 27.0 ft over a several week period, during late August and September. Measured CBD flows at the Davis Weir during the peak of the 2019 action were about 2,500 cfs, and a pulse was generated in the Yolo Bypass. These efforts were possible with

[1] In addition, certain water quality data (i.e. dissolved oxygen, pH, specific conductance, turbidity, chlorophyll) is available during periods of the Delta Smelt actions, collected by DWR.

[2] The 2016 action occurred in July due to the construction schedule of the Wallace Weir. Similar programs in the future were identified as more likely to occur in the fall.

significant coordination with local landowners, although they did result in some localized flooding/drainage issues.

Any alternatives that utilize the CBD for conveyance of Sites Reservoir water, should include coordination with the local landowners regarding the project operation and timing of the additional flows. The project should also consider levee improvements (particularly along the western levee which is lower than the eastern Project levee) and other improvements or arrangements that would address flooding and drainage issues due to the increased flows.

The Work Group raised concerns regarding losses due to seepage and groundwater pumping. The area primarily consists of clay soils and therefore losses due to seepage are not a major concern; however, local landowners have expressed concern regarding the potential for seepage through the levees when water levels exceed 25.5 ft. Similarly, the effect of local groundwater pumping is likely minimal, although this has not been investigated. With the implementation of the Sustainable Groundwater Management Act, groundwater pumping in the area may be more restricted in the future.

2.0 Environmental

As previously described, in 2016, 2018, and 2019, as part of the Delta Smelt Emergency Action, pulse flows were generated through the Yolo Bypass. The purpose of these experiments were to improve the food supply in the Northern Delta, focusing on Delta smelt. It is MBK's understanding that these types of experiments may continue in the future.

Another consideration of the Work Group is related to water temperature. Temperature management for fish species is a major operational consideration on the upper Sacramento River. However, MBK is not aware of temperature concerns in the Sacramento River this far downstream (i.e. near Knights Landing). It seems that water released from Sites Reservoir would be the same temperature or colder than summer drain water in the CBD. There is currently water temperature data at several points in the Colusa Drain collected by GCID, in the Ridge Cut (CDEC – RCS) and in the Sacramento River: upstream of Knights Landing at Wilkins Slough (CDEC – WLK) and downstream at Verona (CDEC – VON).

The giant garter snake is the primary endangered species concern in this area. Other special status species identified as potentially found within the area include the California tiger salamander, yellow-billed cuckoo, Western snowy plover, least Bell's vireo, Delta smelt, Central Valley steelhead, Chinook salmon, green sturgeon, Conservancy fairy shrimp, vernal pool fairy shrimp, Valley elderberry longhorn beetle, vernal pool tadpole shrimp, Hoover's spruge, palmate-bracted bird's-beak, Colusa grass, hairy Orcutt grass, slender Orcutt grass, Keck's checker-mallow, and Greene's tuctoria[3].

3.0 Water Rights

Landowners and irrigation districts hold varying water rights along the CBD, Ridge Cut, Tule Canal, and Yolo Bypass. MBK conducted an initial review of existing water rights along the CBD downstream of Sites Reservoir using the State Water Resources Control Board's electronic files (see Draft Memorandum: Summary of Downstream Water Rights, dated September 17, 2019). Based on this research there are approximately ten water rights along the CBD between Bird Creek and the Knights Landing Outfall Gates[4]. Generally, these are licensed direct diversion water rights for irrigation purposes during April to October.

In addition, many lands are within the Colusa Drain Mutual Water Company (CDMWC), which holds a contract with the U.S. Bureau of Reclamation (Reclamation) for supplemental water supplies for its shareholders who divert water from the CBD under their respective water rights. As allowed under the contract with Reclamation the CDMWC has purchased supplemental water supplies from GCID for the past several years.

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[3] Source: https://www.usbr.gov/mp/nepa/includes/documentShow.php?Doc_ID=32942

[4] Research was not conducted to identify existing water rights along the Ridge Cut, Tule Canal, Sacramento River, or within the Delta.

Appendix C – Environmental Permitting and Planning

Appendix C-1 – Permitting and Environmental Planning Impacts Assessment Technical Memorandum

To:	Value Planning Work Group
CC:	Lee Frederiksen
Date:	March 3, 2020
From:	John Spranza, Jelica Arsenijevic - HDR
	Laurie Warner Herson – Phenix Environmental
Subject:	Permitting and Environmental Planning Impacts Assessment

1.0 Introduction

The Sites Project Authority (Authority) is pursuing development of the Sites Reservoir Project (Project), a new above-ground surface storage reservoir offstream of the Sacramento River in Colusa and Glenn counties, approximately 10 miles west of the town of Maxwell, California. The Project, in addition to providing other important water storage and operational benefits, is being proposed to increase the reliability of water supplies for environmental, agricultural and urban uses. A draft California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) Environmental Impact Report/Environmental Impact Statement (EIR/EIS)[1] has been prepared and was circulated for public review and comment in August, 2017.

In October 2019, the Authority began value planning efforts to identify an alternative that would serve the current needs of the Project participants and potentially reduce overall cost of the Project. The value planning effort has identified several facility modifications, which resulted in 16 new alternatives being considered.

This memorandum (memo) has been prepared to assist with the value planning effort from the environmental permitting and planning perspective. The memo summarizes the alternatives being considered, describing:

- Key differences of the value planning alternatives when compared to Alternative D as described in the Draft EIR/EIS;
- Species within the alternatives footprint that could potentially be impacted through construction and operation of the Project;
- Key permits and approvals required to construct and operate the Project including any additional regulatory requirements beyond those identified in the Draft EIR/EIS;
- Environmental planning considerations related to CEQA/NEPA analysis;
- Qualitative change in mitigation cost; and
- A relative weighting associated with environmentally related criteria (and associated metrics) compared to Alternative D in the Draft EIR/EIS.

Although qualitative in nature, the analysis and conclusions presented in this memo may be used to support the Authority in identifying a revised locally-preferred alternative.

[1] Sites Reservoir Project Draft Environmental Impact Report/Environmental Impact Statement (Sites Project Authority and Reclamation 2017)

2.0 Summary of Alternative D

The Draft EIR/EIS addressed a range of alternatives (Alternatives A, B, C, C1, and D). All alternatives included a Sites Reservoir that would be filled using existing Sacramento River diversion facilities and a proposed Delevan Pipeline on the Sacramento River to allow for release of flows into the Sacramento River. All but one alternative also used the proposed Delevan Pipeline to divert Sacramento River water. The proposed operations varied between Alternatives A, B, C, C1, and those included in Alternative D. The specific operational parameters included in the Draft EIR/EIS were identified to support/evaluate the upper bound of potential impacts. The operations evaluated for Alternative D were based on operations included in the application to the California Water Commission for the Water Storage Investment Program. The operations included in that application were specifically selected to respond to the requirements of that program and its evaluation criteria.

In a letter to Reclamation dated June 25, 2018, the Authority identified Alternative D as the locally preferred alternative:

> "As the planning process is nearing completion, the Authority requests Reclamation use Alternative D as the basis for implementing the project and for identifying the federal interest. The current Reclamation-prepared draft Feasibility Report, dated August 14, 2017, identified Alternative D as providing the highest net Regional Economic Development (RED) benefits and as representing the Locally Preferred Alternative; which aligns with the Authority's decision on June 13, 2016, to formally select Alternative D as our proposed project under CEQA and as the basis for our Proposition 1 application to the Water Commission."

Alternative D consists of constructing and operating a 1.8 million-acre-foot (MAF) reservoir. The reservoir would be created by constructing two main dams, one on Funks Creek and one on Stone Corral Creek, and nine saddle dams. Under Alternative D, Sites Reservoir would be filled by diverting unappropriated flows originating primarily from tributary streams to the Sacramento River below Keswick Dam. These flows would be diverted from the Sacramento River from using surplus capacity at the Tehama-Colusa Canal (T-C Canal) diversion facility near Red Bluff, and Glenn-Colusa Irrigation District's (GCID) diversion Facility near Hamilton City. A new diversion facility near Delevan would be constructed to provide additional diversion capacity for filling the reservoir. A pipeline would be constructed to carry water from the Delevan diversion to the forebay/afterbay for Sites Reservoir.

Under Alternative D, modifications would have to be made to the existing infrastructure to accommodate the operation of the reservoir. These include construction of a terminal reregulating reservoir (TRR) on the Glenn-Colusa Canal, expansion of the existing reregulation reservoir on the Tehama-Colusa Canal (known as Funks Reservoir) into a larger reservoir to serve as the forebay/afterbay for Sites Reservoir and to accommodate a pump storage power generating facility, and an inlet/outlet works for moving water in and out of Sites Reservoir. Alternative D has two options under consideration for expansion of Funks Reservoir one primarily to the south that would be named Holthouse Reservoir; and the other to the north and east would be named Fletcher Reservoir.

2.1 Species Potentially Affected

Table C1-1 identifies the federal and state special-status fish and wildlife species that were potentially affected by the construction and operation of Alternative D.

Table C1-1. Special-Status Species Potentially Affected by Alternative D

Species	Listing Status[1]	Critical Habitat
Keck's checkermallow	FE	
Palmate-bracted bird's beak	FE, SE	
Conservancy fairy shrimp	FE	
Vernal pool fairy shrimp	FT	
Vernal pool tadpole shrimp	FE	
Valley elderberry longhorn beetle	FT	
California red-legged frog	FT	
Foothill yellow-legged frog	ST	
California tiger salamander	FE,ST	
Giant garter snake	FT, ST	
Western yellow-billed cuckoo	FT, SE	X
Swainson's hawk	ST	
Bank swallow	ST	
Tricolored blackbird	ST	
Delta smelt	FT	X
Longfin smelt	ST, FC[2]	
Southern Distinct Population Segment of North American green sturgeon	FT	X
Sacramento River winter-run Chinook salmon Evolutionarily Significant Unit	FE	X
Central Valley spring-run Chinook salmon	FT	X
Central Valley steelhead	FT	X

[1] Acronyms: FE – federally listed as endangered FT – federally listed as threatened; FC – federally listed as a candidate species; SE – state listed as endangered ST – state listed as threatened

[2] Federal candidacy is only for San Francisco Bay-Delta distinct population segment.

2.2 Permits and Approvals Required

Alternative D identified over 20 permits that would be required from regulatory agencies, including, but not limited to California Department of Fish and Wildlife (CDFW), U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (USACE), Regional Water Quality Control Board (RWQCB), State Water Resources Control Board (SWRCB), National Marine Fisheries Service (NMFS), and State Historic Preservation Office (SHPO). Table C1-2 identifies the key permits and approvals required for Alternative D, as well as the agency responsible for issuance of permit/approval, recommended pre-requisites for submittal, and estimated processing time. Key permits are those permits that have the ability to significantly affect the cost or schedule of the construction and operation of the Project.

Table C1-2. Summary of Key Permits and Approvals Required for Alternative D

Agency and Associated Permit or Approval	Recommended Pre-requisites for Submittal	Estimated Processing Time
Federal		
USACE Clean Water Act (CWA) Section 404 Nationwide Permit or Individual Permit Rivers and Harbors Act Section 10 Permit	Application Biological Assessment for submittal to USFWS/NMFS Section 401 Water Quality Certification permit or application NEPA document Section 106 compliance documentation Wetland delineation Mitigation and Monitoring Plan Alternatives analysis (for Individual Permit)	4 to 6 months for Nationwide Permit 8 to 24 months for Individual Permit
USFWS/NMFS Endangered Species Act Section 7 Consultation Biological Opinion(s) Magnuson-Stevens Fisheries Conservation and Management Act	Ongoing informal technical consultation Biological Assessment NEPA document	135 days
USFWS Fish and Wildlife Coordination Act Report	Ongoing informal technical consultation Biological Assessment NEPA document	Generally accompanies USFWS's Biological Opinion
USFWS National Wildlife Refuge Special Use Permit	Application Biological Assessment Section 106 compliance documentation	Over 6 months
SHPO National Historic Preservation Act Section 106 Programmatic Agreement	Cultural Resources Survey and Evaluation Report (if mitigation is necessary to resolve adverse effects to historic properties, then additional reports would be required for SHPO consultation that detail the results of these efforts)	9 months (up to 18 months, if mitigation necessary)
State		
RWQCB Clean Water Act Section 401 Water Quality Certification	Application Fish and Game Code Section 1602 Notification or Alteration Agreement CWA Section 404 permit or application CEQA document	8 to 24 months
SWRCB Water Right Permit	Application Water Availability Analysis Coordination with SWRCB Staff Coordinate with potential protesters CEQA document and Mitigation Plan	18 to 24 months
CDFW California Endangered Species Act 2081 Incidental Take Statement	Ongoing informal technical consultation Application Biological document for 2081 Permit, if requesting Incidental Take Permit CEQA document and Mitigation Plan	6 to 24 months
CDFW	Notification Package	6 to 8 months

Agency and Associated Permit or Approval	Recommended Pre-requisites for Submittal	Estimated Processing Time
Fish and Game Code Section 1602 Notification Section 1603 Streambed Alteration Agreement	Section 401 Water Quality Certification or application CWA Section 404 permit or application CEQA document and Mitigation Plan	

2.3 Summary of Environmental Effects

The Project has the potential to influence Central Valley Project (CVP) and State Water Project (SWP) system operations and water deliveries. For the Draft EIR/EIS analysis, three study areas were developed to evaluate potential Project impacts: the Extended, Secondary, and Primary study areas. Based on the analysis, implementation of all alternatives would affect environmental resources in all three study areas to varying degrees, with most impacts potentially occurring in the Primary Study Area. Under Alternative D, potentially significant environmental effects to aquatic, botanical, and terrestrial biological resources were identified but mitigation was identified to mitigate effects to less than significant levels, except for effects to golden eagles. Similarly, effects to wetlands and other jurisdictional waters were considered less than significant after implementation of proposed mitigation.

The Draft EIR/EIS determined that Alternative D (as well as the other alternatives) would likely result in the following potentially significant and unavoidable direct and indirect environmental effects:

Terrestrial Biological Resources (Golden Eagle)

Construction and filling of the proposed Sites Reservoir Inundation Area, as well as construction of the proposed Recreation Areas, would result in the permanent loss of foraging and nesting habitat for the golden eagle. Although implementation of compensatory mitigation including land preservation and/or acquisition is proposed, these measures would not reduce this loss of habitat to less-than-significant levels.

Paleontological Resources

Construction of the proposed Project facilities could affect paleontological resources. Mitigation measures would reduce the impacts, but not to a less-than-significant level if such resources are encountered during construction.

Cultural Resources (Historical and Tribal Resources, Human Remains)

Construction of the proposed Project facilities would affect built historical and tribal resources, as well as human remains associated with a designated cemetery and adjacent areas. If these resources and/or areas are determined to be eligible for listing in the California Register of Historical Resources or National Register of Historic Places, mitigation measures would not reduce the impact to less-than-significant levels.

Land Use (Community of Sites and Existing Land Uses)

Construction and filling of the proposed Sites Reservoir Inundation Area would result in the physical division and loss of the community of Sites, resulting in a significant and unavoidable impact. Construction of the proposed Project facilities would result in conversion of Prime Farmland, Unique Farmland or Farmland of Statewide Importance to non-agricultural use, resulting in significant and unavoidable impacts. Implementation of mitigation measures would not reduce these impacts to less-than-significant levels.

Air Quality (PM10, ROG, and NOx)

Construction activities associated with all proposed Primary Study Area Project facilities, as well as activities (such as use of roads, recreation, electricity generation and consumption, and sediment dredging) associated with the long-term operation and maintenance of the Project, would result in significant and unavoidable emissions of particulate matter less than 10 microns in diameter (PM10), reactive organic gas (ROG), and nitrogen oxide (NOx).

Climate Change and Greenhouse Gas Emissions

The greenhouse gas (GHG) emissions estimated for construction, operation, and maintenance of the Project when compared to applicable county standards would contribute to a cumulatively considerable effect that would be significant and unavoidable.

Growth-inducing Impacts

Implementation of the Project would improve water supply reliability for agricultural, urban, and environmental uses; provide more options for water management; increase recreational opportunities; and increase temporary and permanent employment opportunities. Although it is not anticipated that the water made available from the Project would result in a direct increase in population or employment, the potential exists for the quantity of water made available by the Project to result in secondary effects of growth consistent with local general plans and regional growth projections in an agency's respective service area.

These significant and unavoidable environmental effects were common to all of the alternatives analyzed in the Draft EIR/EIS due to the magnitude of construction activities and future reservoir-related inundation of resources. There were changes in the level of effects for some alternatives depending on construction and operation of the Delevan Intake including:

- Impact Fish-1c: Hydrostatic Pressure Waves, Noise, and Vibration – Delevan Facilities.
- Impact Fish-1d: Predation Risk – Delevan Facilities.
- Impact Fish-1e: Stranding, Impingement, and Entrainment – Delevan Facilities.
- Impact Fish 1f: Modification of Pulse Flows and Entrainment during Diversions at the Delevan Facilities.

However, the Draft EIR/EIS concluded that these effects were less than significant after implementation of mitigation.

2.4 Estimated Mitigation Costs

In 2016, costs for potential mitigation requirements of Alternative D were estimated to be approximately $500 million. The 2016 estimated mitigation costs identified that there was uncertainty in the estimate as the Project's impact assessment and associated mitigation ratios/acres had yet to be finalized and determined by the state and federal regulatory agencies in their respective permits and approvals. The HDR Permitting Integration Team reviewed the 2016 estimated mitigation costs in late 2019 and found that the addition of new facilities and removal/refinement of proposed facilities resulting from the Value Planning provides the same challenges to providing an accurate estimate of mitigation requirements (see Attachment 1 of Sites Project Value Planning Alternatives Appraisal Report [2020]).

3.0 Value Planning Alternatives

As described above, 16 new alternatives have been developed during the value planning effort. Table C1-3 below presents the differences among each alternative, including cost, size of reservoir, diversion, conveyance, bridge and road considerations, and type of dam.

Table C1-3. Alternatives Considered During Value Planning

Features	Value Planning Alternatives															
	1	2	3	4a	4b	5a	5b	6a	6b	VP1	VP2	VP3	VP4	VP5	VP6	VP7
Cost ($billions)	$4.0	$4.0	$3.9	$3.8	$3.9	$3.5	$3.9	$3.4	$3.6	$3.3	$2.8	$3.3	$3.0	$2.7	$2.9	$2.9
Savings from 1.8 MAF Alternative D ($billions)	$1.2	$1.2	$1.3	$1.4	$1.3	$1.7	$1.3	$1.8	$1.6	$1.9	$2.3	$1.9	$2.1	$2.4	$2.2	$2.2
1.5 MAF Reservoir	•	•	•	•	•	•	•	•								•
1.3 MAF Reservoir									•	•	•	•	•	•	•	
Funks/Sites PGP	•	•		•	•	•	•									
Funks PGP											•	•	•	•	•	•
TRR and TRR PGP	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
TCRR with Pumping Plant and Pipeline			•					•	•	•						
Delevan Canal/Pipeline Release	•	•	•	•	•											
Delevan Pipeline												•				
Dunnigan Pipeline to CBD Release (750 cfs)						•		•		•	•					
Dunnigan Pipeline to CBD Release (1,000 cfs)														•		•
Dunnigan to River Release (750 cfs)							•		•							
Dunnigan Pipeline to River Release (1,000 cfs)													•		•	
Bridge (sized for 1.3 MAF)									•		•	•	•			
Bridge (sized for 1.5 MAF)	•		•	•	•	•	•	•		•				•	•	•
South Road to Lodoga		•														
South Road to Local Residents	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
Rockfill Embankment Dam	•	•	•			•	•									
Earthfill Dam				•				•	•	•	•	•	•	•	•	•
Hardfill Dam					•											

Note: Alternatives VP1, VP2, and VP3 were also evaluated at 1.0 MAF and 1.5 MAF. Alternative VP4 was also evaluated at 1.5 MAF.

Acronyms: PGP – pumping/generating plant; TCRR – Tehama-Colusa regulating reservoir; CBD – Colusa Basin Drain

3.1 Alternative 1

Compared to Alternative D in the EIR/EIS, Alternative 1 reduces the size of the reservoir to 1.5 MAF and uses a multi-span bridge to reduce costs (Figure C1-1 in Appendix A of main report). The other features are generally consistent with Alternative D, including a facility at Funks Reservoir, Delevan Canal, construction of a multi-spanning bridge and southern road for local residents, and conveyance of water through a pipeline to the Sacramento River.

It is assumed that the Delevan Canal would have a maximum capacity of approximately 750 cubic-feet-per-second (cfs) of water.

They key difference between Alternative D and Alternative 1, is that a new diversion facility at Delevan on the Sacramento River is not proposed. Only an outlet is proposed.

3.1.1 Species Potentially Affected

Alternative 1 would potentially affect the same species and critical habitat as Alternative D due to the same relative magnitude of impacts associated with the Project footprint and operations.

3.1.2 Permits and Approvals Required

Like Alternative D, the same environmental permits and approvals identified for Alternative D (Table C1-2) would be required for Alternative 1. There would be little, if any, substantial change in timing or cost of these permits due to the same relative magnitude of impacts associated with the Project footprint and operations.

3.1.3 CEQA/NEPA Considerations

The reduction in reservoir size may reduce effects to inundated cultural, biological, and land use (agricultural) resources but not to less-than-significant levels. A Delevan Canal rather than pipeline could increase significant and unavoidable effects to agriculture through severing parcels and leaving portions of parcels with challenging access for large agricultural equipment or leaving smaller parcels that would no longer be economically viable for production.

3.1.4 Mitigation Differences and Considerations

Due to this alternative's similar relative magnitude of impacts associated with the Project footprint and operations, the challenges of detailed costing for mitigation identified within Attachment 1 continue to place the approximate cost of mitigation at $500 million (ICF [2020] memorandum in Attachment 1). However, some mitigation costs associated with facilities that would not be built (i.e., Delevan diversion) or reduced in size (i.e., smaller construction footprint of river outfall pipeline) would result in some level of mitigation cost savings compared to those of Alternative D. These costs could be developed once a final Value Planning Alternative is selected and some level of initial design detail of the Project footprint is completed. Considerations for seeking to avoid and/or minimize impacts to the extent possible during the design process would also be important to reducing mitigation cost.

3.1.5 Summary of Score

Table C1-4, *Relative Permitability of Each Alternative Compared to Alternative D*, provides a comparison of relative permitting difficulty of each Value Planning Alternative to that of Alternative D (0 = more difficult; 1 = approximately the same; 2 = slightly less difficult; 3 = moderately less difficult). To provide a comparable permitability estimate Table C1-4 holds permitting regulations static from the time when the Draft EIR/EIS was first published (2017) and does not take into consideration new regulations, modeling or other changes in baseline conditions that would prevent an equitable relative comparison between Alternative D and a Value Planning Alternative.

Using the scoring methodology provided in Table C1-4, with no Delevan diversion, a slightly smaller inundation area (smaller size), a narrower easement to river and a river outfall/outlet, Value Planning Alternative 1 is relatively less difficult to permit than Alternative D with a total score of 15 points and an average score of 1.88.

3.2 Alternative 2

Alternative 2 (Figure C1-2 in Appendix A) is very similar to Alternative 1. Alternative 2 uses the southern road to the town of Lodoga in place of the multi-span bridge. Like Alternative 1, it is assumed that approximately 750 cfs of water would be conveyed to the Sacramento River through the Delevan Canal and pipeline. No diversion facility is proposed at Delevan on the Sacramento River.

3.2.1 Species Potentially Affected

Alternative 2 would potentially affect the same species and critical habitat as Alternative D due to the very similar footprint.

3.2.2 Permit Considerations

Like Alternative D, the same environmental permits and approvals would be required for Alternative 2. Table C1-2 identifies the key permits and approvals required for Alternative 2.

3.2.3 CEQA/NEPA Considerations

Similar to Alternative 1, the reduction in reservoir size may reduce effects to inundated cultural, biological, and land use (agricultural) resources but not to less-than-significant levels. For the same reasons as identified for Alternative 1, a Delevan Canal rather than pipeline could increase significant and unavoidable effects to agriculture.

The proposed addition of the South Road to Lodoga would require additional studies to determine environmental effects but it is assumed that through the additional ground disturbance associated with road construction there would be an increase in potential environmental effects.

3.2.4 Mitigation Differences and Considerations

Due to this alternative's similar relative magnitude of impacts associated with the Project footprint and operations, the challenges of detailed costing for mitigation identified within Attachment 1 continue to place the approximate cost of mitigation at $500 million (ICF [2020] memorandum in Attachment 1). However, some mitigation costs associated with facilities that would not be built (i.e., Delevan diversion) or reduced in size (i.e., smaller construction footprint of river outfall pipeline) would result in some level of mitigation cost savings compared to those of Alternative D. These costs could be developed once a final Value Planning Alternative is selected and some level of initial design detail of the Project footprint is completed. Considerations for seeking to avoid and/or minimize impacts to the extent possible during the design process would also be important to reducing mitigation cost.

3.2.5 Summary of Score

Using the scoring methodology provided in Table C1-4, with no Delevan diversion, a slightly smaller inundation area (smaller size), a narrower easement to river and a river outfall/outlet, Value Planning Alternative 2 is relatively less difficult to permit compared to Alternative D with a total score of 15 points and an average score of 1.88.

3.3 Alternative 3

Alternative 3 (Figure C1-3 in Appendix A) eliminates the Sites Pumping/Generating Plant and replaces it with the TCRR and Pumping Plant near Road 69 in combination with an upgraded TRR to fill Sites Reservoir. Water would be released to the Sacramento River through a canal/pipeline to the Delevan release structure. The two-span bridge is used in this alternative.

Like Alternatives 1 and 2, it is assumed that approximately 750 cfs of water would be conveyed to the Sacramento River through the Delevan Canal and pipeline. No diversion facility is proposed at Delevan on the Sacramento River.

3.3.1 Species Potentially Affected

Alternative 3 would potentially affect the same species as Alternative D due to the similar footprint. The newly proposed facilities at the northernmost portion of the future reservoir is outside of the footprint already analyzed; however, the same species would be analyzed for potential Project effects.

3.3.2 Permit Considerations

Like Alternative D, the same environmental permits and approvals would be required for Alternative 3. Table C1-2 identifies the key permits and approvals required for Alternative 3.

3.3.3 CEQA/NEPA Considerations

Similar to Alternatives 1 and 2, the reduction in reservoir size may reduce effects to inundated cultural, biological, and land use (agricultural) resources but not to less-than-significant levels. For the same reasons as identified for Alternative 1, a Delevan Canal rather than pipeline could increase significant and unavoidable effects to agriculture through stranding parcels that would no longer be viable for production.

Replacement of the Funks/Sites Pumping/Generating Plant (PGP) with the TCRR and upgraded TRR PGP would result in the potential for similar environmental effects but in areas on the northeast side of the proposed reservoir.

3.3.4 Mitigation Differences and Considerations

Due to this alternative's similar relative magnitude of impacts associated with the Project footprint and operations, the challenges of detailed costing for mitigation identified within Attachment 1 continue to place the approximate cost of mitigation at $500 million (ICF [2020] memorandum in Attachment 1). However, more specific costs could be developed once a final Value Planning Alternative is selected and some level of initial design detail of the Project footprint is completed. Considerations for seeking to avoid and/or minimize impacts to the extent possible during the design process would also be important to reducing mitigation cost.

3.3.5 Summary of Score

Using the scoring methodology provided in Table C1-4, with no Delevan diversion, a slightly smaller inundation area (smaller size), a narrower easement to river and a river outfall/outlet, Value Planning Alternative 3 is relatively less difficult to permit compared to Alternative D with a total score of 15 points and an average score of 1.88.

3.4 Alternatives 4a and 4b

Alternatives 4a and 4b (Figures C1-4a and C1-4b in Appendix A) include the single Sites PGP with releases through the Delevan Canal/Pipeline. Alternative 4a uses an earthfill dam and Alternative 4b uses a hardfill dam in place of the zoned rockfill dam.

Like Alternatives 1 and 2, it is assumed that approximately 750 cfs of water would be conveyed to the Sacramento River through the Delevan Canal/Pipeline. No diversion facility is proposed at Delevan on the Sacramento River.

3.4.1 Species Potentially Affected

Alternatives 4a and 4b would potentially affect the same species as Alternative D due to the similar footprint.

3.4.2 Permit Considerations

Like Alternative D, the same environmental permits and approvals would be required for Alternatives 4a and 4b. Table C1-2 identifies the key permits and approvals required for Alternatives 4a and 4b.

3.4.3 CEQA/NEPA Considerations

Similar to Alternatives 1, 2 and 3, the reduction in reservoir size may reduce effects to inundated cultural, biological, and land use (agricultural) resources but not to less-than-significant levels. For the same reasons as identified for Alternative 1, a Delevan Canal rather than pipeline could increase significant and unavoidable effects to agriculture.

Proposed construction under Alternative 4a of an earthfill dam and under Alternative 4b of a hardfill dam rather than rockfill embankment dam would need to be analyzed for potential changes in environmental effects associated with construction technique (e.g., borrow on site versus hauling) and materials (e.g., onsite cement batch plant) including potential air quality, greenhouse gas, noise and transportation effects.

3.4.4 Mitigation Differences and Considerations

Due to this alternative's similar relative magnitude of impacts associated with the Project footprint and operations, the challenges of detailed costing for mitigation identified within Attachment 1 continue to place the approximate cost of mitigation at $500 million (ICF [2020] memorandum in Attachment 1). However, more specific costs could be developed once a final Value Planning Alternative is selected and some level of initial design detail of the Project footprint is completed. Considerations for seeking to avoid and/or minimize impacts to the extent possible during the design process would also be important to reducing mitigation cost.

3.4.5 Summary of Score

Using the scoring methodology provided in Table C1-4, with no Delevan diversion, a slightly smaller inundation area (smaller size), a narrower easement to river and a river outfall/outlet, Value Planning Alternative 4a and 4b are relatively less difficult to permit compared to Alternative D with a total score of 15 points and an average score of 1.88.

3.5 Alternative 5a and 5b

Alternatives 5a and 5b (Figures C1-5a and C1-5b in Appendix A) replace the Delevan Canal/Pipeline with a southern release near the southern terminus of the T-C Canal. Alternative 5a releases water to the CBD. Water released to the CBD would be conveyed through the lower portion of the CBD to the Sacramento River. Alternative 5b conveys water by canal to the CBD, then uses a siphon and pumping plant to convey water to the Sacramento River.

Under Alternatives 5a and 5b, the canal and pipeline being considered to convey water to either the CBD or Sacramento River would have a capacity of 750 cfs.

Compared to Alternative D, no diversion facility or outlet is proposed at Delevan on the Sacramento River.

3.5.1 Species Potentially Affected

Alternatives 5a and 5b would potentially affect the same species as Alternative D due to the similar footprint. However, due to new facilities, diversions, conveyance features proposed south of Dunnigan, new species have the potential to occur and may be affected by the construction and/or operation of the Project. California tiger salamander is known to occur in the vicinity of those Project features.

3.5.2 Permit Considerations

Like Alternative D, the same environmental permits and approvals would be required for Alternatives 5a and 5b. Table C1-2 identifies the key permits and approvals required for Alternatives 5a and 5b. However, a USFWS special-use permit would not be required for Alternatives 5a and 5b, as the Delevan Canal/Pipeline is not proposed.

3.5.3 CEQA/NEPA Considerations

Similar to the prior alternatives, the reduction in reservoir size may reduce effects to inundated cultural, biological, and land use (agricultural) resources but not to less-than-significant levels. Eliminating releases

through a Delevan pipeline or canal would potentially reduce agricultural effects in that area but effects would still be considered significant and unavoidable for the Project as a whole due to effect of the reservoir inundation.

Release from the southern terminus of the T-C Canal to the CBD would require additional study. This expands the direct impact area of the Project beyond what was previously analyzed in the Draft EIR/EIS. While it is assumed that significant and unavoidable effects identified in the Draft EIR/EIS would be the same or similar, the potential for new significant effects would need to be analyzed. Areas that would need to be considered would include, but may not be limited to, seepage along the CBD and ensuring and additional use of the CBD does not affect its existing water delivery, flood control and flood conveyance purposes.

3.5.4 Mitigation Differences and Considerations

Due to these alternative's similar relative magnitude of impacts associated with the Project footprint and operations, the challenges of detailed costing for mitigation identified within Attachment 1 continue to place the approximate cost of mitigation at $500 million (ICF [2020] memorandum in Attachment 1). However, more specific costs could be developed once a final Value Planning Alternative is selected and some level of initial design detail of the Project footprint is completed. Considerations for seeking to avoid and/or minimize impacts to the extent possible during the design process would also be important to reducing mitigation cost.

3.5.5 Opportunities Associated with the CBD Alternatives

Moving water through the CBD provides multiple opportunities under Alternative 5a. Recent activities within the lower portions of the CBD have included integrating floodplain agricultural and water delivery activities to create pulse flows containing plankton blooms to provide food for the federally listed Delta smelt. Under the pulse flow, water is redirected from the Sacramento River down the CBD, through the Knights Landing Ridge Cut Slough, past Wallace Weir, through the Yolo Bypass and into the Delta where it is utilized by Delta smelt and other planktivorus fish.

Additional mitigation opportunities that could be realized include upgrading and/or adding gauge structures along the CDB, upgrading of grade control facilities in the CBD to better control the flow of water and the acquisition of CBD lands from willing sellers that are prone to flooding that could be used for wetland and state and federal listed species mitigation for the Project. The potential to improve water quality in the CBD also exists and would also need to be assessed in detail.

3.5.6 Summary of Score

3.5.6.1 Alternative 5a

Using the scoring methodology provided in Table C1-4, with no Delevan diversion, a slightly smaller inundation area (smaller size), no pipeline easement to river, a shorter conveyance off T-C Canal, and northern regulating reservoir facilities, Value Planning Alternative 5a is relatively less difficult to permit compared to Alternative D with a total score of 19 points and an average score of 2.38.

3.5.6.2 Alternative 5b

Using the scoring methodology provided in Table C1-4, with no Delevan diversion, a slightly smaller inundation area (smaller size), no Delevan pipeline easement to river, an easement to the river off the T-C Canal, a river outfall and northern regulating reservoir facilities, Value Planning Alternative 5b is relatively less difficult to permit compared to Alternative D with a total score of 13 points and an average score of 1.63.

3.6 Alternative 6a and 6b

Alternatives 6a and 6b (Figures C1-6a and C1-6b in Appendix A) combine the TCRR and upgraded TRR with the southern release structure and an earthfill dam. More specifically, the TCRR pipeline and TCRR pumping

plant would be constructed to release approximately 2,100 cfs of water into the northernmost portion of the 1.5 MAF proposed reservoir.

Under Alternatives 6a and 6b, the canal and pipeline being considered to convey water to either the CBD or Sacramento River would have a capacity of 750 cfs.

Compared to Alternative D, no diversion facility or outlet is proposed at Delevan on the Sacramento River.

3.6.1 Species Potentially Affected

Alternatives 6a and 6b would potentially affect the same species as Alternative D due to the similar footprint. However, due to new facilities, diversions, conveyance features proposed south of Dunnigan, new species have the potential to occur and may be affected by the construction and/or operation of the Project. California tiger salamander is known to occur in the vicinity of those Project features.

3.6.2 Permit Considerations

Like Alternative D, the same environmental permits and approvals would be required for Alternatives 6a and 6b. Table C1-2 identifies the key permits and approvals required for Alternatives 6a and 6b. However, a USFWS special-use permit would not be required for Alternatives 5a and 5b, as the Delevan Canal/Pipeline is not proposed.

3.6.3 CEQA/NEPA Considerations

As noted above, these alternatives combine the TCRR and upgraded TRR under Alternative 3 with the southern release structure of Alternatives 6a and 6b.

Similar to the prior alternatives, the reduction in reservoir size may reduce effects to inundated cultural, biological, and land use (agricultural) resources but not to less-than-significant levels. Eliminating releases through a Delevan pipeline or canal would potentially reduce agricultural effects in that area but effects would still be considered significant and unavoidable for the Project as a whole due to effect of the reservoir inundation.

Replacement of the Funks/Sites PGP with the TCRR and upgraded TRR PGP would result in the potential for similar environmental effects but in areas on the northeast side of the proposed reservoir.

Release from the southern terminus of the T-C Canal to the CBD would require additional study. This expands the direct impact area of the Project beyond what was previously analyzed in the Draft EIR/EIS. While it is assumed that significant and unavoidable effects identified in the Draft EIR/EIS would be the same or similar, the potential for new significant effects would need to be analyzed. Areas that would need to be considered would include, but may not be limited to, seepage along the CBD and ensuring and additional use of the CBD does not affect its existing water delivery, flood control and flood conveyance purposes.

3.6.4 Mitigation Differences and Considerations

Due to these alternative's similar relative magnitude of impacts associated with the Project footprint and operations, the challenges of detailed costing for mitigation identified within Attachment 1 continue to place the approximate cost of mitigation at $500 million (ICF [2020] memorandum in Attachment 1). However, more specific costs could be developed once a final Value Planning Alternative is selected and some level of initial design detail of the Project footprint is completed. Considerations for seeking to avoid and/or minimize impacts to the extent possible during the design process would also be important to reducing mitigation cost.

3.6.5 Opportunities Associated with the CBD Alternatives

Moving water through the CBD under Alternative 6a has the potential to provide the same benefits as described under Alternative 5a (see section 3.5.5).

3.6.6 Summary of Score

3.6.6.1 Alterative 6a

Using the scoring methodology provided in Table C1-4, with no Delevan diversion, a slightly smaller inundation area (smaller size), no pipeline easement to river, a shorter conveyance off T-C Canal, and northern regulating reservoir facilities, Value Planning Alternative 6a is relatively less difficult to permit compared to Alternative D with a total score of 19 points and an average score of 2.38.

3.6.6.2 Alternative 6b

Using the scoring methodology provided in Table C1-4, with no Delevan diversion, a slightly smaller inundation area (smaller size), no Delevan pipeline easement to river, an easement to the river off the T-C Canal, a river outfall and northern regulating reservoir facilities, Value Planning Alternative 6b is relatively less difficult to permit compared to Alternative D with a total score of 13 points and an average score of 1.63.

4.0 Refined Value Alternatives

Further refinement to alternatives occurred during the Value Planning process. This resulted in the identification of following additional alternatives, VP1 through VP7. All of the refined value planning alternatives propose earthfill dams and include reservoir sizes that are less than the 1.8 MAF proposed under Alternative D. Similar to the prior alternatives, the reduction in reservoir size may reduce effects to inundated cultural, biological, and land use (agricultural) resources but not to less-than-significant levels. Construction of an earthfill dam rather than rockfill embankment dam would need to be analyzed for potential changes in environmental effects associated with construction technique (e.g., borrow on site versus hauling) including potential air quality, greenhouse gas, noise and transportation effects. All of the VP alternatives also propose the south road to local residents and a bridge crossing to serve the western side of the reservoir, similar to Alternative D and therefore assumed to have similar environmental effects.

4.1 Alternative VP1

In addition to design features noted above, Alternative VP1 (Appendix A) uses the TCRR and TRR to fill Sites Reservoir and water is conveyed from the T-C Canal into the CBD at a maximum rate of 750 cfs. VP1 proposes construction of a bridge sized for a 1.5 MAF reservoir.

Compared to Alternative D, no diversion facility or outlet is proposed at Delevan on the Sacramento River.

4.1.1 Species Potentially Affected

Alternative VP1 would potentially affect the same species as Alternative D due to the similar footprint. However, due to new facilities, diversions, conveyance features proposed south of Dunnigan, new species have the potential to occur and may be affected by the construction and/or operation of the Project. California tiger salamander is known to occur in the vicinity of those Project features.

4.1.2 Permit Considerations

Like Alternative D, the same environmental permits and approvals would be required for Alternative VP1. Table C1-2 identifies the key permits and approvals required for Alternative VP1. However, a USFWS special-use permit would not be required for Alternative VP1, as the Delevan Canal/Pipeline is not proposed.

4.1.3 CEQA/NEPA Considerations

Replacement of the Funks/Sites PGP with the TCRR and upgraded TRR PGP would result in the potential for similar environmental effects to those identified under Alternative D but in areas on the northeast side of the proposed reservoir.

Release from the southern terminus of the T-C Canal to the CBD would require additional study. This expands the direct impact area of the Project beyond what was previously analyzed in the Draft EIR/EIS. While it is assumed that significant and unavoidable effects identified in the Draft EIR/EIS would be the same or similar, the potential for new significant effects would need to be analyzed. Areas that would need to be considered include, but may not be limited to seepage along the CBD and ensuring and additional use of the CBD does not affect its existing water delivery, flood control and flood conveyance purposes.

4.1.4 Mitigation Differences and Considerations

Due to this alternative's similar relative magnitude of impacts associated with the Project footprint and operations, the challenges of detailed costing for mitigation identified within Attachment 1 continue to place the approximate cost of mitigation at $500 million (ICF [2020] memorandum in Attachment 1). However, more specific costs could be developed once a final Value Planning Alternative is selected and some level of initial design detail of the Project footprint is completed. Considerations for seeking to avoid and/or minimize impacts to the extent possible during the design process would also be important to reducing mitigation cost.

4.1.5 Opportunities Associated with the CBD Alternatives

Moving water through the CBD (750 cfs) under Alternative VP1 has the potential to provide the same benefits as described under Alternative 5a (see section 3.5.5).

4.1.6 Summary of Score

Using the scoring methodology provided in Table C1-4, with no Delevan diversion, a reduced inundation area, no pipeline easement to river and a shorter conveyance off the T-C Canal, Alternative VP1 is relatively less difficult to permit compared to Alternative D with a total score of 19 points and an average score of 2.38.

4.2 Alternatives VP2 and VP3

In addition to design features noted above, VP2 and VP3 (Figures VP2 and VP 3 in Appendix A) fill the reservoir using the Funks Reservoir and TRR and include a bridge sized for a 1.3 MAF reservoir. Primary changes are related to where and how releases occur. VP2 proposes releases of 750 cfs from the T-C Canal to the CBD via a pipeline at Dunnigan. VP3 proposes releases of 1,500 cfs to the Sacramento River via a Delevan Pipeline.

Compared to Alternative D, no diversion facility or outlet is proposed at Delevan on the Sacramento River under VP2.

4.2.1 Species Potentially Affected

Alternatives VP2 and VP3 would potentially affect the same species as Alternative D due to the similar footprint. However, due to new facilities, diversions, conveyance features proposed south of Dunnigan under VP2, new species have the potential to occur and may be affected by the construction and/or operation of the Project. California tiger salamander is known to occur in the vicinity of those Project features being considered under VP2.

4.2.2 Permit Considerations

Like Alternative D, the same environmental permits and approvals would be required for Alternatives VP2 and VP3. Table C1-2 identifies the key permits and approvals required for Alternatives VP2 and VP3. However, a USFWS special-use permit would not be required for Alternative VP2, as the Delevan Canal/Pipeline is not proposed.

4.2.3 CEQA/NEPA Considerations

Changes in bridge configuration under VP2 and VP3 and use of a Delevan pipeline for releases to the Sacramento River under VP3 would result in effects similar to those identified in the Draft EIR/EIS under Alternative D.

Eliminating releases through a Delevan pipeline or canal as proposed under VP2 would potentially reduce agricultural effects in that area but effects would still be considered significant and unavoidable for the Project as a whole due to reservoir inundation.

Releases from the southern terminus of the T-C Canal to the CBD proposed under VP2 would require additional study. This expands the direct impact area of the Project beyond what was previously analyzed in the Draft EIR/EIS. While it is assumed that significant and unavoidable effects identified in the Draft EIR/EIS would be the same or similar, the potential for new significant effects would need to be analyzed. Areas that would need to be considered would include, but may not be limited to, seepage along the CBD and ensuring that the additional use of the CBD does not affect its existing water delivery, flood control and flood conveyance purposes.

4.2.4 Mitigation Differences and Considerations

Due to this alternative's similar relative magnitude of impacts associated with the Project footprint and operations, the challenges of detailed costing for mitigation identified within Attachment 1 continue to place the approximate cost of mitigation at $500 million (ICF [2020] memorandum in Attachment 1). However, more specific costs could be developed once a final Value Planning Alternative is selected and some level of initial design detail of the Project footprint is completed. Considerations for seeking to avoid and/or minimize impacts to the extent possible during the design process would also be important to reducing mitigation cost.

4.2.5 Opportunities Associated with the CBD Alternatives

Moving water through the CBD under Alternative VP2 has the potential to provide the same benefits as described under Alternative 5a and 6a.

4.2.6 Summary of Score

Using the scoring methodology provided in Table C1-4, with no Delevan diversion, a reduced inundation area, no pipeline easement to river and a shorter conveyance off T-C Canal, Value Planning Alternative VP2 is relatively less difficult to permit compared to Alternative D with a total score of 19 points and an average score of 2.38.

However, with VP3 proposing to release of 1,500 cfs to the Sacramento River via a Delevan Pipeline, a Section 408 permit would be trigged. Alternative VP3 is relatively less difficult to permit compared to Alternative D with a total score of 15 points and an average score of 1.88.

4.3 Alternative VP4

Alternative VP4 (VP4 in Appendix A) fills the reservoir from Funks Reservoir and the TRR with releases of 1,000 cfs from the southern end of the T-C Canal into the CBD. Similar to Alternatives 6b, VP2, and VP3, VP4 has a bridge that is sized for a 1.3 MAF reservoir.

Compared to Alternative D, no diversion facility or outlet is proposed at Delevan on the Sacramento River under VP2.

4.3.1 Species Potentially Affected

Alternative VP4 would potentially affect the same species as Alternative D due to the similar footprint. However, due to new facilities, diversions, conveyance features proposed south of Dunnigan under VP4, new species have the potential to occur and may be affected by the construction and/or operation of the Project. California tiger salamander is known to occur in the vicinity of those Project features being considered under VP4.

4.3.2 Permit Considerations

Like Alternative D, the same environmental permits and approvals would be required for Alternative VP4. Table C1-2 identifies the key permits and approvals required for Alternative VP4. However, a USFWS special-use permit would not be required for Alternative VP4, as the Delevan Canal/Pipeline is not proposed.

4.3.3 CEQA/NEPA Considerations

Changes in bridge configuration under VP4 would result in effects similar to those identified in the Draft EIR/EIS under Alternative D.

Eliminating releases through a Delevan pipeline or canal as proposed under VP4 would potentially reduce agricultural effects in that area but effects would still be considered significant and unavoidable for the Project as a whole due to reservoir inundation.

Releases from the southern terminus of the T-C Canal to the Sacramento River proposed under VP4 would require additional study. This expands the direct impact area of the Project beyond what was previously analyzed in the Draft EIR/EIS. While it is assumed that significant and unavoidable effects identified in the Draft EIR/EIS would be the same or similar, the potential for new significant effects would need to be analyzed. In addition, the pipeline be constructed in proximity to federal project levees which may also require supplemental environmental analysis under NEPA for the Section 408 permitting process.

4.3.4 Mitigation Differences and Considerations

Due to this alternative's similar relative magnitude of impacts associated with the Project footprint and operations, the challenges of detailed costing for mitigation identified within Attachment 1 continue to place the approximate cost of mitigation at $500 million (ICF [2020] memorandum in Attachment 1). However, more specific costs could be developed once a final Value Planning Alternative is selected and some level of initial design detail of the Project footprint is completed. Considerations for seeking to avoid and/or minimize impacts to the extent possible during the design process would also be important to reducing mitigation cost.

4.3.5 Opportunities Associated with the CBD Alternatives

Moving water through the CBD under Alternative VP4 has the potential to provide the same benefits as described under Alternative 5a and 6a.

4.3.6 Summary of Score

Using the scoring methodology provided in Table C1-4, with no Delevan diversion, a reduced inundation area, a pipeline easement to the Sacramento River off the T-C Canal, VP4 is relatively less difficult to permit compared to Alternative D with a total score of 15 points and an average score of 1.88. Similar to VP3, a Section 408 permit would be triggered with construction of a pipeline on the levee, east of the CBD.

4.4 Alternatives VP5, VP6, and VP7

During a meeting of the Ad Hoc Value Planning Work Group on March 2, 2020, the proposed value planning alternatives were further refined. Three alternatives were recommended for consideration in determining the preferred project. Table C1-4 provides a summary of facilities under each alternative.

Table C1-4. Recommended Alternatives and Alternates

Major Facilities	VP5	VP6	VP7 Recommended
Reservoir Size	1.3 MAF	1.3 MAF	1.5 MAF
Bridge Size (avoids future traffic Interruption)	1.5 MAF	1.5 MAF	1.5 MAF
South Road to Local Residents	Included	Included	Included
Misc. Local and Project Roads	Included	Included	Included
Diversion Locations	Funks and TRR	Funks and TRR	Funks and TRR
Dunnigan Release	1,000 cfs to CBD	1,000 cfs to River	1,000 cfs to CBD

As indicated in Table C1-4, VP5, VP6, and VP7 (Figures VP5, VP6, and VP7 in Appendix A) all propose the use of Funks PGP, the TRR and TRR PGP, an earthfill dam and a bridge sized for a 1.5 MAF reservoir. However, VP5 and VP6 propose a 1.3 MAF reservoir size while VP7, identified as the recommended preferred alternative, proposes a 1.5 MAF reservoir. Both VP5 and VP7 would release 1,000 cfs from the T-C Canal to the CBD via a pipeline at Dunnigan. VP6 would release 1,000 cfs from the T-C Canal through a pipeline to the Sacramento River at Dunnigan.

4.4.1 Species Potentially Affected

Alternatives VP5, 6, and 7 would potentially affect the same species as Alternative D due to the similar footprint. However, due to new facilities, diversions, conveyance features proposed south of Dunnigan under VP5, VP6 and VP7, new species have the potential to occur and may be affected by the construction and/or operation of the Project. California tiger salamander is known to occur in the vicinity of those Project features being considered under the three alternatives.

4.4.2 Permit Considerations

Like Alternative D, the same environmental permits and approvals would be required for Alternatives VP5, VP6, and VP7. Table C1-2 identifies the key permits and approvals required for Alternative VP5, VP6, and VP7. However, a USFWS special-use permit would not be required for these alternatives, as the Delevan Pipeline/Canal is not proposed.

4.4.3 CEQA/NEPA Considerations

As noted above, eliminating releases through a Delevan pipeline or canal would potentially reduce agricultural effects in that area but effects would still be considered significant and unavoidable for the Project as a whole due to reservoir inundation. Effects related to bridge size and configuration would likely be similar to those identified in the Draft EIR/EIS for Alternative D.

Releases from the southern terminus of the T-C Canal to the CBD proposed under VP5 and VP7 would require additional study. This expands the direct impact area of the Project beyond what was previously analyzed in the Draft EIR/EIS. While it is assumed that significant and unavoidable effects identified in the Draft EIR/EIS would be the same or similar, the potential for new significant effects would need to be analyzed. Areas that would need to be considered would include, but may not be limited to, seepage along the CBD and ensuring that the additional use of the CBD does not affect its existing water delivery, flood control and flood conveyance purposes.

Releases from the southern terminus of the T-C Canal to the Sacramento River proposed under VP6 would also require additional study. This expands the direct impact area of the Project beyond what was previously

analyzed in the Draft EIR/EIS. While it is assumed that significant and unavoidable effects identified in the Draft EIR/EIS would be the same or similar, the potential for new significant effects would need to be analyzed. In addition, the pipeline would be constructed in proximity to federal project levees which may require supplemental environmental analysis under NEPA for the Section 408 permitting process.

4.4.4 Mitigation Differences and Considerations

Due to this alternative's similar relative magnitude of impacts associated with the Project footprint and operations, the challenges of detailed costing for mitigation identified within Attachment 1 continue to place the approximate cost of mitigation at $500 million (ICF [2020] memorandum in Attachment 1). However, more specific costs could be developed once a final Value Planning Alternative is selected and some level of initial design detail of the Project footprint is completed. Considerations for seeking to avoid and/or minimize impacts to the extent possible during the design process would also be important to reducing mitigation cost.

4.4.5 Opportunities Associated with the CBD Alternatives

Moving water through the CBD under Alternatives VP5, VP6, and VP7 has the potential to provide the same benefits as described under Alternative 5a and 6a.

4.4.6 Summary of Score

Using the scoring methodology provided in Table C1-4, with no Delevan diversion, a reduced inundation area, no pipeline easement to river and a shorter conveyance off T-C Canal, VP5 through VP7 is relatively less difficult to permit compared to Alternative D with a total score of 19 points and an average score of 2.38. VP6 would release 1,000 cfs from the T-C Canal through a pipeline to the Sacramento River at Dunnigan, thereby has a reduced total score for VP6 is 15 and an average score of 1.88.

Table C1-5. Relative Permitability of Each Alternative Compared to Alternative D

Permits	Alternatives															
	D (EIR/EIS)	1	2	3	4a and 4b	5a	5b	6a	6b	VP1	VP2	VP3	VP4	VP5	VP6	VP7
Federal																
Clean Water Act (404)	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Section 408	1	2	2	2	2	3	2	3	2	3	3	1	1	3	1	3
Federal ESA (NMFS and USFWS)	1	2	2	2	2	3	2	3	2	3	3	2	2	3	2	3
Section 106	1	2	2	2	2	3	2	3	2	3	3	2	2	3	2	3
State																
Clean Water Act (401) and Wetland Policy	1	2	2	2	2	2	1	2	1	2	2	2	2	2	1	2
California ESA	1	2	2	2	2	3	2	3	2	3	3	2	2	3	2	3
1602 Lake and/or Streambed Alteration Agreements	1	2	2	2	2	2	1	2	1	2	2	1	2	2	1	2
Water Right(s)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
sum of points	8	15	15	15	15	19	13	19	13	19	19	15	15	19	15	19
Average	**1.00**	**1.88**	**1.88**	**1.88**	**1.88**	**2.38**	**1.63**	**2.38**	**1.63**	**2.38**	**2.38**	**1.88**	**1.88**	**2.38**	**1.88**	**2.38**

Notes:
Relative Permeability Scale: 0 = more difficult; 1 = approximately the same; 2 = slightly less difficult; 3 = moderately less difficult
higher number - relatively easier to obtain permit/approval from regulatory resource agency compared to Alternative D

	No Delevan diversion, slightly smaller inundation (smaller size), narrower Delevan easement to river, river outfall
	No Delevan diversion, slightly smaller inundation (smaller size), no easement to river, shorter conveyance off T-C Canal, northern regulating reservoir facilities (6a)
	No Delevan diversion, slightly smaller inundation (smaller size), no Delevan easement to river, easement to river off T-C Canal and river outfall, northern regulating reservoir facilities (6b)
	No Delevan diversion, slightly smaller inundation (smaller size), no Delevan easement to river, easement to river off T-C Canal and river outfall, northern regulating reservoir facilities removed
	No Delevan diversion, slightly smaller inundation (smaller size), Delevan Canal/Pipeline easement to river, easement to river off T-C Canal and river outfall, northern regulating reservoir facilities removed

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Attachment C-1-1

Sites Reservoir Project: Review of Value Planning - Mitigation Cost Estimate

Update of 2016 Technical Memorandum & Evaluation of Value Planning Alternatives

March 23, 2020

Mr. John Spranza, MS, CCN
Senior Ecologist/Regulatory Specialist
HDR
2379 Gateway Oaks Drive, Suite 200
Sacramento, CA 95833

Subject: **Sites Reservoir Project: Review of Value Planning - Mitigation Cost Estimate Update of 2016 Technical Memorandum & Evaluation of Value Planning Alternatives 1 – 7 (VP1 – VP7)**

Dear Mr. Spranza:

Per your request, ICF has completed our review of the Value Planning technical memorandum (memo), dated October 11, 2019, that was developed by Sites Project team members as part of the initial review and evaluation of the mitigation measures and associated costs for the Sites Project alternatives. The stated purpose of the Value Planning memo was to review the mitigation cost estimate prepared in 2016 (AECOM 2016), based on the then preferred project Alternative C, and to refine the mitigation cost estimate, if possible, to consider the current project alternatives 1, 2, 3, 4a, 4b, 5a, 5b, 6a and 6b being considered in the Value Planning process. In addition to memo review, ICF also evaluated the potential impacts, mitigation measures and associated costs for the recently formulated Value Planning (VP) Alternative 1 – 7.

The memo was developed based on Site's Permitting Integration Team's initial review and applicability of the 2016 mitigation cost estimate, a mitigation planning analysis performed in 2019 by ICF International, and Alternatives developed during the Value Planning process, including most recent versions of Alternatives 6a and 6b.

The findings of the memo are consistent with ICF's 2019 review of the 2016 mitigation acreage assumptions and mitigation cost estimate for the project alternatives, including Alternative 6a, 6b, and VP1- VP7. As stated in the Value Planning memo, a detailed comparison of the 2016 mitigation cost estimate to the present-day project mitigation requirements cannot be performed with precision because 1) the project's impact assessment on terrestrial and aquatic resources, including listed species, has yet to be finalized, and 2) the associated mitigation ratios/acres have yet to be determined by the state and federal regulatory agencies. ICF also concurs with the memo's finding that review of existing analyses and mitigation cost estimates currently being used do not result in any significant changes in estimated mitigation costs (>$50M) when applied to the Value Planning Alternatives.

ICF's 2019 evaluation of the 2016 mitigation assumptions and mitigation cost estimate did not include the more recently developed Alternatives 6a and 6b or VP1 – VP7. A detailed evaluation and comparison of mitigation and mitigation costs associated with Alternatives 6a, 6b and VP1 – VP7

cannot be performed with precision because the project's impact assessment on terrestrial and aquatic resources, including listed species, has yet to be finalized. Based on an evaluation of aerial imagery available on Google Earth, Alternative 6a would appear to affect fewer terrestrial and aquatic resources and Alternative 6b could have impacts comparable to a Delevan diversion. Other considerations that will factor into future evaluations of mitigation and mitigation costs associated with Alternatives 6a, 6b and VP1 – VP7 include the following:

- Alternatives 6a and 6b would eliminate the proposed Delevan diversion and rely on other existing diversions and would include either a Dunnigan release to the Colusa Basin Drain (Alternative 6a) or the Sacramento River (Alternative 6b).
- VP4 and VP7 would both have 1.5 million acre feet (MAF) and therefore more impacts than the other five VP alternatives which would have 1.3MAF reservoirs.
- VP2 – VP7 would include a Funks Pumping/Generating Plant (PGP). Alternatives 1 – 6b and VP1 would not include a Funks PGP however the biological impacts associated with this PGP would not significantly increase the overall project related impacts.
- VP3 would include a Delevan Pipeline to the Sacramento River. VP1, VP2, VP5 and VP7 alternatives would include a Dunnigan Pipeline to Colusa Basin Drain releases and would therefore have fewer impacts associated than VP3. VP4 and VP6 alternatives would include a Dunnigan Pipeline to the River and impacts would likely be comparable to VP3.

Thank you for the opportunity to review the Value Planning technical memo and the recently formulated VP alternatives. Please contact Monique Briard or me if you have any questions.

Sincerely,

Harry Oakes

Harry Oakes
Senior Restoration Ecologist

cc: Monique Briard - ICF

Value Planning: Mitigation Cost Estimate Update of 2016 Technical Memorandum

Sites Reservoir Project

To:	Robert J. Kunde, P.E.
CC:	Jeff Herrin, AECOM
Date:	October 11, 2019
From:	John Spranza, HDR-Sites Integration
Reviewed by:	Jelica Arsenijevic, HDR-Sites Integration
Subject:	Mitigation Measure Evaluation and Cost Estimate Review of 2016 Technical Memorandum

1.0 Background

In October 2016, AECOM, on behalf of the Sites Project Authority (Authority), prepared a technical memorandum (TM) that presented the results of a mitigation measure evaluation and cost estimate that was developed as a planning-level tool for assessing costs associated with implementing select mitigation measures for the Sites Reservoir (AECOM 2016). The 2016 evaluation and cost estimate was based on the mitigation measures developed for North-of-the-Delta-Offstream Storage (NODOS) Mitigation Monitoring Plan (DWR and Reclamation 2013) and then applied to Alternative C, which are directly applicable in scale and magnitude to Alternative D that was included in the Joint Draft EIR/EIS. These estimates have also been included in the current cost planning and financing efforts that have been occurring for project.

A Value Planning effort has been undertaken by Sites Project members to revisit the current Project (Alternative D) and identify items and actions that could be included, excluded or undertaken to provide clarification on the following items:

A. ***Operational*** – as measured by the participants in the Reservoir Project committee based on the storage and delivery reports and progress on the Principles of Agreement with Reclamation and DWR
B. ***Permittable*** – as measured by the inclusion of the Sites Project in the California Water Resiliency Portfolio and by discussions with permitting agencies with CDFW and NMFS.
C. ***Affordable*** – as measured by the participants in the Reservoir Project committee based on the Affordability Analysis.
D. ***Feasible*** – as identified and addressed in the value planning activity and defined by the Authority Feasibility Criteria. This also includes the refinement of operational criteria and the further development of the Principles of an Agreement with Reclamation and DWR.

This memorandum (memo) summarizes HDR's Permitting Integration Team's initial review and applicability of the 2016 mitigation cost estimate, a mitigation planning analysis performed by ICF International (ICF 2019) and Alternatives developed during the Value Planning process to add to the evaluation process of A through D above.

2.0 Purpose

The purpose of this review is to evaluate the mitigation cost estimate included in the 2016 TM, refine the mitigation cost estimate if/where possible to (+/- $50M) and take into consideration the Alternatives being considered in the Value Panning process. To accomplish this and provide the appropriate context this memo includes: 1) a broad-level review of the line items included in the 2016 mitigation cost estimate; 2) mitigation acreage requirements, unit costs, total costs, and assumptions in the 2016 mitigation cost estimate to identify

and assess their applicability to the project's present mitigation needs and; 3) current market costs that were provided by ICF (2019).

It's important to note that this review is focused on large changes in mitigation liability based off of information that had already been prepared for the project. This evaluation is intended to provide the Sites Project Authority context in mitigation costing and a summary of the issues and concerns that result in the current wide-ranging estimates of mitigation costs during the Value Planning process. It is a gross relative estimation and is for comparison/discussion purposes during the Value Planning process only.

3.0 Alternatives Resulting from the Value Planning

The initial Value Planning meeting on October 2, 2019 identified both modifications to previously evaluated facilities and alternative facilities to reduce cost. To speed the analysis, nine alternatives were developed. They are listed below and in Table 1.

- ***Alternative 1*** – This alternative reduces the size of the reservoir to 1.5 MAF and uses a multi-span bridge to reduce costs. The other features are generally consistent with Alternative D.
- ***Alternative 2*** – This alternative is very similar to Alternative 1, but uses the southern road with the more direct route to Lodoga in place of the bridge.
- ***Alternative 3*** – This alternative eliminates the Sites Pumping/Generating Plant and replaces it with the Tehama-Colusa Regulating Reservoir (TCRR) and Pumping Plant near Road 69 in combination with an upgraded Terminal Regulating Reservoir (TRR) to fill Sites Reservoir. Water would be released to the Sacramento River through a canal/pipeline to the Delevan release structure. The canal portion would begin at the TRR and continue east to the Colusa Basin Drain (CBD). It would be necessary to siphon under the CBD and pump the water to the river. The two-span bridge is used in this alternative.
- ***Alternatives 4a and 4b*** – These alternatives include the single Sites Pumping/Generating Plant (PGP) with releases through the Delevan Canal/Pipeline. Alternative 4a uses an earthfill dam and Alternative 4b uses a hardfill dam in place of the zoned rockfill dam.
- ***Alternatives 5a and 5b*** – These alternatives replace the Delevan Canal/Pipeline with a southern release near the southern terminus of the T-C Canal. Alternative 5a releases water to the CBD. Water released to the CBD would be conveyed through the lower portion of the CBD to the Sacramento River. Alternative 5b conveys water by canal to the CBD, then uses a siphon and pumping plant to convey water on to the Sacramento River.
- ***Alternatives 6a and 6b*** – These alternatives combine the TCRR and upgraded TRR with the southern release structure and an earthfill dam. These alternatives appear to have the lowest construction cost.

Table 1. Initial Value Planning Alternatives for Consideration.

	Initial Alternatives								
Features	1	2	3	4a	4b	5a	5b	6a	6b
1.5 MAF Reservoir	•	•	•	•	•	•	•	•	
1.3 MAF Reservoir									•
Funks/Sites PGP	•	•		•	•	•	•		
TCCR and Upgraded TRR PGP			•					•	•
Delevan Canal/Pipeline Release	•	•	•	•	•				
Dunnigan Canal to CBD Release						•		•	
Dunnigan to River Release							•		•
Multi-Span Bridge	•		•	•	•	•	•	•	•
South Road to Lodoga		•							
South Road to Residents	•		•	•	•	•	•	•	•
Rockfill Embankment Dam	•	•	•			•	•		
Earthfill Dam				•				•	•
Hardfill Dam					•				

4.0 Review and Applicability of 2016 Cost Estimate to Alternative D and Value Planning Alternatives

This section provides a discussion of the estimated mitigation costs by resource category that resulted from the 2016 TM as well as a comparison of that estimate, and it's applicability to Alternative D. This then provides a basis for evaluating potential changes in mitigation costs of +/-$50M resulting from the Value Planning alternatives. As previously discussed, review is a gross relative estimation and is for comparison/discussion purposes during the Value Planning process only.

A detailed comparison of the 2016 cost estimate to the present-day project mitigation requirements cannot be performed with precision as the project's impact assessment and associated mitigation ratios/acres have yet to be finalized and determined by the state and federal regulatory agencies[1]. It is anticipated that this information will be obtained in 2020/21 during the permitting and agreement process. However, ICF (2019) did identify assumptions used for the 2016 AECOM TM and Cost Estimate (Table 2) that could result in changes in mitigation-related cost and should be re-evaluated as the project design and environmental documentation phases move forward. These changes are also applicable to any refinements resulting from the Value Planning process and could result in an increase or decrease to the overall $350M[2] – $500M[3] mitigation-related cost estimate. However, as discussed in the bullets below, ICF (2019) determined there are too many unknown variables to accurately estimate a percent change in total cost at the time their review was undertaken. Similarly, the HDR's Permitting Integration Team's current review and mitigation cost analysis continues to find that the addition of new facilities and removal/refinement of proposed facilities resulting from the Value Planning provides the same challenges to providing an accurate estimate of mitigation requirements.

Table 2. Initial 2016 Cost Estimation for Alternative C Mitigation

Habitat Type	Estimated Mitigation Costs
Construction-Related Mitigation[1]	
Vegetation Communities/Botanical Resources	$91,800,000.00
Wetlands/Surface Waters	$83,000,000.00
Aquatic Resources	$56,000,000.00
Wildlife Habitat	$53,000,000.00
Cultural/Historic/Paleontological Resources	$35,000,000.00
Land and Agriculture	$31,000,000.00
Air Quality	$200,000.00
Total Construction Mitigation	**$350,000,000.00**
Operational-Related Mitigation[2]	
Riverine-based species and habitats	$150,000,000.00
Total Estimated Mitigation	**$500,000,000.00**

Note: Total includes Mobilization and Contract Cost Allowances
[1]Source: Sites Reservoir Feasibility Study Technical Memorandum Mitigation Measure Evaluation and Cost Estimate, October 2016, AECOM
[2] Source: Estimate from WISP Application for Alternative D

- ***Project Alternative***: The 2016 TM was based on impacts for the Alternative C project features and presumed mitigation ratios required by the state and federal regulatory agencies in 2016. Alternative D is now the preferred project alternative. Although the two alternatives are similar, Alternative D includes components that were either not part of Alternative C or have been modified since the 2016 evaluation.

[1] California Endangered Species Act, federal Endangered Species Act and Clean Water Act
[2] $350M taken from the AECOM 2016 TM
[3] $500M taken from the updated estimate provided during the September 2019 Joint Workshop.

The addition of new facilities and removal/refinement of proposed facilities resulting from the Value Planning provides the same challenges.

- ***Impact Acreage***: The TM impact assessment for the proposed project, both Alternative D and any refinements resulting from the Value Planning continues to be under development and the total acreage of compensatory state and federal regulatory agency mitigation that will ultimately be required for the project is unknown. Therefore, a direct and accurate 1:1 comparison of mitigation measures related to impact/mitigation acreage to the current project alternative and Value Planning refinements cannot be developed at this time but a comparison that applies some general assumptions and analysis has been included below to provide the requested Value Planning update.
- ***Mitigation Ratios***: Mitigation ratios for Alternative D and any Value Planning refinements have yet to be determined by the regulatory agencies. Although some of the presumed mitigation ratios presented in the 2016 TM may ultimately be applied, some of the mitigation ratios in the "Estimate Worksheet" tables in Attachment 2 of the 2016 evaluation appear to be low and could be subject to change. For example, the mitigation ratio used for permanent impacts to the Blue Oak Woodland vegetation community is 1:1, current mitigation ratios required for onsite/offsite Blue Oak Woodland creation are higher that 1:1. Additionally, it is unknown at this time how mitigation ratios may be applied, or overlap, in terms of permanent/temporary impacts for vegetation communities and for special-status species mitigation. This information will be developed during the mitigation planning phase once a preferred project has been identified.
- ***Land Acquisition Costs***: Some of the mitigation measures assumed the purchase of land through fee-title or the establishment of conservation easement. The unit prices used in the 2016 evaluation for natural vegetation communities ranged from $2,500/acre for annual grassland to $3,000/acre for blue/valley oak woodland. The unit prices used in the 2016 evaluation for agricultural land cover types ranged from $2,000/acre for dryland grain and seed crops to $4,500/acre for deciduous orchards. It is likely that the land acquisition costs assumed in the 2016 evaluation have increased, or will have increased, by the time land is acquired for mitigation purposes. In some instances, higher-than-market prices may be realized because willing sellers could raise the asking prices based on the nature of the project and the conservation easement requirements that could be placed upon their lands.
- ***Mitigation Bank Credit Availability***: Based on the anticipated mitigation acreage required it is unlikely that there will be sufficient mitigation bank credits available for purchase on the open market to meet the need of Alternative D and/or any Value Planning refinements that may occur. It may be beneficial to develop a project specific bank(s) to address some of the mitigation requirements. Bank development costs were not assumed in the 2016 TM, although the mitigation bank unit prices per acre that were assumed may adequately cover bank development costs. Further investigation of mitigation banking feasibility and costs will occur during the mitigation planning phase once a preferred project has been identified.
- ***Vegetation Community Unit Costs***: The accuracy of the estimated costs based on present-day rates vary based on the type of habitat.
    - The unit cost for wetland habitats was based on mitigation bank credit prices and are comparable to present-day unit costs.
    - The unit cost for riparian restoration ($65,000) may be low because there are numerous variables that could factor in to restoring riparian habitat (e.g., grading costs, water costs).
    - Oak woodland mitigation is assumed to be covered by conservation easements of existing habitat. The current cost estimate does not include oak woodland creation which could be considerably higher than $3,000/acre.
- ***Onsite Mitigation and Associated Costs***: Costs assumptions for onsite mitigation were not included in the "Estimate Worksheet" tables in the 2016 evaluation and could not be reviewed. Onsite mitigation was assumed for impacts to streams and aquatic habitat and some terrestrial communities. Stream impacts are presented on an acreage basis as determined by stream length and width categories (e.g., streams 5-10 feet wide). Based on an assumed 2:1 mitigation ratio, a total of 455 acres of onsite stream restoration would be required. It is unknown if this mitigation could be restored/created onsite

and what level of planning and construction would be required to implement onsite restoration for streams, aquatic habitat and terrestrial communities.

- ***O&M Phase Mitigation Costs***: Table 3 in the 2016 TM summarizes the O&M mitigation phase costs. The total estimated annual cost was approximately $5.5 million. The estimate annual cost for some mitigation categories appears to be low and should be re-evaluated in more detail as project mitigation measures are developed and finalized (e.g., vegetation communities/botanical resources [$85,000]; wildlife habitat [$12,400]).
- ***Onsite Land Management***: Annual mitigation land management and monitoring costs for on-site restoration were assumed to be $400/acre. Onsite restoration monitoring was assumed to be required for 31 acres ($12,400/year). This cost appears to be low and should be re-evaluated in more detail as project mitigation measures are developed and finalized.
- ***Design Contingency***: Table 1 in the 2016 TM summarizes the cost estimate allowances and contingencies for mitigation costs and recommended that the design contingency be increased to 12% of project costs to account for design and scope changes and cost estimate refinements. This increase could cover costs of future opportunities and constraints analysis, mitigation site suitability assessments, and studies required to develop mitigation site plans (e.g., hydraulic studies, soil and rare plant surveys).
- ***Cultural Resources Costs***: The potential mitigation costs for each individual measure are estimates based on finding from surveys that still need to be conducted, conditions found during construction, and mitigation that will be developed during consultation so conducting a cost estimate at an individual measure level was not performed. However, the overall estimated cost of $27M should be sufficient for these variables.
- ***Air Quality Costs***: ICF (2019) confirmed that neither Colusa nor Glenn County currently have a voluntary offset program that will require annual mitigation fees to offset construction NOx emissions. The overall cost of $200,000 appears to be reasonable.

4.1 Potential Mitigation Cost Refinements for Value Planning

Construction-based Mitigation Costs

After assessing estimated relative changes in construction-based mitigation types and volumes among the Value Planning Alternatives no substantial changes (>$50M) in the costs of mitigation from those identified in the 2016 TM are readily apparent. The reason for this is twofold. First there is a general lack of readily available data on impacts by habitat/resource type for the Value Planning Alternatives which makes direct computational comparisons not possible. Second, when looked at as a package by each Alternative, construction-based impacts tend to have counterbalancing effects that nullify the overall increase/decrease of any specific effect.

An example of this is that Alternatives 1, 2, and 3 all have a change from a Delevan pipeline to a Delevan canal. While this may have substantial construction cost savings, the footprint of the two variations are approximately the same and although there would undoubtedly be a change in mitigation costs, that difference would be muted by the overall magnitude of the residual mitigation requirement. Table 3 provides an example of this for the changes estimated mitigation costs associated with impacts to vegetation communities. In this case, the largest difference between the all Alternatives is the size of the reservoir and the resulting effects to vegetation communities/botanical resources, which is the largest overall construction-related mitigation cost Table 3. The Alternative C and D reservoirs are 1.8 MAF and would impact 14,200 acres of annual grassland where Alternative 6b is 1.3 MAF impacting 12,500 acres of annual grassland. When those values are used in the calculation of potential annual grassland mitigation costs, it results in an approximate 9 percent reduction of annual grassland mitigation costs ($8.26M), which equates to an approximately 2.3 percent reduction in overall construction mitigation costs. Consequently, although a 1,700 acre reduction in grassland impacts is substantial, when working at such large scales it is a relatively small change in the overall project's estimated construction-related mitigation costs and the $350M estimate in Table 3 should be retained until additional analysis can be performed on a better-defined project description.

Operational-based Mitigation Costs

The removal of the Delevan diversion results in the elimination of a major operational component that would reduce the overall operational effects of the Value Planning Alternatives. It would eliminate the need for approximately $7.5M in aquatic studies (15 @$500k) as well as the cost of mitigating for the entrainment/impingement of fish at the diversion and mitigation costs associated with the diversion of up to 2,000 cfs from the River. Although the Alternatives would be taking less water overall, the place of diversion would be shifted upstream from a priority at Delevan, to Red Bluff and Hamilton City. As the River reach from below Keswick Dam to Hamilton City has a higher biological value to spawning and rearing salmonids, the reduction in overall pumping from three diversions to two does not directly relate to a net reduction in riverine effects and resulting mitigation costs due to the change in pumping locations and resulting effects on riverine resources. Review of existing modeling and analysis performed for the Joint draft EIR/EIS, Biological Assessment and CDFW 60-day negotiations, as well as discussions with the Jacobs modeling team has not resulted in the identification of any currently-available analysis that is reliable enough to identify and quantify the net change in potential operational-mitigation costs. Consequently, the $150M estimate in Table 3 should been retained until additional modeling can be performed.

Table 3. Mitigation Cost Comparison Example

Habitat Type	Estimated Mitigation Costs Alt C	Estimated Potential Change	Estimated Change in Costs
Construction-Related Mitigation[1]			
Vegetation Communities/Botanical Resources	$91,800,000.00	-9%	-$8,262,000.00
Wetlands/Surface Waters	$83,000,000.00		
Aquatic Resources	$56,000,000.00		
Wildlife Habitat	$53,000,000.00		
Cultural/Historic/Paleontological Resources	$35,000,000.00		
Land and Agriculture	$31,000,000.00		
Air Quality	$200,000.00		
Total Construction Mitigation	**$350,000,000.00**		
Operational-Related Mitigation[2]			
Riverine-based species and habitats	$150,000,000.00	unknown	unknown
Total Estimated Mitigation	**$500,000,000.00**	**-2.3%**	**-**$8,262,000.00

Note: Total includes Mobilization and Contract Cost Allowances
[1]Source: Sites Reservoir Feasibility Study Technical Memorandum Mitigation Measure Evaluation and Cost Estimate, October 2016, AECOM
[2] Source: Estimate from WISP Application for Alternative D

5.0 Findings

Review of existing analyses and mitigation cost estimates currently being used did not result in any significant changes in estimated mitigation costs (>$50M) when applied to the Value Planning Alternatives. While there will certainly be changes in cost among and between mitigation categories in Table 3 when a final project description is selected, until additional analysis can be performed on a specific project description the $500M estimate in Tables 2 and Table 3 should be retained.

6.0 Sources

AECOM. 2016. Sites Reservoir Feasibility Study Technical Memorandum Mitigation Measure Evaluation and Cost Estimate, October.

DWR and Reclamation 2013. Mitigation Monitoring Plan Costs for North-of-the-Delta Off stream Storage. Prepared for the California Department of Water Resource and United States Department of Interior, Bureau of Reclamation. Sacramento, CA. November.

ICF International. 2019. Mitigation Measure Evaluation and Cost Estimate Review of 2016 AECOM Technical Memorandum. May.

Appendix D – Repayment

Appendix D Financial Analysis in Support of March 2020 Value Planning

To:	Value Planning Work Group
CC:	JP Robinette
Date:	April 10, 2020
From:	Brian Grubbs
Quality Review by:	Doug Montague
Authority Agent Review by:	Lee Frederiksen
Subject:	Financial Analysis in Support of March 2020 Value Planning

1.0 Purpose and Background

This memorandum documents the financial evaluation of the delivered cost of water given variations in project facility configuration and operational flows in support of the Value Planning Analysis. Montague DeRose and Associates (MDA) provided the following analysis in support of the overall project affordability analysis for the Sites Project Authority (SPA).

- Review of public agencies similar to SPA to determine the potential credit rating for revenue bonds
- Review of historical tax-exempt revenue bond interest rates to determine a projected cost of borrowing for SPA
- Review of Bureau of Labor Statistics indices to determine appropriate escalation factors for construction and labor costs
- Development of an enterprise financial model (FM) to support projected revenues, expenses and appropriate cash balances during the design and construction and through project operations.

2.0 Analysis

2.1 Description of Scenarios

Scenarios analyzed consisted of various combinations of construction costs, hydrological conditions and financing options. AECOM and Jacobs coordinated to provide costs for 13 different facility cost scenarios based on reservoir size and amount of water available for release at FOB Holthouse. The financial model did not add additional costs for transportation of water past that point. These scenarios were entered in the financial model and run through potential financing options including with and without a Water Infrastructure Finance and Innovation Act (WIFIA) Loan of $1.1 billion. There was no funding from the US Bureau of Reclamation (USBR) assumed in these scenarios. The below table provides a summary of these scenarios with relevant details for financial modeling. Additional details of specific items to be constructed are provided in the engineering technical memorandum.

Scenario Name	Reservoir Size	Water Release at Holt House	Average Cost from AECOM Range
	(MAF)	(TAF)	(2019$ billion)

VP1	1.0	191	3.160
	1.3	230	3.386
	1.5	236	3.600
VP2	1.0	191	2.684
	1.3	230	2.910
	1.5	236	3.098
VP3	1.0	not analyzed	
	1.3	243	3.388
	1.5	253	3.602
VP4	1.0	not analyzed	
	1.3	234	2.927
	1.5	243	3.115
VP5	1.3	234	2.855
VP6	1.3	234	2.988
VP7	1.5	243	3.037

2.2 Methodology

MDA developed an enterprise financial model (FM) based on monthly cash flows of the expected revenue and expense streams. The difference between revenue and expense streams determines that amount of funding needed from external borrowing (revenue bonds) and the monthly cash flow modeling provides the timing of when those funds are needed. While many of the revenues are technically grants or loans, this document will refer to all sources of funds as revenues.

Funding Priority: The FM sets up two primary funds to transfer money for construction. The first is the Construction Fund. Inflows are (in order of priority based on lowest cost): WSIP funds, WIIN Act Funds (if available), Cash from Participants, Interim Loan Draws, WIFIA Loan Draws and finally revenue bond draws. Transfers from the Construction Fund will fund the Interim Loan Payoff at the end of Phase 2 and Construction Expenses. The model is programmed to maintain a minimum Construction Fund balance each month to reflect prudent cash flow management practices. When expenses would result in the monthly ending balance dropping below the minimum balance, draws are initiated from the available sources in priority order. Each year in June from 2023 to 2029, revenue bonds are issued to provide enough funds to cover expenses and not allow the Construction fund to fall below the minimum balance before the next revenue bond issue is sold.

The other fund utilized during project construction is the Revenue Bond Fund. Starting in June 2023, a revenue bond is issued to refinance the Phase 2 interim loan balance and provide funds (along with the other sources of revenue) to pay for construction expenses until the next revenue bonds are issued. The initial revenue bond sale in 2023 provides the initial deposit to the Revenue Bond Fund and each month a draw is made to transfer funds from the Revenue Bond Fund to the Construction Fund. Funds remaining in the Revenue Bond Fund earn interest at a short-term rate. Additionally, with each revenue bond offering, a portion of the proceeds will be deposited in a Revenue Bond Fund subaccount called the Debt Service Reserve Fund (DSRF) where it will be held for the benefit of revenue bondholders if there is ever a shortfall in debt service payments on revenue bonds. The DSRF balance earns interest at a long-term rate. These interest earnings add to the Revenue Bond Fund balance and are used pay construction costs. For the VP7 scenario (with WIFIA loan), the interest earned from 2023-2030 on the Revenue Bond Fund balance is projected to be $31 million. The interest earned on the DSRF from 2023-2030 is $5 million. Following the end of construction, interest earned in the DSRF is used to reduce the annual revenue bond debt service cost.

Construction Cost Expense: AECOM provided monthly pre-construction and quarterly construction cash flows for a 1.8 MAF reservoir in June 2018 in 2015$. These estimated cash flows were for January 2019 through June 2030. With guidance from AECOM, the Value Planning scenarios have a reduced construction schedule due to no longer constructing the Delevan Pipeline. Instead of starting construction in July 2022, it now begins

in July 2023. Construction is still completed in June 2030. This is seven years of construction as compared to the prior analysis having eight years of construction. AECOM provided scenarios of construction costs in 2019$, however these were not provided as monthly or quarterly cash flow, but instead for total costs for construction. As the total construction costs varied by scenario, the prior AECOM 2015$ monthly and quarterly cash flows were scaled with the Excel Goal Seek function to output the desired total cost in 2019$. Once 2019$ construction costs had been calculated, escalation factors were applied for inflation to determine total pre-construction and construction costs in nominal$. Pre-construction and construction nominal costs were further escalated by a 4.2% risk mitigation factor provided by AECOM to account for project delays or cost overruns. A sub-category in the construction costs of environmental mitigation costs was escalated for inflation, however it was not escalated by the risk mitigation factor, under guidance from AECOM.

The table below shows the cost schedule for the VP7 scenario (with WIFIA) in 2019$, the cost escalation factor used for escalating construction costs (pre-construction costs are escalated by a different percentage), and the total costs for the reservoir in nominal$. Additional detail on cost escalation is provided in the Assumptions section.

	Costs Schedule ($millions, 2019$)						**Percent Cost Escalation for Construction**		**Costs Schedule ($millions, nominal$)**				
	Pre Const	**Cons**	**Enviro**	**Risk Adder**	**Total**				**Pre Const**	**Cons**	**Enviro**	**Risk Adder**	**Total**
2021	75	-	-	3	78		4.1%		77	-	-	3	80
2022	84	-	-	4	88		6.2%		88	-	-	4	92
2023	64	182	13	10	270		8.3%		68	198	14	11	291
2024	-	431	22	18	471		10.5%		-	476	24	20	520
2025	-	439	10	18	467		12.7%		-	494	11	21	526
2026	-	367	10	15	393		15.0%		-	423	11	18	452
2027	-	367	10	15	393		17.3%		-	431	12	18	461
2028	-	367	10	15	393		19.7%		-	440	12	18	470
2029	-	367	10	15	393		22.1%		-	449	12	19	480
2030	-	184	5	8	196		24.6%		-	229	6	10	245
Total	**223**	**2,705**	**89**	**123**	**3,140**				**233**	**3,139**	**102**	**142**	**3,616**

Water Storage Investment Program (WSIP) Revenues: WSIP revenues are projected to total $816 million. WSIP revenues do not escalate for inflation or vary based on the size of the reservoir. The FM draws WSIP revenues to cover the construction expenses allocated to the State. Based on input provided by Larsen Wurzel & Associates, Inc., each March, 75% of the current year's costs allocated to the State are drawn and transferred to the Construction Fund. Also in March, an additional 20% of the prior year's costs are drawn and transferred to the Construction Fund. The final 5% of State allocated costs are drawn upon when significant construction points are completed which was estimated to occur every three years during construction. This formulation results in WSIP revenues being provided each year through 2030. The highest WSIP revenue year is 2026 when $139 million is provided.

Water Infrastructure Improvements for the Nation (WIIN Act) Revenues: In the Value Planning analysis no WIIN Act revenues are assumed.

US Department of Agriculture (USDA) Loan: In November 2018, the U.S. Department of Agriculture approved a $439 million USDA Community Facilities Direct Loan for the permanent financing of the Maxwell Intertie. The FM transfers the full USDA loan proceeds to the Revenue Bond Fund in December 2024 and treats the transfer as it would a transfer of the proceeds of a revenue bond sale. The USDA loan debt service is based on 40-year principal amortization starting in December 2025 and with last payment in December 2064. Per the USDA Letter of Conditions, a $10 million Depreciation Fund will be funded that "may be used only for emergency maintenance and for replacement of short-lived assets which have a useful life significantly

less than the repayment period of the loan." Additionally, a debt service reserve fund will also be funded to equal 10% of the annual loan debt service.

Interim Loan: To provide funds during the balance of Phase 2 an interim loan is modeled as a bank line of credit. Interest is due each month based on the outstanding balance of the bank line. Any un-utilized amount of the bank line is also charged a lower un-utilized bank fee. The first revenue bonds issued will refinance the principal balance of the interim loan.

Water Infrastructure Finance and Innovation Act (WIFIA) Loan: While the SPA has not yet applied for a WIFIA loan, a scenario run using the FM was the inclusion of a $1.1 billion loan. The main benefit of a WIFIA loan is the potential for a lower interest rate than revenue bond financing. Upon loan closing, the WIFIA loan rate will be set based on the yield of the US Treasury Bond that most closely matches the projected average life of the WIFIA loan plus 1 basis point (.01%). Once the loan is approved, the WIFIA loan performs like a line-of-credit that can be drawn upon over time. The FM assumes the first draw from the WIFIA line of credit occurs in June 2023 and because it is expected to have a lower borrowing cost than revenue bonds, it eliminates the need for any revenue bond financing for the next several years. Interest is due each month on the total amount drawn to date, with the amortization of the full amount beginning within five years of substantial project completion. The WIFIA loan must be fully repaid within 35 years of substantial project completion. The FM assumes the amortization will begin in 2030 with final payments made in 2064.

Revenue Bonds: To meet the construction draw schedule, revenue bonds are generally assumed to be issued each year in June from 2023 through 2029. The first issue in June 2023 is the largest as if must refinance the interim loan that paid for pre-construction costs as well as fund construction costs for the next year. For the VP7 scenario without a WIFIA loan this first revenue bond issue is $401 million. Follow-on issuances are less than $400 million each. The bonds are issued as 40-year bonds with interest-only payments until the project is complete. The first bonds issued in June 2023 have eight years of interest-only payments and 32 years of principal and interest payments. The last bond issuance in June 2029 has two years of interest-only payments and 38 years of principal and interest payments. All revenue bond principal payments begin in 2032 which is the "worst-case" year to begin water deliveries, assuming the reservoir takes two years to fill.

The funding schedule for VP7 scenario with and without a WIFIA loan is:

Funding Schedule ($millions, nominal$)					
	WSIP	**WIINACT**	**Revenue Bonds**	**USDA**	**WIFIA**
2020	8	-	-	-	-
2021	18	-	-	-	-
2022	10	-	-	-	-
2023	37	-	561	-	-
2024	97	-	-	439	-
2025	112	-	331	-	-
2026	139	-	327	-	-
2027	98	-	361	-	-
2028	100	-	350	-	-
2029	119	-	379	-	-
2030	79	-	-	-	-
Total	**816**	**-**	**2,309**	**439**	**-**

WIFIA - Funding Schedule ($millions, nominal$)					
	WSIP	**WIINACT**	**Revenue Bonds**	**USDA**	**WIFIA**
2020	8	-	-	-	-
2021	18	-	-	-	-
2022	10	-	-	-	-
2023	37	-	-	-	382
2024	97	-	-	439	423
2025	112	-	-	-	295
2026	139	-	118	-	-
2027	98	-	362	-	-
2028	100	-	352	-	-
2029	119	-	381	-	-
2030	79	-	-	-	-
Total	**816**	**-**	**1,213**	**439**	**1,100**

Following the construction of the project there will be ongoing operational revenues and expenses.

Operation, Maintenance and Repair Expenses: AECOM provided annual estimates of expenses for various categories of OM&R.

Fixed Expenses: These costs were split into Operation and Maintenance, and Administrative and General categories based on files from AECOM provided in June 2018. Updated expenses were provided for the

Value Planning in 2016$. These expenses were fixed and did not vary by the size of the reservoir. These costs, on a per AF basis, are higher for the smaller sized reservoirs. This is due to the fact that there is less water being released across which to spread the costs. The costs in 2016$ are escalated each year by the inflation rate as found in the assumptions section.

Variable Expense: These costs were split into sub-categories of Fill Wheeling Cost and Pumping Costs based on files provided by AECOM in June 2018. Updated expenses were provided in 2016$. These costs are impacted by the reservoir size as they are dependent on the amount of water passing through the reservoir. These costs were annualized and tied to the amount of water being filled for each reservoir size. The 2016$ costs were escalated each year by the inflation rate found in the assumptions section. Since each annualized cost is based on a projected level of water flows, when the water flows are adjusted by various operational scenarios the expense is scaled proportionally.

Electrical Generation Revenue: AECOM provided electrical generation revenue estimates in June 2018 and updated them in 2016$. These revenues are impacted by the reservoir size as they are a function of the amount of water being released. These revenues were annualized and tied to the amount of water being released for each reservoir size. The 2016$ revenues were escalated each year by the inflation rate found in the assumptions section. Since each annualized revenue is based on the projected level of water releases when the water releases are adjusted by various operational scenarios the revenue is scaled proportionally. Following AECOM scenarios, there are no pump-back operations in the Value Planning scenarios.

2.3 Assumptions

Item	Value	Notes
Interim Loan		
Interest Rate	3.00%	
Unutilized Rate	0.75%	
Revenue Bonds		
Interest Rate	5.00%	1
DSRF% of Maximum Annual Debt Service	50%	
DSRF Earnings Rate	4.00%	
Bond Fund Interest Earnings Rate	2.00%	
First Maturity	12/1/2032	
Final Maturity	6/1/2066	
USDA Loan		
Interest Rate	3.875%	
WIFIA Loan		
Interest Rate	3.500%	2
Construction Risk Mitigation Percentage	4.20%	3
Inflation Escalators		
Pre-Construction Escalation/year	1.50%	4
Construction Escalation/year	2.02%	5
Labor Inflation Rate/year	2.00%	6
Non-Labor inflation rate/year	2.00%	7
Electrical Generation Price Escalation/year	2.00%	8
Months for Generation post COD	24	

Note 1: Based on the 20-year average (Jul 1999-Jun 2019) of the Municipal Market Data Index of 30-year "AAA" rated municipal revenue bond issues. 40 basis points has been added to the interest rate to reflect the higher borrowing cost for an "A" rated water utility. The resultant average interest rate was 4.87%. The FM uses 5%.

Note 2: Based on the 10-year average of the 30-year Treasury Bond (Aug 2009-Jul 2019) and adding one basis point. This equaled 3.27%. The FM uses 3.50%.

Note 3: As provided by AECOM.

Note 4: Based on average of BLS Series PCU5416-5416, the PPI for management and technical consulting = 0.98% over last 10 years and BLS Series PCU5413-5413, the PPI for architectural and engineering services = 1.32% over last 10 years.

Note 5: Based on discussions with AECOM, based on the type of construction involved which is mainly the movement of dirt as opposed to construction of office buildings or hotels which would be a much higher rate. This amount is equal to 15% over seven years and is supported by the Army Corps of Engineers and the Bureau of Reclamation.

Note 6: Based on BLS Series CWUR0400SA0, the CPI for all West urban wage earners = 1.45 over last 10 years.

Note 7: Based on BLS Series CUUR0400SA0, the CPI for all West urban consumers = 1.53 over last 10 years.

Note 8: June-2018 NYMEX ticker for California ISO NP 15 peak and off-peak power was 3.6% per year over the next 54 months. MDA believes this is too high for conservative estimation of future revenues. MDA believes 2% per year escalation is more prudent.

2.4 Results

Additional details for these scenarios are provided in the attached file: “Sites Value Planning-FM-VP Alternatives - 04-10-2020.xlsx”

Scenario			VP1			VP2			VP3			VP4			VP5	VP6	VP7
Reservoir Size		(MAF)	1.0	1.3	1.5	1.0	1.3	1.5	1.0	1.3	1.5	1.0	1.3	1.5	1.3	1.3	1.5
Project Cost	(2019$)	($millions)	3,160	3,386	3,600	2,684	2,910	3,098		3,388	3,602		2,927	3,115	2,855	2,988	3,037
Project Cost	($nominal)	($millions)	3,784	4,055	4,311	3,214	3,485	3,710		4,057	4,313		3,505	3,730	3,419	3,578	3,637
Capital Funds																	
PWA (revenue bonds)	($nominal)	($millions)	2,529	2,800	3,056	1,959	2,230	2,455		2,802	3,058		2,250	2,475	2,164	2,323	2,382
PWA (USDA loan)	($nominal)	($millions)	439	439	439	439	439	439		439	439		439	439	439	439	439
Total PWA	($nominal)	($millions)	2,968	3,239	3,495	2,398	2,669	2,894		3,241	3,497		2,689	2,914	2,603	2,762	2,821
State (WSIP)	($nominal)	($millions)	816	816	816	816	816	816		816	816		816	816	816	816	816
Federal (WIIN Act)	($nominal)	($millions)	-	-	-	-	-	-		-	-		-	-	-	-	-
Capital Funds Percentage																	
PWA		(%)	78%	80%	81%	75%	77%	78%		80%	81%		77%	78%	76%	77%	78%
State		(%)	22%	20%	19%	25%	23%	22%		20%	19%		23%	22%	24%	23%	22%
Federal		(%)	0%	0%	0%	0%	0%	0%		0%	0%		0%	0%	0%	0%	0%
Annualized AF/year Releases																	
PWA NOD		(TAF)	44	53	55	42	52	54		56	59		53	55	52	53	55
PWA SOD		(TAF)	117	143	148	113	139	144		151	159		141	149	141	142	148
PWA		(TAF)	**161**	**196**	**203**	**155**	**191**	**198**		**207**	**218**		**194**	**204**	**193**	**195**	**203**
State		(TAF)	30	34	33	36	39	38		36	35		40	39	41	39	40
Federal		(TAF)	-	-	-	-	-	-		-	-		-	-	-	-	-
Total		(TAF)	191	230	236	191	230	236		243	253		234	243	234	234	243
PWA Annual Costs During Repayment																	
Debt Service (w/o WIFIA)	(2020$)	($millions)	124	135	146	99	111	121		136	147		112	121	108	115	117
Operating Costs	(2020$)	($millions)	16	19	19	16	18	19		19	20		18	19	18	19	19
Operating Revenue	(2020$)	($millions)	(1)	(2)	(2)	(1)	(2)	(2)		(2)	(2)		(2)	(2)	(2)	(2)	(2)
Total	(2020$)	($millions)	139	152	164	114	127	137		153	164		128	138	124	131	134
	(2020$)	**($/AF)**	**862**	**776**	**805**	**730**	**667**	**693**		**738**	**754**		**660**	**678**	**644**	**674**	**661**
With WIFIA Loan of $1.1 Billion (Operating Cost and Operating Revenue do not change)																	
Debt Service (w/WIFIA)	(2020$)	($millions)	114	125	136	89	101	110		125	136		102	111	98	105	107
Total	(2020$)	($millions)	129	142	153	103	117	127		143	154		118	128	114	121	124
	(2020$)	**($/AF)**	**799**	**724**	**755**	**665**	**614**	**642**		**689**	**708**		**608**	**628**	**592**	**622**	**611**
Cost Difference Due to WIFIA loan			(63)	(52)	(50)	(65)	(53)	(51)		(49)	(46)		(52)	(50)	(52)	(52)	(50)

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3.0 Limitations and Risks

All scenarios were prepared using a projected revenue bond interest rate of 5.00% and scenarios with WIFIA loans were based on a 3.50% loan rate. These interest rates are dependent on interest rate levels at the time of the initiation of each revenue bond series and the closing of the WIFIA loan, respectively. While current interest rates are lower than these projected rates, MDA used long-term historical averages to determine the most prudent interest rate for this analysis and then used a discount rate when necessary to provide costs in current dollars as desired by SPA.

The value of the results from this modeling is dependent on the quality and reasonableness of the inputs provided by the other members of the Sites project team. The FM is built as a cash flow model that incorporates the time value of money through interest rates and inflation escalators. If construction is delayed, pushing costs farther into the future, this will escalate those costs. Additionally, if State and Federal funds are not made available at the times and in the amounts projected in our modeling, the costs the Federal and/or State monies would have funded will need to be funded with additional revenue bonds or interim loans. This will increase costs. Likewise, if the construction schedule proves to be conservative and actual construction occurs ahead of schedule, this would have the potential to lower both construction costs and debt costs.

4.0 Conclusions and Recommendations

As with any long-term construction project steps can be taken to lower the final construction and borrowing cost. These include:

1. Reduction in the cost of construction.
2. Pursuit of the additional funding grants from State and Federal programs.
3. Pursuit of low interest loans such as WIFIA and similar programs such as the Reclamation Infrastructure Finance and Innovation Act (RIFIA). The analysis used a $1.1 billion WIFIA loan, however the WIFIA program may be able to provide more funds, if pursued.
4. Working to have grants and lower cost financing made available earlier in the construction period to reduce interim financing costs before permanent financing begins.
5. Increasing the strength of the Participant credit pool by either adding new rated participants to the project or increasing the percentage participation of existing rated Participants, allowing lower cost financing to be obtained in the credit markets.

Additionally, MDA recommends a review of the value of the future water Sites Reservoir will make available. Any financial decision is most easily understood when it can be brought down to the basics of revenue and expenses over time. The certainty of 30 years of un-escalating level debt service payments provides an opportunity for substantial value if the potential revenue stream is not level but increases each year with inflation. The analysis provided here has focused solely on the expenses in building the Sites Reservoir. If clarity can be obtained on the potential revenue stream (or avoided expenses) that the AF of released water represents then clarity can be obtained on the best financial course for participants to take.