Total Project Cost Summary Memorandum

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Contents

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Project feature	Projectwide
Prepared for:	Delta Conveyance Project (DCP) File
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Executive Summary

The Delta Conveyance Design & Construction Authority (DCA) prepared this memorandum to document the updated estimate of total project costs for the Bethany Reservoir Alignment of the Delta Conveyance Project. The updated estimate is being prepared to support strategic and feasibility evaluations being performed by the California Department of Water Resources (DWR) and participating Public Water Agencies. This document includes the rationale, assumptions, pricing sources, and other inputs to the estimating process that were used to develop the total project cost estimate.

The estimate is presented in 2023 dollars and is "undiscounted", an economic term meaning the value does not account for the time value of money. Reporting the estimate in 2023 dollars provides a base cost that allows DWR and participating Public Water Agencies to perform further economic analyses of costs and benefits in a manner that ensures consistency and comparability.

Total project costs include construction and other program costs associated with the following primary features:

- Two intakes (maximum 3,000 cfs each)
- Main Tunnel & Shafts
  - 36-foot-inside-diameter tunnel, 45 miles long
  - 11 Shafts including two double-launch shafts
- A 6,000-cfs Bethany Reservoir Pumping Plant (BRPP)
- Aqueduct from the BRPP to Bethany Reservoir
  - Includes four 15-foot-diameter pipelines
  - Tunneled crossing of Jones Penstocks and the Bethany Conservation Easement
- Discharge Structure to Bethany Reservoir
- Logistics works for access, levee improvements, power, utilities, communication, and site restoration

The total project cost estimate has been prepared in accordance with Association for the Advancement of Cost Engineering (AACE) guidelines and considers items such as labor, materials, equipment, level of effort, and other relevant cost items for a defined scope of work as described in the Environmental Impact Report (EIR) prepared by DWR and the supporting Engineering Project Report (EPR) prepared by the DCA. The updated cost estimate includes an appropriate level of contingency and risk treatment costs to manage uncertainty at the current conceptual stage of project development.

Following project approval, DWR directed DCA to consider potential design or construction innovations to further reduce community or environmental disturbances, schedule, and/or costs or improve constructability. This evaluation resulted in a set of potential reasonable and credible innovations which indicate potential savings when compared to the total project cost estimate. The innovations discussed herein do not represent changes to the project description presented in the EPR and analyzed in the EIR, but rather provide an indication of how normal design development processes can help manage costs for large infrastructure projects. As the innovation concepts advance, DWR will determine and document the need for any revisions to the project description, which will be used by DWR to determine if additional reviews will be required under CEQA and/or for project permitting.

Table ES-1 summarizes the total project costs for the 6,000-cfs Bethany Reservoir Alignment and potential reduced total project costs associated with the innovation concepts.

Table ES-1. Delta Conveyance Project Summary of Total Project Costs

Cost Category	Total Project Cost Estimate ($M[a])	Total Project Cost with Innovations ($M[a])
Construction Cost	$15,012	$14,008
Other Program Costs[b]	$5,108	$4,886
Total Project Cost	**$20,120**	**$18,894**

[a] Costs are in 2023 dollars and are undiscounted.

[b] Other Program Costs represent: Planning, Design, Construction Management, Land Acquisition, Environmental Mitigation, Settlement Agreement, and Community Benefits.

The total project cost estimate presented is primarily intended to support project financial and economic analysis and to provide guidance for further project development. The final costs of the project once constructed will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors.

1. Introduction

On December 21, 2023, California Department of Water Resources (DWR) approved the Delta Conveyance Project (DCP) and selected the Bethany Reservoir Alignment for further engineering, design, and permitting necessary to be completed prior to initiating implementation. DWR completed extensive environmental review and certified the Environmental Impact Report (EIR) (DWR, 2023) as compliant with the California Environmental Quality Act (CEQA).

This memorandum provides an estimate of total costs for the project to support strategic and feasibility evaluations being performed by DWR and participating Public Water Agencies. The updated cost estimate is presented in two primary categories: (1) Construction Costs, and (2) Other Program Costs. The costs presented are inclusive of all activities and work required for the project and provide the rationale, assumptions, pricing sources, and other inputs to the estimating process used to develop the cost estimate.

The estimate is presented in 2023 dollars, which provides a base cost that allows DWR and participating Public Water Agencies to evaluate potential costs and benefits using their own agency-specific approaches and methodologies and avoids potential conflicts with DCA escalation assumptions.

2. Project Scope of Work

This section describes the facilities and elements of work included in the estimate. The project scope of work aligns with the 6,000-cfs Bethany Reservoir Alignment as presented in the *Delta Conveyance Final Draft Engineering Project Report, Bethany Reservoir Alternative* (DCA, 2022) and updates to the Engineering Project Report (EPR) issued in November 2023 (DCA, 2023).

2.1 Layout

Figure 2-1 shows the following proposed conveyance facility features:

- **Intake C-E-3 and Intake C-E-5:** Two 3,000-cfs intakes located along the Sacramento River
- **Main Tunnel and Shafts:** 36-foot-inside-diameter tunnel, approximately 45 miles long, connecting C-E-3 and C-E-5 to the Bethany Reservoir Pumping Plant (BRPP) with 11 shafts along the alignment used for launching, reception, and maintenance (including the Surge Basin shaft)
- **Surge Basin Shaft and Surge Basin:** The Surge Basin Shaft is used as a reception shaft connecting the Main Tunnel to the Surge Basin and providing connection to the BRPP wet well inlet conduit
- **Bethany Reservoir Pumping Plant:** A 6,000-cfs pumping plant with wet well and dry pit structures housing 14 vertical centrifugal end suction type pumps
- **Aqueduct**: Four 15-foot-diameter parallel pipelines approximately 2.5 miles long each, which include 2 tunneled sections and vertical shafts at the connection to the Discharge Structure
- **Discharge Structure:** Located at Bethany Reservoir to discharge flow delivered from the Aqueduct into Bethany Reservoir which delivers water to the California Aqueduct
- **Logistics Works**: Includes access, levee improvements, power, utilities, communication, and site restoration to support construction of the project

Figure 2-1. Schematic of Project Features

Figure 2-2 shows the total alignment extending from the Intake facilities to the discharge structure facilities in Bethany Reservoir for delivery to the existing State Water Project.

The 6,000-cfs-project includes two river intake facilities on the Sacramento River, with on-bank intake structures and sedimentation basins that connect to the main tunnel via drop shafts. The main tunnel would be 36-foot-inside-diameter and approximately 45 miles long and would be constructed as four reaches driven in opposite directions from the Twin Cities Complex and Lower Roberts Island double-launch shafts. The tunnel drives would end at reception shafts at Intake 3, Terminous Tract, and the Surge Basin located at the BRPP. The other shafts would be used as maintenance shafts during tunnel construction and for future project operations and maintenance. The Surge Basin and BRPP at the southern end of the alignment connect to a four-pipeline aqueduct and discharge structure at Bethany Reservoir.

Figure 2-2. Project Map

Data Source: DCA, DWR

2.2 Project Schedule

A project schedule was developed to represent major phases of the project that includes permits, procurement, design, construction, and startup. The schedule was developed by estimating the duration of time required to complete the design and construction of each major project element along with the logical sequencing of activities required to complete the entire project such that testing and startup can occur in years 2043 and 2044 with the project becoming fully operational at the beginning of year 2045. Figure 2-3 shows the overall DCP schedule and logical sequences of the major project elements.

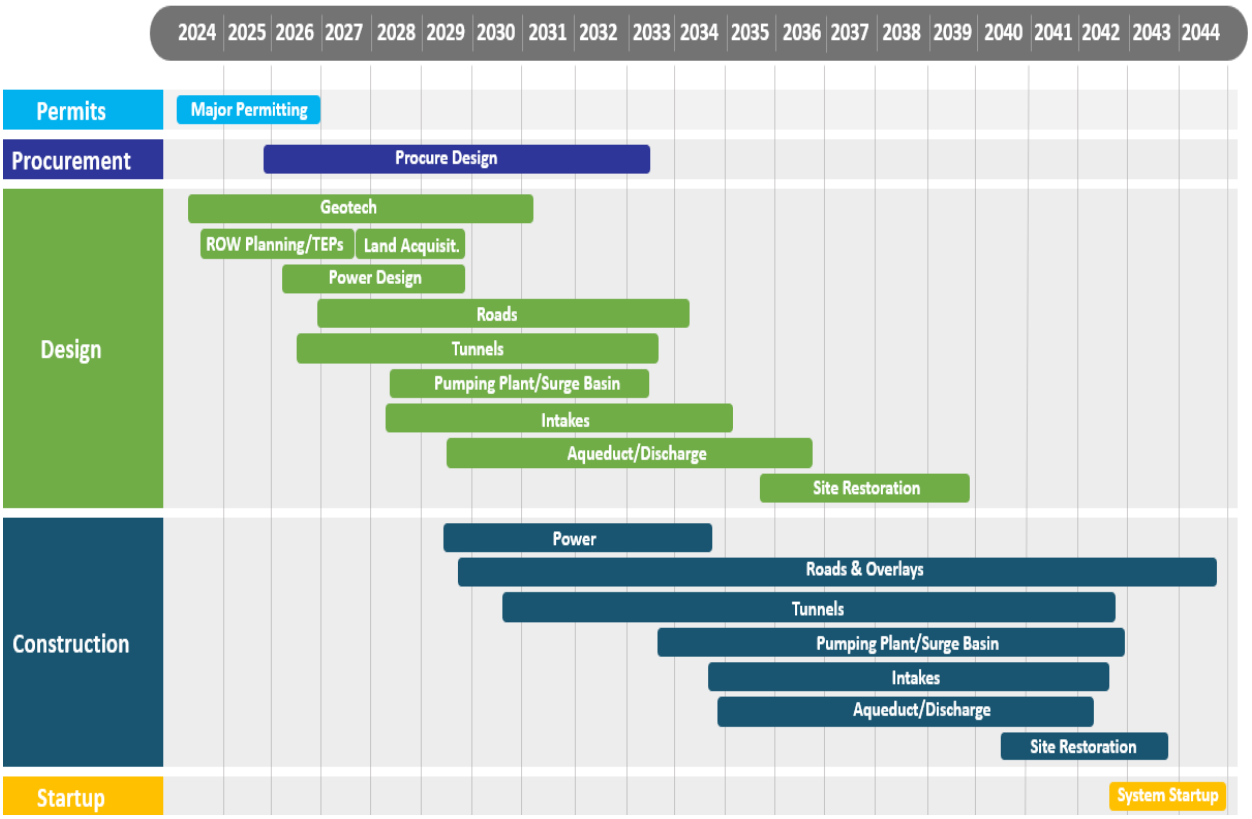

Figure 2-3. Delta Conveyance Project Schedule

3. Methodology and Estimate Classification

Total project costs for this estimate are divided into two categories: Construction Costs and Other Program Costs. The methodology used for developing the estimate and the estimate classification are presented below.

3.1 Methodology

The construction cost estimate has been prepared with quantities taken from drawings and other information contained in the EPR documents and, where applicable, has been adjusted to reflect the commitments described in the EIR. The construction cost estimate has been prepared with a crew-based estimating approach that uses materials, labor, and equipment crew estimates to complete work activities at the lowest level of detail for the anticipated method of construction as described in the EPR and EIR. Because of the scale and complexity of the project, a rigorous estimating approach was used to develop

the construction costs which included development of concept level drawings and technical memorandums, obtaining deterministic costs for unit rates and materials, replacing most of the cost allowances with actual estimates and material price quotes, and estimating the work based on the current understanding of subsurface ground conditions.

The other program costs were developed by considering the planning, design, and construction management labor costs (soft costs) and include all anticipated activities associated with delivering the project. Soft costs were developed by estimating the labor and level of effort over a given duration of time to complete the work, and other associated costs with these activities. The other program costs category of the estimate also includes costs for land, mitigation, power, the Contra Costa Water District (CCWD) Settlement Agreement, and the Community Benefits Program, which can be a mixture of direct, indirect, and labor costs.

Details of the construction costs are further presented in Section 4 and details of the other program costs are further presented in Section 5.

3.2 Estimate Classification

The DCA used the guidance provided in *17R-97: Cost Estimate Classification System Recommended Practice* (AACE, 2020) to determine the class of estimate. Based on the design stage and maturity, the project construction cost estimate generally categorizes as a Class 4 estimate, although some areas are considered Class 5. Appendix A, *Basis of Estimate-Construction Costs,* attached to this memorandum includes an Estimate Maturity Checklist that qualitatively evaluates the design maturity for individual project features. According to AACE 17R-97, estimate classification progresses down from Class 5 to Class 1 as project definition improves coinciding with improved expected accuracy (see Figure 3-1).

AACE guidelines provide anticipated accuracy ranges based on general and industry-specific benchmarking and empirical data. The total project cost estimate provides the DCA's opinion of the most probable cost. Due to the uncertainty associated with ground conditions along the tunnel alignment and industry experience with underground tunneling projects, DCA has assigned an accuracy range between +80% and -55% to the current cost estimate, but the far ends of the range have a much lower probability of occurrence than the most probable value. As illustrated on Figure 3-1, the accuracy range is expected to decrease as project definition improves and the estimate classification shifts towards Class 1.

The Class 4 estimate for the DCP is primarily presented to support project financial and economic analysis and to provide guidance for further project development. In general, the end use of cost estimates evolve over time – as the project definition increases from early conceptual design stages to final design, the end usage shifts from supporting strategic evaluations to funding authorizations and budgets to project control purposes. The final costs of the project once constructed will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors.

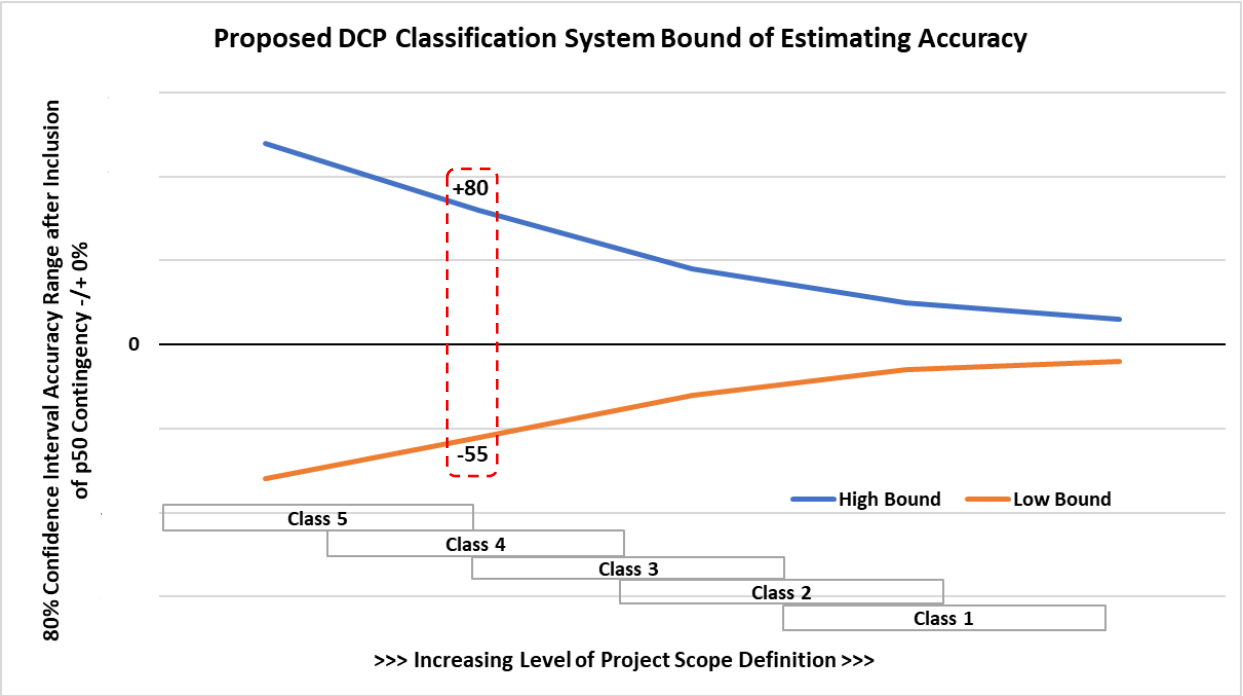

Figure 3-1. DCA Estimate Class within Range of Accuracy Modified from AACE 17R-97

4. Construction Cost Estimate

This section presents the construction cost estimate for the project including summaries of the major components and items considered while developing the estimate. Appendix A provides a more detailed breakdown and understanding of the construction cost estimate.

- **Cost Basis** – A variety of elements serve as the cost basis for the construction cost estimate, such as material prices, labor rates, equipment rates, productivity of construction crews, schedule, indirect costs, sales tax, contractor markup and profit, and other add-on costs (such as insurance and bonds). The estimate does not include escalation for the construction period and for future start dates. The prices in this estimate are in 2023 dollars.
- **Allowances** – Allowances are resources included in the estimate to cover the costs of known but undefined requirements for an individual activity or work item. The estimate recognizes the following allowances associated with the project:
  - Allowance for all diesel/gas-powered equipment to become zero emissions by 2035
  - Allowance for testing and commissioning of mechanical and electrical equipment before the systemwide commissioning
- **Risk Treatment Costs** – Risk treatment costs are included to account for identified risks associated with design and construction of the project and reflect potential costs beyond those developed by direct interpretation of the concept designs. Risk treatment costs also help manage potential risks by reducing threats and improving opportunities and have been developed based on industry standards, professional judgement and experience, and an assessment of uncertainties and potential risks for each major project feature.
- **Contingency** – In addition to risk treatment costs for each project feature, an overall construction contingency is applied to all project features beyond those directly accounted for in the estimate.

Contingency is an amount added to a construction cost estimate to account for uncertain items, conditions, or events that are likely to result in additional project costs. An assessment of project design maturity (i.e. approximately 10% level of design maturity overall) was completed along with an assessment of potential risks to determine the appropriate amount of contingency. An overall estimated construction cost contingency of 30% was included in the total project cost estimate.

4.1 Summary of Construction Estimate

Table 4-1 summarizes the construction costs and the risk treatment costs for each project feature. The 30% contingency is then applied to the summation of the estimated construction and risk treatment costs which results in an overall construction cost estimate for the project. Appendix A provides more details and a breakdown of the construction cost estimate.

Table 4-1. Summary of Construction Costs

Feature	Construction Estimate ($M[a])	Risk Treatment ($M[a])	Total Cost ($M[a])
Intakes	$1,660	$54	$1,714
Main Tunnels and Shafts	$6,018	$335	$6,353
Pumping Plant & Surge Basin	$2,496	$40	$2,536
Aqueduct Pipe & Tunnels	$541	$22	$563
Discharge Structure	$95	$4	$99
Access Logistics & Early Works	$241	$12	$253
Communication	$13	-	$13
Restoration	$17	-	$17
Subtotal Construction Costs [b]	**$11,081**	**$467**	**$11,548**
Construction Contingency (30%)			$3,464
Total Construction Cost Estimate [b]			**$15,012**

[a] Costs are in 2023 dollars and are undiscounted.
[b] The Total Construction Cost estimate excludes provision of electrical power supply and associated infrastructure to deliver power to work sites – these costs are included with the Other Program Costs.

5. Other Program Costs

In addition to construction costs, there are a series of other program costs that need to be included in the total project cost estimate. These have been grouped into two sub-categories:

1) Planning, design, and construction management costs (soft costs)
2) Other costs

Following is a summary of these other program costs.

5.1 Planning, Design, and Construction Management Costs

Planning, design, and construction management costs (soft costs) include labor and other direct and indirect costs associated with delivering the project. These represent what is often referred to as non-

construction professional services-related costs, or soft costs, of the project. Table 5-1 summarizes the categories and elements that represent the planning, design, and construction management activities.

Table 5-1. Planning, Design, Construction Management Cost Basis Categories

2023 Cost Basis Categories – Planning/Design/Construction Management
DWR Permitting & Oversight: • Engineering Standards Compliance • Program Controls Monitoring (Schedule and Budget) • Invoice Processing and Payment • Startup and Commissioning Support • Ongoing Environmental Permitting & Compliance Monitoring
DCA Permits & Agency Coordination: • Permit Coordination • Agency Coordination • Mitigation Monitoring & Reporting Coordination
DCA Program Management: • Executive Office (Human Resources, Legal, Finance, Program Office Direct Costs) • Program Management Leadership • Program Support (Assurances, Program Controls, Contracts/Procurement, Community Engagement)
DCA Engineering, Design, and Construction Management: • Engineering (Design Project Management/Technical Support, Construction Project Management/Technical Support, Geotechnical Exploration, Survey, Property Acquisition/Right-of-Way, Startup/Commissioning, Supplemental Programmatic Technical Services – Value Engineering, Hydraulic Modeling) • Design (Project Management, Basis of Design Reports, 30% Design, 60% Design, 90% Design, 100% Design, Independent Technical Review Coordination, Engineering Services During Construction, Startup/Commissioning Support) • Construction Management (Construction Project Management, Construction Oversite Services, Startup/Commissioning Support)

5.2 Other Costs

Other costs include items such as land acquisition, mitigation requirements, power, the settlement agreement and community benefits that are included as part of the overall cost of the project. Table 5-2 shows the different categories for these other costs.

Table 5-2. Other Cost Basis Categories

2023 Cost Basis Categories – Other Costs
Land: • Easements • Land Purchase
DWR Mitigation: • Tribal Monitoring • Mitigation Plans • Habitat Restoration Projects • Other Significant Mitigation
Power: • Design Services for Power Provided by Utility • Procurement/Construction of Infrastructure to Provide Power (SMUD, PG&E, WAPA) • Power Utilization Cost During Construction
Contra Costa Water District Settlement Agreement: • Agreed Cost Share (50-cfs pumping capacity)
Community Benefits: • Allowance for Community Benefits Program

The following points summarize the development and basis of the other costs:

- **Land Acquisition** – The land acquisition estimate is based on an estimate of costs to purchase the property and right-of-way to construct and operate the project. In addition to the property and rights-of-way costs, the estimate includes relocation assistance, utility relocation land costs, legal, and consulting fees.
- **Mitigation** – This estimate covers the environmental mitigation requirements outlined in the EIR and provided by DWR. These costs include items for Tribal monitoring, mitigation plan development, habitat mitigation (including compensatory mitigation), and other significant mitigation, as described in the EIR.
- **Power** – This item includes the costs for the design, procurement, and construction of the electrical infrastructure required to bring power to each project site from the major power utility companies in the project area. This item also includes the estimated cost associated with the electrical power consumption during construction. Primarily, this includes electrical consumption costs at the Intakes, Pumping Plant, and the Twin Cities Complex and the Lower Roberts Island double-launch shafts, where power is supplied for the tunnel boring machines. It also includes the power used during the commissioning and start-up of the overall conveyance system.
- **Contra Costa Water District (CCWD) Settlement Agreement** – This item includes the agreed cost share of $47 million for a 50-cfs pump station to be located at the Union Island Maintenance Shaft to transfer water to CCWD's existing facilities on Victoria Island.
- **Community Benefits Program** – This item is an allowance of $200 million to fund a community benefits program that would provide tangible benefits to local communities potentially effected by DCP construction approximately equal to 1% of the total project cost. Total actual benefits to the

community associated with implementation of the project are ultimately likely to represent a value beyond this funding commitment due to additional benefits associated with project leave behinds, job training and employment, local business participation, and other local and regional economic gains.

5.3 Summary of Other Program Costs

Table 5-3 summarizes the estimated cost associated with the other program costs. As noted in the table, an appropriate contingency between 15% to 30% has been added to each item based on whether it was a services-related or construction-related cost.

Table 5-3. Other Program Costs

Item	Estimated Cost ($M[a])
Planning, Design, Construction Management (Soft Costs)	
DWR Permitting & Oversight[b]	$426
DCA Program Management Office[b]	$668
DCA Engineering Management / Detailed Design / Construction Management[b]	$2,167
DCA Permitting and Agency Coordination[b]	$67
Other Costs	
Land[c]	$158
Mitigation[b,c]	$960
Power[c]	$415
CCWD Settlement Agreement	$47
Community Benefits Program	$200
Total Other Program Costs	**$5,108**

[a] Costs are in 2023 dollars and are undiscounted.

[b] Other Program Costs including soft costs and portions of the mitigation costs include a 15% contingency.

[c] Land and the construction related elements of Mitigation and Power costs include a 30% contingency.

6. Total Project Cost Summary

Table 6-1 summarizes the total project cost estimate for the project.

Table 6-1 Total Project Cost Summary

Feature	Total Cost ($M[a])	Percent of Construction (%)
Construction Costs		
Intakes	$1,714	Not Applicable
Main Tunnels	$6,353	
Pumping Plant & Surge Basin	$2,536	
Aqueduct Pipe & Tunnels	$563	
Discharge Structure	$99	
Access Logistics & Early Works	$253	
Communication	$13	
Restoration	$17	
Construction Subtotal	**$11,548**	
Contingency (30%)	$3,464	
Total Construction Cost	**$15,012**	
Other Program Costs		
DCO Oversite	$426	2.84%
Program Management Office	$668	4.45%
Engineering / Design /Construction Management	$2,167	14.44%
Permitting and Agency Coordination	$67	0.45%
Total Planning/Design/Construction Management	**$3,328**	**22.17%**
Land	$158	Not Applicable
DWR Mitigation	$960	
Power	$415	
CCWD Settlement Agreement	$47	
Community Benefits Program	$200	
Total Other Costs	**$1,780**	
TOTAL PROJECT COSTS	**$20,120**	

[a] Costs are in 2023 dollars and are undiscounted.

7. Total Project Costs with Innovations

Following project approval, DWR directed DCA to further evaluate several project features presented in the EPR/EIR and consider potential design or construction innovations to improve constructability or further reduce community or environmental disturbances, schedule, and/or costs. This evaluation resulted in a set of potential innovations at this early conceptual stage of the project that are considered by the DCA to be reasonable and credible based on industry experience. The innovations discussed herein do not represent changes to the project description presented in the EPR and analyzed in the EIR, but rather provide an indication of how normal design development processes can help manage costs for large infrastructure projects. As the innovation concepts advance, DWR will determine and document the need for any revisions to the project description, which will be used by DWR to determine if additional reviews will be required under CEQA and/or for project permitting. Appendix B summarizes the considered innovations.

Innovation concepts were initially developed by the DCA through a screening process that evaluated compatibility and appropriateness given the current level of project definition. The resulting 19 innovation concepts were then advanced into initial concept design to support an analysis of potential cost savings compared to those taken from drawings and other information contained in the EPR and EIR documents.

Table 7-1 presents the estimated construction cost savings for the combined set of innovations, grouped by project feature, reflecting reductions in construction quantities, crews, and equipment. The total construction cost savings includes a proportionally scaled portion of risk treatment cost (see Table 4-1).

Table 7-1 Construction cost savings from recommended combined set of innovations

Feature	Construction Cost Savings ($M[a])	Risk Treatment Cost Savings ($M[a,b])	Total Construction Cost Savings ($M[a])
Intakes	$35	$1	$36
Tunnels & Shafts	$211	$12	$223
Pumping Plant & Surge Basin	$370	$6	$376
Aqueducts	$75	$3	$78
Discharge Structure	$40	$1	$41
Logistics	$18	$1	$19
Total	**$749**	**$24**	**$773**

[a] Costs are in 2023 dollars and are undiscounted.

[b] Risk treatment cost savings are estimated as a scaled proportion of construction cost savings relative to the Total Project Cost estimate for the Bethany Reservoir Alignment as depicted in the EIR/EPR.

Table 7-2 compares the total project cost estimate described in Section 6 to a potential total project cost estimate associated with these early innovation concepts. The cost reductions associated with the innovations (see Table 7-1) only account for potential reductions in construction costs including risk treatment costs. In order to provide an indication of the potential full cost savings of innovations as described in Appendix B, contingencies and other program costs were applied proportionally to the revised construction costs. The costs for land acquisition, mitigation, power, the CCWD settlement

agreement, and the community benefits program were not adjusted from the total project cost estimate described in Section 6 of this memorandum.

Table 7-2. Summary of Total Project Cost and Total Project Cost with Innovations

Feature	Total Project Cost ($M[a])	Percent of Construction (%)	Total Project Cost with Innovations ($M[a])
Construction Costs			
Intakes	$1,714	Not Applicable	$1,678
Main Tunnels	$6,353		$6,130
Pumping Plant & Surge Basin	$2,536		$2,160
Aqueduct Pipe & Tunnels	$563		$485
Discharge Structure	$99		$58
Access Logistics & Early Works	$253		$234
Communication	$13		$13
Restoration	$17		$17
Construction Subtotal	**$11,548**		**$10,775**
Contingency (30%)	$3,464		$3,233
Total Construction Cost	**$15,012**		**$14,008**
Other Program Costs			
DCO Oversite[b]	$426	2.84%	$398
Program Management Office[b]	$668	4.45%	$623
Engineering/ Design /Construction Management[b]	$2,167	14.44%	$2,022
Permitting and Agency Coordination[b]	$67	0.45%	$63
Total Planning/Design/Construction Management[b]	**$3,328**	**22.17%**	**$3,106**
Land	$158	Not Applicable	$158
DWR Mitigation	$960		$960
Power	$415		$415
CCWD Settlement Agreement	$47		$47
Community Benefits Program	$200		$200
Total Other Program Costs	**$1,780**		**$1,780**
TOTAL PROJECT COSTS	**$20,120**		**$18,894**

[a] Costs are in 2023 dollars and are undiscounted.

[b] DCO Oversite, Planning, Design, and Construction Management costs are assumed to be the same percentage of construction as the total project cost estimate.

As shown in Table 7-2, reductions in construction effort associated with a set of reasonable and credible innovations identified at this early stage of design has the potential to reduce the total cost of the project

by $1.23B, or approximately 6%. Cost savings shown in Table 7-2 are limited to just those derived from changes in construction cost and proportional reductions in risk treatment costs and labor associated with planning, design, and construction management. Potential additional cost savings associated with innovations that were not considered in the analysis include:

- Reduced schedule durations for individual project features could reduce overhead costs and escalation impacts associated with individual components of the project.
- Reduced schedule durations for project features that affect the overall project schedule (i.e. "critical path" features) could potentially expedite the overall project construction timeline resulting in reduced overhead costs and escalation impacts. Expediting the overall project schedule could also bring the project into operation sooner.
- Innovations may reduce the impact of uncertainty within the cost estimate currently captured by risk treatment costs and project contingencies.
- Innovations may reduce the land required for construction and operations of the project, which could reduce land acquisition costs.
- Innovations may reduce the impacts of construction and operations, which could reduce mitigation requirements associated with the project.

The potential benefits of the identified innovations or future innovations should be further analyzed as project definition improves. Additional benefits of potential design or construction innovations to improve constructability or further reduce community or environmental disturbances, schedule, and/or costs savings associated with potential innovations could be realized but would require further analyses in coordination with DWR.

8. References

AACE International (AACE). 2020. 17R-97: Cost Estimate Classification System Recommended Practice. August 7.

California Department of Water Resources (DWR). 2023. Delta Conveyance Project Final Environmental Impact Report. December 2023. SCH# 2020010227.

Delta Conveyance Design and Construction Authority (DCA). 2022. Delta Conveyance Final Draft Engineering Project Report. Bethany Reservoir Alternative. May 2022.

Delta Conveyance Design and Construction Authority (DCA). 2023. Delta Conveyance Final Draft Engineering Project Report Update Bethany Reservoir Alternative. November 2023.

Appendix A
Bethany Reservoir Alignment Basis of Estimate – Construction Costs

Subject	**Bethany Reservoir Alignment Basis of Estimate – Construction Cost**
Project Feature	Project-wide
Prepared For:	Delta Conveyance Project (DCP) File
Prepared By:	Delta Conveyance Design and Construction Authority (DCA)
Copies To	California Department of Water Resources (DWR) / Delta Conveyance Office (DCO)
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1. Introduction

This memorandum prepared by the Delta Conveyance Design and Construction Authority (DCA) describes construction cost development methods and procedures for the Delta Conveyance Project Bethany Reservoir Alignment (Project). The documentation includes the rationale, assumptions, pricing sources, and other inputs to the estimating process used by the team in development of the construction cost estimate.

1.1 Purpose

The purpose of this document is to provide a construction cost estimate for the project as defined in the Final Environmental Impact Report (EIR) prepared by the California Department of Water Resources (DWR) and the supporting Engineering Project Report (EPR) prepared by the DCA. This document is in the form of a Basis of Estimate (BOE) and describes how construction costs have been developed for the Bethany Reservoir Alignment (6,000-cubic-foot-per-second [cfs] capacity) with the rationale, assumptions, pricing sources, and other inputs to the estimating process DCA used to develop the cost estimate. This estimate is presented in 2023 dollars and is "undiscounted", meaning the value does not account for the time value of money.

This BOE complies with Association for the Advancement of Cost Engineering International (AACE) *34R-05: Basis of Estimate Recommended Practice* (AACE, 2021). The estimate has been prepared using a standard process for a defined scope, as discussed within this report. DCA understands the assumed facility arrangements are at a conceptual planning level. As design development progresses, any potential changes are expected to be within the expected range of accuracy of the construction estimate.

Section 15 summarizes the total construction cost, and Attachments 1 and 2 provide more detailed breakdowns of the cost components.

Contingency has not been included and is being developed separately as part of the project cost management process.

This BOE is limited to the development of construction costs and excludes other program costs, such as planning, design, and construction management labor costs (soft costs), or other activities associated with delivering the project beyond the direct construction costs. This document also excludes the costs for providing electrical power and transmission to support the project, because those costs are being coordinated with the utility provider. All of these other program costs will be reported separately in the total project cost summary document, and thus are not included in this BOE.

1.2 Organization

This document is organized as follows:

- Introduction
- Project Scope of Work
- Estimate Methodology
- Estimate Classification
- Design Basis
- Planning Basis (Schedule)
- Cost Basis
- Allowances
- Assumptions
- Exclusions and Exceptions
- Program Risks
- Risk Treatment Costs
- Contingency
- Estimate Checking and Review
- Summary
- References
- Document History and Quality Assurance

1.3 Background

DCA completed Engineering Project Reports (EPRs) that presented conceptual engineering information for three potential conveyance alignments for the project: Central alignment, Eastern alignments, and Bethany Reservoir alignment (DCA, 2022a and DCA, 2022b). Updates to these reports were prepared in late 2023 (DCA, 2023a and DCA, 2023b). On December 21, 2023, DWR approved the project and certified the Environmental Impact Report (EIR) (DWR,2023). Based upon an extensive environmental review, as documented in the EIR, DWR selected the Bethany Reservoir Alignment for further engineering, design, and permitting.

This report provides the BOE for construction costs associated with the Bethany Reservoir Alignment for the 6,000-cfs flow capacity, as presented in the EPR and EIR.

1.4 Approach

This BOE complies with AACE *34R-05: Basis of Estimate Recommended Practice* (AACE 2021). It has been developed using a buildup of quantities for the key features where drawings and quantity information are available. Other less-defined elements of work have been developed with stochastic methods using judgment and experience, and these have been added to the estimate either as built-up or allowance items. The structure of the estimate assigns the work elements into a work breakdown structure (WBS) based on anticipated works contracts that are broadly based on the main discipline features and key site locations. The feature and WBS groupings are subject to revision as the project definition is further developed.

This BOE presents the key elements in a general north to south sequence, followed by the early site development and logistics works. Section 3 provides details about the construction estimate methodology. Note the following comments regarding the estimate:

- The estimate was prepared using 2023 prices.
- A preliminary set of construction activities has been developed in conjunction with the cost estimate for assessment of activity durations and interfaces.
- Lump sum allowances are included for elements of work where no design information was available or if the estimates were provided for items not included in the DCA scope.

2. Project Scope of Work

This section describes the facilities and elements of work included in this BOE. The project scope of work aligns with the 6,000-cfs Bethany Reservoir Alignment as presented in the *Delta Conveyance Final Draft Engineering Project Report, Bethany Reservoir Alternative* (DCA 2022b) and updates to the EPR issued in November 2023 (DCA 2023).

2.1 Layout

Figure 2-1 shows the following proposed conveyance facility features:

- **Intake C-E-3 and Intake C-E-5:** Two 3,000-cfs intakes located along the Sacramento River.
- **Main Tunnel and Shafts:** 36-foot internal diameter tunnel, approximately 45 miles long, connecting C-E-3 and C-E-5 to the Bethany Reservoir Pumping Plant (BRPP) with 11 shafts, inclusive of the surge basin shaft, along the alignment used for launching, reception, and maintenance.
- **Surge Shaft and Surge Basin:** Shaft is used as a reception shaft connecting the Main Tunnel to the Surge Basin and providing connection to the BRPP wet well inlet conduit.
- **Bethany Reservoir Pumping Plant:** A 6,000-cfs pumping plant with wet well and dry pit structures housing fourteen vertical centrifugal end suction type pumps.
- **Aqueduct**: Four 15-foot-diameter parallel pipelines approximately 2.5 miles long each, which include 2 tunneled sections and vertical shafts at the connection to the Discharge Structure.
- **Discharge Structure:** Located at Bethany Reservoir to discharge flow delivered from the Aqueduct.
- **Logistics works**: Including access, power, and utilities.

Figure 2-1. Schematic of Project features

The total alignment is illustrated on the project map (Figure 2-2), extending from the Intake facilities to the discharge facilities in Bethany Reservoir for delivery to the existing State Water Project.

The 6,000-cfs-project includes two river intake facilities on the Sacramento River, with on-bank intake structures and sedimentation basins that connect to the main tunnel via drop shafts. The main tunnel at 36-foot-inside-diameter (ID) and approximately 45 miles long, would be constructed as four reaches driven in opposite directions from the Twin Cities Complex and Lower Roberts Island double launch shafts. The tunnel drives would end at reception shafts at Intake 3, Terminous Tract, and the Surge Basin located at the BRPP, with all other shafts used as maintenance shafts during construction of the tunnel and for future project operations and maintenance. The Surge Basin and BRPP at the southern end of the alignment connect to a four-pipeline aqueduct and the discharge structure at Bethany Reservoir.

Figure 2-2. Project Map
Data Source: DCA, DWR

2.2 Features

2.2.1 Intakes

The intakes, C-E-3 (Intake 3 [or B per the EIR]) and C-E-5 (Intake 5 [or C per the EIR]), and associated sedimentation facilities are designed to divert up to 6,000 cfs (3,000 cfs maximum per intake) from the Sacramento River. Each intake consists of the following major components:

- Intake structure
- Thirty fish screens (T-screen option)
- Thirty 60-inch-diameter discharge pipes from Intake to Sedimentation basin
- Sedimentation basin
- Flow control and isolation gate structure
- Four sediment drying lagoons
- Appurtenant features

The two intake sites, along with sedimentation basin facilities, are located in the northern Delta along the Sacramento River near the town of Hood.

Figure 2-3 provides a conceptual rendering of one of the on-bank intake and sedimentation facilities. The intakes have on-bank cylindrical tee fish screens. The various control gates would be used to comply with the approach velocity of 0.2 foot per second (fps) at the fish screens and the 3,000 cfs maximum flow per intake. The sedimentation basins would be designed to remove sand-sized settleable solids before entering the conveyance system.

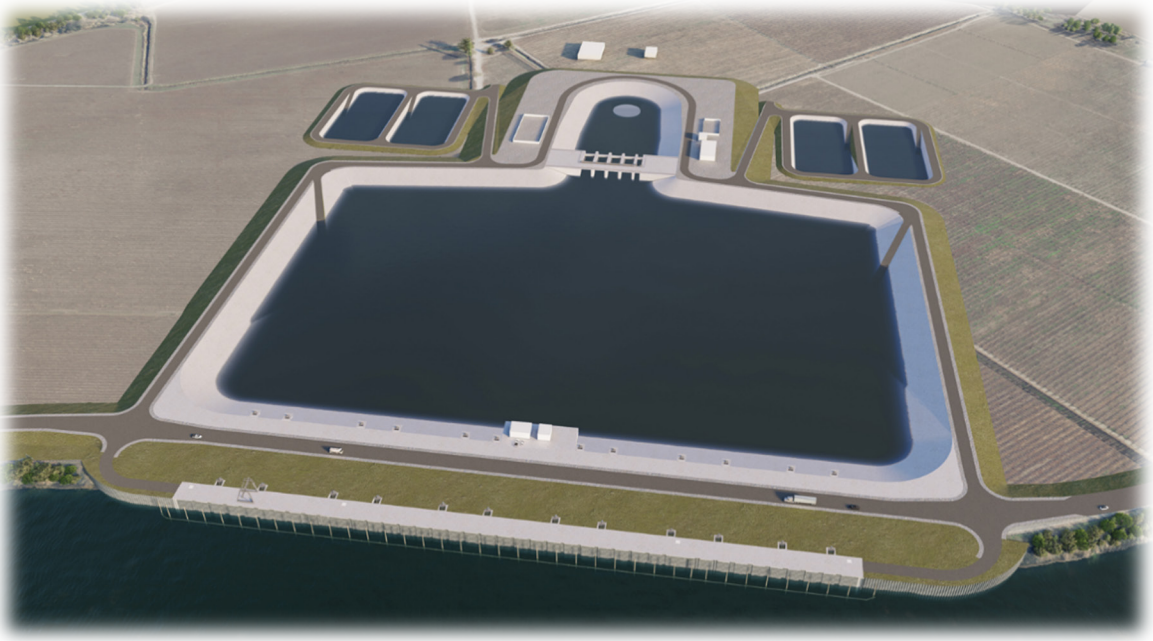

Figure 2-3. Conceptual On-bank Intake and Sedimentation Facilities

2.2.2 Tunnel and Shafts

The single main tunnel alignment is a 36-foot-ID tunnel, approximately 45 miles long and composed of four tunnel reaches. Each tunnel reach is driven between a launch and a reception shaft using a tunnel

boring machine (TBM). From Figure 2-2, there are two double launch shafts and three reception shafts. The launch shafts consist of two double launch shafts with interlocking 115-foot-ID shafts, named the Twin Cities Double Launch Shaft, and the Lower Roberts Island Double Launch Shaft. The reaches heading south from the Twin Cities Double Launch Shaft and north from the Lower Roberts Island Double Launch Shaft terminate into the Terminous Tract Reception Shaft with a 70-foot ID. The reach heading north from the Twin Cities Double Launch Shaft terminates at the C-E-3 Intake Reception Shaft with an 83-foot ID; this shaft also serves as an outlet shaft for Intake 3. The fourth tunnel reach, heading south from Lower Roberts Island Double Launch Shaft, terminates into the Surge Basin Reception Shaft with a 120-foot ID.

Between each launch and reception shaft, intermediate maintenance shafts, each at a 70-foot ID, are provided approximately every 5 miles, for a total of 6 maintenance shafts (Figure 2-2). These shafts are provided for TBM maintenance and temporary access during construction. The C-E-5 Intake Maintenance Shaft also serves as an outlet shaft for Intake 5 and is sized at 83-foot-ID.

The average shaft depth is approximately 180 feet, with an average tunnel invert depth of approximately 140 feet below existing grade (refer to the EPR conceptual drawings for detailed dimensions). These shafts would be constructed to a top elevation about 25 to 45 feet above existing grade for flood protection during tunnel construction and during operations. The shafts are also constructed to a top elevation to maintain the maximum water surface elevation expected within the shaft during a surge event caused by sudden stoppage of the pumping station.

Tunnel construction includes installing 6-foot-long precast concrete segmental lining rings. Each ring would consist of seven segments plus the key, with a thickness of about 18 inches.

2.2.3 Bethany Reservoir Pumping Plant Complex

The BRPP Complex covers all the works within the project area north of Kelso Road and before the aqueduct continues south toward the Bethany Reservoir. The main features included in the BRPP Complex include the Surge Basin Reception Shaft, Surge Basin, BRPP, inlet conduit connecting the reception shaft to the wet well within the BRPP, and the main deep box pumping plant with the aqueduct pipes between the box and the aqueduct interface at Kelso Road.

2.2.3.1 Surge Basin Reception Shaft

The Surge Basin Reception Shaft is a 120-foot-ID and 205-foot-deep structure that would first serve as the Main Tunnel reception shaft from the southern Lower Roberts Island Double Launch Shaft reach. Once the TBM is removed and the tunnel reach completed, the shaft would be modified to become the Surge Basin overflow structure and the connection to the inlet conduit to the pumping plant. The Main Tunnel connects to the base of the shaft and the inlet wet well conduit connects on the opposite side, approximately 65 feet higher in elevation.

2.2.3.2 Surge Basin

The Surge Basin structure is an open-top, rectangular, below-ground-level basin. The top of the basin would be at existing grade and the bottom elevation (top of floor slab) at about 30 or 40 feet below the ground surface (Figure 2-4).

The Surge Basin would be located immediately to the east of Mountain House Road and would contain an access ramp that would connect to an access road to Mountain House Road to facilitate the removal of the TBM and vehicle access during the construction and operation of the Surge Basin.

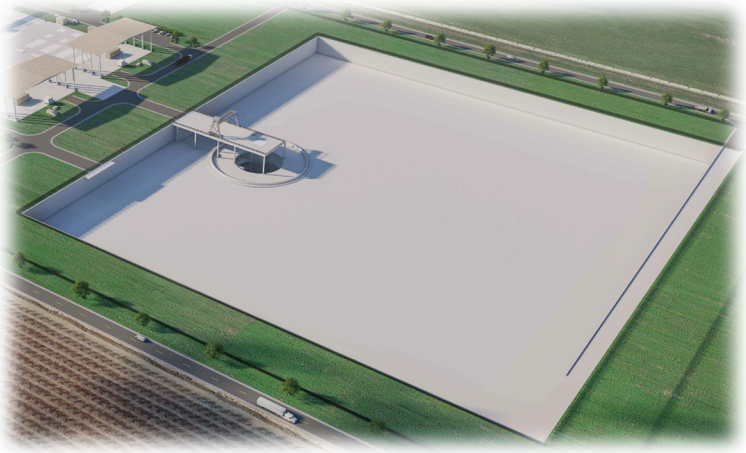

Figure 2-4. Surge Basin (Bethany)

The Surge Basin would normally be empty and would be used during infrequent hydraulic transient-surge events created by power failure or sudden stoppage to the pump station. Under these conditions, surge flows in the Main Tunnel would flow into the Surge Basin through the Surge Basin Reception Shaft. A circular weir wall with gates would be located around the top outlet of the shaft to allow water to overflow into the Surge Basin and prevent these overflows from immediately re-entering the tunnel.

The Surge Basin would include a gantry crane on a bridge structure between the southern edge of the basin and the vertical reception shaft. The bridge structure would include a removable panel, centered over the reception shaft, and a rail-mounted gantry crane that would be used to install portable submersible pumps and connect discharge piping into the reception shaft to dewater the tunnel.

2.2.3.3 Inlet Wet Well Conduit

The inlet wet well conduit would convey water from the Surge Basin Reception Shaft to the BRPP wet well. The inlet wet well conduit would be approximately 400 feet long, and 60 feet wide. Two sets of isolation bulkhead gates and openings would be provided in the inlet wet well conduit to isolate water flowing through the conduit and entering the BRPP wet well during inspection or maintenance, with double isolation provisions for the safety of the workers. The overhead-mounted gantry crane on the Surge Basin bridge structure would be used to install and remove the bulkhead panels.

2.2.3.4 Pumping Plant

The BRPP facilities would be adjacent to the surge basin (refer to Figure 2-5). The pumps lift water from a wet well hydraulically connected to the surge shaft via the inlet wet well conduit. The pumps would be operated to maintain the flow rate supplied into the tunnel at the northern Sacramento River intakes. The desired flow of the pumping plant would range from a minimum of 600 cfs to a maximum of 6,000 cfs, which would be achieved with fourteen 500-cfs pumps (12 duty pumps and 2 standby pumps).

The major components of the BRPP include the below-ground pumping plant and wet well, above-ground water surge tanks (open to atmosphere), electrical building, heating and air conditioning mechanical equipment yard, transformer yard, electrical substation adjacent to the electrical building, standby engine

generator building, equipment storage building, offices, welding shop, machine shop, storage area, and a walled enclosure/storage facility and two separate dry-pit pump bays adjacent to the wet well.

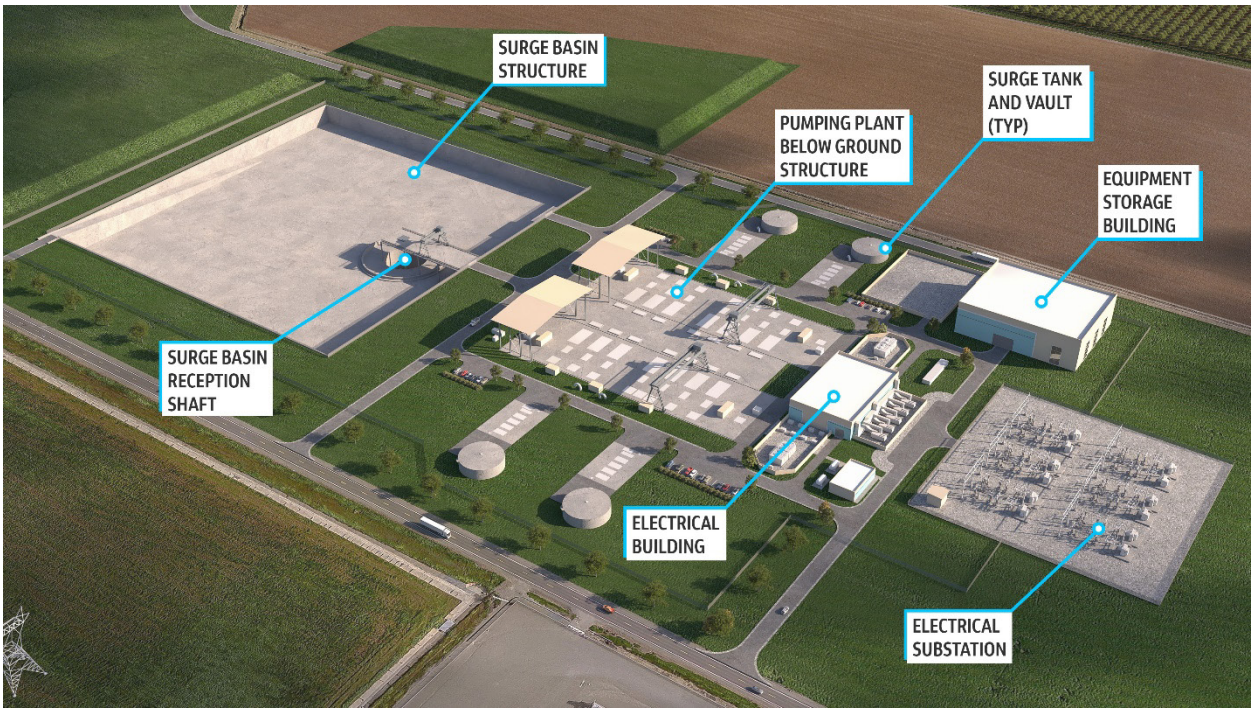

Figure 2-5. Bethany Reservoir Pumping Plant

2.2.4 Aqueduct

For the Bethany Reservoir Alignment, the aqueduct would convey water from the BRPP to Bethany Reservoir Discharge Structure located along the bank of the existing State Water Project Bethany Reservoir. The Bethany Reservoir Aqueduct would consist of four pressurized 180-inch-ID welded steel pipes. Each pipeline would convey up to 1,500 cfs. The aqueduct pipelines would be constructed using open-cut and backfill trench methods, except where the aqueduct pipelines crossed beneath the existing C. W. “Bill” Jones Pumping Plant discharge penstocks and the existing Bethany Reservoir Conservation Easement near Bethany Reservoir, where tunneling methods would be used for aqueduct construction (Figure 2-6).

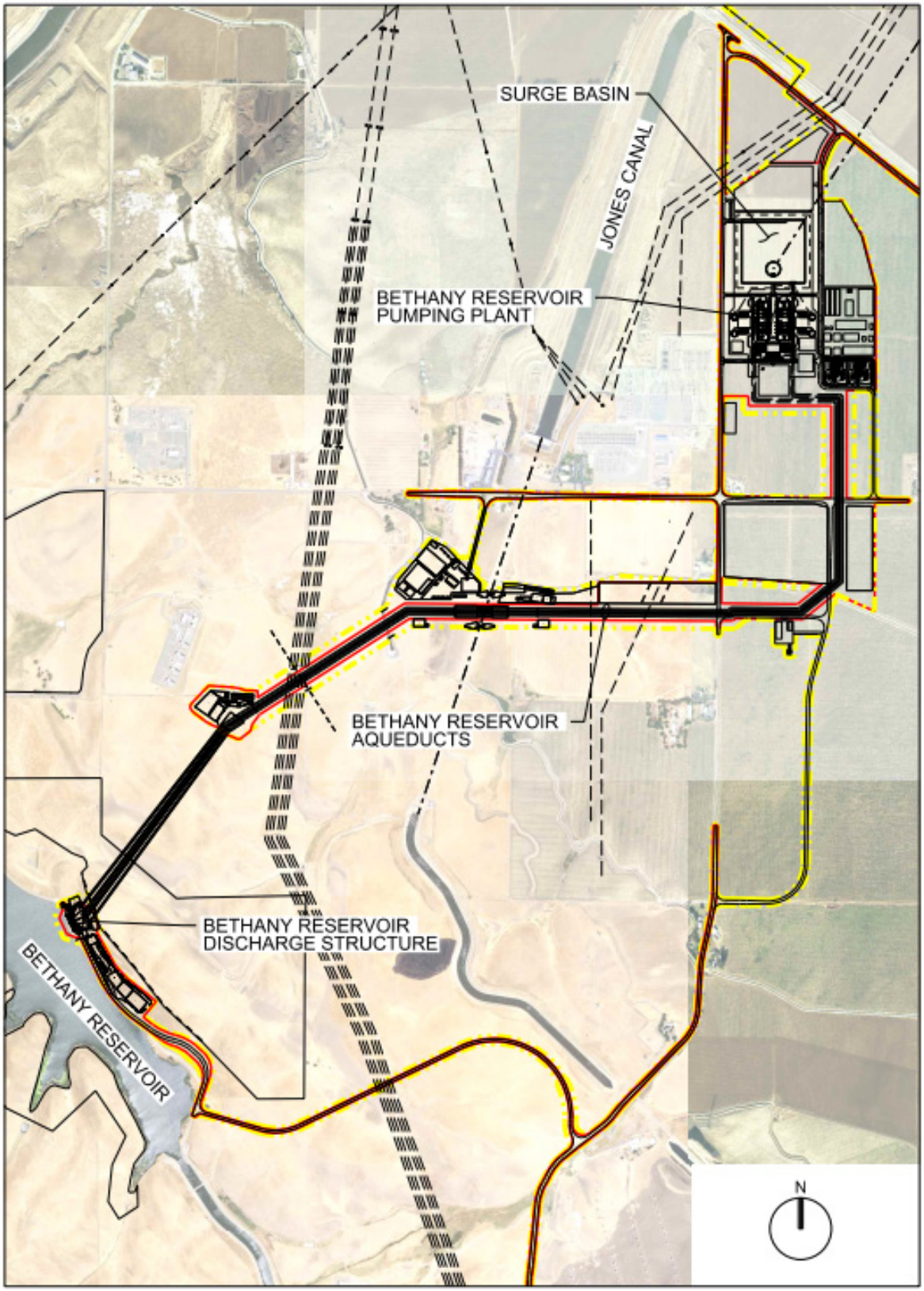

Figure 2-6. Bethany Aqueduct pipeline

2.2.5 Early Works Access Logistics

This section describes the works identified to support the main works contracts. These items include provision of access, levee protection, power, and utilities that would be available at the start of a main construction activities. The work elements defined in this section include roads and rail.

2.2.5.1 Early Works – Logistics – Roads and Levee

Early works for roads include the following provisions:

- Sacramento County Roads
  - Employee Park & Ride facility at Hood Franklin Road
  - Hood Franklin Road Snodgrass Slough bridge widening
  - Intakes 3 & 5 access roads
  - Lambert Road widening
- Twin Cities Complex Access Roads and Levees
  - Dierssen Road paving
  - Franklin Boulevard improvements at Dierssen Road
  - Twin Cities Road widening (East)
  - Twin Cities Complex ring levee
- San Joaquin County Roads
  - New Hope Tract Blossom Road widening
  - Canal Ranch access road construction
  - Terminous Tract Highway 12 widening
  - King Island access road construction
  - Lower Roberts Island access road construction
  - Lower Roberts Island levee protection work
  - Upper Jones Tract access road construction
  - Union Island access road
- Bethany Complex Access Roads
  - Byron Highway Lindemann Rd intersection
  - Byron Highway frontage road
  - Kelso Road widening
  - Mountain House Road widening
  - Mountain House Road shaft access
  - Mountain House Road by-pass
  - Bethany Reservoir access road
- Bethany Reservoir Access Road
  - Bethany Reservoir access road

2.2.5.2 Early Works – Logistics – Rail

Early works for rail include the Lower Roberts Island Rail Yard construction and extension of the rail line from the Port of Stockton.

2.2.6 Early Works Power and Utilities

2.2.6.1 Power

Power supplies to the main works sites are not included in the base construction cost estimate because this provision is being developed by DWR in coordination with the power providers (SMUD, PG&E, WAPA). These costs will be included in the other program cost element of the total project cost estimate. The power costs for each individual project do include the costs for both temporary and permanent requirements at each project site, as necessary.

2.2.6.2 Utilities

Work to provide or protect utilities is included in the mobilization and site preparation estimates for each contract. This includes:

- General allowances where no details are available
- Water supply to Bethany Complex
- Protection works for the East Bay Municipal Utility District (EBMUD) aqueduct tunnel

2.2.7 Systemwide

2.2.7.1 Communications and Control

Systemwide communications systems include fiberoptic cable for each site. Control panel equipment at each facility is included within the individual feature projects.

2.2.7.2 Testing and Commissioning

Testing and commissioning for the project, which follows all construction, is not included in this construction estimate but is included in the total project cost estimate. An allowance for contractor participation and assistance with testing and commissioning equipment within each facility is included in the feature project costs.

3. Estimate Methodology

This estimate has been prepared with quantities taken from drawings and other information contained in the EPR documents and, where applicable, adjusted to reflect the conclusion set out in the EIR. The cost estimate has been prepared using the Heavy Construction Systems Specialists (HCSS) Heavy Bid estimating software platform. This is a crew-based estimating system that uses labor and equipment crew estimates to complete work activities for the anticipated method of construction and anticipated durations. Because of the scale and complexity of the project, a more rigorous estimating approach was used to develop the construction costs which included development of concept level drawings and technical memorandums, obtaining deterministic costs for unit rates and materials, replacing most of the cost allowances with actual estimates and material price quotes, and estimating the work based on the current understanding of subsurface ground conditions.

Surface facilities include the Intakes, Surge Basin, BRPP, Aqueduct pipelines, and Discharge Structure. Early works for access logistics and levee protection are also included in the surface works estimate and are separated into the individual work packages required.

Tunnel and shaft estimates have been prepared for the main 36-foot-internal-diameter tunnels, the pipejack tunnels at the intakes, and the tunneling and shaft work required for the aqueduct section from the BRPP to the Discharge Structure located at the Bethany Reservoir.

The WBS in Table 3-1 has been used to code cost items and is based on an assumed number of works contracts with associated construction elements. This WBS is used to assess the number of contractor setups required for the overall estimate. The contract grouping and total number of contracts are subject to change as the project develops.

Table 3-1. Work Breakdown Structure, and Estimate Coding

Feature Code	Feature Name	Contract Code	Contract Name
1	Intakes	13	Intake 3 Facilities
		15	Intake 5 Facilities
2	Tunnels and Shafts	21	Reach 1 Shafts & Tunnel (Twin Cities to Intake 3)
		22	Reach 2 Shafts & Tunnel (Twin Cities to Terminous)
		23	Reach 3 Shafts & Tunnel (Lower Roberts to Terminous)
		24	Reach 4 Shafts & Tunnel (Lower Roberts to Bethany Complex)
3	Pumping Plant	33	BRPP, Surge Basin, and Reception Shaft
5	Aqueduct	55	Bethany Aqueduct including Tunnels and Shafts
6	Discharge	66	Bethany Discharge Structure
7	Logistics	71	Sacramento County Access Roads – Intakes Access Roads and Park & Ride
		72	Twin Cities Advanced Sitework – Access Roads & Levees
		73a	Lower Roberts Island Access Roads and Park & Ride
		73b	State Route 12 Road
		74a	Bethany Complex Access Roads – Byron Hwy & Interchange
		74b	Bethany Complex Access Roads – BRPP area & Roundabout
		75	Bethany Reservoir Access Road
		76	Projectwide Road Maintenance
		77	Lower Roberts Island Rail & Rail Yard
		78	Lower Roberts Island Levee improvements advanced work
8	Communications & Power	83	SCADA Projectwide
		86	Power (SMUD)
		87	Power (PG&E)
		88	Power (WAPA)

Table 3-1. Work Breakdown Structure, and Estimate Coding

Feature Code	Feature Name	Contract Code	Contract Name
9	Environmental	91	Bouldin Island Compensatory Mitigation
		92	I-5 Pond Compensatory Mitigation
		93	Projectwide Restoration & Site Establishment

SMUD = Sacramento Municipal Utility District
PG&E = Pacific Gas and Electric Company
WAPA = Western Area Power Administration

4. Estimate Classification

DCA used the guidance provided in *17R-97: Cost Estimate Classification System Recommended Practice* (AACE, 2020) to determine the class of estimate. The engineering information available for these estimates is assessed to determine the maturity class of estimate as shown in Table 4-1. Based on this information, the project construction cost estimate falls generally within Class 4, although with some areas still at Class 5. The Class 4 designation should be considered an overall classification level; individual project features would have different levels of design maturity that contribute to this judgement.

Table 4-1. Estimate Maturity Checklist

General Project Information	Class 5 Initiation	Class 4 Planning
Project Scope Description	Preliminary	**Advanced** [a]
Plant Capacity	Assumed	**Advanced** [a]
Site Location	Assumed	**Specific** [a]
Site Layout	None required	**Preliminary** [a]
Earthwork Quantities	None required	**Preliminary** [a]
Process Selection and Criteria	None required	**Preliminary** [a]
Design Discipline Criteria and Standards	None required	**Preliminary** [a]
Equipment Lists	**None required** [a]	Preliminary
Geotechnical Information	**None required** [a,b,c]	**Preliminary** [a,b,c]
Permitting Requirements	**Assumed** [a]	Preliminary
Site Environmental Survey	**None required** [a,b]	**Preliminary** [a,b]
Site Hazards Survey	**None required** [a]	Preliminary
Aerial Photography	None required	**Preliminary** [a]
Site Survey	**None required** [a,b]	**Preliminary** [a,b]
Building Programming	**None required** [a]	Preliminary
Architectural Material Boards	None required	**None required** [a]
Traffic Plan	None required	**None required** [a]
Acoustical Study	None required	**None required** [a]
Contract Packaging Strategy	**None required** [a]	Advanced

Table 4-1. Estimate Maturity Checklist

General Project Information	Class 5 Initiation	Class 4 Planning
Equipment Procurement Approach	**None required** [a]	Preliminary
Calculations	None required	**Preliminary** [a]
Project Schedule	Assumed	**Preliminary** [a]
Project Risk Log	Assumed	**Preliminary** [a]

Notes:
[a] **Bold and underline** text represents the current class of information available.
[b] Information levels may vary for project features where both columns are **bold and underline**
[c] Majority of tunnel alignment has no Geotechnical information

The accuracy of the estimate is proportionally impacted by considering different project elements such as underground tunneling requirements, the project's location in an environmentally sensitive area, limited geotechnical information, permitting requirements, a site environmental survey, and a site hazards survey. The additional uncertainty associated with defining these elements should also be reflected in the project risk management approach and associated consideration of contingency costs allowance that are not included in this construction cost estimate.

Figure 4-1 shows the class location of this estimate within the varying limits of accuracy. The range of accuracy will decrease as the class of estimate becomes more definitive (decreasing class number) from left to right according to AACE 17R-97 (AACE, 2020). The construction cost estimate provides the DCA's opinion of the most probable cost. Due to the uncertainty associated with ground conditions along the tunnel alignment and industry experience with underground tunneling projects, DCA has assigned an accuracy range between +80% and -55% to the current cost estimate. The zero axis represents the current total construction estimate including appropriate contingency with the 80% confidence interval range represented by percentage increase or decrease on that value.

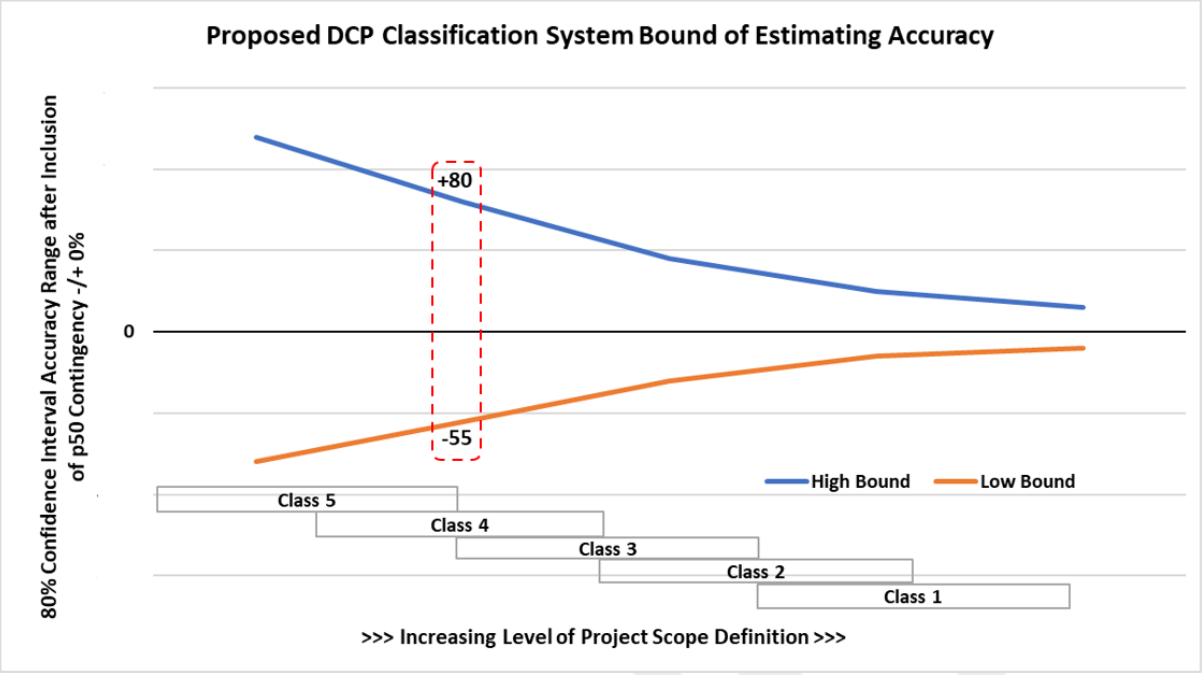

Figure 4-1. DCA Estimate Class within Range of Accuracy Modified from AACE 17R-97

The Class 4 estimate for the DCP is primarily presented to support project financial and economic analysis and to provide guidance for further project development. The final costs of the project once constructed will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors.

5. Design Basis

The scope of the project used for this estimate is as defined in the EPRs (DCA 2022a, 2022b) and the EPR Update (DCA 2023a, DCA 2023b). These documents contain summaries for the Central and Eastern Alignments and for the Bethany Reservoir Alignment, as well as concept-level engineering drawings and supporting technical memoranda. This BOE document only considers the 6,000-cfs capacity option for the Bethany Reservoir Alignment together with the tee-screen option for the intake structures.

6. Planning Basis

This section describes the basis for developing the sequence of activities used in conjunction with the construction estimate. The sequence has been used to support the development of duration-related costs in the estimate. Refer to the construction portion of the DCP summary schedule presented in Figure 6-1.

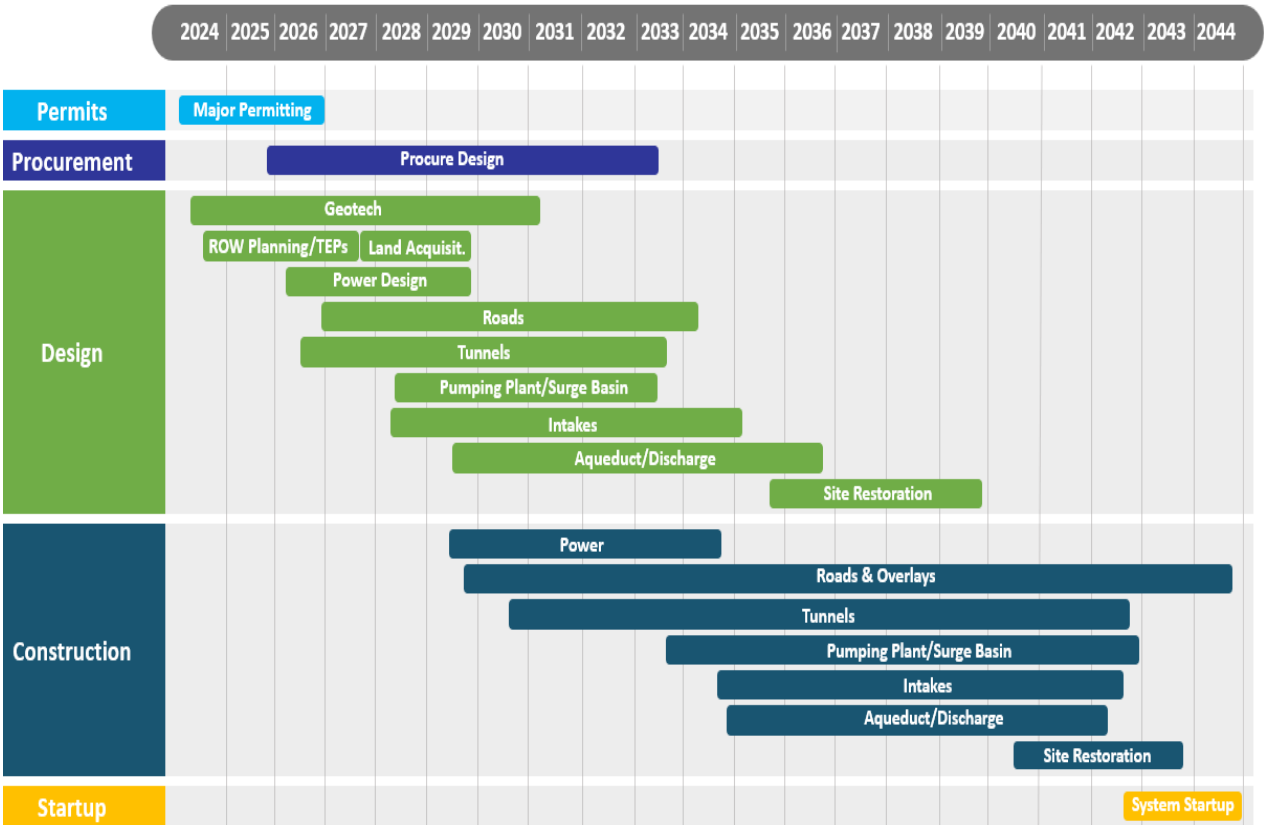

Figure 6-1. Delta Conveyance Project Summary Schedule

6.1 Preconstruction Activities

For this BOE, the preconstruction activities are assumed to include all activities required to achieve the start of early works construction, followed by main works construction.

6.2 Construction Sequence

Preliminary construction sequences were developed using the activities from the HCSS estimate. The estimate includes the allocated resources required to perform each task to complete the work. These tasks would include labor, equipment, materials, and, in some cases, subcontracts. The estimators calculated the time that would be required to perform each individual task for a given crew. The arrangement of activities is based on this effort, and depending on the type of work performed, the durations were adjusted to reflect likely work sequences. The durations were also adjusted to accommodate multiple crews working concurrent where necessary.

7. Cost Basis

Following is a summary of the cost element considerations. In general, all costs are based on 2023 dollars reflecting local area rates.

- Material Prices – material prices in the estimate are using 2023 prices. Concrete prices are based on supply from commercial or onsite batch plants and the estimate considers the cost of construction and operations of the batch plant to be included in the concrete unit rates.
- Labor Rates – labor rates are based on prevailing wage rate determination for the local area with fringe benefits and are fully burdened to include tax, insurance, and overtime, and are adjusted for the anticipated shift pattern. Typical fringes vary and may include health & welfare, pension, vacation & holiday, and training.
- Equipment Rates – equipment rates are sourced from established and industry accepted databases reflecting the nature of the work, such as U.S. Army Corps of Engineers and Equipment Watch Cost Reference Guide, or from quotes obtained from suppliers. Rates used could be overall hourly hire rates, or operating rates and ownership costs if the equipment is purchased.
- Productivity – crews were developed for each type of work based on either labor or equipment-based production, and generally using a 5-days-per-week, 24-hour schedule for tunneling and some shaft work elements, and single 10-hour shifts for other surface works.
- Indirect Costs – indirect costs are generally project specific overhead costs that are not associated with a specific work element. Their value can be spread over the project duration and often determined by the duration of the works. Typical types of indirect cost include:
  - Management and supervision salaries
  - Engineering salaries
  - Administrative salaries
  - Automobile and other miscellaneous expenses
  - General plant and facilities costs
- Sales Tax – sales tax rates of 9.25% were used on equipment and materials required for the project. Duty fees were applied where applicable.
- Escalation – the estimate does not include escalation for the construction period and for future start dates. The prices are in 2023 dollars.

- Contractor Mark-up and Profit – industry accepted contractor overheads and profits reflective of the nature of the work are applied.
- Add-on Costs – insurance, bonds, and other add-on costs are included in the estimates.

8. Allowances

Allowances are resources included in estimates to cover the costs of known but undefined requirements for an individual activity, work item, account, or subaccount. This estimate recognizes the following allowances associated with the project:

- Allowance for all diesel-/gas-powered equipment to become zero emissions by 2035.
- Allowance for testing and commissioning of mechanical & electrical equipment before the systemwide commissioning.

With the development of the design, these allowances would become incorporated into future revisions of the main estimates and design drawings.

9. Assumptions

As is normally the case, certain assumptions were made to reflect the conceptual level of design development. These assumptions may be related to the scope of the work where the design documents do not provide full details, or related to the pricing where the buildup of the cost may require specific experience-based assumptions. As the design progresses, these assumptions will be confirmed or refined.

10. Exclusions and Exceptions

Exclusions and exceptions are costs that might normally be considered part of the estimate but have not been included because they are not part of the scope or are included in other non-construction parts of the project. This construction estimate does not include the following items.

- Construction cost contingency
- Electrical power supply and associated infrastructure to deliver power to work sites, which are being incorporated in the overall project estimate as part of the other program costs noted below
- Other program-related costs, including:
  - DWR oversight costs
  - DWR EIR mitigations costs
  - DCA planning, design, and construction management costs
  - DCA permitting and other administrative cost
  - Power costs (power supply to the work sites and consumption during construction)
  - Land-right-of-way costs
  - Settlement Agreements
  - Community Benefits Program

11. Program Risks

A program-level evaluation of potential risks is ongoing and will be used to identify areas of potential additional costs and potential saving opportunities.

12. Risk Treatment Cost

Risk treatment costs have been assessed as part of the risk evaluation process and are considered for each feature type. These risk treatment costs are considered containment costs to help manage potential risks by reducing threats and improving opportunities and are included in this construction cost estimate assigned to each project element based on the associated features and value of the project. Attachment 3 provides details about this distribution.

13. Contingency

As noted above, the construction estimates presented in this document include risk treatment costs but do not include contingency. Contingency is an amount added to a construction cost estimate to account for uncertain items, conditions, or events that are likely to result in additional project costs. An assessment of the construction contingency would be derived by an assessment of the current state of design development, evaluation of program risks and judgement. Together, these assessments would be used to establish an appropriate construction contingency amount that would be added to the construction cost. Contingency is included and documented as part of the total project cost estimate.

14. Estimate Checking and Review

The estimating review and validation process included the following:

- Internal checks by the estimating team
- Design review with estimating team and design team
- Independent estimate and reconciliation with the DCA program management support team
- Management review with executive managers within DCA

As indicated above, the DCA program management support team completed an independent check estimate. A reconciliation process was completed comparing the DCA's Engineering Design Management team's estimate to the check estimate following industry recognized guidelines (Sundaram, 2024).

Using the EPR (2022b) and updates to the EPR (2023b) to prepare both estimates, a cost comparison was performed at the project level of the WBS. The independent check did not include some elements of work, such as the compensatory mitigation and power supply projects. Items with significant variances were reconciled through a series of meetings between the lead estimators for the relevant features, and appropriate modifications to the estimate were agreed upon. Through this process, an overall reconciled cost difference was obtained.

15. Summary

Table 15-1 summarizes the updated 2023 construction cost estimate. More detailed summaries are provided in Attachments 1 and 2, which show the buildup of cost types and bid items respectively.

Table 15.1. Bethany Reservoir Alternative – Direct Construction Cost Estimate Summary

Feature	Contract/Element	Construction Estimate ($M[a])	Risk Treatment ($M[a])	Total Construction Cost ($M[a])
Intakes	13- Intake 3 Facilities	855	28	882
	15- Intake 5 Facilities	806	26	832
Main Tunnels	21- Reach 1 Shafts & Tunnel (Twin Cities to Intake 3)	1,033	60	1,093
	22- Reach 2 Shafts & Tunnel (Twin Cities to Terminous)	1,735	95	1,830
	23- Reach 3 Shafts & Tunnel (Lower Roberts to Terminous)	1,292	69	1,362
	24- Reach 4 Shafts & Tunnel (Lower Roberts to Bethany Complex)	1,958	111	2,068
Pumping Plant	33- BRPP, Surge Shaft and Basin	2,496	40	2,536
Aqueduct	55- Bethany Aqueduct Pipeline, Tunnels and shafts	541	22	563
Discharge	66- Bethany Reservoir Discharge Structure	95	4	99
Access Logistics	71- Sacramento County Access Roads – Intakes and Park & Ride	30	1.6	32
	72- Twin Cities Advanced Sitework – Access Roads & Levees	20	1.0	21
	73a – San Joaquin County Access Roads Lower Roberts Island and Park & Ride	46	2.3	48
	73b – State Route 12 Access Road – Terminus Site	2	0.1	2
	74a – Bethany Complex Access Roads – Byron Hwy & Interchange	60	3.1	63
	74b – Bethany Complex Access Roads – BRPP area & Roundabout	21	1.1	22
	75- Bethany Reservoir Access Road	10	0.5	11
	76- Projectwide Road Maintenance	25	1.3	26
	77- Lower Roberts Island Rail & Rail Yard	16	0.8	17
	78- Lower Roberts Island Levee improvements advanced work	10	0.5	11
Communication	83- SCADA Projectwide	13	-	13

Table 15.1. Bethany Reservoir Alternative – Direct Construction Cost Estimate Summary

Feature	Contract/Element	Construction Estimate ($M[a])	Risk Treatment ($M[a])	Total Construction Cost ($M[a])
Restoration	93 - Projectwide Restoration & Site Establishment	17	-	17
Total Direct Construction[b, c, d]		**11,081**	**467**	**11,548**

[a] Costs are in 2023 dollars and are undiscounted
[b] Total excludes provision of electrical power supply and associated infrastructure to deliver to work sites
[c] Total includes Risk Treatment costs
[d] Total excludes contingency

Note that Attachments 1 and 2 include costs for several compensatory mitigation projects that have not been included in Table 15-1. The estimates for these elements are as follows:

- Bouldin Island Compensatory Mitigation = $36.4 M
- I-5 Pond Compensatory Mitigation = $54.3 M

The costs associated with these compensatory mitigation projects will be incorporated in the total project cost estimate as part of the DWR Mitigation other program cost item.

16. References

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17. Document History and Quality Assurance

The reviewers listed here have completed an internal quality control (QC) review and approval process for deliverable documents that is consistent with procedures and directives identified by the Engineering Design Manager and the DCA.

Rev.	Date	Version Description	Approval Names and Roles			
			Prepared by	Internal QC Review by	Consistency Review by	Approved for Submission by
0	02/29/2024	Initial submission	Martin Ellis / Cost & Schedule Lead	Shaun Firth / QC Reviewer	Adam Murdock / Engineering Design Manager	Terry Krause / Engineering Project Manager
1	04/01/2024	Revised draft	Martin Ellis / Cost & Schedule Lead	Shaun Firth / QC Reviewer	Adam Murdock / Engineering Design Manager	Terry Krause / Engineering Project Manager
2	05/08/2024	Revised draft	Martin Ellis / Cost & Schedule Lead	Shaun Firth / QC Reviewer	Adam Murdock / Engineering Design Manager	Terry Krause / Engineering Project Manager

Attachment 1
Project Cost Summary Table

Bethany Reservoir Alternative Basis of Estimate - Construction
Attachement 1 - Estimate Cost Summary

A	B	C	D	E	F	G	H	I	J
PROJECT	**Man Hours**	**Labor cost**	**Permanent Materials**	**Construction Materials**	**Equipment Cost**	**Subcontractor Costs**	**Estimate Total**	**Risk Mitigation Total**	**Project Total**
13 - Intake 3 Facilities	2,884,849	$ 278,941,337	$ 277,487,055	$ 203,171,550	$ 94,090,290	$ 1,135,019	$ 854,825,251	$ 27,647,192	$ 882,472,443
15 - Intake 5 Facilities	2,728,882	$ 263,386,005	$ 263,306,867	$ 188,741,805	$ 88,988,082	$ 1,105,663	$ 805,528,421	$ 26,052,808	$ 831,581,230
21 - Reach 1 Shafts & Tunnel (Twin Cities to Intake 3)	1,330,971	$ 208,433,785	$ 495,859,696	$ 100,900,590	$ 195,745,000	$ 31,669,380	$ 1,032,608,451	$ 60,335,345	$ 1,092,943,796
22 - Reach 2 Shafts & Tunnel (Twin Cities to Terminous)	2,414,995	$ 366,966,472	$ 826,724,333	$ 160,733,395	$ 328,889,339	$ 51,463,336	$ 1,734,776,876	$ 95,159,675	$ 1,829,936,551
23 - Reach 3 Shafts & Tunnel (Lower Roberts to Terminous)	1,894,724	$ 283,279,054	$ 604,771,308	$ 121,429,839	$ 245,863,385	$ 37,069,474	$ 1,292,413,060	$ 69,221,103	$ 1,361,634,163
24 - Reach 4 Shafts & Tunnel (Lower Roberts to Bethany Complex)	2,980,572	$ 440,657,237	$ 948,104,596	$ 183,589,965	$ 324,296,568	$ 61,089,231	$ 1,957,737,597	$ 110,583,877	$ 2,068,321,474
33 - Bethany Pumping Plant, Surge Shaft and Basin	7,486,564	$ 751,954,884	$ 845,359,805	$ 435,342,562	$ 338,840,061	$ 124,242,938	$ 2,495,740,250	$ 40,000,000	$ 2,535,740,250
55 - Bethany Aqueduct Pipeline, Tunnels and shafts	938,518	$ 111,073,090	$ 273,393,252	$ 73,923,203	$ 62,803,909	$ 19,630,952	$ 540,824,406	$ 21,775,643	$ 562,600,049
66 - Bethany Discharge Structure	370,460	$ 36,061,254	$ 31,644,354	$ 19,553,873	$ 7,976,161	$ 27,732	$ 95,263,374	$ 3,724,357	$ 98,987,731
71 - Sacramento County Access Roads - Intakes, Batch plant & P&R	84,485	$ 7,282,941	$ 14,374,707	$ 6,029,690	$ 2,251,437	$ 351,000	$ 30,289,775	$ 1,561,699	$ 31,851,474
72 - Twin Cities Advanced Sitework - Access Roads & Levees	72,988	$ 7,048,034	$ 5,081,051	$ 3,459,007	$ 3,794,908	$ 855,136	$ 20,238,135	$ 1,043,450	$ 21,281,586
73a - Lower Roberts Island Access Roads & P&R	151,484	$ 13,625,048	$ 15,167,853	$ 13,648,528	$ 2,781,566	$ 351,000	$ 45,573,995	$ 2,349,732	$ 47,923,727
73b - State Route 12 Access Road - Terminus Site	2,565	$ 234,710	$ 1,444,662	$ 3,354	$ 125,497	$ -	$ 1,808,224	$ 93,230	$ 1,901,453
74a - Bethany Complex Access Roads - Byron Hwy & Interchange	228,472	$ 19,988,238	$ 20,213,517	$ 15,819,619	$ 3,149,309	$ 326,311	$ 59,496,993	$ 3,067,583	$ 62,564,576
74b - Bethany Complex Access Roads - PP area & Roundabout	24,229	$ 2,289,023	$ 13,704,118	$ 105,916	$ 1,656,647	$ 3,309,643	$ 21,065,347	$ 1,086,100	$ 22,151,447
75 - Bethany Reservoir Access Road	11,712	$ 1,125,293	$ 6,115,714	$ 108,273	$ 1,493,524	$ 1,462,662	$ 10,305,466	$ 531,336	$ 10,836,801
76 - Projectwide Road Maintenance	30,688	$ 2,794,080	$ 17,525,833	$ 3,748,997	$ 1,007,134	$ -	$ 25,076,044	$ 1,292,886	$ 26,368,930
77 - Lower Roberts Rail & Rail Yard	28,237	$ 2,492,579	$ 8,904,451	$ 2,974,747	$ 1,103,423	$ 829,732	$ 16,304,932	$ 840,660	$ 17,145,592
78 - Lower Roberts Levee improvements advanced work	35,303	$ 3,575,866	$ 2,492,965	$ 1,789,996	$ 2,386,736	$ 98,457	$ 10,344,020	$ 533,323	$ 10,877,344
83 - SCADA Projectwide	49,851	$ 5,784,645	$ 1,039,279	$ 2,411,342	$ 4,213,011	$ -	$ 13,448,276	$ -	$ 13,448,276
93 - Projectwide Restoration & Site Establishment	87,807	$ 7,978,351	$ 2,042,640	$ 121,547	$ 6,854,544	$ -	$ 16,997,083	$ -	$ 16,997,083
Grand Total	**23,838,357**	**$ 2,814,971,925**	**$ 4,674,758,056**	**$ 1,537,607,798**	**$ 1,718,310,532**	**$ 335,017,666**	**$ 11,080,665,979**	**$ 466,900,000**	**$ 11,547,565,979**

PROJECT	**Man Hours**	**Labor cost**	**Permanent Materials**	**Construction Materials**	**Equipment Cost**	**Subcontractor Costs**	**Estimate Total**	**Risk Mitigation Total**	**Project Total**
91 - Bouldin Island Compensatory Mitigation	172,384	$ 16,222,171	$ 4,958,073	$ 8,309,306	$ 6,949,439	$ -	$ 36,438,989	$ -	$ 36,438,989
92 - I-5 Pond Compensatory Mitigation	252,751	$ 24,490,107	$ 3,832,616	$ 12,862,323	$ 12,989,515	$ 98,457	$ 54,273,017	$ -	$ 54,273,017
Grand Total	**425,135**	**$ 40,712,278**	**$ 8,790,688**	**$ 21,171,629**	**$ 19,938,954**	**$ 98,457**	**$ 90,712,006**	**$ -**	**$ 90,712,006**

Note: Contractors indirect costs and mark ups are distributed and included with cost columns C through G for each project identified in column A

Attachment 2
Estimate Bid Item Summary Cost Table

Bethany reservoir Alternative Basis of Estimate - Construction
Attachement 2 - Estimate Bid Item Prices

Project/Contract	Bid Item	Unit	Quantity	Total 2023$
13 - Intake 3 Facilities				
	113317105 - Mobilization / Site Setup Intake 5 Pipe Jacking	LS	1	346,670
	113317110 - Purchase 60" WSP AWWA C300	LF	7650	6,166,818
	113317115 - Off Load 60" WSP AWWA C300	LF	7650	12,469
	113317136 - Plant & Equipment	LS	1	6,883,773
	113317137 - Indirects	MO	12	3,549,342
	113317139 - Demob & Clean Up	LS	1	231,114
	113317220 - Setup Akkerman MTBM Equipment	EA	30	286,308
	113317230 - Pipe Jack 60" WSP AWWA C300	LF	7650	1,334,466
	113317231 - Weld 60" AWWA C300 Joints	EA	383	350,545
	113317232 - Pipe Reception Pit	EA	30	361,657
	113317235 - Muck Excavation & Truck Haul Off	CY	5562	250,568
	133001000 - Int 3 Ph M Contractors Profit & Burden	LS	1	112,728,000
	133002000 - Int 3 Environmental Protection	LS	1	14,635,224
	133002100 - Int 3 Tire Wash Station	EA	1	53,845
	133003000 - Int 3 Ph 1Contractor Mobilization	LS	1	1,024,164
	133005000 - Int 3 Ph M Contractor Mngt & Admin., Technica	MO	85	91,029,164
	133007000 - Int 3 Ph M Contractor's Temporary Facilities	LS	1	16,506,406
	133008000 - Int 3 Ph M Lost Labor Time	LS	1	2,091,140
	133009000 - Int 3 Ph M Cont Temporary Facility Operations	MO	85	21,200,533
	133010000 - Int 3 Owners Office Facilities	LS	1	217,191
	133013000 - Int 3 Ph 1 Erect Rebar & Metal Fab Shop	SF	8000	2,973,727
	133014000 - Int 3 Ph M Dismantle Metal & Rebar Fab Shop	LS	1	417,403
	133016000 - Int 3 Ph M Operate Metal & Rebar & Fab Shop	TON	36682	6,726,071
	133305000 - Int 3 Ph 1 Site Work	LS	1	57,693,487
	133306000 - Int 3 Ph 2 Site Work	LS	1	80,397,434
	133307000 - Int 3 Ph 2 Cofferdam	LS	1	29,152,086
	133308000 - Int 3 Ph 2 Erect Work Trestle	LF	1034	6,969,554
	133309000 - Int 3 Ph 3 Final Site Work	LS	1	43,574,192
	133311000 - Int 3 Ph 2 Jet Grout Under Intake	CY	102600	14,273,606
	133313000 - Int 3 Ph 2 Excavate Inside Intake Cofferdam	CY	74978	3,277,784
	133314000 - Int 3 Ph 2 Install Training Wall Anchors & Backfil	LS	1	7,458,395
	133315000 - Int 3 Ph 2 Drilled Piers	EA	1215	85,622,077
	133317000 - Int 3 Ph 2 Tremie Concrete Under Intake Structure	CY	8547	3,466,176
	133319000 - Int 3 Ph 2 Dewater Intake C'dam & Place Xbra	LS	1	8,251,635
	133319500 - Int 3 Ph 2 Prep & Leveling Slab Concrete	CY	2142	2,285,765
	133321000 - Int 3 Ph 2 Intake Structural Concrete	CY	30673	41,241,753
	133322000 - Int 3 Ph 2 Intake Gate Shaft & outlet Structures	EA	30	14,066,767
	133322600 - Int 3 Ph 3 Jack 60" Dia Pipe	LF	0	-
	133323000 - Int 3 Ph 2 5'x5' Gates, Frames & Opera	EA	60	9,724,118
	133324000 - Int 3 Ph 2 8'x8' Gates, Frames & Opera	EA	30	5,908,178
	133324400 - Int 3 Ph 2 Set Guides for Screens & Stoplogs	LF	2700	850,757
	133324500 - Int 3 Ph 2 Intake Stoplogs	EA	5	1,545,074
	133325000 - Int 3 Ph 3 Fish Screens & Panels	LS	30	43,620,484
	133327000 - Int 3 Ph 3 Intake Structure MEP	LS	1	12,173,390
	133329000 - Int 3 Ph 3 Finish Out	LS	1	3,431,129
	133355000 - Int 3 Ph 2 Sediment Basin Drilled Piers	EA	400	6,949,828
	133357000 - Int 3 Ph 2 Radial Gate Flow Control Structure	CY	20908	22,732,867
	133359000 - Int 3 Ph 3 Sediment Basin Radial Gates & Stoplogs	LS	1	22,915,022
	133361000 - Int 3 Ph 3 Sediment Basin MEP & Finish Work	LS	1	1,895,589
	133901100 - Int 3 Ph 3 Purchase & Store Equip for Ops	LS	1	4,746,799
	133901400 - Int 3 Ph 3 Start up and Commissioning	LS	1	3,390,000
	21400510 - Build Slurry Wall Receiving Shaft at Intake C-E-3	LS	1	16,316,309
	21400515 - Reach 1 Receiving Shaft at Intake C-E-3	LS	1	11,518,400
13 - Intake 3 Facilities Total				854,825,251

Bethany reservoir Alternative Basis of Estimate - Construction
Attachement 2 - Estimate Bid Item Prices

Project/Contract	Bid Item	Unit	Quantity	Total 2023$
15 - Intake 5 Facilities				
	115517145 - Mobilize / Site Setup Intake 3 Pipe Jacking	LS	1	346,670
	115517150 - Purchase 60" WSP AWWA C300	LF	7980	6,432,838
	115517155 - Offload 60" WSP AWWA C300	LF	7980	11,651
	115517176 - Plant & Equipment	LS	1	6,803,413
	115517177 - Indirects	MO	12	3,547,146
	115517190 - Demob & Clean Up	LS	1	231,114
	115517260 - Setup Akkerman MTBM Equipment	EA	30	286,308
	115517270 - Pipe Jack 60" WSP AWWA C300	LF	7980	1,392,031
	115517271 - Weld 60" AWWA C300 Joints	EA	399	365,189
	115517272 - Pipe Reception Pit	EA	30	361,657
	115517274 - Muck Excavate & Haul Off	CY	5825	262,533
	155001000 - Int 5 Ph M Contractors Profit & Burden	LS	1	105,768,000
	155002000 - Int 5 Ph M Environmental Protection	LS	1	13,685,133
	155002100 - Int 5 Tire Wash Station	EA	1	53,845
	155003000 - Int 5 Ph 1Contractor Mobilization	LS	1	1,024,164
	155005000 - Int 5 Ph M Contractor Mngt & Admin., Technica	MO	85	85,290,142
	155007000 - Int 5 Ph M Contractor's Temporary Facilities	LS	1	17,974,141
	155008000 - Int 5 Ph M Lost Labor Time	LS	1	1,898,080
	155009000 - Int 5 Ph M Cont Temporary Facility Operations	MO	85	21,200,533
	155010000 - Int 5 Owners Office Facilities	LS	1	522,238
	155015000 - Int 5 Ph 1 Erect Rebar & Metal Fab Shop	SF	8000	2,973,727
	155015100 - Int 5 Ph M Dismantle Metal & Rebar Fab Shop	LS	1	417,403
	155016000 - Int 5 Ph M Operate Metal & Rebar & Fab Shop	TON	35354	6,485,757
	155205000 - Int 5 Ph 1Site Work	LS	1	51,387,815
	155206000 - Int 5 Ph 2 Site Work	LS	1	67,764,500
	155207000 - Int 5 Ph 2 Cofferdam	LS	1	28,067,147
	155208000 - Int 5 Ph 2 Erect Work Trestle	LF	1064	6,969,554
	155209000 - Int 5 Ph 3 Final Site Work	LS	1	40,738,041
	155211000 - Int 5 Ph 2 Jet Grout Under Intake	CY	34200	7,052,349
	155213000 - Int 5 Ph 2 Excavate Inside Intake Coffertam	CY	74978	3,277,784
	155214000 - Int 5 Ph 2 Install Training Wall Tiebacks & Backfi	LS	1	7,076,782
	155215000 - Int 5 Ph 2 Drilled Piers	EA	1215	83,374,231
	155217000 - Int 5 Ph 2 Tremie Concrete Under Intake Stru	CY	8547	3,466,176
	155219000 - Int 5 Ph 2 Dewater Intake C'dam & Place Xbra	LS	1	8,264,383
	155219500 - Int 5 Ph 2 Prep & Leveling Slab Concrete	CU	2142	2,285,765
	155221000 - Int 5 Ph 2 Structural Concrete	CY	30256	40,649,033
	155222000 - Int 5 Ph 2 Intake Gate Shaft & outlet Structures	EA	30	13,671,165
	155222600 - Int 5 Ph 3 Jack 60" Dia Pipe	LF	0	-
	155223000 - Int 5 Ph 2 5'x5' Gates, Frames & Opera	EA	60	9,724,118
	155224000 - Int 5 Ph 2 8'x8' Gates, Frames & Opera	EA	30	5,908,178
	155224400 - Int 5 Ph 2 Set Guides for Screens & Stoplogs	LF	2700	850,757
	155224500 - Int 5 Ph 2 Intake Stoplogs	EA	5	1,545,074
	155225000 - Int 5 Ph 3 Fish Screens & Panels	EA	30	43,620,484
	155227000 - Int 5 Ph 3 Intake Structure MEP	LS	1	12,173,390
	155229000 - Int 5 Ph 3 Finish Out	LS	1	2,978,442
	155255000 - Int 5 Ph 2 Sediment Basin Drilled Piers	EA	400	6,949,828
	155257000 - Int 5 Ph 2 Radial Gate Flow Control Structure	CY	20723	22,262,756
	155259000 - Int 5 Ph 2 Sediment Basin Radial Gates & Stoplogs	LS	1	22,914,901
	155261000 - Int 5 Ph 3 Sediment Basin MEP & Finish Work	LS	1	1,896,305
	155901100 - Int 5 Ph 3 Purchase & Store Equip for Ops	LS	1	1,802,531
	155901400 - Int 5 Ph 3 Startup & Commissioning Support	LS	1	3,300,000
	21600530 - Build Slurry Wall Pass Through Maint. Intake C-E-5	LS	1	15,809,869
	21600535 - Pass Through Maintenance Shaft Intake C-E-5	LS	1	12,413,351
15 - Intake 5 Facilities Total				**805,528,421**
21 - Reach 1 Shafts & Tunnel (Twin Cities to Intake 3)				
	21100425 - Twin Cities Reach 1 Launch Shaft Construction Site	LS	1	7,377,330
	21300440 - Reach 1 Tunnel	LF	42849	1,006,146,367
	21300445 - Remove TBM	EA	1	2,086,446
	21300450 - Remove Shaft Utilities & Conveyor Belt	LS	1	357,683
	21300455 - Remove Tunnel Conveyor Belt	LS	1	798,168
	21300460 - Remove Tunnel Utilities & Cleanup	LS	1	787,025
	21300462 - Instrumentation Shafts & Tunnel	LS	1	10,185,045
	21300465 - Indirects Reach 1	LS	1	-
	21300470 - Plant & Equipment Reach 1	LS	1	-
	22200531 - RTM Pads	LS	1	4,870,387
21 - Reach 1 Shafts & Tunnel (Twin Cities to Intake 3) Total				**1,032,608,451**

Bethany reservoir Alternative Basis of Estimate - Construction
Attachement 2 - Estimate Bid Item Prices

Project/Contract	Bid Item	Unit	Quantity	Total 2023$
22 - Reach 2 Shafts & Tunnel (Twin Cities to Terminous)				
	22100515 - Twin Cities Reach 2 Launch Shaft Construction Site	LS	1	8,191,815
	22200519 - Build Slurry Wall Reach 2 Launch Shaft	LS	1	27,082,082
	22200520 - Reach 2 Launch Shaft Twin Cities	LS	1	22,846,607
	22200523 - RTM Pads	LS	1	4,870,387
	22300530 - Reach 2 Tunnel 36 Foot	LF	66807	1,580,495,955
	22300535 - Remove TBM	LS	1	2,086,446
	22300540 - Remove Shaft Utilities & Conveyor Belt	LS	1	357,683
	22300545 - Remove Tunnel Conveyor Belt	LS	1	1,076,394
	22300550 - Remove Tunnel Utilities & Cleanup	LS	1	1,057,297
	22300552 - Instrumentation Shafts & Tunnel	LS	1	17,823,829
	22300555 - Reach 2 Indirects	LS	1	-
	22300560 - Reach 2 Plant & Equipment	LS	1	-
	22500610 - Build Slurry Wall Pass Through New Hope Shaft	LS	1	14,675,297
	22500615 - Pass Through Maintenance Shaft New Hope	LS	1	12,828,242
	22500621 - Furnish & Place Shaft Cover	LS	1	355,200
	22500630 - Pass Through Maint Shaft New Hope Work Area	LS	1	7,399,057
	22600625 - Build Slurry Wall Pass Through Canal Ranch Tract	LS	1	14,397,806
	22600630 - Pass Through Maintenance Canal Ranch Tract	LS	1	12,970,273
	22600636 - Furnish & Place Shaft Cover	LS	1	370,049
	22600640 - Pass Through Maint. Shaft Canal Ranch Tract Work A	LS	1	5,365,801
	731710000 - New Hope Tract Road	MI	0.28	167,919
	731770000 - Canal Ranch Tract	MI	1.17	212,496
	760000000 - Project Wide Road Maintenance	LS	1	146,241
22 - Reach 2 Shafts & Tunnel (Twin Cities to Terminous) Total				**1,734,776,876**
23 - Reach 3 Shafts & Tunnel (Lower Roberts to Terminous)				
	23100005 - Lower Roberts Reach 3 Launch Shaft Construct Site	LS	1	13,642,772
	23300020 - Reach 3 Tunnel 36 Foot	LF	49975	1,169,490,462
	23300025 - Remove TBM	LS	1	2,082,941
	23300030 - Remove Shaft Utilities & Conveyor Belt	LS	1	357,683
	23300035 - Remove Tunnel Conveyor Belt	LS	1	1,319,639
	23300040 - Remove Tunnel Utilities & Cleanup	LS	1	1,300,542
	23300042 - Instrumentation Shafts & Tunnel	LS	1	12,731,306
	23300045 - Reach 3 Tunnel Indirects	LS	1	-
	23300050 - Reach 3 Tunnel Plant & Equipment	LS	1	-
	23400014 - Terminous Tract Slurry Wall Reception Shaft	LS	1	11,858,585
	23400015 - Terminous Tract Reception Shaft	LS	1	12,807,556
	23400021 - Furnish & Place Shaft Cover	LS	1	370,049
	23400095 - Terminous Tract Reception Shaft Construction Site	LS	1	8,427,432
	23500096 - Build Slurry Wall Pass Through Maint.Kings Island	LS	1	14,735,734
	23500097 - Pass Through Maint Shaft Kings Island	LS	1	13,257,462
	23500103 - Furnish & Place Shaft Cover	LS	1	370,049
	23500110 - Pass Through Maint. Kings Island Work Area	LS	1	7,001,664
	24200127 - RTM Pad	LS	1	22,114,325
	731870000 - Kings Island Access Road	MI	3	544,858
23 - Reach 3 Shafts & Tunnel (Lower Roberts to Terminous) Total				**1,292,413,060**
24 - Reach 4 Shafts & Tunnel (Lower Roberts to Bethany Complex)				
	24100115 - Lower Roberts Reach 4 Launch Shaft Construct Site	LS	1	15,952,706
	24200118 - Slurry Wall Reach 4 Launch Shaft Lower Roberts	LS	1	27,922,450
	24200120 - Reach 4 Launch Shaft Lower Roberts	LS	1	23,184,163
	24200121 - RTM Pad	LS	1	22,114,325
	24200125 - Furnish & Install Shaft Cover	LS	1	370,049
	24300125 - Reach 4 Tunnel 36 Foot	LF	76697	1,767,845,909
	24300130 - Remove TBM	LS	1	2,037,822
	24300135 - Remove Shaft Utilities & Conveyor Belt	LS	1	357,683
	24300140 - Remove Tunnel Conveyor Belt	LS	1	1,157,476
	24300145 - Remove Tunnel Utilities & Cleanup	LS	1	1,209,130
	24300150 - Reach 4 Tunnel Indirects	LS	1	-
	24300155 - Reach 4 Tunnel Plant & Equipment	LS	1	-
	24300190 - Instrumentation Shafts & Tunnels	LS	1	20,370,090
	24500199 - Build Slurry Wall Pass Through Upper Jones Tract	LS	1	15,173,003
	24500200 - Pass Through Shaft Upper Jones Tract	LS	1	13,476,934
	24500206 - Furnish & Place Shaft Cover	LS	1	370,049
	24500220 - Pass Through Shaft Upper Jones Tract Work Area	LS	1	5,499,181
	24600225 - Build Slurry Wall Pass Through Union Island	LS	1	15,344,697
	24600230 - Pass Through Shaft Union Island	LS	1	13,647,623
	24600235 - Furnish & Place Shaft Cover	LS	1	370,049
	24600240 - PassThrough Shaft Union Island Work Area	LS	1	8,450,304
	731820000 - Upper Jones Tract Road	MI	2	441,979
	731880000 - Union Island Access Road	MI	2	2,441,978
24 - Reach 4 Shafts & Tunnel (Lower Roberts to Bethany Complex) Total				**1,957,737,597**

Bethany reservoir Alternative Basis of Estimate - Construction
Attachement 2 - Estimate Bid Item Prices

Project/Contract	Bid Item	Unit	Quantity	Total 2023$
33 - Bethany Pumping Plant, Surge Shaft and Basin				
	24400205 - Slurry Wall Reach 4 Reception Shaft Surge Basin	LS	1	19,917,361
	24400210 - Reach 4 Tunnel Reception Shaft Surge Basin	LS	1	25,071,914
	331001000 - Pump Plant/Surge Basin Contractors Profit & Burden	LS	1	338,442,637
	331002000 - Environmental Protection - Pump Plant/Surge Basin	LS	1	13,894,039
	331007000 - SB Temp. Construction Facilities Build	LS	1	3,612,219
	331007500 - Lost Labor Time - Pump Plant/Surge Basin	LS	1	5,906,869
	331015000 - Dismantle Rebar & Metal Fab Shop	SF	8970	369,428
	331103000 - Mobilize Pump Plant/Surge Basin Contractor	LS	1	1,737,286
	331105000 - Pump Plant Contractor Mngt & Admin., Technica	MO	84	128,709,210
	331109000 - Pump Plant Temp. Faciltities Build	LS	1	11,981,994
	331110000 - Owners Office Facilities	LS	1	522,238
	331112500 - Temporary Fire/EMT Station	LS	1	1,370,115
	331115000 - Pump Plant/SB Temporary Facility Operate	MO	84	28,419,811
	331117500 - Pump Plant/SB Erect Rebar & Metal Fab Shop	SF	8970	3,761,077
	331117800 - Pump Plant/Surge Basin- Rebar Shop Operation	TON	92633	43,999,895
	331120000 - Construction Water Supply from Banks Canal	LS	1	5,225,302
	331400000 - PP Substation Civil & Structural Work	LS	1	8,894,969
	332005000 - Surge Basin Clear & Grub/Demolition	LS	1	252,672
	332010000 - Surge Basin E xcavation & Demo'n	LS	1	12,294,677
	332015000 - Surge Basin Ramp Construction	LS	1	1,586,680
	332105000 - Pump Plant Initial Earthwork	LS	1	4,952,147
	332105100 - Pump Plant Final Site Work	AC	38	6,619,979
	332105200 - Pumping Plant SWPPP	ACRE	130	17,360,409
	332115000 - Diaphragm Wall Construction	SF	1221343	455,364,278
	332120000 - Excavate Pump Plant Phase 1 Below Floor El 42.0	CY	224000	6,819,266
	332121000 - Excavate Pump Plant Phase 2 Below Floor El 3.0	CY	129422	4,053,741
	332122000 - Excavate Pump Plant Phase 3 Below Floor El (-)22	CY	129422	4,457,492
	332123000 - Excavate Pump Plant Phase 4 Below Floor El (-)47	CY	129422	5,054,542
	332125000 - Excavate Pump Plant Phase 5 Below Floor El (-)72.0	CY	75911	3,304,984
	332126000 - Excavate Pump Plant Phase 6 Below Floor El (-)86.2	CY	105778	4,770,500
	332130000 - Excavate Pump Plant Inlet Conduit All Levels	CY	141423	6,659,150
	332135000 - Excavate PP Mech(E-W) & Elect(N-S) Rooms	0	260817	4,474,294
	332136000 - Excavate Surge Vault & Tank Inlet	CY	106053	9,373,773
	332145000 - 36" Drilled Piers Pump Plant & Surge Vaults	EA	154	4,717,654
	332150000 - 15' Dia Bethany Res. Pipe to Conn. with AQUE.PIPE	LF	6608	46,098,923
	332175000 - Remove Sec of Diaph. Walls - WW, Pipe. Elect. Cond	SF	11493	569,923
	333010000 - 36" Diaphragm Walls	SF	422000	93,426,542
	333020000 - Tiebacks	EA	1088	6,774,041
	333030080 - Rebar in Surge Basin Drilled Shafts	TON	16269	42,268,607
	333035000 - Drilled Tiedown Shafts	0	2589	155,203,479
	333100000 - PP Storage Areas & Yards	SF	11000	29,560
	333105000 - Generator Building	SF	3500	3,651,656
	333106000 - HVAC Mechanical Equipment Yard	SF	10200	2,043,848
	333110000 - Foundation Slab @ El. -110.50	CY	51543	38,251,986
	333111000 - Intermediate Slab @ El. -86.25	CY	18436	15,188,003
	333112000 - Intermediate Slab @ El. -72.00	CY	18436	15,419,969
	333113000 - Intermediate Slab @ El. -47.00	CY	18846	16,821,433
	333114000 - Intermediate Slab @ El. -22.00	CY	18436	16,018,288
	333115000 - Operation Deck Conc. @ El. 3.00	CY	18436	14,650,915
	333116000 - Roof Deck Concrete @ El. 47.00	CY	18508	16,933,124
	333116500 - PC Concrete Hatches @ El. 47.00	CY	2557	3,414,757
	333119000 - Concrete - Interior Column Facing	CY	6174	9,428,343
	333120000 - Structure Concrete Vert. Wall Liners	CY	38680	45,441,186
	333121000 - Interior Conc. Walls (Stairwells, Doghouses, etc.)	CY	23723	61,259,752
	333122000 - Pump Plant Conc. Fill around Pump Inlets/Housing	CY	3460	2,935,223
	333123000 - Mechanical Room Conc. Inv. Slab @ El. 3.00	CY	4988	4,610,843
	333124000 - Mechanical Room Conc. Walls	CY	4497	6,336,645
	333125000 - Mechanical Room Conc. Roof Slab	CY	4584	5,931,378
	333130000 - Surge Tanks Valve Vault - Inv. Slab Conc.	CY	2152	2,066,302
	333131000 - Surge Tanks Valve Vault - Conc. Walls	CY	2944	5,094,036
	333132000 - Surge Tanks Valve Vault - Conc. Roof Slab	CY	780	1,883,459
	333135000 - Surge Tanks - Inv. Slab Conc.	CY	1628	1,687,956
	333136000 - Surge Tanks - Conc. Walls	CY	1501	3,251,783
	333137000 - Surge Tanks - Conc. Roof Slab	CY	764	1,966,906
	333140000 - Wet Well Inlet Conduit Invert Slab	CY	9472	7,439,373
	333141000 - Wet Well Inlet Conduit Intermediate. Slabs	CY	16720	15,357,998
	333142000 - Wet Well Conduit Walls	CY	19367	26,010,244
	333143000 - Wet Well Conduit Top Deck Conc. @ El. 3.00	CY	4021	3,900,148
	333143100 - Isolation Gates - Wetwell Conduit	LS	1	7,910,626
	333144000 - Pump Plant Miscellaneous Metals	LS	1	13,475,089
	333145000 - 500 CFS Pumps & Motors (14 ea)	EA	14	92,767,168
	333147000 - 108" Dia. Steel Pipe, Valves, to 15' Dia. RW Conn.	LF	2700	90,556,635
	333149000 - PP Wet Well Bulkheads	LS	1	17,324,228
	333150000 - Pump Plant Overhead Gantry Cranes	LS	1	7,069,575

Bethany reservoir Alternative Basis of Estimate - Construction
Attachement 2 - Estimate Bid Item Prices

Project/Contract	Bid Item	Unit	Quantity	Total 2023$
33 - Bethany Pumping Plant,	333152000 - Service Elevators	EA	6	5,041,636
	333155000 - Pump Plant Structural Canopies (2 ea)	SF	30000	1,174,825
	333157000 - Wet Well Dewatering Pumps	EA	2	22,243,603
	333160000 - HVAC Mechanical Systems	LS	1	5,464,433
	333165000 - Valve Vault Piping & Valves	LS	1	26,509,076
	333166000 - Surge Tank Piping & Valves	LS	1	2,110,917
	333190000 - PP Electrical Building - Civil & Structural Work	SF	45500	20,929,321
	333195000 - PP Equipment Storage Building	SF	45800	15,653,055
	334010000 - Surge Basin Concrete Slabs	LS	1	78,043,685
	334020000 - Surge Basin Structures	LS	1	2,269,020
	334030000 - Surge Basin Gantry Crane Bridge	LS	1	5,139,366
	334040000 - Dewatering System	LS	1	3,229,175
	334050000 - Surge Basin Site Restoration	LS	1	830,208
	336120005 - PP Substation - Electrical Distribution	LS	1	80,751,532
	336120007 - Pump Plant Buildings - Electrical	LS	1	57,717,516
	336140009 - Pump Plant - Electrical System	LS	1	15,992,669
	336150005 - Pump Plant - Site Electrical System	LS	1	26,640,940
	336160005 - SCADA System - Pump Plant Only	LS	1	1,875,715
	337111000 - Start-up & Commissioning - Pumping Plant	LS	1	9,701,000
33 - Bethany Pumping Plant, Surge Shaft and Basin Total				**2,495,740,250**
55 - Bethany Aqueduct Pipeline, Tunnels and shafts				
	552001000 - Aqueduct Pipes - Contractors Profit & Burden	LS	1	53,493,856
	552005000 - Mobilization - DCA AQUEDUCT PIPES - Section 1	LS	1	278,056
	552006000 - Dewatering Treatment & Disposal	LS	1	518,776
	552006500 - Traffic Control	LS	1	342,448
	552006700 - Environmental Protection - Aqueduct Pipe Contract	LS	1	8,918,594
	552007000 - Lost Labor Time - Aqueduct Pipe Inst. Contract	LS	1	309,892
	552008000 - NEW DISCHARGE STRUCTURE - Site Preparation	LS	1	5,559,113
	552010000 - Clear & Grub - Section 1	AC	81	758,296
	552015000 - Strip & Stockpile Topsoil - Section 1	LF	6307.8	837,837
	552020000 - Trench Excavation - Section 1	CY	317497	2,606,962
	552025000 - Place Trench Stabilization Material - Section 1	CY	15412	1,109,584
	552030000 - Furnish Pipe Support Cradles - Section 1	EA	1448	841,462
	552035000 - Backfill - Section 1	LS	1	27,171,889
	552040000 - Compact and Finish - Section 1	LS	1	251,289
	552045000 - Dewatering - Section 1	LS	1	973,591
	552047000 - Add Dewatering Wells @ Kelso, BBID, Mtn. House Rd.	LS	1	613,279
	552050000 - General Support Crew - Section 1	LS	1	2,033,906
	552055000 - Site Restoration & DeMobilization - Section 1	LS	1	29,588
	553005000 - Mobilization - DCA AQUEDUCT PIPES - Section 2	LS	1	278,056
	553006000 - Dewatering Treatment & Disposal	LS	1	518,776
	553006500 - Traffic Control	LS	1	342,448
	553010000 - Clear & Grub - Section 2	AC	62	477,340
	553015000 - Strip & Stockpile Topsoil - Section 2	LS	1	497,282
	553020000 - Trench Excavation - Section 2	CY	189000	1,525,153
	553025000 - Place Trench Stabilization Material - Section 2	CY	7892	624,128
	553030000 - Furnish Pipe Support Cradles - Section 2	LS	1	429,818
	553035000 - Backfill - Section 2	LS	1	15,953,684
	553040000 - Compact and Finish - Section 2	LS	1	150,501
	553045000 - Dewatering - Section 2	LS	1	747,796
	553046000 - Bridges at Jones Penstocks	LS	1	1,911,129
	553047000 - Bridges at BBID	LS	1	1,429,741
	553048000 - Bridges at Gas LIne Crossing	LS	1	1,429,741
	553050000 - General Support Crew - Section 2	LS	1	1,207,632
	553055000 - Site Restoration & DeMobilization - Section 2	LS	1	29,588
	555010000 - Purchase and Transport Pipes	LS	1	147,200,051
	555015000 - Unload & Store Pipes at Storage Yard	LS	1	3,182,620
	555020000 - Installation of Pipes at Open Cut	LF	9971.5	6,126,287
	555040000 - Internal Lining	LF	57200	20,447,646
	555045000 - Cathodic Protection	LS	1	647,036
	555050000 - Installation of Pipes at Crossings	LF	920	34,135,119
	555055000 - Installation of Pipes at Tunnels & Shafts	LF	3408.5	25,204,308
	555056000 - Install Pipe at Disch Structure Vertical Shafts	EA	4	2,169,775
	555060000 - General Support Crew	LS	1	3,257,427
	555065000 - Geotechnical Monitoring and Instrumentation	LS	1	351,536
	555070000 - Indirect Cost - Section 1, 2, Tunnels & Shafts	LS	1	10,256,608
	85101000 - Mobilize Portals	LS	1	1,702,180
	85102000 - Excavate East Penstock Portal	CY	160245	2,738,587
	85102500 - Excavate West Penstock Portal	CY	224321	3,227,979
	85103000 - Excavate Conservation Easement Portal	CY	239336	4,116,579
	85103100 - Portal Headwall Cut Support	LS	1	518,086
	85103150 - Staging Areas Portals	LS	1	3,023,838
	85103500 - Plant & Equipment	LS	1	-
	85104000 - Indirect Cost	LS	1	-

Bethany reservoir Alternative Basis of Estimate - Construction
Attachement 2 - Estimate Bid Item Prices

Project/Contract	Bid Item	Unit	Quantity	Total 2023$
55 - Bethany Aqueduct Pipel	85201000 - Mobilize Tunnels & Shafts	LS	1	662,974
	85201500 - Site Setup Tunnels & Shafts	LS	1	404,143
	85202000 - Excavate Jones PenstockTunnel 1	LF	200	1,721,806
	85202500 - Excavate Jones Penstock Tunnel 2	LF	200	1,721,806
	85203000 - Excavate Jones Penstock Tunnel 3	LF	200	1,721,806
	85203500 - Excavate Jones Penstock Tunnel 4	LF	200	1,721,806
	85203550 - Staging Areas Penstock Tunnels	LS	1	3,023,838
	85204000 - Excavate Conservation Easement Tunnel 1	LF	3064	22,994,554
	85204500 - Excavate Conservation Easement Tunnel 2	LF	3064	22,994,554
	85205000 - Excavate Conservation Easement Tunnel 3	LF	3064	24,496,527
	85205500 - Excavate Conservation Easement Tunnel 4	LF	3064	24,496,527
	85205550 - Staging Areas Conservation Easement Tunnels	LS	1	6,047,676
	85205600 - Shaft Access Excavation	LS	1	2,392,667
	85206000 - Excavate Shaft 1	LS	1	5,601,227
	85206500 - Excavate Shaft 2	LS	1	5,601,227
	85207000 - Excavate Shaft 3	LS	1	5,601,227
	85207500 - Excavate Shaft 4	LS	1	5,601,227
	85207550 - Staging Areas Shafts	LS	1	1,511,919
	85208000 - Plant & Equipment	LS	1	-
	85208500 - Indirect Cost	LS	1	-
55 - Bethany Aqueduct Pipeline, Tunnels and shafts Total				**540,824,406**
66 - Bethany Discharge Structure				
	663005000 - Discharge Structure - Contractors Profit & Burden	LS	1	13,411,795
	663010000 - Mobilize for Bethany Reservoir Discharge Structure	LS	1	212,419
	663011000 - Discharge Structure Contr. Management Tech.	MO	24	13,248,456
	663015000 - Discharge Structure - Temp. Faciltities Build	LS	1	2,736,027
	663016000 - Discharge Structure - Temporary Facility Operate	MO	24	2,371,824
	663016500 - Lost Labor Time - Beth. Discharge Structure Cont.	LS	1	280,827
	663016700 - Environmental Protection - Disch. Struct.	LS	1	5,144,531
	663018000 - SITE WORK - Bethany Discharge Structure	LS	1	2,108,963
	663019000 - Cofferdam @ Discharge Structure	LS	1	5,446,342
	663021000 - Slab 1 East Section - Discharge Structure	CY	9342	6,620,099
	663022000 - Slab 2 Middle Section - Discharge Structure	CY	6593	4,761,282
	663023000 - Slab 3 West Section - Discharge Structure	CY	3420	2,784,841
	663026000 - Conc. Structural Walls - Bethany Discharge Struct.	CY	11400	16,010,938
	663050000 - Soil Nail Retaining Wall	SF	7689	1,172,630
	663055000 - Radial Gates & Stoplogs - Bethany Disch. Struct.	LS	1	15,089,082
	663060000 - Embankment Fill from Site Excavation	FCY	38266	145,435
	663062000 - Discharge Structure - Mech./Elect.	LS	1	2,591,734
	663064000 - Stop Log Struct. and Fuel Storage	LS	1	393,648
	663070000 - Discharge Structure - Finish Out	LS	1	732,501
66 - Bethany Discharge Structure Total				**95,263,374**
71 - Sacramento County Access Roads - Intakes, Batch plant & P&R				
	711001000 - Contractors Overhead and Profit	LS	1	4,393,006
	711002000 - Contractor Site Management & Facilities	MO	18	6,574,060
	711003000 - Mobilization	LS	1	169,935
	711120000 - Hood Franklin Road	MI	2.5	54,059
	711130000 - Intakes Access Road	MI	3.93	11,125,403
	711140000 - Intake #3 Access Road	MI	0.18	392,734
	711150000 - C-E-5 Intake Access Road	MI	1	2,032,299
	711315000 - Employee Park & Ride - Hood Franklin	LS	1	1,893,570
	711460000 - Lambert Road Widening	MI	3.39	3,654,711
71 - Sacramento County Access Roads - Intakes, Batch plant & P&R Total				**30,289,775**
72 - Twin Cities Advanced Sitework - Access Roads & Levees				
	721001000 - Contractors Overhead and Profit	LS	1	3,134,787
	721002000 - Contractor Site Management & Facilities	MO	8	3,463,476
	721003000 - Mobilization	LS	1	135,252
	721410000 - Twin Cities Site Development & Ring Levee	LS	1	9,742,205
	721420000 - Diersen Road Paving	MI	0.8	835,203
	721430000 - Franklin Blvd Improvements at Dierrsen	MI	0.49	1,277,522
	721470000 - Twin Cities Road Widening (East)	MI	1.01	1,649,690
72 - Twin Cities Advanced Sitework - Access Roads & Levees Total				**20,238,135**

Bethany reservoir Alternative Basis of Estimate - Construction
Attachement 2 - Estimate Bid Item Prices

Project/Contract	Bid Item	Unit	Quantity	Total 2023$
73a - Lower Roberts Island Access Roads & P&R				
	711313000 - Employee Park & Ride - Charter Way	LS	1	1,064,525
	731001000 - Contractors Overhead and Profit	LS	1	11,158,598
	731002000 - Contractor Site Management & Facilities	MO	28	11,585,468
	731003000 - Mobilization - Both	LS	1	169,935
	731830000 - Lower Roberts Island Road	MI	5.93	21,595,469
73a - Lower Roberts Island Access Roads & P&R Total				**45,573,995**
73b - State Route 12 Access Road - Terminus Site				
	731730000 - Highway 12 /Terminous Tract Widening	MI	0.82	1,808,224
73b - State Route 12 Access Road - Terminus Site Total				**1,808,224**
74a - Bethany Complex Access Roads - Byron Hwy & Interchange				
	741001000 - Contractors Overhead and Profit	LS	1	12,753,303
	741002000 - Contractor Site Management & Facilities	MO	45	19,625,790
	741003000 - Mobilization	LS	1	197,246
	741900000 - Byron Hwy Frontage Rd	MI	1.18	2,511,984
	741910000 - Byron Hwy	MI	1.05	4,816,936
	741920000 - Byron Hwy - Lindermann Rd Interchange	MI	1.82	19,591,735
74a - Bethany Complex Access Roads - Byron Hwy & Interchange Total				**59,496,993**
74b - Bethany Complex Access Roads - PP area & Roundabout				
	741930000 - Mountain House Shaft Access Road	MI	2.4	7,470,635
	741940000 - Kelso Road Widening	MI	1.48	2,343,254
	741950000 - Mountain House Road Widening	MI	3.74	6,854,429
	741970000 - Mountain House By-pass Rd	MI	0.78	4,397,029
74b - Bethany Complex Access Roads - PP area & Roundabout Total				**21,065,347**
75 - Bethany Reservoir Access Road				
	741960000 - Bethany Road	MI	1.57	9,782,459
	751001000 - Contractors Overhead and Profit	LS	1	72,569
	751002000 - Contractor Site Management & Facilities	MO	1	112,880
	751003000 - Mobilization	LS	1	21,242
	751960000 - Bethany Road	MI	0.16	316,315
75 - Bethany Reservoir Access Road Total				**10,305,466**
76 - Projectwide Road Maintenance				
	133305000 - Int 3 Ph 1 Site Work	LS	1	220,565
	155205000 - Int 5 Ph 1Site Work	LS	1	181,351
	760000000 - Project Wide Road Maintenance	LS	1	24,674,129
76 - Projectwide Road Maintenance Total				**25,076,044**
77 - Lower Roberts Rail & Rail Yard				
	770000000 - Lower Roberts Rail & Rail Yard	LS	1	16,304,932
77 - Lower Roberts Rail & Rail Yard Total				**16,304,932**
78 - Lower Roberts Levee improvements advanced work				
	781410000 - Lower Roberts Levee Improvement advanced work	LS	1	10,344,020
78 - Lower Roberts Levee improvements advanced work Total				**10,344,020**
83 - SCADA Projectwide				
	836160020 - Bethany Complex Communications (Contra Costa/Almed	MI	52.59	13,448,276
83 - SCADA Projectwide Total				**13,448,276**

Bethany reservoir Alternative Basis of Estimate - Construction
Attachement 2 - Estimate Bid Item Prices

Project/Contract	Bid Item	Unit	Quantity	Total 2023$
93 - Projectwide Restoration & Site Establishment				
	133901500 - Int 3 Ph 2 Site Restoration	ACRE	110	1,450,973
	133901600 - Int 3 Establishment Period	YR	5	703,974
	155901500 - Int 5 Ph 2 Site Restoration	ACRE	120	1,450,201
	155901600 - Int 5 Establishment Period	YR	5	582,668
	221015000 - Twin Cities - Launch Shaft Site Restoration	LS	1	6,398,179
	223015000 - Lower Roberts Island - Launch Shaft Site Restore	LS	1	2,289,747
	334050000 - Surge Basin Site Restoration	LS	1	302,759
	334050010 - Surge Basin Establishment Period	YR	5	155,383
	721410000 - Twin Cities Site Development & Ring Levee	LS	1	2,197,919
	781410000 - Lower Roberts Levee Improvement advanced work	LS	1	1,465,279
93 - Projectwide Restoration & Site Establishment Total				**16,997,083**
Grand Total				**11,080,665,979**

Project/Contract	Bid Item	Unit	Quantity	Total 2023$
91 - Bouldin Island Compensatory Mitigation				
	911017000 - Mitigation Bouldin Island Site B-1	LS	1	25,682,772
	911018000 - Mitigation Bouldin Island Site B-2	LS	1	5,627,733
	911019000 - Mitigation Bouldin Island Site B-3	LS	1	5,128,484
91 - Bouldin Island Compensatory Mitigation Total				**36,438,989**
92 - I-5 Pond Compensatory Mitigation				
	921015000 - Mitigation I-5 Pond 6	LS	1	17,319,832
	921016000 - Mitigation I-5 Ponds 7&8	LS	1	32,490,700
	921017000 - SR 12 Wildlife Crossing Culvert	LS	1	4,462,485
92 - I-5 Pond Compensatory Mitigation Total				**54,273,017**
Grand Total				**90,712,006**

Attachment 3
Risk Treatment Costs

Bethany reservoir Alternative Basis of Estimate - Construction
Attachement 3 - Distribution of Risk Treatment Costs

PROJECT	Total	Risk Treatment Cost	Percentage of total
HCSS bid item name	(All)		
Sum of Bid Total			
PROJECT	Total	Risk Treatment Cost	Percentage of total
13 - Intake 3 Facilities	$ 854,825,251	$ 27,647,192	3%
15 - Intake 5 Facilities	$ 805,528,421	$ 26,052,808	3%
21 - Reach 1 Shafts & Tunnel (Twin Cities to Intake 3)	$ 1,032,608,451	$ 60,335,345	6%
22 - Reach 2 Shafts & Tunnel (Twin Cities to Terminous)	$ 1,734,776,876	$ 95,159,675	5%
23 - Reach 3 Shafts & Tunnel (Lower Roberts to Terminous)	$ 1,292,413,060	$ 69,221,103	5%
24 - Reach 4 Shafts & Tunnel (Lower Roberts to Bethany Complex)	$ 1,957,737,597	$ 110,583,877	6%
33 - Bethany Pumping Plant, Surge Shaft and Basin	$ 2,495,740,250	$ 40,000,000	2%
55 - Bethany Aqueduct Pipeline, Tunnels and shafts	$ 540,824,406	$ 21,775,643	4%
66 - Bethany Discharge Structure	$ 95,263,374	$ 3,724,357	4%
71 - Sacramento County Access Roads - Intakes, Batch plant & P&R	$ 30,289,775	$ 1,561,699	5%
72 - Twin Cities Advanced Sitework - Access Roads & Levees	$ 20,238,135	$ 1,043,450	5%
73a - Lower Roberts Island Access Roads & P&R	$ 45,573,995	$ 2,349,732	5%
73b - State Route 12 Access Road - Terminus Site	$ 1,808,224	$ 93,230	5%
74a - Bethany Complex Access Roads - Byron Hwy & Interchange	$ 59,496,993	$ 3,067,583	5%
74b - Bethany Complex Access Roads - PP area & Roundabout	$ 21,065,347	$ 1,086,100	5%
75 - Bethany Reservoir Access Road	$ 10,305,466	$ 531,336	5%
76 - Projectwide Road Maintenance	$ 25,076,044	$ 1,292,886	5%
77 - Lower Roberts Rail & Rail Yard	$ 16,304,932	$ 840,660	5%
78 - Lower Roberts Levee improvements advanced work	$ 10,344,020	$ 533,323	5%
83 - SCADA Projectwide	$ 13,448,276	$ -	0%
93 - Projectwide Restoration & Site Establishment	$ 16,997,083	$ -	0%
Grand Total	**$ 11,080,665,979**	**$ 466,900,000**	4%

Appendix B
Total Project Costs with Innovations

Title:	**Project Wide Innovations Summary**
Prepared for:	Delta Conveyance Project (DCP) File
Prepared by:	Delta Conveyance Design and Construction Authority (DCA)
Copies to:	Files
Date/Version:	May 8, 2024 / Version 1
Reference no.:	EDM_PW_CE_MEM_Projectwide-Innovations-Summary_001325_V01_D_20240508

1. Introduction

1.1 Context and Purpose

On December 21, 2023, California Department of Water Resources (DWR) approved the Delta Conveyance Project (DCP) and selected the Bethany Reservoir Alignment for further engineering, design, and permitting necessary to be completed prior to initiating implementation. DWR completed extensive environmental review and certified the Environmental Impact Report (EIR) (DWR, 2023) as compliant with the California Environmental Quality Act (CEQA).

Following project approval, DWR directed DCA to further evaluate several project features presented in the Bethany Reservoir Alignment Engineering Project Report (EPR) and consider potential design or construction innovations to further reduce community or environmental disturbances, schedule, and/or costs or improve constructability. This evaluation resulted in a set of potential innovations that at this early conceptual stage of the project are considered by the DCA to be reasonable and credible based on industry experience. The innovations discussed herein do not represent changes to the project description presented in the EPR and analyzed in the EIR, but rather provide an indication of how normal design development processes can help manage costs for large infrastructure projects.

As the innovation concepts are further advanced, DWR will review the innovation concepts to determine and document if the innovation concepts would result in a change in the project description presented in the EPR and analyzed in the EIR. The results of these reviews will be used by DWR to determine if additional reviews will be required under the CEQA and for project permitting.

1.2 Summary of Innovations

This memorandum summarizes the process used to identify and select innovation concepts for evaluation and compares the potential cost and schedule savings to the project as described in the EIR/EPR. A summary of these innovations and their assessment related to cost and schedule is shown in Table 1-1.

Table 1-1. Summary of Innovations

Innovation ID	Innovation Title	Potential Cost Savings[a] ($M[b])	Potential Schedule Savings[c] (Days)
Intakes			
INV-I2	Intake Fish Screen Barrier System	$ 1.07	14
INV-I3	Raise Intake 3 and 5 Tee Screen Elevation	$ 4.13	28
INV-I4/I5	Intake Structure Configuration	$ 29.81	26
Tunnels and Shafts			
INV-T1	Provide Separate Access to Double Launch Shafts	($ 0.63)	No Change
INV-T2	Tunnel Lining Optimization	$ 45.85	No Change
INV-T3	Planning for Semi Continuous Mining	$ 70.35	184
INV-T4	Optimizing Tunnel Profile and Shaft Sizes	$ 95.43	192
Pumping Plant and Surge Basin			
INV-P1	Optional Pumping Plant Belowground Configuration	$ 138.72	981
INV-P3	A) Surge Basin Slab Uplift Resistance B) Surge Basin Wall Configuration	P3A: $ 178.44 P3B: $ 52.39	P3A: 280 P3B: 237
Aqueducts			
INV-A1/A5	Reduce Pipe Diameter and Trench Section	$ 60.38	79
INV-A4	Bethany Conservation Easement Tunnel/Shaft Considerations	$ 14.36	222
Discharge Structure			
INV-D1	Reconfigure Discharge Structure Retaining Wall	$ 1.39	No Change
INV-D2	Refine Bethany Reservoir Discharge Structure Configuration	$ 38.50	554
Hydraulics and Operations			
INV-H1/H2	Reduce Diameter of Intake Shafts and Maintenance Shafts	$ 40.11	No Change
Logistics			
INV-L1	Eliminate Rail-Served Materials Depot – Lower Roberts Island	$ 16.30	128
INV-L2	Hood Franklin Road Intersection Innovation	$ 2.05	No Change

[a] Potential Cost Savings refers to reductions associated with potential innovations compared to the Construction Cost estimate for the Bethany Reservoir Alignment as depicted in the EPR. Values in () represent a potential increase in costs.

[b] Costs are in 2023 dollars and are undiscounted.

[c] Schedule savings represent the number of physical construction days that could be saved for the feature studied. The potential schedule savings would reduce the overall project schedule only if the schedule for that feature impacts the overall project critical path.

As shown in Table 1-1, each innovation concept is identified with an ID number and grouped by project feature (i.e. Intakes, Tunnels and Shafts, etc.). The innovation concepts presented in Table 1-1 are mutually exclusive and have been analyzed as independent concepts except for the following:

- Innovation T4 considers the cost differential associated with adjusting the tunnel profile and assumes the reduced shaft diameter included with innovation H1/H2.
- Innovation A4 considers a revised profile of the tunnel under the Bethany Reservoir Conservation Easement and incorporates the reduced diameter of the aqueduct pipelines as presented in innovation A5.

A summary of the potential cost savings by major project feature is presented in Table 1-2.

Table 1-2. Potential cost savings from combined set of innovations

Feature	Potential Construction Cost Savings[a] ($M[b])	Potential Risk Treatment Cost Savings[a,c] ($M[b])	Total Potential Cost Savings[a] ($M[b])
Intakes (I2, I3, I4, I5)	$35	$1	$36
Tunnels & Shafts (T1, T2, T3, T4, H1/H2)	$211	$12	$223
Pumping Plant & Surge Basin (P1, P3)	$370	$6	$376
Aqueducts (A1, A4, A5)	$75	$3	$78
Discharge Structure (D1, D2)	$40	$1	$41
Logistics (L1, L2)	$18	$1	$19
Total	**$749**	**$24**	**$773**

[a] Potential Cost Savings refers to reductions associated with potential innovations compared to the construction cost estimate for the Bethany Reservoir Alignment as depicted in the EPR. Values in () represent a potential increase in costs.

[b] Costs are in 2023 dollars and are undiscounted.

[c] Risk treatment cost savings are estimated as a scaled proportion of construction cost savings relative to the Total Project Cost estimate for the Bethany Reservoir Alignment as depicted in the EIR/EPR.

As shown in Table 1-2, the innovations evaluated for the tunnels and shafts and the pumping plant and surge basin present the greatest potential savings and make up the majority of the combined innovation savings. The potential benefits of the identified innovations or future innovations should be further analyzed as project definition improves. Additional benefits of potential design or construction innovations to improve constructability or further reduce community or environmental disturbances, schedule, and/or costs savings associated with potential innovations could be realized but would require further analyses in coordination with DWR.

2. Development and Screening of the Innovations

The purpose of identifying and developing innovations at this early stage of conceptual design was to demonstrate the potential project benefits associated with industry innovation, constructability improvements, and eventual value engineering activities that will likely occur in future design phases. Initially, 167 innovative ideas were identified with potential to improve the project. The DCA analyzed the ideas and categorized them into 51 potential innovations that were then advanced through additional

feasibility-level analyses and reviewed in a series of workshops with DCA and DWR staff. The result of this screening and evaluation process was the identification of 19 reasonable innovation concepts that could result in potential cost and/or schedule reductions, which are summarized in this memorandum.

3. Analysis of the Innovations

The DCA determined a variety of potential improvements, or innovations, to the EPR conceptual design based on additional engineering and design consideration and additional geotechnical subsurface information not available at the time of completing the EPR conceptual design. When deciding which innovations might be considered for further evaluation, the innovation concept was compared to the EPR conceptual design in terms of cost and schedule.

3.1 Cost Considerations

To evaluate the cost savings, a high-level concept design and subsequent cost estimate for the innovations was compared to the baseline construction cost estimate for the project described in the EPR/EIR. For some innovations, the basic design remained the same, but with a change to the quantities, and hence cost. For other innovations, new potential construction approaches associated with the concepts were evaluated and compared using the same unit costs as presented in the baseline construction cost estimate to determine the potential construction cost savings.

Cost evaluations resulted in either a cost increase, cost decrease, or minimal change compared to the baseline cost estimate prepared for the EPR concept design. The cost evaluation also considered how each innovation could either reduce or optimize construction materials, labor hours, and construction sequencing to ultimately reduce the cost and schedule duration while still meeting the overall functional requirements of the project. The construction cost savings presented for the innovations include the same cost basis used to develop the baseline construction cost estimate as related to materials, labor and equipment, taxes, contractor markup and profit, and other add on costs such as insurance and bonds. This analysis does not re-evaluate risk treatment costs associated with design and construction of the project features, but rather applies a proportionally scaled portion of the risk treatment costs as described for the baseline construction cost estimate for the project.

Innovation construction cost savings presented in this memorandum do not currently include contingency. However, it is recommended that the same contingency be applied to the innovation construction costs savings as used for the baseline total project cost estimate when comparing the cost impacts. Innovations may reduce the impact of uncertainty within the cost estimate currently captured by risk treatment costs and project contingencies and should be further evaluated in the future.

Labor costs associated with design and construction of the project features were not re-evaluated for this evaluation, so any comparison with the baseline total project cost estimate should use a proportionally scaled labor cost to indicate the total costs of the project including potential innovations. Cost savings discussed in this memorandum do not include effects related to the reduced schedule durations for each individual construction project nor for the reduction of the overall project schedule. Labor cost and schedule cost savings should be further evaluated during future design stages.

3.2 Schedule Considerations

Each innovation was individually assessed to determine the impact on the construction schedule compared to the EPR schedule. Where quantities of materials changed, the same production rates were

applied to ascertain new activity durations. Where new activities were introduced, production rates from similar activities were used wherever possible to determine the new activity duration.

The schedule savings referenced in this memorandum are in terms of construction days for each individual feature and not overall project schedule. The potential schedule savings for each individual feature would reduce the overall project schedule only if the schedule for that feature impacts the overall project critical path. An evaluation of overall project schedule savings should be completed as part of future design phases.

4. Description of the Innovations

This section summaries each innovation and compares it with the EPR design, including an assessment of the impacts on potential cost and schedule.

4.1 Intakes

4.1.1 INV-I2 Intake Fish Screen Barrier System

EPR Concept	
The EPR concept for the fish screen barrier system at the intakes included a combination of thirty three 24-inch-diameter pipe piles with approximately 1,015 feet of floating fabricated steel log booms affixed in front of the piles spaced at approximately 35 feet.	
Innovation Concept	
This innovation concept includes a combination of twelve 24-inch-diameter piles with approximately 995 feet of floating HDPE log booms in between the piles using proprietary vendor-fabricated floating “pile sliders” attached to each pile spaced at 100 feet maximum	
Cost Savings:	$1,070,000
Schedule Savings:	14 construction days

4.1.2 INV-I3 Raise Intake 3 and 5 Tee Screen Elevation

EPR Concept	
The EPR concept for both Intake 3 and Intake 5 places the bottom of the tee screens at EL -13 feet, which provides approximately 8.6 feet of submergence below the design (low) water surface elevation at Intake 5, and approximately 8.7 feet of submergence at Intake 3. The minimum recommended tee screen submergence is one half of the screen diameter, or 4 feet for the current 8-foot-diameter tee screen units. At the same time, the EPR concept places the screen sill at EL -17 feet, which is equal to the average river bottom elevation.	
Innovation Concept	
This innovation proposes to increase the separation between the river bottom and the bottom of the Intake 5 tee screens by up to 4.6 feet (up to 4.7 feet at Intake 3) and reduce the screen submergence to the minimum 4 feet. The height of the structure is reduced by up to 4.6 feet (up to 4.7 feet at Intake 3).	
Cost Savings:	$4,133,000
Schedule Savings:	28 construction days

4.1.3 INV-I4 and INV-I5 Intake Structure Configuration

EPR Concept	
The EPR intake structure configuration concept includes thirty 60-inch-diameter discharge pipes, each with a separate gate structure located along the discharge pipe alignment near the sedimentation basins.	
Innovation Concept	
Combined, these two innovations include replacing the thirty 60-inch-diameter discharge pipes with fifteen 84-inch-diameter discharge pipes and combines the gate box structures with the intake structure. In addition, structural elements are added to each bay of the intake structure to resist tunnel jacking forces from construction of each of the 84-inch-diameter discharge pipes.	
Cost Savings:	$29,810,000
Schedule Savings:	26 construction days

4.2 Tunnels and Shafts

4.2.1 INV-T1 Provide Separate Access to Double Launch Shafts

EPR Concept	
In the EPR, access to the raised launch shaft pads is via ramps that are shared by two potential contractors, each responsible for driving a tunnel from the double shaft in opposite directions.	
Innovation Concept	
This innovation adds two additional ramps together with a slightly larger top of pad area that would enable each contractor to access their respective halves of the double launch shaft and with an effective dividing wall between them. Reorganization of the equipment and access routes would mean that each contractor could be entirely responsible for maintaining their own construction roads.	
Cost Savings:	($630,000)
Schedule Savings:	No change to schedule

4.2.2 INV-T2 Tunnel Lining Optimization

EPR Concept	
The reinforcement details for the tunnel lining in the EPR concept was based on the maximum net pressure that could be encountered for the entire 45-mile-long tunnel being applied to all tunnel reaches. The design accounted for internal and external water pressure but assumed no soil loads acting on the tunnel to counteract the internal pressures.	
Innovation Concept	
This innovation reduces the amount of reinforcement required in the tunnel lining by considering the maximum net internal pressure that will be encountered within each tunnel reach individually and accounting for an effective soil pressure to counteract the internal pressures.	
Cost Savings:	$45,850,000
Schedule Savings:	Reduced construction time but no impact to the overall schedule

4.2.3 INV-T3 Planning for Semi-continuous Mining

EPR Concept	
The EPR assumed tunnel excavation using a TBM with separate phases for excavation and tunnel lining installation. In this manner, a full precast concrete segmental tunnel lining ring is installed before the TBM rams push the machine forward from the leading edge of the lining to excavate the next section.	
Innovation Concept	
This innovation concept considers the latest TBM technology that allows a TBM to thrust forward from a partially completed segmental lining ring such that excavation and lining installation can happen concurrently.	
Cost Savings:	$70,350,000
Schedule Savings:	101 construction days for Reach 1 160 construction days for Reach 2 118 construction days for Reach 3 184 construction days for Reach 4

4.2.4 INV-T4 Optimize Tunnel Profile and Shaft Sizes

EPR Concept	
The tunnel profile in the EPR slopes continuously from north to south at a constant slope of about 0.01% and is excavated to a depth of approximately 200 feet. The diaphragm walls and final linings of the shafts are shown as 5 feet and 3 feet thick respectively and the shafts invert slabs are 30 feet thick.	
Innovation Concept	
This innovation considers optimizing the vertical tunnel profile and the configuration of the reception and maintenance shafts by reducing the depth of the tunnel between Intake No. 3 and the Stockton Deep Ship Channel Crossing and then increasing the depth of the tunnel from Lower Roberts Island Launch Shaft to the Surge Basin Reception Shaft to provide clearance underneath the future East Bay Municipal Utility District (EBMUD) Mokelumne Aqueducts Resiliency Project (MARP) tunnel. It also considers reducing diameter of the reception and maintenance shafts along with the thickness of the diaphragm walls, final lining and invert slab of the reception and maintenance shafts.	
Cost Savings:	$95,430,000
Schedule Savings:	192 construction days

4.3 Pumping Plant and Surge Basin

4.3.1 INV-P1 Optional Pumping Plant Belowground Configuration

EPR Concept	
In the EPR, the Bethany Reservoir Pumping Plant (BRPP) is a below ground structure with vertical rectangular diaphragm walls and consists of dry-pit pump bays housing the pumping plant equipment and piping plus an adjoining rectangular concrete wet well and wet well inlet conduit connected to the reception shaft located within the Surge Basin. Separate dry pit pump structures would be connected to both sides of the wet well that would be located along the center of the overall structure.	
Innovation Concept	
This innovation would replace the vertical, deep box diaphragm wall arrangement with interlinking shafts of diaphragm wall construction that would house the pumping plant equipment and piping and a tunnel that would replace the wet well and wet well inlet conduit	
Cost Savings:	$138,720,000
Schedule Savings:	981 construction days

4.3.2 INV-P3A/B- Surge Basin Base Slab Uplift Resistance/Surge Basin Wall Configuration

EPR Concept	
In the EPR, uplift resistance to the surge basin base slab is provided by an array of six-foot diameter passive (not pre-stressed) drilled shafts. The surge basin perimeter walls are constructed using concrete diaphragm walls consisting of an upper structural section with two rows of tieback anchors and a lower unreinforced, cut off wall section.	
Innovation Concept	
This innovation considers tiedown anchors for the base slab instead of the drilled shafts (P3A) and a conventional tied-back sheetpile/concrete wall system for the surge basin walls (P3B).	
Cost Savings:	$230,830,000
Schedule Savings:	P3A: 280 construction days P3B: 237 construction days

4.4 Aqueducts

4.4.1 INV-A1 and INV-A5 Reducing Pipe Diameter and Trench Section

EPR Concept	
The EPR concept includes four 180-inch-diameter parallel aqueduct pipelines installed from the BRPP to the Bethany Reservoir Discharge Structure with the parallel pipes spaced at 30 feet on center constructed partially below ground (0.7 x pipeline diameter) and partially above ground (0.3 x pipeline diameter) backfilled with Controlled Low Strength Material (CLSM) from the bottom of the excavated trench to the ground surface and soil cover to 6 feet above the top of pipes.	
Innovation Concept	
This innovation reduces the diameter of the four aqueduct pipelines to 166-inch-diameter, and spaces the pipelines at 21 feet on center while maintaining the backfill and soil cover dimensions.	
Cost Savings:	$60,380,000
Schedule Savings:	79 construction days

4.4.2 INV-A4 Bethany Conservation Easement Tunnel/Shaft Considerations

EPR Concept	
In the EPR, the Bethany Conservation Easement tunnels and Bethany Reservoir Discharge Structure shafts were designed for a 180-inch-diameter pipeline. The tunnel had a constant 0.65% gradient and the shafts consisted of four circular shafts with an internal diameter of 55-feet.	
Innovation Concept	
This innovation considers the reduced aqueduct pipeline diameter proposed in INV-A5 to reduce the size of the excavated tunnel and shafts. It also considers raising the gradient of the tunnel which reduces the depth of the discharge structure shafts and reduces the diameter of the shafts from 55-feet to 32-feet.	
Cost Savings:	$14,360,000
Schedule Savings:	222 construction days

4.5 Discharge Structure

4.5.1 INV-D1 Reconfigure Discharge Structure Retaining Wall

EPR Concept	
In the EPR, shoring during construction of the discharge structure to support hillside excavation would be required and would provide a 10-foot minimum buffer from the closest edge of the Bethany Reservoir Conservation Easement. It was assumed that the shoring system included a combination of soil-nail reinforced wall and excavations sloped between 2H:1V and 1.5H:1V.	
Innovation Concept	
This innovation involves construction of a steepened slope excavation, with soil nail reinforcement to decrease the total area of the cut and volume of excavation. This will also increase the ten-foot buffer from the Bethany Reservoir Conservation Easement and provide an access road for maintenance.	
Cost Savings:	$1,387,000
Schedule Savings:	No change

4.5.2 INV-D2 Refine Bethany Reservoir Discharge Structure Configuration

EPR Concept	
The discharge structure concept in the EPR includes four 55-foot-diameter shafts and four separate channels to convey flow from each shaft to the Bethany Reservoir. Each flow channel would be isolated from the reservoir when not in operation using two radial gates.	
Innovation Concept	
This innovation proposes raising the discharge elevation of each aqueduct pipeline just above the crest of the dam spillway which provides isolation from the reservoir and eliminates the need for the isolation radial gates.	
Cost Savings:	$38,500,000
Schedule Savings:	554 construction days

4.6 Hydraulics and Operations

4.6.1 INV-H1 and INV-H2 Reduce Diameter of Intake Shafts and Maintenance Shafts

EPR Concept	
The EPR design includes 83-foot-diameter shafts at Intake Structures 3 and 5 and five 70-foot-diameter maintenance shafts.	
Innovation Concept	
This innovation reduces the shafts at Intake 3 and Intake 5 to 70-foot-diameter and reduces the maintenance shafts to 66-foot-diameter.	
Cost Savings:	$40,110,000
Schedule Savings:	No change to schedule

4.7 Logistics

4.7.1 INV-L1 Eliminate Rail-Served Materials Depot – Lower Roberts

EPR Concept	
The EPR included new rail access to Lower Roberts Island from the Port of Stockton's rail network via a new bridge over Burns Cut and a new rail-served materials depot on Lower Roberts Island.	
Innovation Concept	
This innovation maintains the construction of the Burns Cut bridge while deferring the construction of the rail-served materials depot on Lower Roberts Island as a future option.	
Cost Savings:	$16,305,000
Schedule Savings:	128 construction days

4.7.2 INV-L2 Hood Franklin Road Intersection Innovation

EPR Concept	
The EPR concept involves the widening of an existing bridge over Snodgrass Slough on Hood-Franklin Road to accommodate left and right turn pockets onto the Intake Haul Road from Hood-Franklin Road leading to the two intake construction sites.	
Innovation Concept	
This innovation involves the installation of a single-lane roundabout that would eliminate the need to widen the bridge and would provide efficient traffic movement.	
Cost Savings:	$2,050,000
Schedule Savings:	No change to schedule

5. Summary and Future Considerations

Compared to the EPR project description, the proposed set of 19 combined innovations are estimated to reduce the construction cost of the project by up to $773M (without contingency) and save a combined total of 2,925 construction days on the various projects. These proposed innovation concepts are recommended for further study as the project develops. Further evaluation of these potential innovations should be fully coordinated with other innovations, environmental impact considerations, risk elements, and other changes that might result from additional future project development.

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