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**Subject:** South Delta Conveyance Facilities Canal and Tunnel Options Summary Comparison (Final Draft)

**Project feature:** South Delta Conveyance Facilities

**Prepared for:** California Department of Water Resources (DWR) / Delta Conveyance Office (DCO)

**Prepared by:** Delta Conveyance Design and Construction Authority (DCA)

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## 1. Purpose and Summary

The purpose of this technical memorandum (TM) is to summarize a reconnaissance-level comparison between two options to deliver water from the Southern Forebay to the Harvey O. Banks (Banks) Pumping Plant approach channel (referred to as the California Aqueduct):

- 1) Dual tunnels extending from the southern end of the Southern Forebay to the California Aqueduct (Figure 1)
- 2) Canal extending from near the southern end of the Southern Forebay to the California Aqueduct (Figure 2)

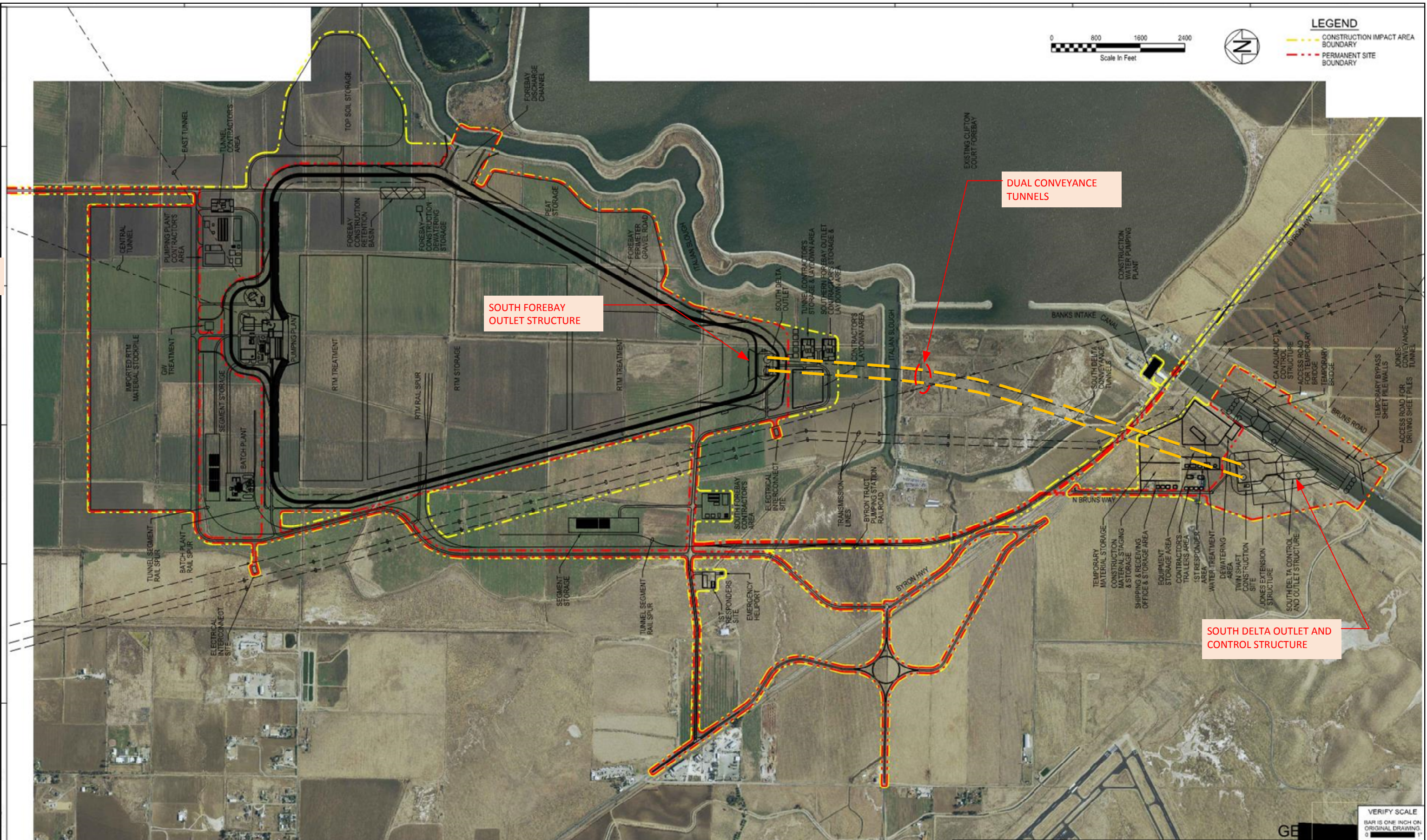
The dual-tunnel and canal options were compared on a reconnaissance level to determine the apparent best approach to delivering water to the California Aqueduct. The dual-tunnel option was selected as the apparent best option and is included in the current engineering concept drawings provided to the DCO environmental team for analysis. This TM summarizes the comparison between the two options, and provides the associated advantages and disadvantages.

### 1.1 Background

In general, the dual tunnel option was proposed as a Delta Conveyance Project (project) feature because it would provide a more implementable, seismically reliable, and relatively clean construction approach with minimal ground disturbance and no permanent surface disturbances. The tunnel would extend under many components, including:

- Sensitive areas
- Buried utilities
- The Western Area Power Administration (WAPA) and Pacific Gas & Electric Company (PG&E) power easements
- Several roads

Reusable tunnel material (RTM) from the tunnel construction would be conveyed through the tunnel to the Southern Forebay, where it would be used for embankment construction. This would reduce the need for the surface transportation of excavated material. Some of the disadvantages of dual tunnels are potentially higher costs and construction risks.

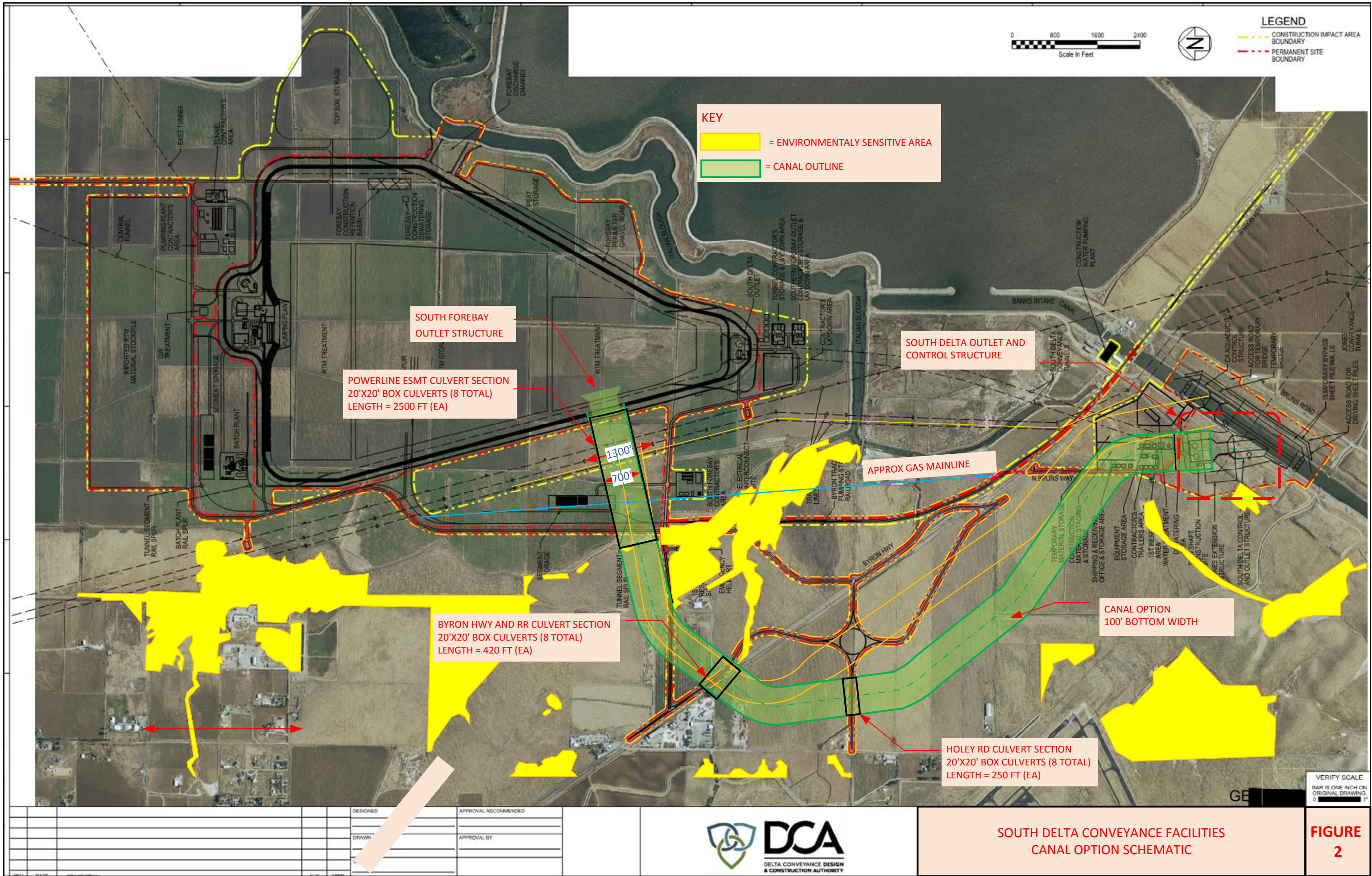


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SOUTH DELTA CONVEYANCE FACILITIES  
DUAL TUNNEL OPTION SCHEMATIC

FIGURE  
1



The canal option includes significantly more ground disturbance and permanent surface facilities than the tunnel option. It also involves long-term maintenance and safety-related considerations that add additional challenges to construction and permitting. The major considerations for the canal option include:

- Potential conflicts with environmentally-sensitive areas
- Greater potential for seismic disturbance due to West Tracy Fault
- Potential conflicts and constraints of existing utility crossings and interfaces
- Permanent ground disturbance
- Potential conflicts and constraints related to the public interests and land uses

The main benefit of the canal construction relative to tunnel construction is the potential cost savings.

## 1.2 Summary

The reconnaissance-level cost comparison indicates the canal option may have about a 10 percent cost savings over the dual-tunnel option if the constructability risk of the canal option is assumed to be the same as the dual-tunnel option. However, when considering the following challenges, the dual-tunnel option appears to have significant advantages for a long-term serviceable facility with relatively low maintenance:

- Amount of temporary and permanent disturbance
- Greater reliability relative to the West Tracy Fault
- Additional land acquisition requirements
- Environmental disturbance
- Traffic conflicts on the Byron Highway
- Approval and permitting challenges with WAPA and PG&E
- Construction challenges within the WAPA and PG&E easements
- Partial water delivery potential
- Daily security and safety

For these reasons, the dual-tunnel delivery system is recommended as the best apparent option for implementation as part of the project.

## 2. Conceptual Development of Options

This section summarizes the key characteristics associated with each potential approach.

### 2.1 Dual-tunnel Option

Figure 1 provides a preliminary sketch of the tunnel option. This section describes the facilities starting from the upstream inlet at the Southern Forebay Outlet Structure and continuing downstream to the South Delta Outlet and Control Structure, which controls flows into the California Aqueduct.

#### 2.1.1 Southern Forebay Outlet Structure

The Southern Forebay Outlet Structure would be located at the southern end of the Southern Forebay (Figure 3). This site was selected to minimize the length of the dual tunnels that would extend between this structure and the South Delta Outlet and Control Structure. It would also be at the opposite end of the Southern Forebay from the inlet (proposed South Delta Pumping Plant), allowing water to flow

through the Southern Forebay, which would help reduce stagnation. Figure 4 shows the general layout of the Southern Forebay Outlet Structure and its components.

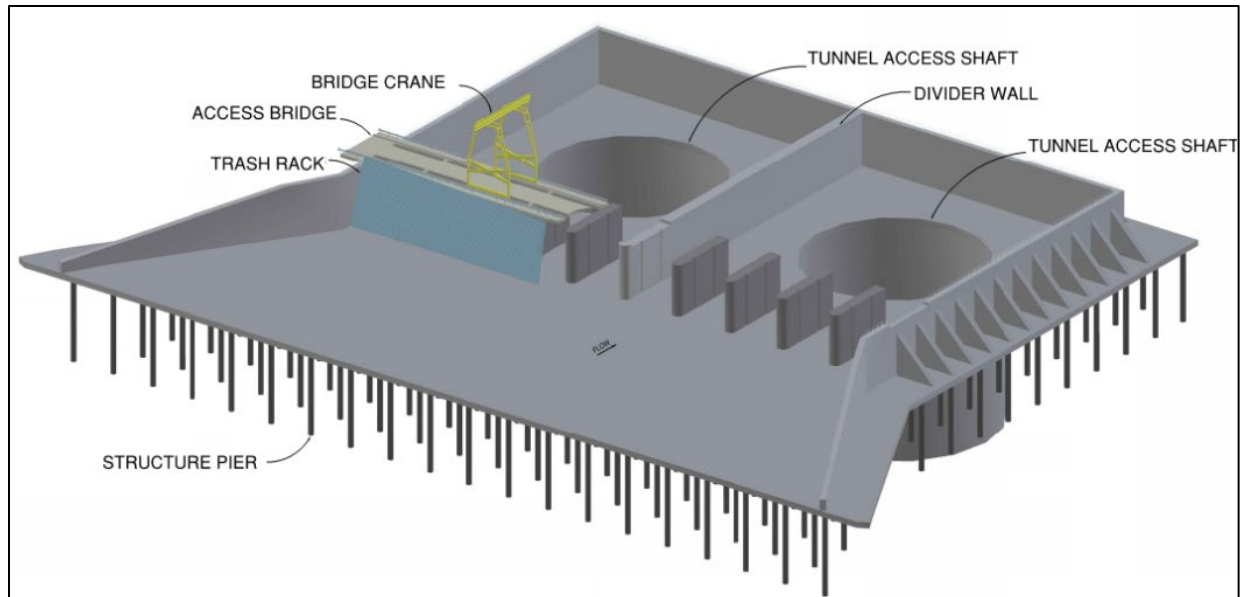


Figure 3. Southern Forebay Outlet Structure

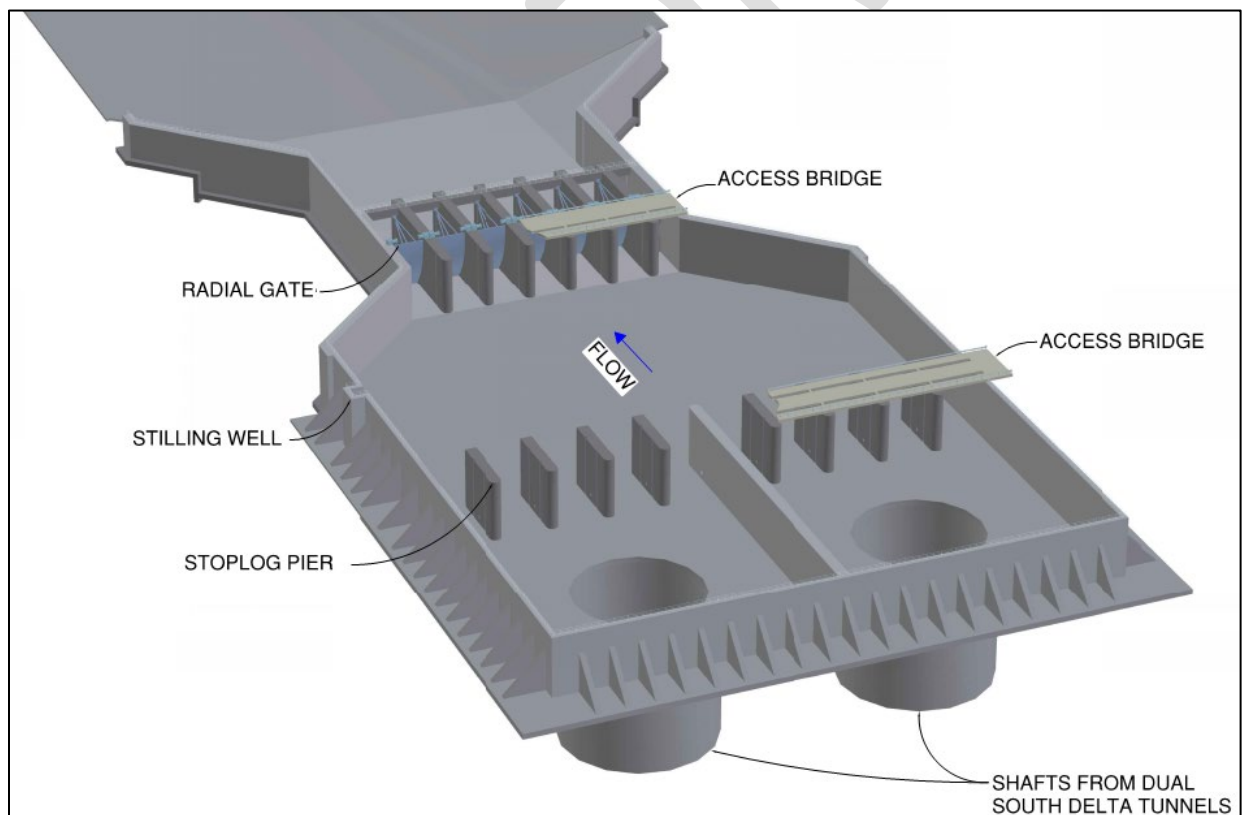


Figure 4. South Delta Outlet and Control Structure

The structure entrance would have a large apron extending into the forebay. This apron would slightly accelerate flow, protect against erosion at the entrance, and provide a hard surface to dredge to if needed in the future.

The next downstream feature is a trash rack that would be placed to catch debris before water enters the shafts and tunnels. Generally, water entering the Southern Forebay should be clean and debris-free. However, there is a potential for aquatic weed growth in the forebay, and for debris to enter the forebay during severe wind events. Such weeds and debris would need to be screened before flow entered the tunnel shafts. If desired, the structure footprint would be suitable to support an automatic rake system, though this is not currently shown.

Downstream of the screen, piers would be placed perpendicular to the flow path. These piers would serve as support for the access bridge and provide a location for large bulkhead gates to be inserted to terminate flow into one or both of the tunnel shafts for isolation. Each pier would have a dual set of slots to provide double isolation for the safety of personnel that may be working downstream. To allow a quicker response for isolation, it was assumed that the gates could be left in place and secured in the open position. A gantry crane would be provided so the gates could be lifted and lowered when needed.

The structure would be divided into two chambers, each serving one of the dual tunnels. This would allow one tunnel to be isolated and dewatered for maintenance and repair, while allowing un-interrupted flow through the other tunnel. Under normal conditions, this structure would be free-flowing, with no day-to-day operational requirements except debris management.

### **2.1.2 Dual Conveyance Tunnels**

As Figure 3 shows, the Southern Forebay Outlet would have two drop shafts, each feeding one of the dual tunnels that extended to the California Aqueduct. The tunnels are considered Reach 5 of the Delta Conveyance Tunnel System. A tunneling configuration was selected over a canal delivery system for reasons described in this TM.

The tunnels' alignment would generally take the most direct route between the Southern Forebay Outlet Structure and the South Delta Outlet and Control Structure. There would be some deviation from a straight line along the route, to comply with WAPA and PG&E requirements that the tunnels do not traverse under powerline towers.

The tunnels would have no intermediate structures, and no day-to-day operator input would be required. Dewatering would be accomplished by pumping the tunnels out on the downstream end and discharging the flow into the California Aqueduct.

The tunnels would cross the West Tracy Fault.

### **2.1.3 South Delta Outlet and Control Structure**

As Figure 1 shows, the dual tunnels would terminate at the South Delta Outlet and Control Structure. This structure would be located on the western bank of the California Aqueduct, between the John E. Skinner Delta Fish Protective Facility and the Banks Pumping Plant, just southwest of the Byron Highway. To maintain the "fish-screened" nature of the flow, it would be necessary to introduce the Delta Conveyance System flow downstream of the John E. Skinner Delta Fish Protective Facility. To limit the length of the tunnels, the South Delta Outlet and Control Facility would be placed as far north as practical along the California Aqueduct while allowing space to construct the California Aqueduct Control Structure and avoid

conflicts with the Byron Highway Bridge and the PG&E power transmission easement, which crosses the aqueduct just south of the Byron Highway.

Figure 5 shows the general configuration of the South Delta Outlet and Control Structure. The termination shafts of the tunnel would extend vertically into a collection basin, where the flow would transition to an open channel system. The basin would have two separate tunnel transition compartments, each associated with one of the shafts. This configuration would allow one tunnel to be isolated for dewatering and maintenance while maintaining the other tunnel in full operational mode.

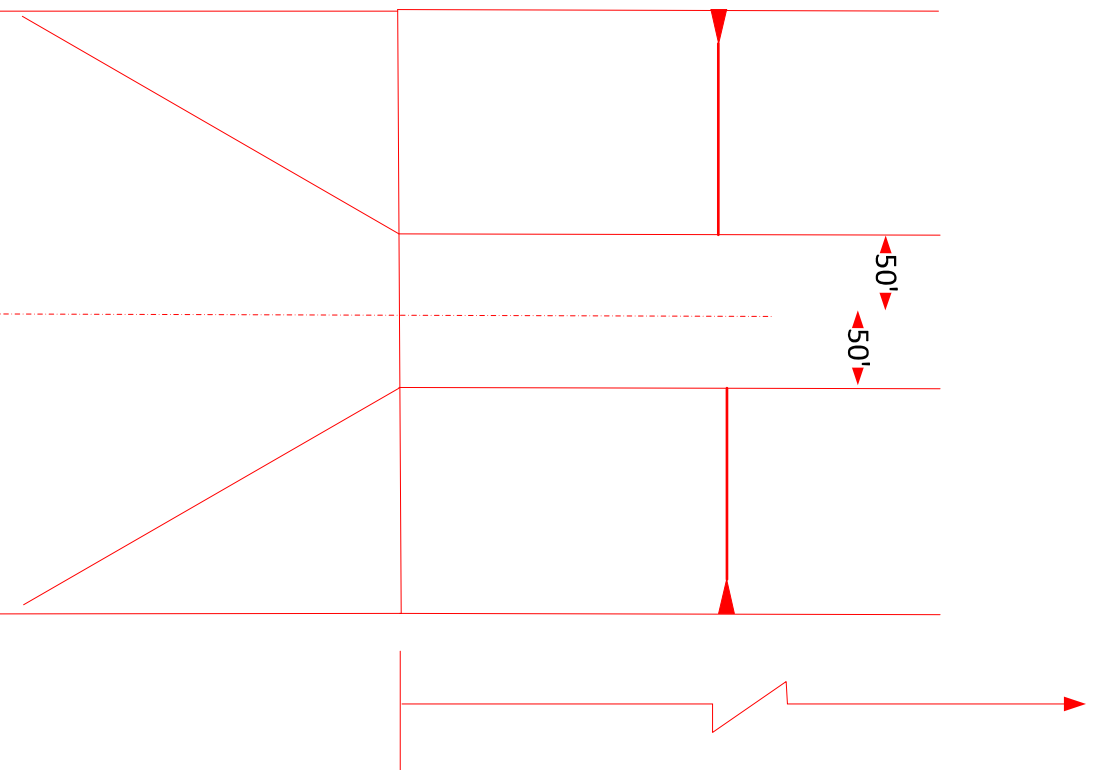
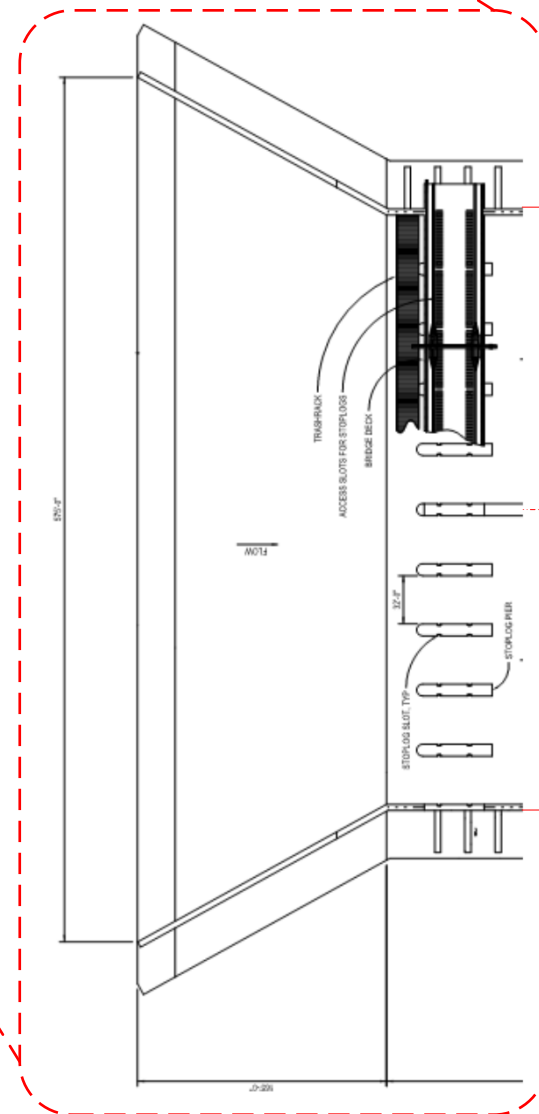
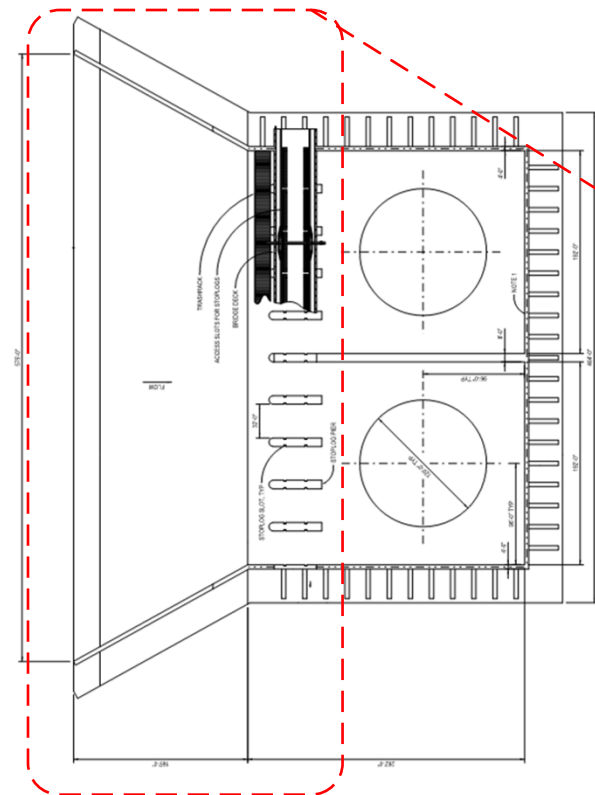
A series of piers would be installed across the basin and oriented transverse to the flow. Each pier would have two vertical slots to accept two sets of bulkhead gates for isolation. The gates would provide double isolation for worker safety during maintenance activities in the tunnel. A bridge with slot openings for the gates would cross over the structure on top of the piers to provide access and facilitate bulkhead installation. Bulkheads would be stored on the site and installed with a mobile crane from the bridge deck.

Flow would proceed from the basin into a section of the facility containing radial gates. These gates would provide singular flow control for water withdrawn from the Southern Forebay and conveyed into the California Aqueduct. Vertical slots would be provided in the piers between the gates, both upstream and downstream. Bulkhead gates, inserted into these slots, would allow each gate bay to be isolated and dewatered, as needed, for gate maintenance and repair. The height of the gates would be set to match the maximum water surface elevation in the Southern Forebay, so the downstream system could be completely isolated if needed. Large gates would be operated to deliver the bulk flowrates. Smaller radial gates (or vertical sluice gates) would be used to allow flow trimming to match downstream pumping needs. Stilling wells would be provided both upstream and downstream of the gates to monitor water surface levels. These levels would be used with the gate-rating curves to establish the required gate setting to maintain the desired flow. The gates would be controlled with electric operators. Since this is the critical control facility for delivering water from the Southern Forebay, a backup generator would be located onsite to allow operations during a power failure. This generator would also be used to provide backup power to the California Aqueduct Control Structure and the optional Jones Pumping Plant Control Structure.

A short, concrete-lined channel section would convey the flow from the gate section into the California Aqueduct. The structure and outlet channel have been rotated approximately 40 degrees from the California Aqueduct to facilitate a smoother transition of flow into the aqueduct.

Depending on gate opening, flow through the gates could be supercritical, which could result in erosive velocities entering the earthen-lined California Aqueduct. To control the energy from the gates, the invert of the structure would be set at an elevation suitable to cause a hydraulic jump within the concrete-lined section. This would limit flow velocities entering the California Aqueduct to about 5 feet per second (fps) under maximum flow. In addition, articulated concrete mats would be placed to reduce erosion in the unlined California Aqueduct near its confluence with the project, which is an area of possible turbulence. The need for additional energy dissipation would be further reviewed during final design and would not be expected to change the facility's footprint.

PORTION OF  
STRUCTURE FROM  
TUNNEL OPTION THAT  
WOULD BE USED FOR  
CANAL ALTERNATIVE



TRAPAZOIDAL CANAL OPTION

FIGURE 5  
SOUTHERN FOREBAY OUTLET  
CANAL OPTION

## 2.2 Canal Option

Figure 2 provides a preliminary sketch of the canal option. This section describes the facilities, starting from the upstream inlet at the Southern Forebay Outlet Structure, and continuing downstream to the South Delta Outlet and Control Structure, which controls flow into the California Aqueduct.

### 2.2.1 Southern Forebay Outlet Structure

For this analysis, the transition into the canal option from the Southern Forebay is generally similar to the Forebay Outlet Structure that feeds the dual-tunnel option. The major difference is the change from vertical shafts that would feed the dual tunnels to the horizontal transition structure that would feed box conduits and an open-channel canal system (Figure 5). To maintain acceptable inlet flow velocities, the outlet structure would be approximately the same size for both options, and both would include the following components:

- Piers
- Trash racks
- Large bulkhead panels for isolation
- A crane to lift the panels
- A bridge for access

### 2.2.2 Canal System – Power Easement Culverts

The beginning of the canal extends under the major WAPA and PG&E powerline easements that run approximately north to south on the western side of the Southern Forebay. WAPA and PG&E have placed several restrictions on work in this easement. The following major items would affect canal construction.

- Excavations must be more than 200 feet from the towers.
- No dewatering activities that could affect the stability of the transmission tower footings would be authorized.
- No ground elevation changes would be allowed that would reduce the ground-to-conductor clearance below 35 feet.
- The powerline easement prohibits piling or placing material within the easement boundaries.
- Berms must not be placed next to the base of transmission line towers.
- Structures, including buildings, sheds, swimming pools, basketball courts, tennis courts, and gazebos, would not be allowed on the easement.
- Equipment within the easement must be less than 14 feet high.

Because of the surrounding grade and operational water levels in the Southern Forebay, a canal option would require an elevated berm height of about 30 feet above the surrounding ground on each bank. This type of structure would be prohibited under several of the restrictions listed here:

- It would require fill within the embankment.
- The ground-to-conductor clearance would need to be at least 35 feet.
- The combined embankment and equipment height would exceed 14 feet.

To address these limitations, box-conduit-style cast-in-place concrete culverts have been assumed for conveyance through the powerline easements. These conduits would be large box sections, 20 feet by

20 feet, with eight in total. The boxes are assumed to extend approximately 2,000 feet from the Southern Forebay along the canal option alignment. This length would traverse the powerline easements, as well as the proposed access roads and railroad spur that would service the Southern Forebay construction. This would eliminate the need for separate bridges on those access features. Even with the culverts, a tower on the WAPA single-tower powerline would need to be relocated. Relocating this tower could also require the addition of another tower on the opposite side of the excavation to properly support the line.

The culverts could create construction challenges. Because of the size, the culverts are assumed to be cast-in-place. A large volume of excavation would be required, which is normally accomplished by large, tracked excavators. Because of the 14-foot height restrictions, ramps would need to be constructed down into excavations so the equipment could operate from elevations below surrounding grade.

Groundwater control would also be a challenge. Well points and slurry walls, typical methods for groundwater control, both require the use of drilling rigs. Drilling rigs are prohibited by the WAPA requirements and would not be practical with the height restriction. Alternative approaches, such as drain trenches or underdrain piping, may be necessary.

It would also be necessary to construct large forms or move them into place. Large quantities of steel reinforcement would also be required for the concrete structures. These large materials are typically, and most efficiently, moved by crane. However, because of the height restrictions, smaller pieces of equipment and materials would need to be moved into place from the ends of the excavation.

The box culvert structure would be approximately 160 feet wide. Normally, concrete pumper trucks with large booms are used to reach out into the center of the construction area. However (again, because of the height restrictions), this would not be possible. Pumper trucks or trailer-mounted concrete pumps would need to be staged at the ends of the excavation and slicklines would need to be extended to facilitate the concrete's conveyance to the appropriate point of placement.

The construction and installation constraints identified may be manageable, but the combination of complex constructability issues would make this option less feasible and, at a minimum, would decrease production and increase overall costs.

A final noted challenge is the natural gas mainline that runs parallel to the power easement. This line would need to be rerouted, either below or above the canal footprint. In either case, an outage would likely be required, which could affect the line users. The culverts could also be aligned to siphon under the gas mainline. In this case, the line would need to be temporarily supported for approximately 200 feet during construction. A pipe bridge is usually constructed to provide the needed support. In either case, this work is usually performed with large equipment including a tracked excavator, crane, and a drill rig for support piers. Because of height restrictions, other methods would have to be devised to complete the work.

### **2.2.3 Canal System – Open Channels**

Based on preliminary hydraulic calculations, the assumed canal would have a 100-foot bottom width with 3:1 horizontal to vertical (H:V) inboard sideslopes. The proposed invert of the canal is at an elevation of -18.5 feet (above mean sea level). It is assumed that the top of the canal would need to extend to an elevation of 28 feet (above mean sea level) to match the potential elevation of the Southern Forebay. Much of the canal would be entirely in-cut; however, about the first (upstream) 2,000 feet of canal length would require embankments above existing grade. It is expected that the canal would cross the West Tracy Fault in this area. Figure 6 shows assumed sections for both canal conditions: canal completely in-cut or a

combination of cut and embankment. Outboard embankment slopes are assumed to be 4H:1V. A 35-foot-wide access road has been added on both sides of the canal, either at-grade or at the top of the embankment. The entire width of permanent disturbance would range from 470 feet to 680 feet. The entire canal system (including culverts) would be approximately 18,000 feet long.

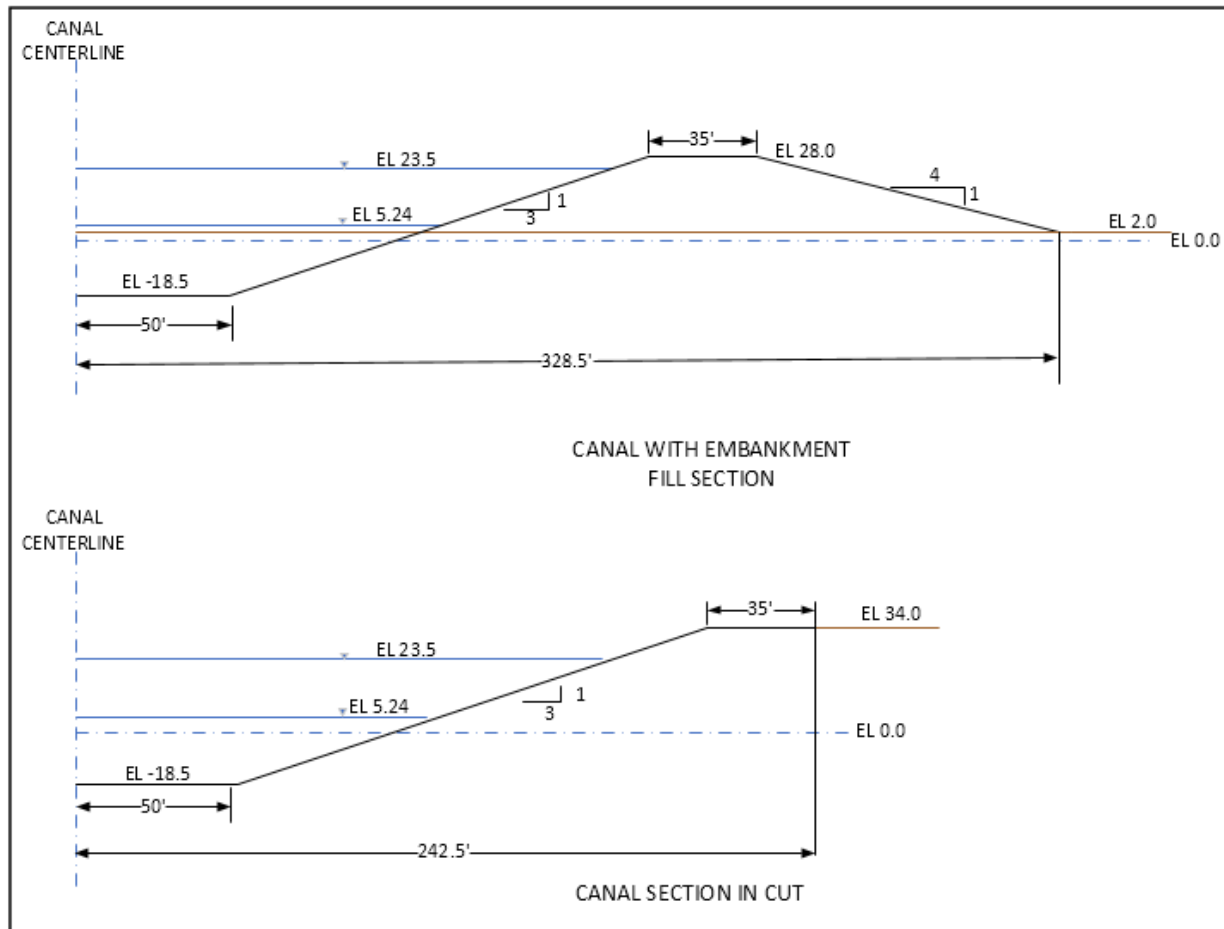


Figure 6. Canal Sections

In areas where embankment would be installed, it is assumed that ground improvement would be required beneath the embankment. This would be accomplished by deep mechanical mixing techniques, extending approximately 50 feet below grade. This would help maintain the integrity of the embankments under both normal and seismic conditions. To maintain the integrity of the canal itself, and prevent water loss through percolation that could affect the surrounding groundwater table, it is assumed the canal would be lined with 4-inch-thick concrete lining, similar to downstream portions of the California Aqueduct. Given the depth of the canal invert relative to local ground surface and groundwater levels, the canal could not be fully dewatered unless the surrounding ground water level was also reduced. Alternatively, the canal could be unlined, but flatter sideslopes and seepage control features would need to be considered, and appropriate provisions added to the project.

## 2.2.4 Canal System – Road Crossing Culverts

The canal system crosses Byron Highway, Holey Road, and North Bruns Way. It is assumed that box culverts similar to the power line crossing system would be needed for crossings of Byron Hwy and Holey Road. It is assumed that North Bruns Way can be abandoned west of the canal crossing. Currently, it serves one property that would need to be purchased because of the project footprint. These box culverts would be

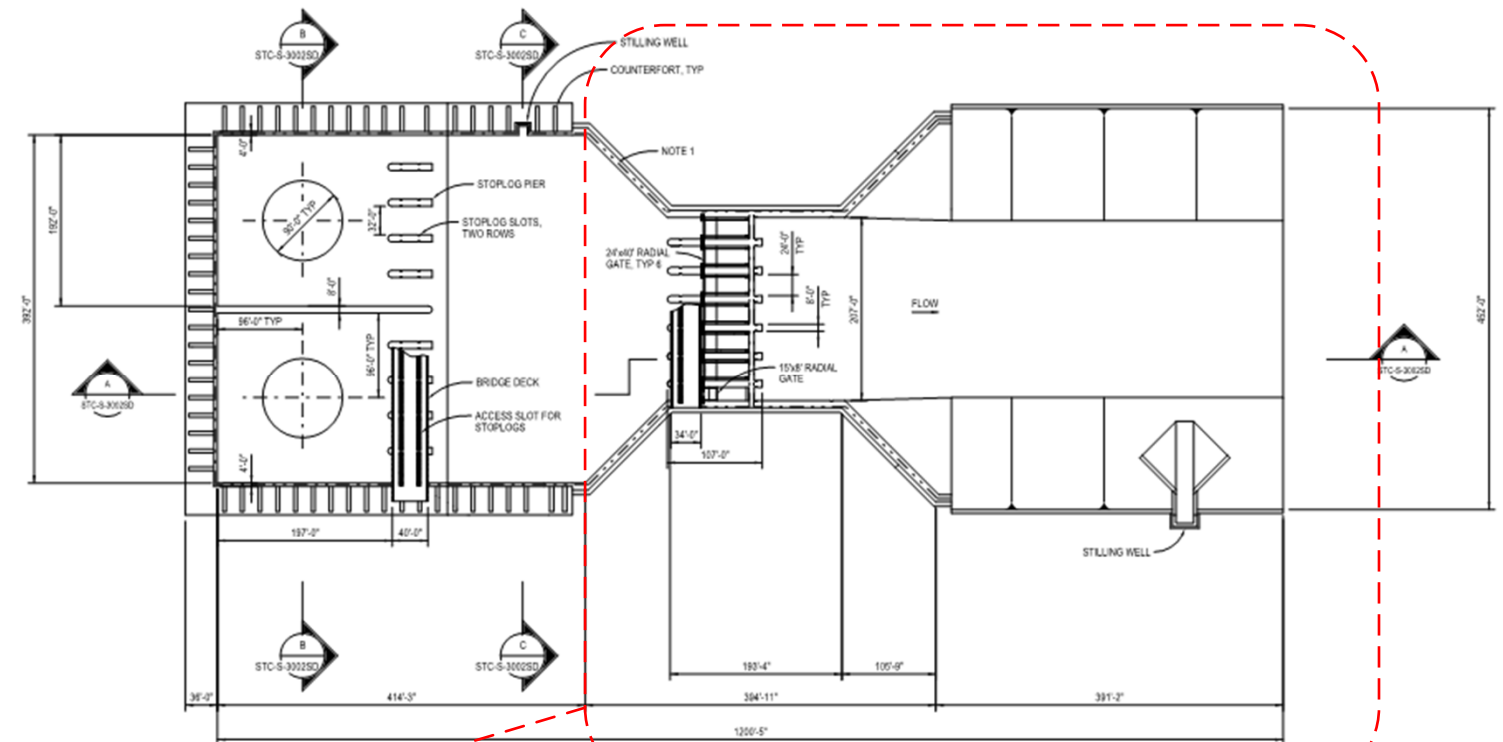
assumed to be the same size as the culverts in the powerline easement. However the culverts would be shorter (approximately 250 feet, each).

Temporary road bypasses would need to be constructed around the culvert construction zone to maintain bi-directional traffic flow, especially to Byron Highway. Construction activities and the temporary bypass would limit flow (speed) through the area. Byron Highway already has high traffic counts and Level of Service (LOS) E during peak daily traffic hours, as defined by Contra Costa County (Caltrans, 2015). The construction work would likely degrade the LOS to F during peak daily traffic hours

### **2.2.5 South Delta Outlet and Control Structure**

The South Delta Outlet and Control Structure is assumed to be of similar configuration to the structure developed for the dual-tunnel option. The main difference would be that the inlet, consisting of the tunnel shafts and a collection box, would be changed to an inlet transition from the trapazoidal canal to the vertical channel section through the radial gates. The features surrounding the control gates and downstream would be assumed common to both options (Figure 7). There is an anticipated cost reduction relative to removal of the large collection box around the shafts in the tunnel option.

TRAPAZOIDAL CANAL OPTION



PORTION OF STRUCTURE FROM TUNNEL OPTION  
THAT WOULD BE USED FOR CANAL ALTERNATIVE

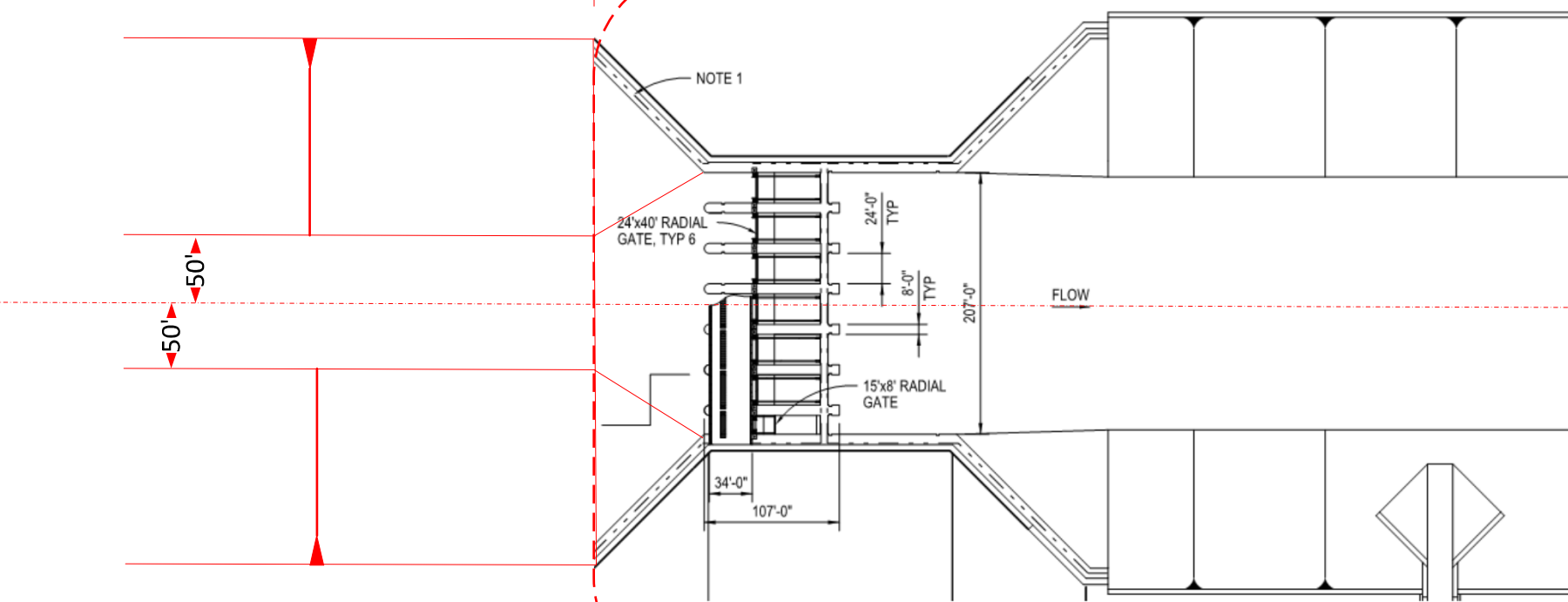


FIGURE 7  
SOUTH DELTA OUTLET AND CONTROL STRUCTURE  
CANAL OPTION

### 3. Reconnaissance-level Cost Comparison

A reconnaissance-level cost comparison was conducted for the two options. The cost comparison in this TM uses unburdened costs that do not include markups of any kind. Costs are not all-inclusive and only represent the items required to compare the two options. Tables 1 and 2 shows the cost comparisons for the Canal Option and Tunnel Option, respectively.

**Table 1. Reconnaissance-level Cost Comparison—Canal Option**

Description	Unit	No. of Units	Unit Cost	Total Cost
Canal excavation	yd <sup>3</sup>	7,366,034	\$15	\$110,490,510
Compacted embankment fill	yd <sup>3</sup>	942,136	\$20	\$18,842,711
Ground Improvement	LF <sup>a</sup>	3,870	\$10,207	\$39,506,250
Excess Material disposal	yd <sup>3</sup>	6,423,898	\$15	\$96,358,477
Canal concrete lining 4-inch thick with wire mesh	yd <sup>3</sup>	35,166	\$200	\$7,033,289
Power easement culvert slab on grade	yd <sup>3</sup>	52,567	\$300	\$15,770,000
Power easement culvert walls	yd <sup>3</sup>	50,389	\$600	\$30,233,625
Power easement culvert roof	yd <sup>3</sup>	48,194	\$800	\$38,555,556
Byron Highway culvert slab on grade	yd <sup>3</sup>	12,469	\$300	\$3,740,667
Byron Highway culvert walls	yd <sup>3</sup>	8,789	\$600	\$5,273,625
Byron Highway culvert roof	yd <sup>3</sup>	8,097	\$800	\$6,477,333
Holey Highway culvert slab on grade	yd <sup>3</sup>	9,192	\$300	\$2,757,500
Holey Highway culvert walls	yd <sup>3</sup>	5,389	\$600	\$3,233,625
Holey Highway culvert roof	yd <sup>3</sup>	4,819	\$800	\$3,855,556
Southern Forebay Outlet	yd <sup>3</sup>	1	\$76,000,000	\$76,000,000
South Delta Outlet and Control Structure	lump sum	1	\$105,000,000	\$105,000,000
<b>Total</b>				<b>\$563,128,723<sup>b,c</sup></b>

<sup>a</sup> Depth of ground improvement = 50 feet

<sup>b</sup> Costs are for comparison only and are un-burdened

<sup>c</sup> Added constructability risk for this alternative would result in higher costs, which are not reflected in this estimate

Notes:

LF = linear feet

yd<sup>3</sup> = cubic yards

**Table 2. Reconnaissance-level Cost Comparison—Tunnel Option**

Description	Unit	No. of Units	Unit Cost	Total Cost
Tunnels and Shafts	lump sum	1	\$409,000,000 <sup>a</sup>	\$409,000,000
Southern Forebay Outlet	lump sum	1	\$76,000,000 <sup>a</sup>	\$76,000,000
South Delta Outlet and Control Structure	lump sum	1	\$135,000,000 <sup>a</sup>	\$135,000,000
<b>Total</b>				<b>\$620,000,000<sup>b</sup></b>

<sup>a</sup> Costs taken from Dual-tunnel option prepared by DCA staff

<sup>b</sup> Depth of ground improvement = 50 feet

## 4. Advantages and Disadvantages of Each Option

Each option has associated advantages and disadvantages. Some of these include direct costs, others include items that can affect overall cost (risk and difficulty of construction), and others include environmental or public concerns, as well as difficulties in land acquisition or permitting. This section summarizes these items for each alternative.

### 4.1 Dual-tunnel Option

#### Advantages

- 1) Would significantly reduce disturbance area and permanent surface features
- 2) Would cross the West Tracy Fault in a tunnel, which is expected to perform better than a canal in the event of ground deformation along the fault.
- 3) Would eliminate construction through, or very close to, sensitive environmental areas
- 4) Would eliminate most interferences with utilities and services such as:
  - a) WAPA power easement
  - b) Power tower relocation
  - c) Natural gas mainline
  - d) Byron Highway
  - e) Holey Road
  - f) North Bruns Road
- 5) Would provide flexibility to use one tunnel to deliver reduced flows to California Aqueduct if tunnel repairs were needed
- 6) Would significantly reduce the exposure for noise and dust by transferring RTM through the tunnel for use in constructing the Southern Forebay, compared to the aboveground equipment transfer for the canal option
- 7) Would reduce exposure for vandalism and public safety

#### Disadvantages

- 1) Anticipated cost would be nominally higher than canal option
- 2) Construction method would be expected to result in greater risk, which could result in increased costs or unexpected delays
- 3) May lengthen construction duration, as tunnel would need to be complete before the start of construction of Southern Forebay Outlet and South Delta Outlet and Control Structure
- 4) Inspection, maintenance, and repairs could be more expensive than the canal option

### 4.2 Canal Option

#### Advantages

- 1) Anticipated cost would be nominally less than dual-tunnel option
- 2) May shorten construction duration, as the Southern Forebay Outlet and South Delta Outlet and Control Structure could be constructed concurrent with canal

- 3) Would provide major source of embankment fill material for Southern Forebay
- 4) Inspection, maintenance, and repairs would be expected to be less expensive due to access

### Disadvantages

- 1) Would significantly increase disturbance area and permanent surface facilities
- 2) Would be subject to higher risk of damage associated with canal embankment deformation during a significant seismic event on the West Tracy Fault
- 3) Would require more land acquisition
- 4) Would require construction through, or very close to, sensitive environmental areas requiring further scrutiny
- 5) Work beneath powerlines may not be permitted by power companies and would result in greater risk and greater level of cost uncertainty
- 6) At a minimum, strict requirements would be imposed on proposed crossings of powerline easements:
  - a) To maintain the ground to conductor clearance requirement (minimum of 35 feet), large box culverts would need to be constructed
  - b) To stay within the maximum allowable equipment height (14-feet), alternative construction methods would need to be implemented that would decrease production and increase cost and risk
  - c) Actual feasibility of constructing the facilities in the powerline easement in accordance with these restrictions is considered questionable and would require more detailed analysis
- 7) Dewatering for construction through the powerline easements would also require alternative methods, with likely reduced effectiveness
- 8) Dewatering for maintenance or lining repair would require groundwater management or additional cost for an unlined canal with seepage control
- 9) It is unknown how receptive WAPA or PG&E would be to a large culvert system crossing their easement:
  - a) There has been considerable resistance in past project planning to any portion of the Southern Forebay encroaching on their easement
  - b) One particular requirement states that *"No cut or fill or cofferdam construction and/or dewatering activities would be authorized that could affect the stability of the transmission tower footings"*
- 10) At least one power tower on the WAPA line would require relocation, and addition of another tower on the opposite side of the construction may be required
- 11) Construction of the culvert would likely require a vertical relocation of the natural gas transmission mainline, in turn requiring close coordination with the utility and a possible outage:
  - a) One option would be to construct a pipe bridge to support the existing mainline; the bridge would be about 200-feet long, and completing this work near the powerlines would increase the risk to the contractor and the two major utilities
- 12) A temporary bypass road would be required to maintain traffic on Byron Highway, which currently operates at LOS E for significant periods of the day; bypass and construction would increase traffic flow and likely degrade the LOS to Level F

- 13) A temporary bypass would also be required for Holey Road, which would have less traffic, but the bypass could still change traffic flow
- 14) Potential for noise and dust when transferring excavated material from the canal for use in constructing the Southern Forebay would increase compared to the transfer of RTM through the tunnel
- 15) Because the canal option would generally be constructed and operated at-grade, there is greater potential for unauthorized public access and vandalism
- 16) If significant repairs are needed on the canal or culvert system, water delivery from the project to the California Aqueduct would have to be completely suspended

## 5. Recommendations

The reconnaissance-level cost comparison indicates the canal option may result in approximately a 10 percent cost savings over the dual tunnel option if the constructability risk of the canal option is assumed to be the same as the dual-tunnel option. However, when considering the following challenges, the dual-tunnel option appears to have significant advantages over the canal option for a long-term serviceable facility with relatively low maintenance:

- Amount of temporary and permanent disturbance
- Greater reliability relative to the West Tracy Fault
- Additional land acquisition requirements
- Environmental challenges
- Traffic changes on the Byron Highway
- Approval and permitting challenges with WAPA and PG&E
- Construction challenges within the WAPA and PG&E easements
- Partial water delivery potential
- Daily security and safety concerns

For these reasons, the dual-tunnel delivery system is recommended as the best apparent option for implementation as part of the project.

## 6. References

California Department of Transportation (Caltrans). 2015. *Project Study Report-Project Development Support (PSR-PDS) To Request Approval for Locally Funded Project to Proceed to the Project Approval and Environmental Document Phase (PA&ED), On Route: New State Route 239, Between: State Route 4 at 0.6 mile south of Balfour Road in Brentwood, And: Interstate 580/205 Separation near Tracy*. August 5.

## 7. Document History and Quality Assurance

Reviewers listed have completed an internal quality review check and approval process for deliverable documents that is consistent with procedures and directives identified by the Engineering Design Manager (EDM) and the DCA.

Approval Names and Roles			
Prepared by	Internal Quality Control review by	Consistency review by	Approved for submission by
Ted Davis / EDM South Delta Conveyance Facility Lead	Phil Ryan / EDM Design Manager	Gwen Buchholz / DCA Environmental Consultant	Terry Krause / EDM Project Manager

This interim document is considered preliminary and was prepared under the responsible charge of Philip K. Ryan, California Professional Engineering License C41087.

### Note to Reader

This is an early foundational technical document. Contents therefore reflect the timeframe associated with submission of the initial and final drafts. Only minor editorial and document date revisions have been made to the current Conformed Final Draft for Administrative Draft Engineering Project Report version.