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1. Purpose and Introduction

The Bethany Reservoir Alternative of the Delta Conveyance Project (project) would include intakes along the Sacramento River between the confluences with American River and Sutter Slough. It would also include a tunnel between the intakes and the Bethany Reservoir Pumping Plant (BRPP), which would pump the water directly into the existing Bethany Reservoir and Central Valley Project (CVP) C.W. Bill Jones (Jones) Pumping Plant approach channel (aka Delta-Mendota Canal [DMC]). A Surge Basin would be constructed immediately upstream of the pumping plant to contain flow from a hydraulic surge event during operations. The pumping plant would discharge flow through the Bethany Reservoir Aqueduct (Aqueduct), comprised of multiple large-diameter pipelines connecting to both the Bethany Reservoir and an outlet structure connecting the system to the DMC. The purpose of this technical memorandum (TM) is to document methods used to identify and evaluate potential sites for intakes, shafts, BRPP, Surge Basin, and Aqueduct, the criteria used for the evaluations, and recommendations for the preferred location of each facility.

The details regarding the selection of intake and launch shaft locations for the Bethany Reservoir Alternative are identical to those described for the Central and Eastern corridors in the *Intake Site Identification and Evaluation TM* (DCA 2021a) and *Shaft Siting Study TM* (DCA 2021b), respectively. The logic behind the selection of the maintenance and reception shaft locations is also identical to the Central and Eastern corridors, as described in the *Shaft Siting Study TM* (DCA 2021b); however, some additional locations were considered, as discussed in more detail here. Where appropriate, descriptions of features and processes that are unchanged from the *Intake Site Identification and Evaluation* and *Shaft Siting Study TMs* for Central and Eastern Options (DCA 2021a, 2021b) will be provided by reference only.

The Bethany Reservoir Alternative was determined to be most compatible with the Eastern corridor, since the tunnel launch from Lower Roberts Island can excavate a tunnel directly to the BRPP Surge Basin reception shaft within the 15-mile-maximum threshold established for the project, whereas the tunnel drive length from Bouldin Island on the Central corridor would exceed 15 miles. As such, the Bethany Reservoir Alternative following the Central corridor would require an additional tunnel drive in the South Delta which was considered too impactful for further evaluation due to the increased impacts to traffic, natural resources, habitat, air quality, and the nearby communities.

2. Organization

This TM is organized as follows:

- Intake Location Siting Study – presents the methods and analysis used to identify and evaluate potential intake locations and recommends preferred locations.
- Launch Shaft Siting Study – presents the methods and analysis used to identify and evaluate potential launch shaft sites and recommends preferred sites.
- Maintenance and Reception Shaft Siting Study – presents the methods and analysis used to identify and evaluate potential maintenance and reception shaft sites and recommends preferred sites.
- Bethany Reservoir Pumping Plant and Surge Basin Siting Study – presents the methods and analysis used to identify and evaluate potential pumping plant and surge basin sites and recommends preferred sites.
- Bethany Reservoir Aqueduct Alignment (Route Study) – presents the methods and analysis used to identify and evaluate potential aqueduct alignments connecting the pumping plant to the existing Bethany Reservoir.
- Road Traffic Modification Locations – presents a summary of existing road and highway conditions within the project area and identifies road traffic modification locations.
- Bethany Reservoir Haul Route – presents the methods and analysis used to identify and evaluate potential haul routes to the Bethany Reservoir.
- Rail-Served Material Depot Locations – presents a summary of existing rail conditions within the project area and identifies rail served project sites.

3. Intake Location Siting Study

Recommended intake locations for the Bethany Reservoir Alternative are identical to those discussed in the *Intake Site Identification and Evaluation TM* for the Central and Eastern corridors (DCA 2021a).

4. Launch Shaft Siting Study

The tunnel would require three types of shafts to facilitate construction: (1) launch, (2) reception, and (3) maintenance shafts. Potential launch shaft site locations were initially selected along each of the Central and Eastern corridors using the intakes and Southern Forebay as the northern and southern starting points, respectively. A site size of 250 to 400 acres was considered for the size constraint and to minimize environmental footprint. The sites were then ranked using a 1 to 5 scale (5 being favorable, 4 being somewhat favorable, 3 being neutral, 2 being somewhat unfavorable, and 1 being unfavorable) for multiple subcriteria relating to construction considerations, geotechnical/geological conditions, property and land use, and existing infrastructure. Each subcriterion was also assigned an importance factor using a 1 to 5 scale (5 being very important, 1 being of little importance). Each ranking was multiplied by the importance factor to result in an adjusted ranking. The compiled adjusted rankings for all sites along both corridors were then divided into three groups (more favorable, acceptable, and less favorable) using a percentile-based approach. A complete listing of subcriteria, importance factors, and adjusted rankings for the potential launch shaft sites for Central and Eastern corridors are included in the *Shaft Siting Study TM* (DCA 2021b).

Tunnel launch shaft locations for the Bethany Reservoir Alternative were selected using the same methods discussed in the *Shaft Siting Study TM* (DCA 2021b). As discussed, the Bethany Alternative was determined to be most compatible with the Eastern corridor using the same intake locations, tunnel alignment, and shaft locations from the northern end of the project to the Lower Roberts Island launch shaft site. For the Bethany Alternative, the alignment would then be extended from Lower Roberts Island to a new pumping plant at a location on the southern or eastern side of the Clifton Court Forebay (CCF). The DCP conveyance would continue from the pumping plant to the existing Bethany Reservoir, but would not require additional siting of shafts.

The Glanville Tract site (referred to as the "Twin Cities Complex") east of Interstate 5 (between Twin Cities Road and Dierssen Road) was adopted from the Eastern corridor as the preferred site for the northernmost double launch shaft site for the Bethany Reservoir Alternative, as discussed in the *Shaft Siting Study TM* (DCA 2021b). The Lower Roberts Island site was also selected as a preferred tunnel launch shaft site for the Bethany Reservoir Alternative; however, the site would be reconfigured to a double-launch site, as opposed to a combination launch and reception shaft for the Eastern corridor. The Eastern corridor would also include a tunnel launch site for the main tunnel originating at the Southern Complex, which would be received at Lower Roberts Island. The tunnel launch from the Southern Complex was desirable for the Eastern corridor so reusable tunnel material (RTM) would be generated locally for use in constructing the Southern Forebay. Since RTM is not needed for embankment construction for the Bethany Reservoir Alternative, configuring the Lower Roberts Island site to launch TBMs in both the north and south directions would remove the need for an additional tunnel launch shaft near the southern end of the project plus the supporting infrastructure. The double-launch configuration at Lower Roberts Island was determined to be preferable to having an additional tunnel launch site in the South Delta, similar to the Southern Complex, due to logistical advantages at the Lower Roberts Island site (that is, proximity to major roads and railroads from the adjacent Port of Stockton versus the anticipated logistical challenges associated with a tunnel launch shaft around the CCF).

5. Maintenance and Reception Shaft Siting Study

Potential maintenance and reception shaft site locations were initially selected along the Central and Eastern corridors and were limited to approximately 1/8-mile from existing roads, at least ¼-mile from existing houses and conservation land, and at least ½-mile from existing schools. A site size of 10 acres was considered for the size constraint. The sites were then ranked using the same 1 to 5 scale used to site the launch shafts, which included multiple subcriteria relating to construction considerations, geotechnical/geological conditions, property and land use, and existing infrastructure. Each subcriterion was also assigned an importance factor using a 1 to 5 scale (5 being very important, 1 being of little importance). Each ranking was multiplied by the importance factor to result in an adjusted ranking. The compiled adjusted rankings for all sites along both corridors were then divided into two groups (more favorable and less favorable) using a percentile-based approach. A complete listing of subcriteria, importance factors, and adjusted rankings for the potential maintenance and reception shaft sites for Central and Eastern corridors is included in the *Shaft Siting Study TM* (DCA 2021b).

Tunnel reception and maintenance shaft locations for the Bethany Reservoir Alternative were selected using the same methods discussed in the *Shaft Siting Study TM* (DCA 2021b). Reception and maintenance shafts between the Intakes and Lower Roberts Island were adopted from the Eastern corridor.

Additional tunnel reception and maintenance shaft sites were considered for a modified tunnel alignment from Lower Roberts Island to Bethany Reservoir as part of the Bethany Reservoir Alternative, which included considering shafts on Lower Roberts Island, Lower Jones Tract, Upper Jones Tract, Victoria Island,

Union Island, and in the area between the CCF and Bethany Reservoir. The additional sites were ranked and are shown (along with the Central and Eastern corridor reception and maintenance shafts) in Attachment 1.

Due to the reconfiguration of the Lower Roberts Island launch site to include a tunnel launch in the southern direction, a reception shaft would be required at the southern end of the tunnel. The location of the southern reception shaft was considered as a factor in siting the Bethany Reservoir Pumping Plant (BRPP) and Surge Basin features, since the reception shaft would ideally be repurposed to connect with the pumping plant inlet conduit and wet well, as well as connect to the adjacent Surge Basin (refer to Section 6). The primary consideration related to the reception shaft was that it be located no greater than 15 miles from the Lower Roberts Island launch shaft and best satisfy the siting criteria summarized above and further described in the *Shaft Siting Study TM* (DCA 2021b). As Attachment 1 shows, the preferred reception shaft site is located south of Byron Highway, east of the Jones Pumping Plant, and adjacent to Mountain House Road. This reception shaft would be located within the Surge Basin structure, as Section 6 discusses.

Once the reception shaft location was established for the tunnel drive from Lower Roberts Island, potential maintenance shaft locations were evaluated to target an approximate 4- to 6-mile spacing along the tunnel alignment while applying the siting study considerations summarized and further described in the *Shaft Siting Study TM* (DCA 2021b). As Attachment 1 shows, the selected tunnel maintenance shaft locations for the tunnel alignment between Lower Roberts Island and the Surge Basin reception shaft would be on Upper Jones Tract and Union Island. Both locations are accessible from existing public roads while minimizing the overall tunnel length.

6. Bethany Reservoir Pumping Plant and Surge Basin Siting

The Bethany Complex refers to the combined elements at the southern end of the project, including the BRPP, Surge Basin, Bethany Reservoir Aqueduct (Aqueduct), and discharge and control structures at Bethany Reservoir and the DMC, as applicable. One of the primary portions of Bethany Complex would include the BRPP to convey water to the Bethany Reservoir, a Surge Basin to contain flow from a hydraulic surge event during operations, and surge tanks to manage hydraulic surge within the Aqueduct pipelines. The Bethany Complex would also include the Aqueduct connecting the BRPP to Bethany Reservoir, the discharge structure at the reservoir, and the facilities for connecting to the CVP for the 7,500-cfs project design capacity. This section focuses on siting the BRPP and Surge Basin since they would influence the location of the other features in the Bethany Complex.

The purpose of the BRPP would be to lift flows to a hydraulic gradeline sufficient for delivery into Bethany Reservoir, which operates at approximately elevation 245 feet above sea level. Accordingly, the BRPP would connect to the Aqueduct, consisting of two or more pressurized pipelines of varying lengths that depend on the project design capacity and the proximity of the BRPP to Bethany Reservoir. The purpose of the Surge Basin is to provide an overflow catchment basin at the end in the tunnel between the intakes and the BRPP to mitigate transient surge pressures.

6.1 General Setting for Bethany Reservoir Pumping Plant and Surge Basin

The BRPP and Surge Basin would generally need to be located between the southern edge of the CCF and the northern or eastern edge of Bethany Reservoir. The Surge Basin would need to be located where the topography would support a catchment with a bottom elevation near 0 to 10 feet to be compatible with the hydraulic gradeline within the tunnel. The Surge Basin and BRPP would not have to share a common

location, but if separated, the pumping plant could require additional surge control features in the wet well.

The area for siting is occupied by multiple canals, high-voltage overhead transmission lines, high-pressure gas and petroleum lines, a major energy facility, the existing Jones (CVP) and Harvey O. Banks (State Water Project [SWP]) pumping plants, a highway, school, and multiple conservation easements. The terrain is relatively flat and close to sea level near the CCF but rises steadily and becomes more rolling terrain to the south and reaches elevations over 300 feet in some areas near Bethany Reservoir. Other than the facilities listed, most of the land is open space or used for agricultural production. Attachment 2.1 depicts the overall area considered for siting the BRPP and Surge Basin.

6.2 Specific Siting Considerations and Criteria for Bethany Reservoir Pumping Plant and Surge Basin

Establishing potential sites for the BRPP and Surge Basin focused on five primary goals:

1) **Finding sites with acceptable space and topography** – The BRPP and Surge Basin would need to be located on a relatively large site (75 acres or more) to allow adequate space for construction equipment and material storage and staging areas. The site would need to be located on relatively flat terrain and would need to be compatible with adjacent topography for conveyance routes to the reservoir.
2) **Compatibility with key hydraulic considerations** – For conventional surface configurations, the BRPP would need to be located on relatively lower elevation sites because of limitations in the length of pump shafts to reach the water in the tunnel deep underground (operating water surfaces as low as elevation -50 to -60 feet). Additionally, the site elevation would ideally be compatible with a conventionally excavated Surge Basin. If the Surge Basin catchment area was below the existing grade, that would eliminate the need for construction of above grade embankments and not require the surge basin to fall under the Division of Safety of Dams jurisdiction.
3) **Feasible Connection to Bethany Reservoir** – Approximately one-third of the northern and eastern sides of Bethany Reservoir are formed by dams or embankments. It is not desirable to connect to the reservoir through these structures. Therefore, the BRPP would need to be located so there is a reasonable conveyance route to the reservoir where outlet construction can avoid existing dams or embankments.
4) **Tunnel and shaft considerations** – The BRPP and Surge Basin location would need to be compatible with the Lower Roberts Island launch site and the Eastern Corridor for tunnels and shafts. This would include limiting the length to 15 miles as well as the need for an acceptable reception shaft location at the BRPP and Surge Basin site as part of the surge overflow scheme. The rationale for associating the Bethany Reservoir Alternative to the Eastern Corridor is discussed in further detail in Section 6.3.
5) **Connection to Delta Mendota Canal** – Because the project could ultimately include connection to the CVP (the Jones Pumping Plant and DMC), one of the goals of siting the BRPP and Surge Basin is to be within reasonable proximity and with a reasonable route to connect to the DMC.

6.3 Bethany Reservoir Alternative Association to Eastern Tunnel and Shaft Corridor

Initial consideration of the Bethany Reservoir Alternative included both the Central and Eastern Corridors. Material presented in Section 5 covers this topic in part, but additional context is provided below.

The choice between the Central and Eastern Corridors for the Bethany Reservoir Alternative is primarily a function of tunnel length and whether shafts would need to be added in either scenario. The more favorable geotechnical conditions, cost, and complexity of constructing shafts (particularly tunnel launch shafts) and access to the launch shaft sites creates a clear advantage for the Eastern Corridor. In order to associate the Bethany Reservoir Alternative to the Central Corridor without adding a launch shaft, it would be necessary to tunnel from the planned launch shaft at Bouldin Island. This, however, is about 20 miles from the surge basin, which is too far for a single bore. Alternatively, the bore could be between Bacon Island and the surge basin, but Bacon Island is planned for a reception shaft because it is too remote and has too many logistics issues to be used for a launch shaft. So, the launch shaft would need to be added as part of the surge basin, which is undesirable because of all the additional construction activity and access challenges already in play with the surge basin and pumping plant. The tunneling operation for a tunnel of this length would encompass the entire duration of pumping plant construction, leading to the probable need for an additional working shaft and increasing cost and complexity with competing uses of the site. Furthermore, this scenario would require a maintenance shaft on Victoria Island, which has limited access via two small 90-degree turn bridges on SR 4. At least one of these bridges would have to be replaced at a cost of approximately $50M.

The Eastern Corridor offers the significant advantage of already having a launch shaft at Lower Roberts Island, within a reasonable tunneling length from the surge basin. This launch shaft is currently planned for tunneling to the north, and could be converted to a double-launch shaft for tunneling south to the surge basin. The required maintenance shafts on the Jones Tract and Union Island are in favorable locations, and this scenario avoids the addition of a new launch shaft and interference with concurrent work at the surge basin and pumping plant site. This provided strong rationale for associating the Bethany Reservoir Alternative to the Eastern Corridor.

6.4 Identification and Evaluation of Sites Bethany Reservoir Pumping Plant and Surge Basin

Twelve locations were initially selected as potential sites for the BRPP and Surge Basin in the area between CCF and Bethany Reservoir, as illustrated in Attachment 2.2.

Each of the sites were evaluated considering the following criteria and subcriteria:

- System Operations and Flexibility Considerations – Operations and maintenance (O&M) access, relative O&M complexity, CVP expansion, reservoir water quality impacts from likely discharge location, and hydraulic operations complexity
- Construction Considerations – Proximity to roads suitable for construction traffic, available space, compatibility with tunnel/shaft locations, conflicts with existing infrastructure (power lines, canals, penstocks, and flood risk
- Geotechnical Considerations – Seismicity and challenges associated with soil type, depth, etc.
- Property and Land Use – Parcels affected by surface facilities, future development, farmland impacts, and conflicts with public facilities (schools, housing, airports, parks)
- Environmental Setting – Conservation easements, federal or state special status species or critical habitats (red-legged frog, kit fox, or other special status species critical habitat, vernal pool habitat, or alkali wetlands), and proximity to sensitive receptors

The sites were ranked using a 1 to 5 scale (4 to 5 being more favorable, 3 being acceptable, 1 to 2 being less favorable) for each of subcriterion. Each one was also assigned an importance factor using a 1 to

5 scale (5 being very important, 1 being of little importance). Each ranking was multiplied by the importance factor to result in an adjusted ranking. A complete listing of subcriteria, importance factors, and ranking factors for each sub-criterion considered for the BRPP and Surge Basin siting study is presented in Attachment 2.3.

The adjusted rankings for each of the sites were summed and then ranked from highest (1) to lowest (12). The results of the rankings are shown in Table 6.1.

Table 6.1. Results of Potential BRPP and Surge Basin Site Rankings

Criterion	Importance Factor	PS-1	PS-2	PS-3	PS-4	PS-5	PS-6	PS-7	PS-8	PS-9	PS-10	PS-11	PS-12
System Operations and Flexibility Considerations													
O&M Access	4												
Relative O&M Complexity	5												
CVP Expansion	3												
Reservoir Water Quality Impacts from Likely Discharge Location	2												
Hydraulic Operations Complexity	4												
Construction Considerations													
Proximity to Roads Suitable for Construction Traffic	5												
Space Available	3												
Compatibility with Tunnel/Shaft Locations	3												
Requires Additional Shaft Location	4												
Conflicts with Existing Infrastructure (power lines, canals, penstocks)	2												
Flood Risk	4												
Geotechnical Considerations													
Seismicity	3												
Challenges Associated with Soil Type, Depth, etc.	3												
Property and Land Use													
Parcels Affected by Surface Facilities	1												
Future Development	2												
Farmland Impacts	2												
Conflicts with Public Facilities (schools, housing, airports, parks)	4												
Environmental Setting													
Conservation Easements	5												
Federal or State special status species or critical habitats	3												
Proximity to Sensitive Receptors	4												
Rank		9	10	4	7	5	10	12	7	6	1	2	3

More Favorable (4-5)
Acceptable (3)
Less Favorable (1-2)

A number of the sites considered for the BRPP and Surge Basin ranked lower within the group due to the following common disadvantages:

- PS-1, PS-4, PS-7, PS-8: Ranked low since these sites would require surface disturbance within conservation easements
- PS-1, PS-2, PS-4, PS-5, PS-7, PS-8, PS-9: Ranked low since these locations would require additional tunnel length and an additional tunnel launch shaft
- PS-1, PS-2, PS-4, PS-5, PS-7, PS-8, PS-9: Ranked low due to significant O&M complexity associated with a cavern-style pumping plant with additional surge chambers and separate Surge Basin sites as would be required for other locations
- PS-6: Ranked low due to challenges with the Surge Basin operating elevations, extensive site development requirements, conflicts with high voltage power lines, and difficult access given the potential space available

- PS-1, PS-6, PS-7, PS-9: Ranked low due to poor soil conditions and/or proximity to nearby fault crossing and related seismicity challenges
- PS-1, PS-2, PS-7, PS-8, PS-9: Ranked low due to poor location relative to Byron Highway and I-580 and anticipated challenges required to provide site access

The four top-ranking sites (PS-3, PS-10, PS-11, and PS-12) shared the following advantageous characteristics:

- Do not require southern tunnel drive location (compatible with tunnel drive south from Lower Roberts Island)
- Avoids cavern-style pumping plant and separate BRPP and Surge Basin sites
- Adequate room to construct complex without major obstructions and with access to Byron Highway
- Compatible with below grade or partial-below grade Surge Basin
- Compatible with Aqueduct routes that provide a discharge location within Bethany Reservoir that supports circulation within Bethany Reservoir
- Minimal flood risk
- Better ground conditions compared to in-Delta sites

The following points provide details regarding the advantages and disadvantages of the four top ranking sites in addition to those summarized here:

- Site PS-3 ranked fourth-highest within the group. The site advantages include those listed; however, connection with the CVP would require a separate tunnel, and an Aqueduct route to Bethany Reservoir would cross through sensitive vernal pool/conservation areas and highly variable terrain. The site would also only be accessible from Byron Highway, is close to Byron Airport, and potentially conflicts with the future Byron Highway expansion plans.
- Site PS-12 ranked third-highest within the group. This site location would allow for easy connection to the CVP and for additional (although indirect) access to the I-580. However, the respective tunnel alignment for this site would weave through critical facilities in the area and would potentially conflict with the future Byron Highway expansion plans. This site is also somewhat constrained by adjacent high-voltage power lines.
- Site PS-11 ranked second-highest within the group. This location would have similar advantages to PS-12; however, it would not likely conflict with future Byron Highway expansion or other future development. Disadvantages would include a lower ground elevation, which would require a partially aboveground Surge Basin and would increase flood risk. In addition, the Aqueduct would require crossing Byron Highway and existing railroad tracks, and the CVP penstocks. Also, the connection to the CVP would be more difficult than for sites PS-10 and PS-12.
- Site PS-10 ranked highest within the group. This location would allow for access from both Byron Highway and the I-580, allow for relatively easy connection to the CVP, and avoid conflict with future development. In addition, the Aqueduct would not require crossing Byron Highway. One minor disadvantage identified with this location is that the Aqueduct would require crossing the CVP penstocks.

Site PS-10 was ultimately selected as the recommended location for the BRPP and Surge Basin, primarily due to its logistical advantages, lack of need for the Aqueduct pipelines to cross the Byron Highway or

railroad, proximity to CVP, compatibility with belowgrade Surge Basin site, and avoidance of conflict with current and potential future infrastructure and development.

7. Selection of Bethany Reservoir Aqueduct Alignment (Route Study)

The Aqueduct portion of the Bethany Reservoir Alternative would convey water from the new BRPP to Bethany Reservoir (and in the 7,500-cfs project design capacity, to the DMC). The Aqueduct would consist of large-diameter pipelines, pressurized by the pumping plant. The pipelines would be 180-inch-diameter welded steel pipe material. The Aqueduct would include one or multiple pipes within the trench as a function of the project design capacity and the delivery connections. The Aqueduct feeding Bethany Reservoir would range from two to four parallel 180-inch-diameter pipelines (specifically, two pipelines for the 3,000-cfs project design capacity, three pipelines for the 4,500-cfs project design capacity, four pipelines for the 6,000-cfs and 7,500-cfs project design capacities) with the addition of a single 180-inch-diameter pipeline feeding the CVP for the 7,500-cfs project design capacity.

The Aqueduct would include pipeline appurtenances such as air and vacuum valves and pipelines drains (blowoffs). Most of the Aqueduct would be constructed using open-cut-and-cover methods, including undercrossings at existing roads and canals. However, some portions would be tunneled, as needed, to carry the pipelines under existing surface features. Specifically, the Aqueduct would be tunneled under the existing Jones Pumping Plant discharge penstocks and under existing Bethany Reservoir conservation easements that cannot be avoided by the Aqueduct route.

The Aqueduct feeding Bethany Reservoir would terminate at an outlet structure discharging into Bethany Reservoir (Bethany Reservoir Discharge Structure). The Aqueduct feeding the CVP would terminate at a baffled apron drop structure on the eastern bank of the DMC (Jones Outlet Structure).

7.1 General Setting for Aqueduct Alignments

This section covers the siting of the Aqueduct portion of the Bethany Complex and considers Site PS-10 as the starting point in accordance with the siting results for BRPP and Surge Basin portion described in Section 6.

The area between the BRPP and Bethany Reservoir is occupied by multiple canals, the CVP discharge penstocks, high-voltage overhead transmission lines, a high-pressure gas line, a major energy facility, a school, and multiple conservation easements (Attachment 2.1). The terrain is relatively flat and low elevation at the BRPP but becomes more rolling and rises steadily to over elevation 300 feet in areas near Bethany Reservoir. Other than the facilities listed here, most of the land is open space or used for agricultural production.

7.2 Identification of Potential Aqueduct Alignments

The establishment of potential Aqueduct alignments focused on five primary goals:

1) **Finding the shortest routes possible with compatible topography** – Pipeline route selection always focuses on minimizing alignment length to reduce impacts and cost, but the topography in the project area is one element that would prevent a short, direct route to Bethany Reservoir. Routes would need to avoid uneven terrain so deep excavations or tunnels could be minimized to the extent possible.

Further, because of the large width of up to four 180-inch-diameter pipes in parallel, relatively wide construction corridors would be needed.

2) **Avoiding conflicts with existing infrastructure** – Existing power lines, canals, gas lines, and other infrastructure would need to be avoided to the extent possible or crossed in favorable locations.

3) **Consider use of existing roads and public rights of way and avoid excess bisecting of private parcels** – Consideration would need to be given to following existing roads if feasible, in lieu of new surface disturbance. Where roads would not be followed, it would be good practice to select alignments along the edge of parcels or situated so as not to permanently isolate land that could be used for agriculture or other purposes.

4) **Avoiding impacts to sensitive species or habitats** – Potential wetlands, vernal pools, and other sensitive areas often present major permitting constraints. This route study was not preceded by formal wetland surveys or other means of identifying all potential sensitive areas, but features that could be observed on aerial photos or were known from project records were noted and avoided were possible.

5) **Avoiding or minimizing impacts to conservation easements** – The conservation easements bordering Bethany Reservoir and other lands to the north (Attachment 2.1) are areas of land that generally cannot be disturbed. Within the overall aqueduct area, there is only one narrow gap in the easements (on Christensen Road). So, alignments would need to pass through that gap, go around the southeastern end of the easements, or be tunneled under the easement(s).

Six optional alignments or routes were identified for the Aqueduct between the BRPP and Bethany Reservoir (Attachment 3.1):

- Alignment A: Generally east-to-west route partially using Christensen Road to pass between conservation easement areas and delivering to the upstream end of the reservoir
- Alignment B: Same as Alignment A, but instead using Kelso Road
- Alignment C: Shorter route through farmed and open space, passing around the southeastern end of the conservation easements and delivering to the downstream end of the reservoir
- Alignment D: Same as Alignment C, but sited to cross the DMC on-grade instead of in a tunnel
- Alignment E: Longer route through farmed and open space and eventually on Mountain House Road, delivering to the downstream end of the reservoir
- Alignment F: Relatively short route through farmed and open space that would tunnel under a narrow strip of easement near the reservoir and discharge to the middle portion of the reservoir

For the aqueduct between BRPP and the DMC (for a 7,500-cfs project design capacity), only one feasible alignment was identified. The existing Jones Pumping Plant and high-voltage overhead transmission lines adjacent to BRPP essentially dictate the Aqueduct route, so the route study ultimately did not include this portion of the Aqueduct.

7.3 Evaluation of Aqueduct Alignments

Each alignment was evaluated considering the following criteria and subcriteria:

- Constructability and Cost – Overall length, potential utility conflicts and crossings required, general topography (ability to avoid deeper excavations), and geotechnical considerations
- Operational Complexity/Impacts – Reservoir water quality benefits/impacts, and O&M considerations

- Property and Land Use – Parcels affected by surface facilities, future development, farmland impacts, and conflicts with public facilities (schools, housing, airports, parks), and potential impacts to conservation easements
- Environmental Setting – Federal or state special status species or critical habitats (red-legged frog, kit fox, or other special status species critical habitat, vernal pool habitat, or alkali wetlands), and proximity to sensitive receptors

The alignments were ranked using a 1 to 5 scale (4 and 5 being more favorable, 3 being acceptable, 1 to 2 being less favorable) for each subcriterion. Each criterion was also assigned an importance factor using a 1 to 5 scale (5 being very important, 1 being of little importance). The importance factors were multiplied by the initial ranking to result in an adjusted ranking. A complete listing of subcriteria, importance factors, and ranking factors for each subcriterion considered for the alignment evaluation is presented in Attachment 3.2.

The adjusted rankings for each of the alignments were summed and then ranked from highest (1) to lowest (6). The results of the rankings are shown in Table 7.1.

Key differentiators that can be observed in Table 7.1 are as follows:

- Alignment E is considered poor because it would pass in front of Mountain House School and near four to five more private residences than any other alignment.
- There is significant additional route length (approximately 0.5 to 0.75 mile) associated with Alignments B and E.
- Alignment B rates the lowest for utility conflicts because of features along Kelso Road, especially the alignment's proximity to high-voltage overhead transmission line towers.
- Alignments A and B would present challenges to construct more than one pipeline between the conservation easements on Christensen Road. The construction corridor for a multiple pipeline trench with pipe of this diameter would exceed the space available between conservation easements on each side of the road, requiring either significant encroachment and surface disturbance of the easements, or tunneling under the easements.
- Alignments A, B, and F would be the most favorable relative to reservoir water quality, with water entering at the upper or middle portion of the reservoir. This would offer improved circulation and mixing as compared to alignments discharging water at the downstream end.
- Only Alignment F includes room for multiple aqueducts and provides favorable reservoir water quality. While Alignments A and B send water to the upstream end of Bethany Reservoir, it does not appear that more than one pipeline could be routed down Christensen Road between the conservation easements, so these alignments may need to be accompanied by additional pipelines on other routes.
- Alignments B, C, and D would have comparatively more challenging topography that could require additional tunneling or more difficult construction conditions.

7.4 Recommended Alignment

Alignment F was selected as the recommended route for the Aqueduct due to its generally shorter length, minimal effects on reservoir water quality, favorable topography, and reasonable distance from sensitive receptors. Further, it would have no impact on the conservation easements or major construction

constraints imposed by the easements (assuming tunneling far beneath the easements is deemed acceptable by the easements' controlling interests).

Table 7.1. Results of Potential Aqueduct Alignments

Criterion	Importance Factor	A- Red	B- Blue	C - Orange	D- Cyan	E - Green	F - Purple
Constructability and Cost							
Length	5						
Utility Conflicts/Crossings	3						
Topography	3						
Geotechnical Considerations (soil type, depth, seismicity)	3						
Operational Complexity/Impacts							
Reservoir Water Quality	3						
O&M Considerations	3						
Property and Land Use							
Parcels Affected by Surface Facilities	2						
Future Development	1						
Farmland Impacts	2						
Conflicts with Public Facilities	4						
Conservation Easements	5						
Environmental Setting							
Fed/State special status species/critical habitats	3						
Proximity to Sensitive Receptors	3						
Rank		2	5	2	4	6	1

More Favorable (4-5)
Acceptable (3)
Less Favorable (1-2)

8. Selection of Road Traffic Modification Locations

Construction of many project facilities would occur in locations served by roads that currently are characterized by traffic congestion and/or poor road conditions. Some of the roads are located on top of levees that have some foundation problems. Therefore, construction of project features would require improvement of some roads, new access roads, and new interchanges. Existing roadways that possibly could be used to access construction sites were analyzed as part of the project.

8.1 Existing Highway Conditions

The Surface Transportation Assistance Act (STAA) of 1982 allows large trucks to operate on the Interstate and certain primary routes. These routes are referred to as the National Network. These trucks, referred to as STAA trucks, are longer than trucks identified as "California legal trucks." On STAA routes the maximum length of trailer of a semitrailer truck is 53 feet, and STAA trucks have a larger turning radius than most local roads can accommodate. STAA Terminal Access routes are roads where STAA trucks may exit the interstate and travel onto State and local routes. Considering road systems could be used during project construction, Interstate 5, Interstate 580 and Interstate 205 near Tracy are National STAA truck routes. State Route 12, portions of State Route 4 between Interstate 5 and the Port of Stockton, and

portions of State Route 160 between State Route 4 and a location south of Isleton are STAA Terminal Access routes.

California Legal Truck Routes provide a network for large California Legal Trucks to operate. California Legal Trucks must meet certain requirements, including a maximum length of 65 feet for single trailers and trailers with 40-feet dimension from kingpin to rear axle (KPRA) and 75 feet for double trailers. Geometric conditions of the roads, including the presence of a sharp turning radius, are used to classify roads as California Legal with KPRA Advisory routes. State Route 160 between Isleton and a location on Sutter Island (0.8 miles south of Courtland) and State Route 4 between Tracy Boulevard in San Joaquin County to Sand Creek Road in the City of Brentwood are identified as a California Legal Truck Route with a KPRA Advisory.

State Route 160 between a location 1 mile north of the Freeport Bridge and a location on Sutter Island (0.8 miles south of Courtland), State Route 4 between the Port of Stockton and Tracy Boulevard in San Joaquin County, and State Route 4 between Sand Creek Road in City of Brentwood and State Route 160 are identified as a California Legal Truck Route for 65-foot maximum length trailers with 40-foot KPRA.

Interstates 5, 580 and 205 are in good condition and characterized by periods of traffic congestion.

State Routes 4 and 12 are generally in good condition based upon limited pavement condition data and characterized by periods of traffic congestion. State Routes 4 and 12 in these reaches include several bridges including multiple moveable bridges. Intermittent traffic delays occur due to bridge openings related to navigation needs.

State Route 4 in these reaches include three bridges. The bridges across Old River and Middle River are characterized by narrow lanes and sharp turns on the approach roadway consistent with its designation as an advisory truck route due to reduced lane width and the acute angle of approach. On State Route 12, two drawbridges across the Mokelumne River and Little Potato Slough are moveable bridges that are characterized by intermittent traffic delays.

State Route 160 is primarily constructed on top of Sacramento River levees and provides access to communities along the Sacramento River. This route has advisory truck limits on the length of trucks allowed along this road that is characterized by reaches without adequate shoulders. State Route 160 in this reach includes four bridges which are all moveable bridges.

8.2 Existing Roads Conditions

More than thirty local roads could provide direct access to potential project construction sites in the Delta. Many of these roads are characterized as rural two-lane paved roadways with 10-foot wide lanes and minimal shoulders. These roads are used by local and agricultural vehicles and traffic. These roads include Hood-Franklin Road, Twin Cities Road, West Walnut Grove Road, West Eight Mile Road, West March Lane, West Byron Road, Mountain House Parkway, and Tracy Boulevard, and are summarized in Table 8.2.1.

Table 8.2.1. Local Road Characterizations

County	Road	Type	Lanes	Lane Width (feet)	Shoulder Width (feet)	Segment
Sacramento	Hood-Franklin Road	paved	2	12	2	Interstate 5 to State Route 160
Sacramento	Lambert Road	paved	2	10	1	Interstate 5 to State Route 160

Table 8.2.1. Local Road Characterizations

County	Road	Type	Lanes	Lane Width (feet)	Shoulder Width (feet)	Segment
Sacramento	Dierssen Road	gravel	2	9	0	Franklin Boulevard to 1.4 miles west of Interstate 5
Sacramento	Twin Cities Road	paved	2	12	1	Interstate 5 to River Road
Sacramento	Franklin Blvd	paved	2	10	2 to 4	Lambert Road to Twin Cities Blvd
Sacramento	Russell Road	paved	2	10	0 to 1	River Road to Herzog Road
Sacramento	Vorden Road	paved	2	10	0 to 1	River Road to Herzog Road
Sacramento	Herzog Road	paved	2	10	0 to 1	Vorden Road to Lambert Road
Sacramento	Jackson Slough Road	paved	2	10	0 to 1	State Route 160 to State Route 12
Sacramento	Terminous Road	paved	2	10	0 to 1	Jackson Slough Road to State Route 12
San Joaquin	W Walnut Grove Road	paved	2	12	4	Interstate 5 to River Road
San Joaquin	Lauffer Road	gravel	2	10	0	Vail Road to Mokelumne River
San Joaquin	Vail Road	paved	2	10	0 to 1	W. Walnut Grove Road to Mokelumne River
San Joaquin	Blossom Road	paved	2	10	0 to 1	Peltier Road to W Walnut Grove Blvd
San Joaquin	Staten Island Road	paved	2	10	1	W. Walnut Grove Road to S Fork Mokelumne River
San Joaquin	Gas Well Road	gravel	2	8	0	Staten Island Road to S Fork Mokelumne River
San Joaquin	Gotta Road	paved	2	10	0 to 1	N. Jacob Brack Road to N Guard Road
San Joaquin	N Jacob Brack Road	paved	2	10	0 to 1	Turner Road/Interstate 5 interchange to Gotta Road
San Joaquin	N Guard Road	paved	2	10	0 to 1	State Route 12 to Gotta Road
San Joaquin	Stefani Road	paved	2	8	0	W 8 Mile Road to Telephone Cut
San Joaquin	Glasscock Road	paved	2	10	0 to 1	State Route 12 to south of Sycamore Slough
San Joaquin	Correia Road	paved	2	10	0 to 1	State Route 12 to Potato Road at White Slough
San Joaquin	Peltier Road	paved	2	10	0 to 1	Interstate 5 to Blossom Road

Table 8.2.1. Local Road Characterizations

County	Road	Type	Lanes	Lane Width (feet)	Shoulder Width (feet)	Segment
San Joaquin	W Eight Mile Road	paved	2	10	0 to 1	Interstate 5 to Empire Tract Road at Little Connection Slough
San Joaquin	W March Ln	paved	6	12		Interstate 5 to March Ln
San Joaquin	Holt Road	paved	2	10	0 to 1	State Route 4 to San Joaquin River
San Joaquin	Jacobs Road	paved	2	10	0 to 1	Holt Road to Burns Cutoff Road
San Joaquin	Inland Dr	paved	2	10	0 to 1	State Route 4 to House Road at Burns Cut
San Joaquin	Bacon Island Road	paved	2	10	0 to 2	State Route 4 to S. Bacon Island Road Bridge at Middle River
San Joaquin	S Bacon Island Road	paved	2	10	0 to 2	S. Bacon Island Road Bridge at Middle River to Connection Slough Swing Bridge
San Joaquin	Lower Jones Road	paved	2	10	0 to 1	Holt Road to W Lower Jones Road
San Joaquin	W Lower Jones Road	gravel	2	8	0	Lower Jones Road to Bacon Island Road
San Joaquin	McDonald Road	paved	2	10	0 to 1	Inland Dr to Whiskey Slough
San Joaquin	Tracy Blvd	paved	2	12	0 to 4	State Route 4 to Interstate 205
San Joaquin	Mountain House Pkwy	paved	4 to 6	12	4	Interstate 205 to Byron Road
San Joaquin	Byron Road	paved	2	12	2	Mountain House Pkwy to State Route 4
San Joaquin	Clifton Court Road	paved	2	10	0	Tracy Blvd to Bonetti Road
San Joaquin	Bonetti Road	paved	2	9	0	North of Clifton Court Road
Contra Costa	Byron Highway	paved	2	12	2 to 4	Mountain House Pkwy to State Route 4
Alameda	Byron Bethany Road	paved	2	12	2 to 4	Mountain House Pkwy to State Route 4
Alameda	W. Grant Line Road	paved	2	12	1 to 4	Interstate 580 to Great Valley Pkwy
Alameda	Kelso Road	paved	2	11	1	Great Valley Pkwy to Mountain House Road
Alameda	Mountain House Road	paved	2	12	1 to 2	W. Grant Line Road to Byron Bethany Road

Overall conditions and pavement conditions on existing roads that could provide direct access to potential project construction sites range from poor to good. However, most roads that could provide direct access to potential construction sites are poor or fair.

There are more than 40 bridges, including 12 moveable bridges, along local roads that could provide direct access to potential project construction sites. Caltrans has rated 14 of these local bridges as functionally obsolete or structurally deficient. Seven local bridges are being planned in the area being considered for potential project construction sites, including:

- Bridge along Twin Cities Road across Snodgrass Slough was identified as Functionally Obsolete, and is planned to be replaced by a new structure on a different alignment. Sacramento County has completed environmental review and is in the process of final design and right of way acquisition.
- Bridge along Walnut Grove Road across Mokelumne River is a swing bridge was identified as Structurally Deficient, and identified on the Highway Bridge Program to be replaced.
- Bridge along the Walnut Grove crossing of the Sacramento River was identified as Structurally Deficient, and identified on the Highway Bridge Program to be replaced or rehabilitated.
- Bridge along Franklin Boulevard across the Mokelumne River Overflow was identified as Structurally Deficient, and identified on the Highway Bridge Program to be replaced.
- Bridge along Eight Mile Road across White Slough (Honker Cut) was identified as Functionally Obsolete, and identified on the Highway Bridge Program to be replaced.
- Bridge along Byron Highway across the California Aqueduct was identified as Structurally Deficient. Contra Costa County has initiated an environmental review process to replace the bridge.
- Bridge along Cotta Road across Upland Canal was identified as Structurally Deficient, and identified on the Highway Bridge Program to be replaced.
- Culvert on Mountain House Road at Byron Bethany Irrigation District Canal is believed to be rated deficient. The portion of Mountain House Road between W. Grant Line Road and Kelso Road is signed at 7 Ton Maximum Load.

The timing of potential bridge retrofits or replacements is not currently known. Woodward Island Bridge connecting Upper Jones Tract at Bacon Island Road with Woodward Island over Middle River was constructed by San Joaquin County in 2019 to replace the Woodward Island Ferry. However, this bridge was only designed for local residents, employees, and agricultural traffic.

8.3 Selection of Road Traffic Modification Locations

Most of the existing local roadways are characterized by poor pavement or foundation conditions, narrow paved areas with small or no shoulders, bridges with poor conditions or narrow lanes, and/or roads and bridges with traffic congestion. Therefore, a series of transportation projects would be considered to access the project construction sites. The potential roadway projects could include:

- Parallel access or haul roads to provide construction and operations access to avoid using levee roads.
- Expansion of existing roads to provide wider paved areas, including wider shoulders.
- Realignment of roads to accommodate new interchanges or rail-served material depots.
- New access interchanges.
- New haul road to Bethany Reservoir to support construction traffic.
- Bridge modifications.

- Park-and-Ride Centers or Materials Depots to provide a central location for employees and materials to transfer from numerous employee vehicles or small trucks to buses and larger trucks.
- Asphalt overlays for existing roads both during and following construction.

Selection of the roadways used for construction are summarized in the *Logistics Strategy – Bethany Reservoir Alternative (Draft) TM (DCA, 2021c)* and were be based upon other uses of the roads by the communities, including proximity to communities, schools, emergency responders, wildlife areas, and recreation areas; and use of the roadways as major commute corridors (e.g., State Routes 4 and 12). Roadway modifications were selected to minimize the miles traveled by construction equipment and employees. Roadways would be upgraded to the standards of the agency that owns the roadways, with thoughts around how the roadways are now utilized, and the potential for the work to provide other benefits such as widened shoulders for increased bicycle use.

The selection of the route for the new haul road to Bethany Reservoir was analyzed separately and is described in additional detail below.

Consolidation centers would allow materials and equipment to be transferred from several trucks to one larger truck to transport items to construction sites and minimize truck trips beyond the influence of major highways and freeways. Consolidation centers would also provide park-and-ride areas to convey the employees to the construction sites on electric buses or vans (recharged by on-site solar panels, when possible) to reduce traffic congestion and air quality emissions. The materials depots would be located on relatively flat sites near major freeways or roadways, Rail-Served Material Depots, or barge landings. These areas could be used by the community or other construction projects following construction of the project. Two park and ride facilities, one at Interstate 5 and Hood-Franklin Road and one at Charter Way in Stockton were identified for the consolidation centers (DCA 2021c).

8.4 Bethany Reservoir Haul Route

The Bethany Reservoir haul route alignment initially considered during concept design follows an existing unpaved patrol and access road leading from Mountain House Road along the northern side of the SWP canal system and up the hillside leading to Bethany Reservoir. The terrain in this area is steep and variable. The existing access road generally follows topography, resulting in grades that exceed the maximum requirements for the Bethany Reservoir Alternative haul route of 7 percent, based on California Department of Transportation (Caltrans) maximum grades for trucks in rural areas. Additionally, the existing access road would need to be widened to support two-way construction traffic.

Modifications to upgrade the existing access road for the Bethany Reservoir Alternative were found to impact areas of alkali wetland, and resulted in significant quantities of cut and fill, which expanded the temporary and permanent footprint of the haul route. Consequently, several alternative access road alignments were considered to minimize wetland impacts while optimizing the cut and fill requirements for construction. These alternatives are illustrated in Attachment 4 - Bethany Reservoir Haul Route Alignment Study. The plan view contained therein shows each of the alternative alignments, with associated profiles indicating grades and locations of sections of cut and fill. The characteristics of each alternative are summarized in Table 8.4.1 for comparative purposes only.

Table 8.4.1. Comparison of Access Road Alternatives

	Initial Route	Alternative 1	Alternative 2	Alternative 3
Length[a] (miles)	1.1	1.1	1.0	1.2
Max grade[b] (percent)	7	7	7	7
Existing Disturbance (acres)	2.7	1.6	2.7	0.6
Total Disturbance Footprint[c] (acres)	9.7	11.4	11.6	9.5
Net Increase in Disturbance (acres)	7.0	9.8	8.9	8.9
Cut volume[d] (CY)	153,000	196,000	197,000	64,000
Fill volumed (CY)	1,100	28,000	32,000	19,000
Earthworks Balance[e] (CY)	151,900 cut	168,000 cut	165,000 cut	45,000 cut
Area of encroachment into wetlands (SF)	24,000	8,000	None	None

[a] Concept design is based on mapping contours in the absence of detailed site survey.

[b] Caltrans maximum grade for trucks of 7% on rural areas has been adopted

[c] Earthwork concept design is based on 2H:1V cut & fill slopes

[d] No allowance for topsoil stripping or reinstatement, unsuitable materials, or flattening batters for stabilization in areas of weak or highly erodible material.

[e] Earthworks volumes are excess quantities and are quantified as solid in-place ("bank") volumes and ignore considerations such as bulking factors, cut to fill losses, etc.

Notes:

CY = cubic yard(s)

SF = square foot (feet)

8.4.1 Evaluation

Each considered haul route would achieve the required grades, but with varying lengths, cut and fill quantities, and wetland impacts as summarized in Table 8.1. Attachment 4 shows the locations of the cut and fill areas. The attributes of the evaluated haul routes can be summarized as follows:

- Initial Route: Follows an existing access track running along the southern edge of the alkali wetlands. The route crosses the wetlands at three separate locations, yielding the largest wetland impacts of 24,000 square feet. The alignment follows natural ground and is relatively flat for approximately the first half of its length, with the second half common with Alternative 1. Large cuts would be required to minimize the steep road slope in the second half, but still would not achieve 7 percent grades. As a result of following natural ground initially, the concept design has a lower surplus cut earthworks balance than Alternative 1.
- Alternative 1: Runs parallel to the existing SWP canal and would involve significant cut earthworks to achieve feasible grades. This route is also near two large transmission towers (that is, within approximately 20 feet), so foundation conditions for these towers would need to be considered. The route is also in direct conflict with a couple of low voltage powerline poles. This route is close to the base of natural slopes and fill slopes supporting the California Aqueduct, so earthwork in this area would need to consider potential impacts to the SWP system. This route encroaches into the identified alkali wetlands at two locations, resulting in a net impact of 8,000 square feet. The second half of Alternative 1 alignment is common with the Initial Route.
- Alternative 2: Exits from Mountain House Road at a point further north than the Initial Route or Alternative 1 and avoids wetland impacts. The route runs close to existing access roads that are used

for electrical tower and power pole maintenance. However, this access route is oriented over a hill that requires significant volumes of cut earthwork to achieve feasible grades.

- Alternative 3: Exits from Mountain House Road at a point further north than all other consider routes. The haul route generally follows natural contours of the topography to minimize cut and fill requirements but results in a slightly longer overall alignment. This alternative has the least amount of cut and fill, the smallest disturbance footprint, and has no impact on wetlands.

8.4.2 Recommendations

Based on this evaluation, Alternative 3 is considered the most feasible from an engineering perspective and is recommended as the preferred alternative for the Bethany Reservoir haul route. Given the grade and anticipated construction traffic loading, the road would be paved in accordance with adopted project standards.

9. Selection of Rail-Served Material Depot Locations

Railroads could be used to deliver large amounts of construction materials and/or remove large amounts of excavated material, including RTM. The two railroad companies in the project area include the Union Pacific Railroad (UPRR) and Burlington Northern Santa Fe Railroad (BNSF). Use of railroads would require construction of a rail-served material depot with rail sidings. The rail siding would be designed to allow for the train to leave or pick-up rail cars, hold the rail cars, and off-load or load the rail cars. The depot would include areas where trains would move off the main line to deposit the rail cars and areas to transfer the materials to trucks. The sidings could also be used to move RTM and other soil material from the construction site to trains to be hauled to other areas for reuse and/or disposal.

9.1 Existing Rail Network near Delta

In general, rail facilities are designed and constructed to handle either unit train service (full train loads at one time) or manifest service (less than a full train load at one time). Unit trains are typically in the 100-car size with all cars containing the same commodity originating from the same location to specific destination points with stops only to allow changes of railroad crews. Manifest trains are defined by the movement of various commodities from a wide range of origins and to a wide range of destinations. Most rail cars moving from an origin facility to a destination move via manifest train service. Both unit trains and manifest trains handle multiple types of rail cars.

Railroads typically own and maintain the rights-of-way (ROW) for the rail lines. Railroads maintain the railroad ROW and rail infrastructure. Railroads may elect to allow public agencies to operate passenger or commuter service upon these lines, such as Amtrak or Altamont Corridor Express (ACE). However, the public agencies hold no property rights on the rail lines, although the public agencies could participate in supporting upgrades and maintenance. Dispatch of all rail movements, including passenger and freight trains, are controlled by the railroad companies.

UPRR owns the Sacramento-Lathrop and Lathrop-Byron rail lines. The Sacramento-Lathrop rail line is a general freight line that extends from Sacramento through Stockton (part of the UPRR Sacramento Subdivision) and from Stockton to Lathrop (part of the UPRR Fresno Subdivision) along an alignment generally parallel to Interstate 5. This line is capable of handling rail cars of any weight and/or size. Currently, only freight trains operate between Sacramento and Stockton. The San Joaquin Regional Rail Commission, operators of the ACE, has recently announced its desire to seek permission from UPRR to operate commuter train service between Stockton and Sacramento.

UPRR also owns the Lathrop – Byron rail line that extends from Lathrop moving southwesterly into Tracy and then northwesterly through the communities of Mountain House, Byron, and Brentwood as part of the UPRR Tracy Subdivision. This line once served as a major freight corridor for rail traffic to serve the San Francisco Bay Area. Currently UPRR only operates local freight service between the Stockton and rail yards to serve industrial customers. The rail line from downtown Tracy and through the communities of Mountain House, Byron, and Brentwood has not been used since the early 1990s and only provides rail car storage. The line is maintained to a level suitable for slow rail movements of empty rail cars.

BNSF owns the Antioch - Stockton rail line that extends from Antioch to Stockton as part of the BNSF Stockton Subdivision. This line serves as the BNSF primary freight corridor serving the San Francisco Bay Area, including movement of premium intermodal and automobile trains. Amtrak operates over this line with the "San Joaquins" passenger trains seven times per weekday in each direction (fourteen total trains). The line is capable of handling rail cars of any weight and/or size.

9.2 Potential Rail-Served Materials Depot Locations

Rail-Served Materials Depots for the project were identified related to proximity to tunnel launch shaft sites to provide tunnel liner segments, TBM equipment, and aggregate to the construction sites and to convey RTM from the tunnel launch shaft sites. A track facility with connection to a mainline would be utilized for the storing, sorting, loading and unloading of rail cars for one or more industries. The layout of the track facility would be related to use of the facilities by unit trains or manifest trains. Since proximity to rail is poor at most sites, and good freeway access exists, only one Rail-Served Materials Depots was selected for further consideration, as summarized below:

- Extended from either UPRR or the BNSF, rail lines that are located on the Port of Stockton and would be extend with a project-rail line onto Lower Roberts Island to serve the tunnel launch shaft site on the island.

10. References

Delta Conveyance Design and Construction Authority (DCA). 2021a. *Intake Site Identification and Evaluation*. Final Draft.

Delta Conveyance Design and Construction Authority (DCA). 2021b. *Shaft Siting Study*. Final Draft.

Delta Conveyance Design and Construction Authority (DCA). 2021c. *Logistics Strategy – Bethany Reservoir Alternative*. Draft.

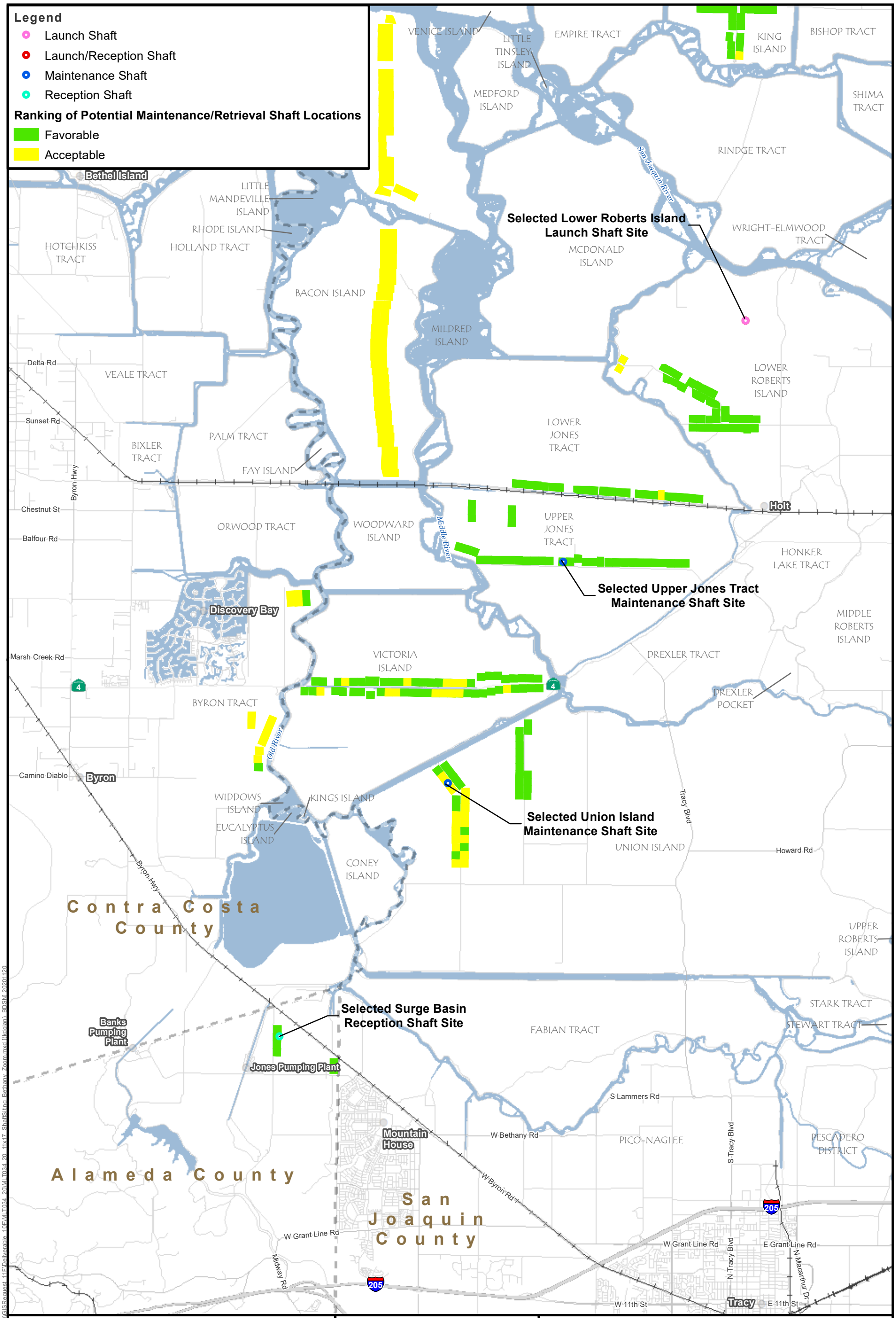
11. Document History and Quality Assurance

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**
Ron Fehringer / EDM Project Engineer (changes only)	Phil Ryan / EDM Design Manager	Gwen Buchholz / DCA Environmental Consultant	Terry Krause / EDM Project Manager

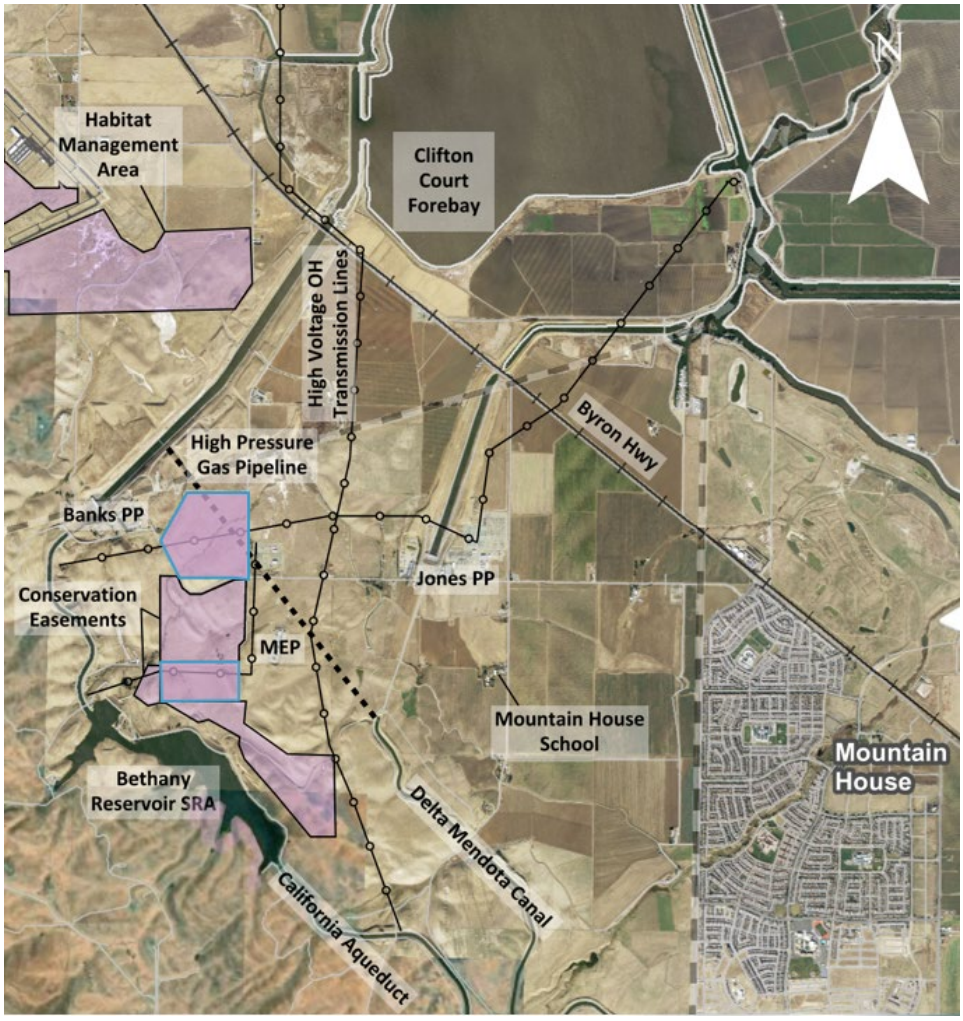
This interim document is considered preliminary and was prepared under the responsible charge of Philip K. Ryan, California Professional Engineering License C41087.

Attachment 1
Maintenance/Reception Shaft Siting Study



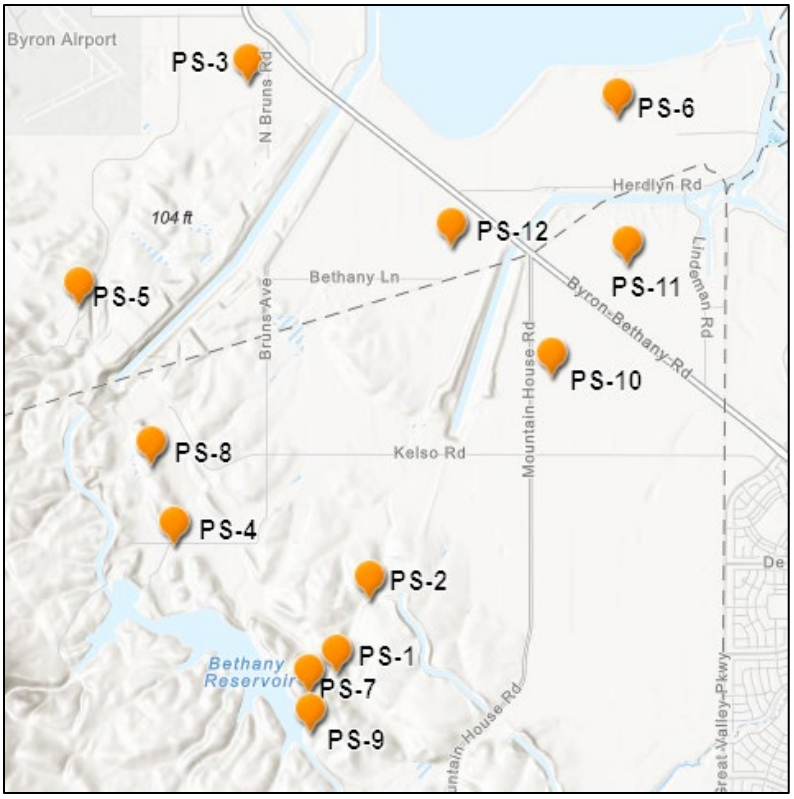
Data Source: DCA, DWR

Attachment 2
Bethany Reservoir Pumping Plant and Surge Basin Siting Study



Attachment 2.1

General Area for Siting of the Bethany Reservoir Pumping Plant and Surge Basin

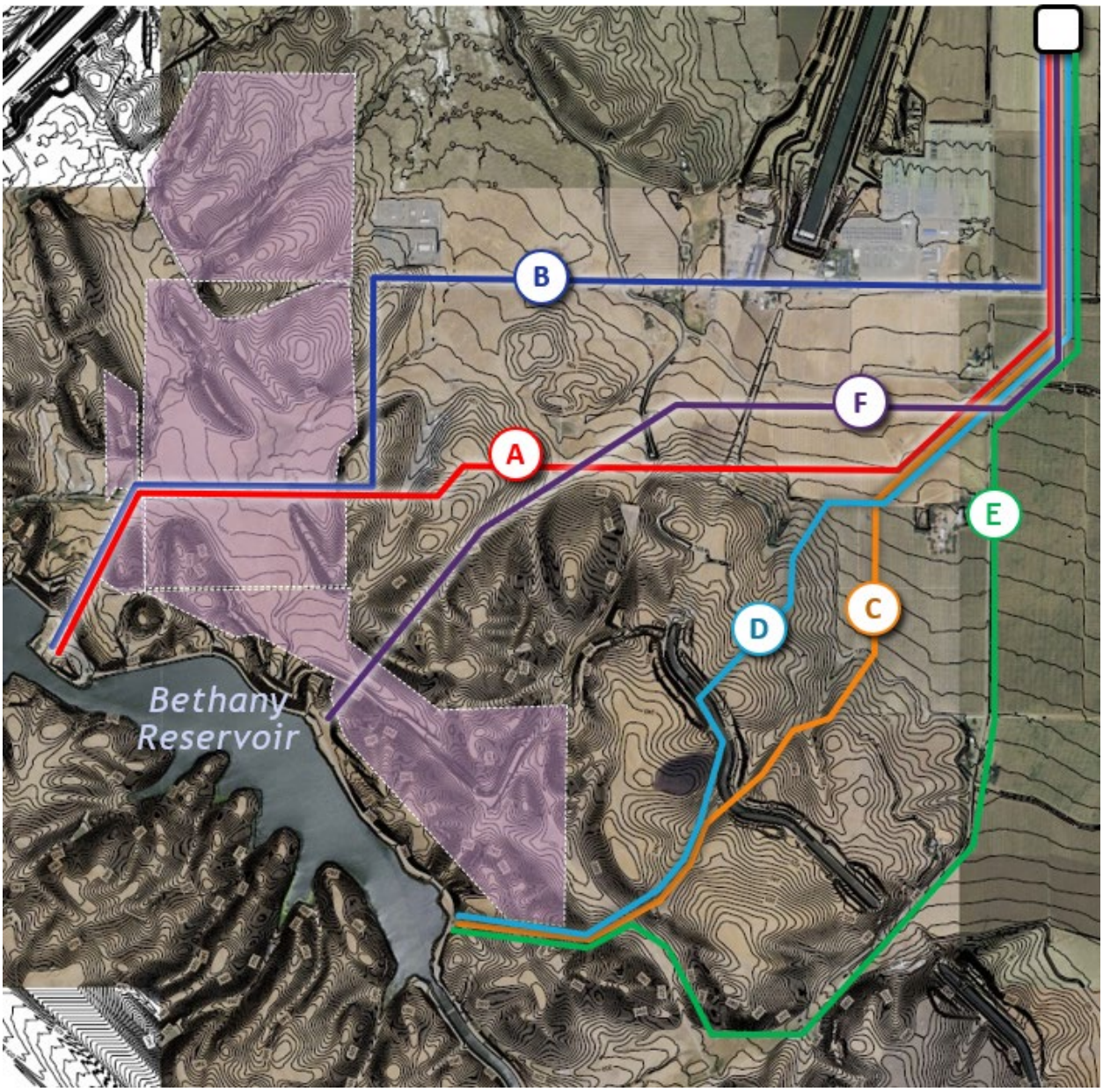


Attachment 2.2

Potential Site Locations for the Bethany Reservoir Pumping Plant and Surge Basin Site

Criterion	Importance Factor (I)	Sub-Criterion	Explanation of Scoring
System Operations and Flexibility Considerations	4	O&M Access	5: Excellent access for O&M vehicles and equipment on high ranking roads over short distances 4: Good O&M access on moderately ranked roads and reasonably short distances 3: Acceptable O&M access with potential speed or load restrictions or tight turning radii over moderate distance 2: Same as 3, except over long distance 1: Challenging O&M access requiring very slow speed over very long distance
	5	Relative O&M Complexity	5: Relative to other alternatives, O&M is less complex, requires routine equipment and skills similar to other nearby facilities (i.e. surface pumping plant with relatively short penstocks) 3: Relative to other alternatives, O&M is of average complexity, requires some specialized equipment and skills (i.e. long penstocks w/ cathodic protection systems) 1: Relative to other alternatives, more complex O&M requirements with higher risk of failure (i.e. deep cavern pumping plant)
	3	CVP Expansion	5: Close proximity to DMC with minimal to no crossings 3: Practical route to DMC with moderate length and crossings 1: Significant length and crossings to connect to DMC
	2	Reservoir Water Quality Impacts from Likely Discharge Location	4: Likely discharge location has no apparent negative impacts on water quality due to residence time 2: Likely discharge location could create potential water quality issues due to residence time and would likely require additional circulation infrastructure be included
	4	Hydraulic Operations Complexity	5: Location and configuration of pumping plant provides relatively straight forward solution to handling of surge flows/pressures. 3: Location and configuration of pumping plant requires more complex solution to handling of surge flows/pressures. 1: Location and configuration of pumping plant requires potentially excessive solution to handling of surge flows/pressures.
Construction Considerations	5	Proximity to Roads Suitable for Construction Traffic	5: Ability to connect to I-580 and Byron Hwy with moderate construction effort (i.e. construction of new interchange, new roads, etc.) 3: Ability to connect to only Byron Hwy and/or lower capacity roads with moderate construction efforts and/or improvements to existing roads (i.e. construction of new interchange, new roads, etc.) 1: Challenging construction access requiring use of low capacity roads and multiple new roads, bridges and/or complex infrastructure crossings
	3	Space Available	5: Construction footprint for project facilities easily fits within proposed site 3: Construction footprint fits proposed site with moderate means/methods restrictions 1: Construction footprint may fit proposed site by using extensive earthwork, moving adjacent infrastructure, and/or securing special permits and clearances
	3	Compatibility with Tunnel Shaft Locations	5: Tunnel corridor avoids crossing critical infrastructure and results in overall total shorter alignment; shafts are accessible 4: Tunnel corridor requires increased overall alignment length to avoid crossing critical infrastructure; shafts are accessible 3: Tunnel corridor crosses near critical infrastructure, but can be managed/minimized; shafts are accessible 2: Tunnel corridor requires complex alignment to avoid crossing critical infrastructure; shafts are accessible 1: Tunnel corridor crosses critical infrastructure; shaft in congested location and difficult to access
	4	Requires Additional Shaft Location	5: Does not require an additional tunnel launch shaft in the South Delta area due to overall tunnel length and changing ground conditions 1: Does require an additional tunnel launch shaft in the South Delta area due to overall tunnel length and changing ground conditions
	2	Conflicts with Existing Infrastructure (power lines, canals, penstocks)	5: No known, potential conflicts 4: Minor potential conflicts that can be easily mitigated thru routine design, coordination, and permitting 3: Moderate potential conflicts that can be mitigated with extensive design, coordination, and permitting 2: Extensive likely conflicts that can possibly be mitigated with design, coordination, and permitting 1: Extensive conflicts that may take excessive effort to avoid
	4	Flood Risk	5: Topography is more than 3 feet above El. 20.8 ft (Est. 200-yr flood elevation w/ future Sea-Level Rise and Climate Change hydrology for Year 2100) 3: Topography is between 0 and 3 feet above El. 20.8 ft (Est. 200-yr flood elevation w/ future Sea-Level Rise and Climate Change hydrology for Year 2100) 1: Topography is below El. 20.8 ft (Est. 200-yr flood elevation w/ future Sea-Level Rise and Climate Change hydrology for Year 2100)
Geotechnical Considerations	3	Seismicity	5: No known nearby faults (beyond 1 mile from site) 3: Known nearby fault crossing, possible moderate challenges anticipated (0.25 to 1 mile from site) 1: Known nearby fault crossing, significant challenges anticipated (less than 0.25 mile from site)
	3	Challenges Associated with Soil Type, Depth, etc.	5: No known, significant challenges 4: Few minor challenges anticipated, low risk 3: Few moderate challenges anticipated, moderate risk 2: Several moderate challenges anticipated, moderate risk 1: Significant challenges anticipated, high risk
Property and Land Use	1	Parcels Affected by Surface Facilities	5: Minimal potential effect on relatively lower number of parcels 3: Average potential effect on relatively average number of parcels 1: Significant potential effect on relatively large number of parcels
	2	Future Development	5: Area not within current or 10-year spheres of influence for cities in Alameda, San Joaquin and Contra Costa counties. No known impact to future infrastructure development. 3: Area within 1 mile of existing or 10-year sphere of influence for cities within the counties noted above and/or known impact to future infrastructure development. 1: Significant portion of area within current or 10-year sphere of influence for cities within the counties noted above and/or significant impact to future infrastructure development.
	2	Farmland Impacts	5: No Farmland Designations, uncultivated open space 4: No Farmland Designations, active ranch land 3: Prime Farmland, Unique Farmland, Farmland of Statewide Importance, Farmland of Local Importance, active crop, orchard or vineyard land, Willamson Act Grazing Land 1: Enrolled in Williamson Act Farmland Security Zone
	4	Conflicts with Public Facilities (schools, housing, airports, parks)	5: No known, potential conflicts 4: Minor potential conflicts that can be easily mitigated through routine design, coordination, and permitting 3: Moderate potential conflicts that can be mitigated with extensive design, coordination, and permitting 2: Extensive, likely conflicts that can possibly be mitigated with design, coordination, and permitting 1: Extensive, likely conflicts that may be insurmountable
Environmental Setting	5	Conservation Easements	5: Option does not affect a conservation easement 3: Option only affects a conservation easement by aqueduct tunneling beneath easement 1: Option affects an existing or planned conservation easement, but has unique elements that may warrant pursuing exceptions to a conservation easement
	3	Federal or State Special Status Species or Critical Habitats	5: No special status species critical habitat 4: Limited effect on special status species critical habitat 3: Minor effect on special status species critical habitat 2: Moderate effect on special status species critical habitat 1: Significant effect on special status species critical habitat
	4	Proximity to Sensitive Receptors	5: No air quality/noise/aesthetics receptors within one mile of permanent project facilities 3: Potential air quality/noise/aesthetics receptors exist within one mile, mitigation strategies available 1: Potential air quality/noise/aesthetics receptors exist within one mile, mitigation strategies available but challenging to implement

Attachment 3
Bethany Reservoir Aqueduct Alignment Siting Study



Attachment 3.1

Optional Aqueduct Alignments

Criterion	Importance Factor (I)	Sub-Criterion	Explanation of Scoring
Constructability and Cost	5	Length	5: Relative to other options, offers shorter overall length 3: Generally average length among the options 1: Relative to other options, requires much greater overall length
	3	Utility Conflicts/Crossings	5: No known, potential conflicts 3: Moderate potential conflicts that can be mitigated with design, coordination, and permitting 1: Extensive conflicts that may require excessive measures to avoid
	3	Topography	5: Alignment avoids deeper excavations or difficult terrain for trenching and construction access 3: Moderate portion of alignment would require deeper excavations or cross difficult terrain 1: Significant portion of alignment would require deeper excavations or cross difficult terrain
	3	Geotechnical Considerations (Soil Type, Depth, Seismicity)	5: No known, significant challenges 3: Some moderate challenges anticipated, moderate risk 1: Significant challenges anticipated, high risk
Operations Complexity/ Impacts	3	Reservoir Water Quality	5: Discharge location has no apparent negative impacts on reservoir water quality due to residence time 3: Discharge location could create potential reservoir water quality issues due to residence time and would likely require additional circulation infrastructure be included
	3	O&M Considerations	5: Relative to other options, O&M is less complex due to lesser length, better access, and/or less required appurtenances 3: Relative to other options, O&M is likely about the same 1: Relative to other options, O&M is more complex due to additional length, poorer access, and/or more required appurtenances
Property and Land Use	2	Parcels Affected by Surface Facilities	5: Minimal potential effect on relatively lower number of parcels 3: Average potential effect on relatively average number of parcels 1: Significant potential effect on relatively large number of parcels
	1	Future Development	5: Area not within current or 10-year spheres of influence for cities in Alameda, San Joaquin and Contra Costa counties. No known impact to future infrastructure development. 3: Area within 1 mile of existing or 10-year sphere of influence for cities within the counties noted above and/or known impact to future infrastructure development. 1: Significant portion of area within current or 10-year sphere of influence for cities within the counties noted above and/or significant impact to future infrastructure development.
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	4	Conflicts with Public Facilities (schools, housing, airports, parks)	5: No known, potential conflicts 4: Minor potential conflicts that can be easily mitigated through routine design, coordination, and permitting 3: Moderate potential conflicts that can be mitigated with extensive design, coordination, and permitting 2: Extensive, likely conflicts that can possibly be mitigated with design, coordination, and permitting 1: Extensive, likely conflicts that may be insurmountable
	5	Conservations Easements	5: Option does not affect a conservation easement 3: Option only affects a conservation easement by aqueduct tunneling beneath easement 1: Option affects an existing or planned conservation easement, but has unique elements that may warrant pursuing exceptions to a conservation easement
Environmental Setting	3	Federal or State Special Status Species or Critical Habitats	5: No special status species critical habitat 4: Limited effect on special status species critical habitat 3: Minor effect on special status species critical habitat 2: Moderate effect on special status species critical habitat 1: Significant effect on special status species critical habitat
	4	Proximity to Sensitive Receptors	5: No air quality/noise/aesthetics receptors within one mile of permanent project facilities 3: Potential air quality/noise/aesthetics receptors exist within one mile, mitigation strategies available 1: Potential air quality/noise/aesthetics receptors exist within one mile, mitigation strategies available but challenging to implement

Attachment 4
Bethany Reservoir Haul Route Alignment Study

ALTERNATIVE 3

CONSERVATION EASEMENTS

DAYLIGHT LINES

DISCHARGE AREA

ROAD CONTINUES TO DISCHARGE AREA. DOES NOT TERMINATE HERE.

ALTERNATIVE 2

EXISTING WETLANDS

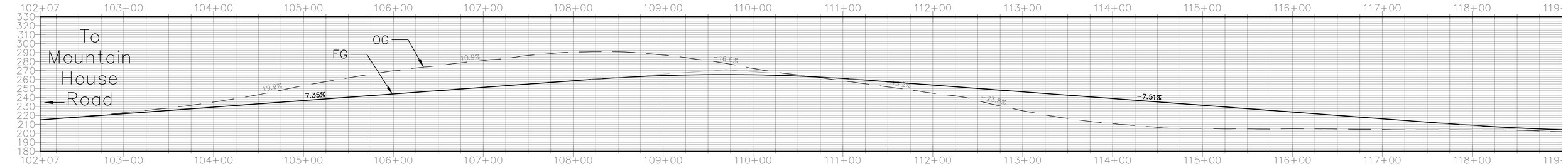
CURRENT DESIGN

ELECTRICAL TOWERS

ALTERNATIVE 1

Attachment 4.1

Bethany Access Haul Road Alternatives



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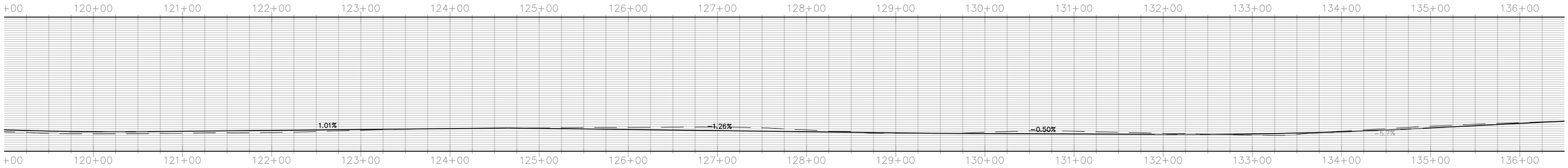

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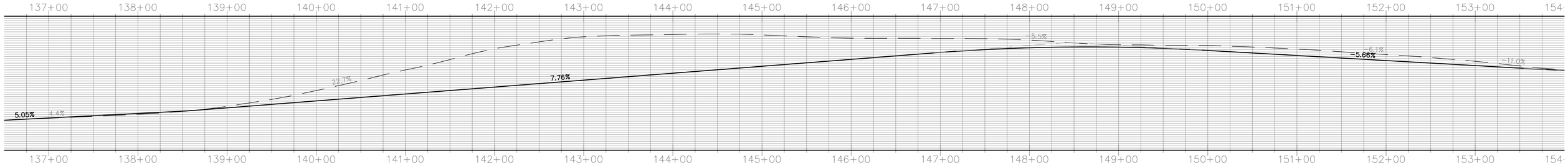
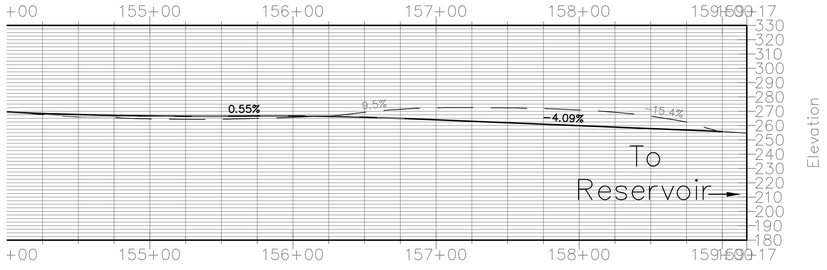
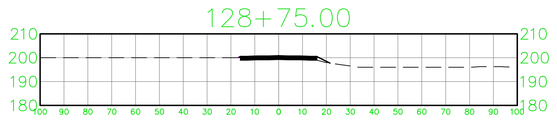
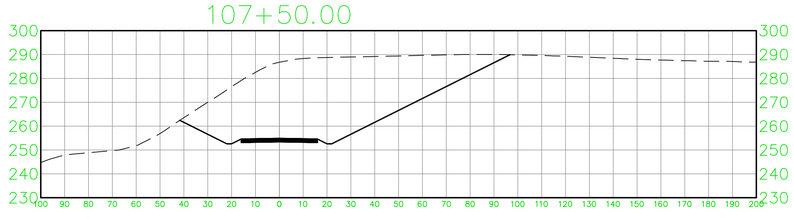
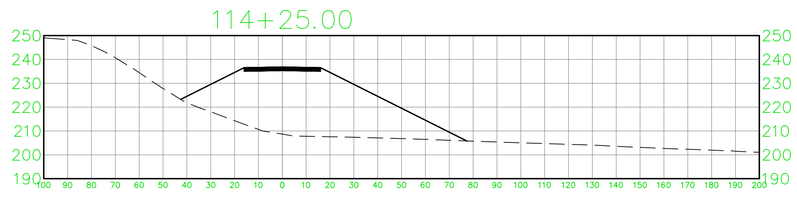


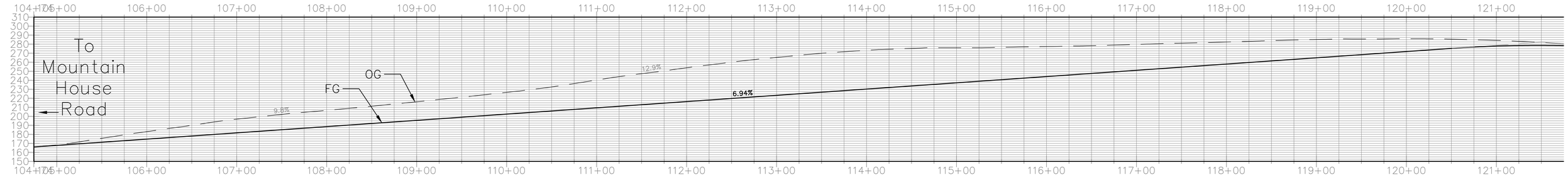


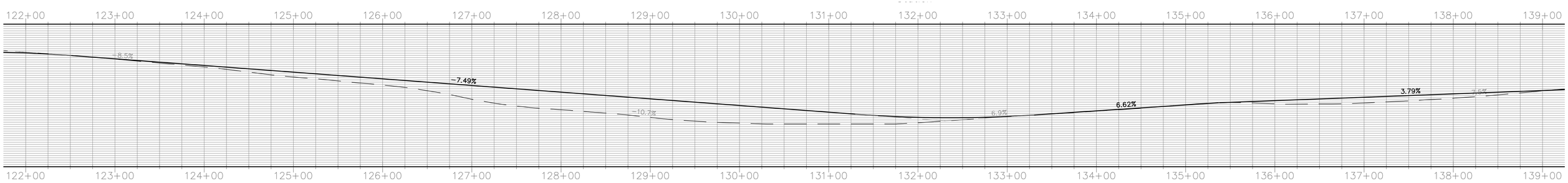


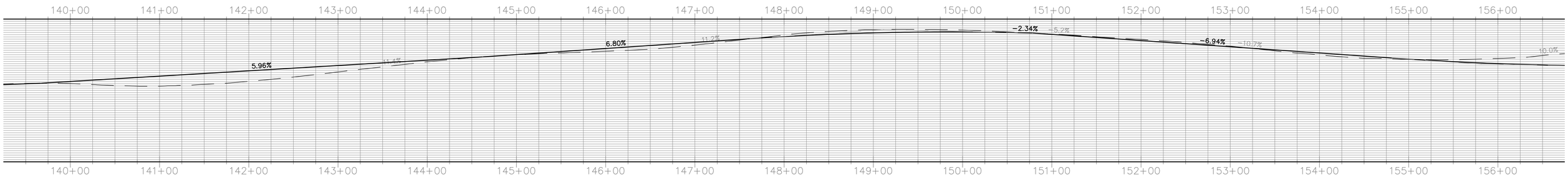


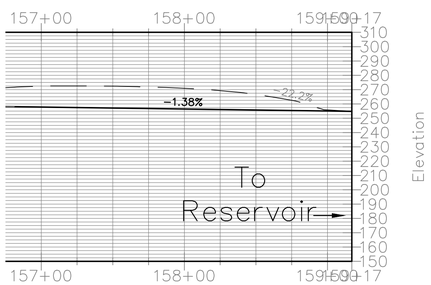


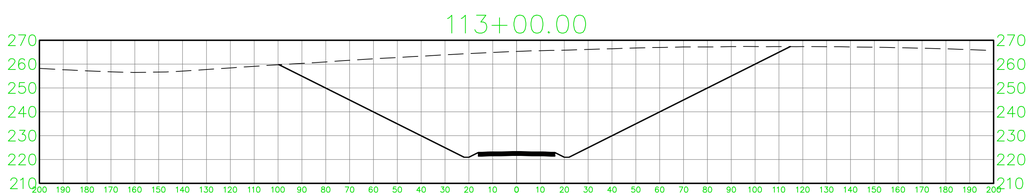
Attachment 4.2
Bethany Haul Access Road ALT 1

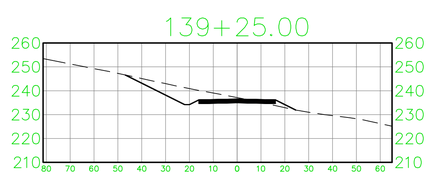






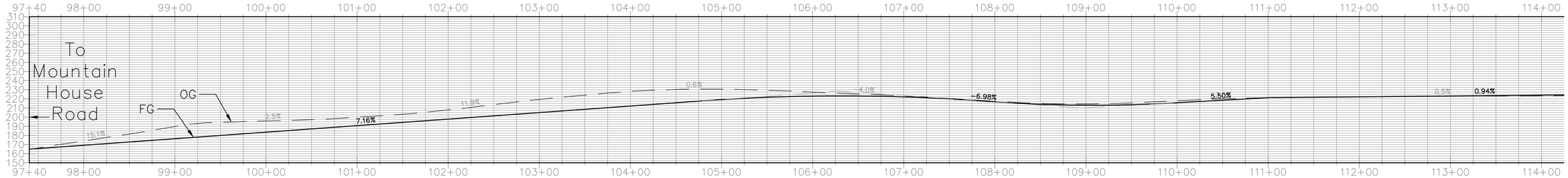


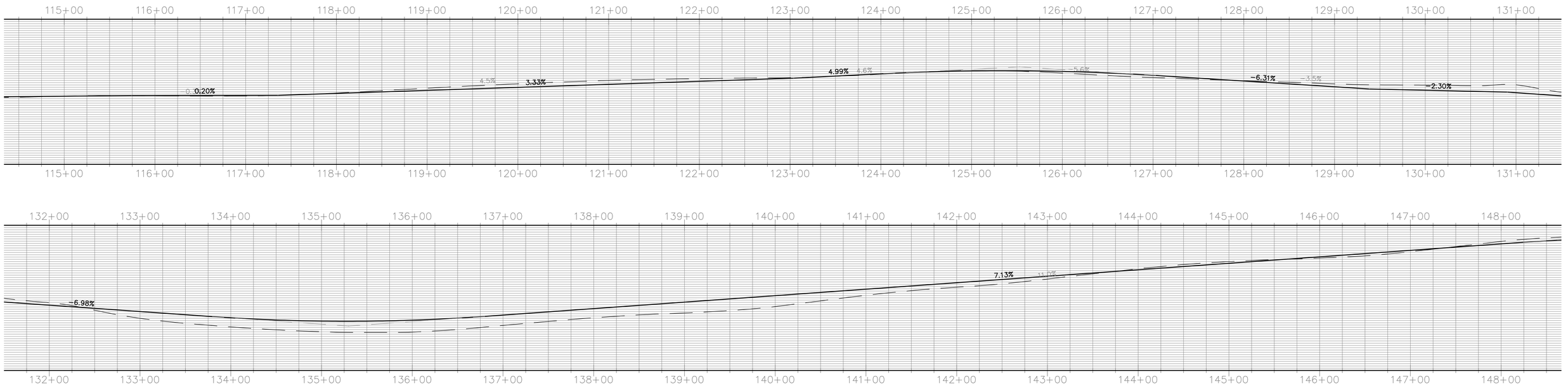


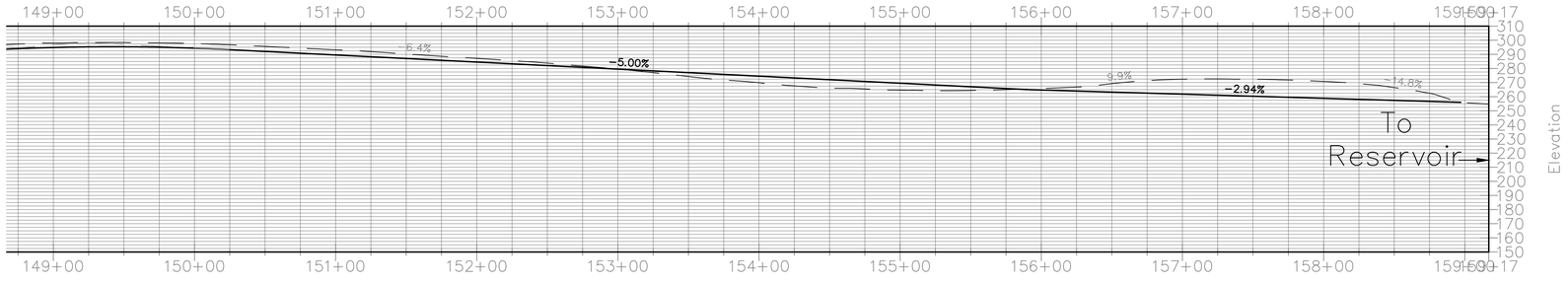


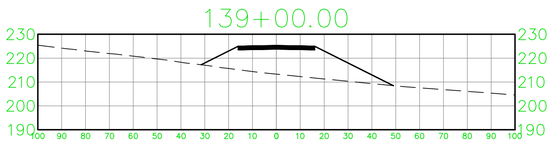
Attachment 4.3

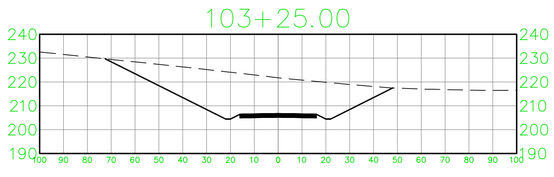
Bethany Haul Access Road ALT 2

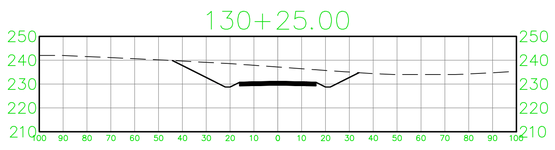






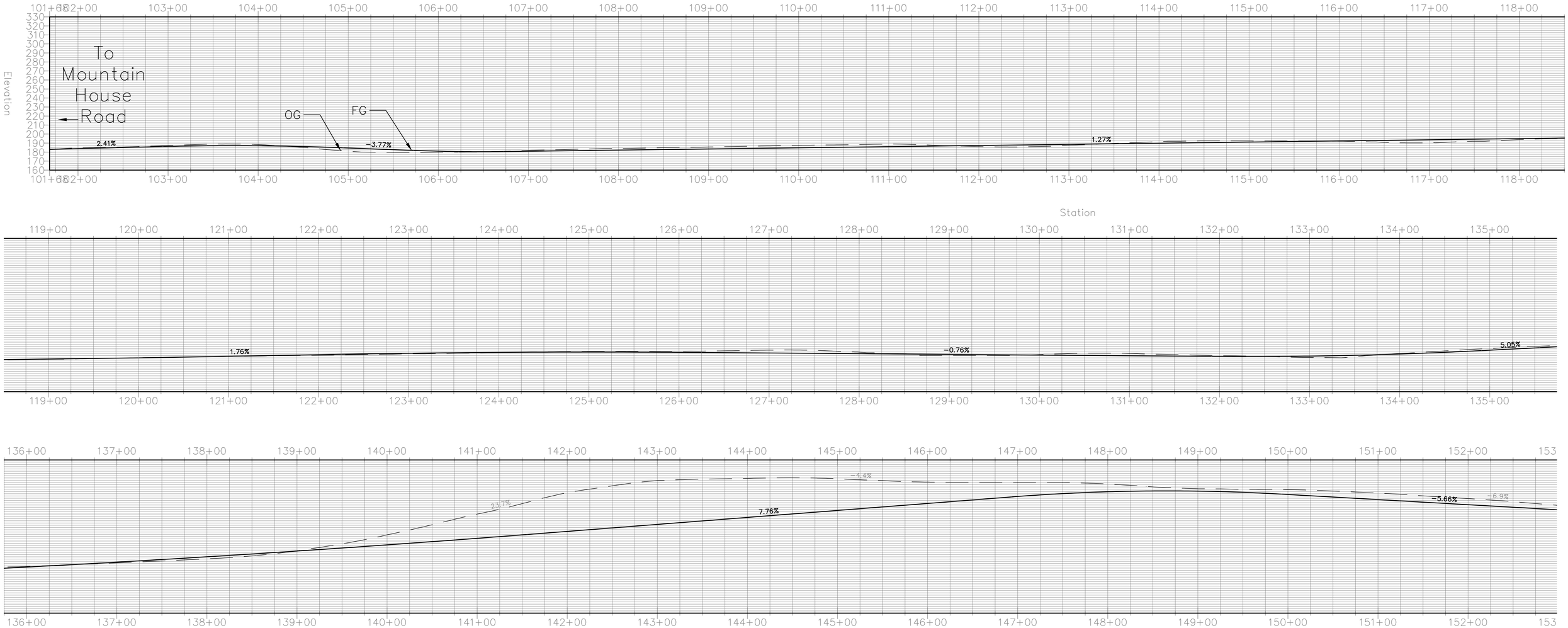


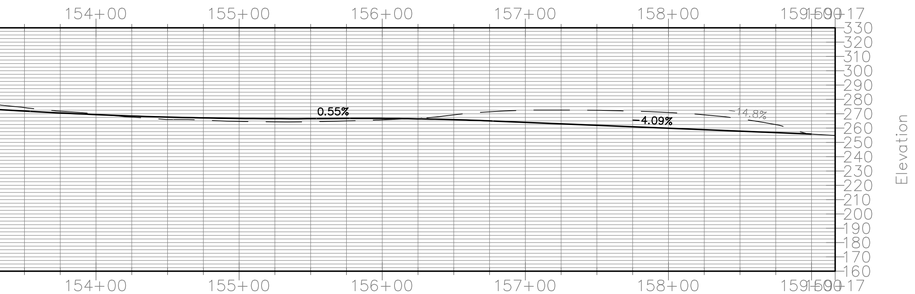


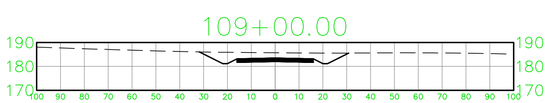


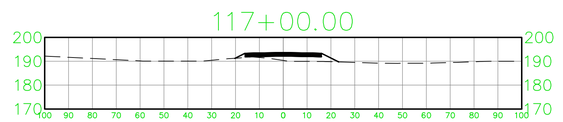
Attachment 4.4

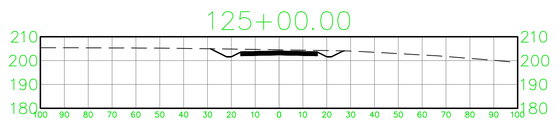
Bethany Haul Access Road ALT 3











Attachment 4.5

Bethany Haul Access Road Current Design