

Dungeness Off-Channel Reservoir Project Background – Summary of Work Presented

This packet of information and the presentation given to the Dungeness Reservoir Work Group (Work Group) on June 20, 2024, summarize work completed on the design and evaluation of the Dungeness Reservoir project by Clallam County’s consulting team since prior design options were presented to the Work Group on August 16, 2023. Key items of work have included the following:

Public Comment and Response

- **Meeting with Dungeness Homeowner’s Association:** A presentation and summary were provided to members of the Dungeness Homeowner’s Association and neighbors of the proposed reservoir site on November 1, 2023.
- **Frequently Asked Questions Document Updates:** Clallam County and Anchor QEA are updating the Frequently Asked Questions document that was originally prepared to address questions and comments provided based on our presentation of the preliminary design in 2022. An updated copy of that document will be completed and posted to the project website late in June or early in July 2024. The document will continue to be updated as additional questions are submitted by the public and members of the Work Group.
- **Additional Public Meetings:** Clallam County plans to host another public meeting during the summer of 2024 to present an update on the Dungeness Reservoir project. Additional public meetings will be scheduled, as needed, throughout the design process.

Coordination with the Dungeness Reservoir Work Group

- **Meetings with Dungeness Reservoir Work Group:** The County and the consultant team are continuing to meet regularly (monthly, as needed) with the Dungeness Reservoir Work Group to discuss the work and address comments from members of the Work Group.
- **Meetings with the Clallam County Board of Commissioners:** Clallam County staff continue to brief the County Board of Commissioners regularly on project progress and key issues. The County’s Project Manager has scheduled time during the Board of Commissioners July 1, 2024, work session for a presentation that will include the same information presented at the June 20, 2024, Work Group Meeting.

Phase 1 Seismic Fault Investigation Study

Anchor QEA and their geotechnical engineering subconsultant, Shannon & Wilson, completed a detailed review of seismic conditions at the site. An overview of this work was provided during the April 17, 2024, Dungeness Reservoir Work Group meeting. The Phase 1 Seismic Fault Investigation Study is a detailed study of a fault zone that passes through the site and provides recommendations

for design of a reservoir that can accommodate potential deformation from seismic events at the site. The study included the following work:

- **Detailed LiDAR Evaluation:** High resolution LiDAR data was processed and evaluated to better understand topographic features, or lineaments identified during the reconnaissance-level evaluation that suggest the presence of subsurface fault activity at the site.
- **Desktop Review:** The review included a detailed analysis of all available information about the “Sequim Fault” and other seismic studies completed in the Sequim area.
- **Detailed Site Review:** The LiDAR data and geologic mapping were reviewed.
- **Connections to Known Fault Activity East and West of the Site:** The LiDAR data was used to try and determine whether there are connections between the features observed at the site and known fault zones located east and west of the site.
- **Research Geologic History at the Site:** Additional research and analysis was completed to evaluate paleochannels (historic flow channels) and the geochronology at the site.
- **Review Regional Geologic and Glacial History:** A detailed review was completed of the geologic and glacial history on the North Olympic Peninsula.
- **Phase 1 Seismic Fault Investigation Study Report:** A report was provided with recommendations for design of the reservoir.

The findings of the study support the hypothesis that there is an active fault zone that crosses the north half of the proposed reservoir site. Other key findings include the following:

- **Seismic Deformation Zones:** Based on the information reviewed and developed as part of the study, Shannon & Wilson identified and mapped zones at the site that are more likely to see surface deformation during a seismic event. These zones include the following:
 - **Primary Deformation Zone:** The primary fault scarp mapped at the site based on the detailed LiDAR review, plus area north and south of that scarp. This is the zone of the highest potential for surface deformation during a seismic event.
 - **Secondary Deformation Zone:** The secondary fault scarp mapped at the site based on the detailed LiDAR review, plus area north and south of that scarp. The scarp likely represents a secondary line of deformation associated with the primary fault. This is the zone with the next highest potential for surface deformation during a seismic event.
 - **Distributed Secondary Deformation Zone:** The area between the Primary and Secondary Displacement Zones and areas north of the Primary Deformation Zone. These areas also have potential for deformation due to location between other potential zones of deformation.
 - **Low Probability Deformation Zone:** Area where study found no evidence of past surface deformation.
- **Seismic Displacement Estimates:** Preliminary displacement estimates were provided for the Primary, Secondary, and Distributed Secondary Deformation Zones. Design of a reservoir within these zones would need to accommodate these displacement values.

Based on the key findings of the study, the following recommendations were offered:

- **Reservoir Location:** If possible, shift the reservoir footprint south and configure the reservoir such that the primary structural embankment and reservoir water surface are within the Low Probability Deformation Zone.
- **Seismic Evaluations:** Perform additional seismic hazard analyses to support the design.
- **Monitoring During Construction:** Excavation slopes should be observed during reservoir construction by a Licensed Geologist.

Evaluation of Additional “Option E” Reservoir Configurations

The reservoir configurations that were evaluated during preliminary design and following completion of preliminary design during the spring and summer of 2023 (“Options A through D”) were not configured so that the primary structural embankment and reservoir water surface are within the Low Probability Deformation Zone. Four additional reservoir configurations have been evaluated, referred to as the “Option E” reservoir configurations. These configurations, summarized in this packet and in the presentation prepared for the Work Group, are intended to be responsive to the recommendations from the Phase 1 Seismic Fault Investigation Study and reflect earlier input from the public regarding the height of the reservoir embankment, volume of water stored above ground, and distance between the reservoir and private properties north of the reservoir.

Limitations and Additional Work Required

The reservoir configurations presented in this packet should be considered preliminary. The design of the reservoir, including definition of the reservoir footprint, height of embankment, and volume of water stored is a work in progress. Additional work will need to be completed before selecting a preferred reservoir alternative. These include the following:

- **Coordination with Bonneville Power Administration (BPA):** BPA owns and operates power transmission facilities that cross the site through an easement from east to west. The proposed “Option E” reservoir configurations represent varying levels of impact on the BPA easement. The potential configurations need to be reviewed with BPA to better understand the constraints and limitations around work in that easement.
- **Review with Funding Agencies:** Funding has been secured for construction of various elements of the reservoir project. Additional coordination will be required to update the funding agencies to ensure that the project meets their requirements.
- **Public Meeting and Outreach:** As noted above, an additional public meeting will be held in the summer of 2024 to review this information and solicit additional feedback from the public. This feedback will be considered when selecting a preferred design.
- **Additional Analyses Required:** The embankment slopes, embankment height, volume, and other parameters will continue to be adjusted as additional geotechnical site investigations, seismic analyses, hydrologic and hydraulic analyses, and other analyses are completed.

Table 1
Comparison of Option E Reservoir Configurations

Design Parameter	Reservoir Configuration			
	2024 Revised Configuration Option E1	2024 Revised Configuration Option E2	2024 Revised Configuration Option E3	2024 Revised Configuration Option E4
Maximum Water Surface Elevation/Overflow Elevation (feet)	435.0	435.0	435.0	432.0
Top of Embankment Elevation (feet)	440.0	440.0	440.0	437.0
Average Reservoir Bottom Elevation (feet) ¹	381.5	381.5	381.5	386.0
Low-level Outlet Invert Elevation (feet)	381.5	381.5	381.5	385.0
Approximate Existing Ground Elevation at North Embankment (feet) ²	415.0 (North Reservoir) 429.0 (South Reservoir)	415.0	415.0	415.0
Approximate Existing Ground Elevation at South Embankment (feet) ³	424.0 (North Reservoir) 445.0 (South Reservoir)	445.0	450.0	444.0
Approximate Embankment Height at North End of Reservoir (feet)	25.0 (North Reservoir) 11.0 (South Reservoir)	25.0	25.0	22.0
Approximate Embankment Height at South End of Reservoir (feet)	16.0 (North Reservoir) No Embankment (South Reservoir)	No Embankment	No Embankment	No Embankment
Maximum Depth of Water Above Ground at North End of Reservoir (feet)	20.0 (North Reservoir) 6.0 (South Reservoir)	20.0	20.0	17.0
Maximum Depth of Water Above Ground at South End of Reservoir (feet)	11.0 (North Reservoir) -10.0 (South Reservoir)	-10.0	-15.0	-12.0
Interior Embankment Slope (feet/feet) ⁴	4H:1V	4H:1V	4H:1V	4H:1V
Exterior Embankment Slope (feet/feet) ⁴	3H:1V	3H:1V	3H:1V	3H:1V
Estimated Storage Capacity (acre-feet)	959 522 (North Reservoir) 437 (South Reservoir)	1,236	1,465	1,610
Anticipated Flow Benefit	Up to 25 cfs for 19.3 days, or Up to 15.1 cfs for 32.0 days	Up to 25 cfs for 24.9 days, or Up to 19.5 cfs for 32.0 days	Up to 25 cfs for 29.5 days, or Up to 23.1 cfs for 32.0 days	Up to 25 cfs for 32.5 days, or Up to 25.4 cfs for 32.0 days
Percent of Storage Capacity Below Existing Ground Elevation	67% (North Reservoir) 77% (South Reservoir)	76%	79%	85%
Percent of Storage Capacity Above Existing Ground Elevation	33% (North Reservoir) 23% (South Reservoir)	24%	21%	15%
Distance from Top of Embankment to North Property Boundary (feet)	2,390	2,320	2,320	2,320
Maximum Water Surface Area, Full Reservoir (acres)	19.5 (North Reservoir) 13.3 (South Reservoir)	40.8	46.2	47.2
Surface Area, Bottom of Reservoir (acres)	2.1 (North Reservoir) 1.9 (South Reservoir)	7.7	10.5	25.0
Estimated Area Required for Low Permeability Layer or Liner (acres)	43.7	40.8	46.2	17.2
Estimated Area of Till Exposed by Excavation (acres) ⁶	7.3	11.5	13.2	23.3
Total Estimated Cut Required (CY)	1,107,452	1,513,551	1,875,689	2,215,977
Total Estimated Cut in Till Layer (CY) ⁶	314,347	286,918	338,713	577,012
Total Estimated Fill Required (CY)	395,657	420,620	408,010	257,931
Total Estimated Excess Material to be Placed On-site or Hauled Away (CY) ⁷	711,795	1,092,931	1,467,679	1,958,046

Design Parameter	Reservoir Configuration			
	2024 Revised Configuration Option E1	2024 Revised Configuration Option E2	2024 Revised Configuration Option E3	2024 Revised Configuration Option E4
Opinion of Probable Costs – Reservoir and Appurtenances⁸				
• Opinion of Probable Construction Costs (February 2022 Dollars) ¹¹	\$30,955,000	\$34,162,000	\$38,306,000	\$37,973,000
• Opinion of Probable Construction Costs (June 2024 Dollars)¹³	\$33,279,000	\$36,725,000	\$41,179,000	\$40,821,000
• Additional Design Costs, Not Already Contracted (June 2024 Dollars) ¹⁴	\$400,000 to \$700,000	\$400,000 to \$700,000	\$400,000 to \$700,000	\$400,000 to \$700,000
• Construction Administration, Other Costs (June 2024 Dollars) ¹⁷	\$2,476,000 to \$3,096,000	\$2,938,000 to \$3,673,000	\$3,294,000 to \$4,118,000	\$3,266,000 to \$4,082,000
• Total	\$36,341,000 to \$37,307,000	\$40,063,000 to \$41,098,000	\$44,873,000 to \$45,997,000	\$44,487,000 to \$45,603,000
Opinion of Probable Costs – Intake, Settling Basin, Inlet Pipelines⁹				
• Opinion of Probable Construction Costs (February 2022 Dollars) ¹¹	\$3,574,000	\$3,574,000	\$3,574,000	\$3,574,000
• Opinion of Probable Construction Costs (June 2024 Dollars)¹³	\$3,842,000	\$3,842,000	\$3,842,000	\$3,842,000
• Additional Design Costs, Not Already Contracted (June 2024 Dollars) ¹⁵	0	0	0	0
• Construction Administration, Other Costs (June 2024 Dollars) ¹⁷	\$307,000 to \$384,000	\$307,000 to \$384,000	\$307,000 to \$384,000	\$307,000 to \$384,000
• Total	\$4,149,000 to \$4,226,000	\$4,149,000 to \$4,226,000	\$4,149,000 to \$4,226,000	\$4,149,000 to \$4,226,000
Opinion of Probable Costs – Downstream Irrigation Pipelines¹⁰				
• Opinion of Probable Construction Costs (June 2021 Dollars) ¹²	\$4,082,000	\$4,082,000	\$4,082,000	\$4,082,000
• Opinion of Probable Construction Costs (June 2024 Dollars)¹³	\$4,827,000	\$4,827,000	\$4,827,000	\$4,827,000
• Additional Design Costs, Not Already Contracted (June 2024 Dollars) ¹⁶	\$514,000	\$514,000	\$514,000	\$514,000
• Construction Administration, Other Costs (June 2024 Dollars) ¹⁷	\$386,000 to \$483,000	\$386,000 to \$483,000	\$386,000 to \$483,000	\$386,000 to \$483,000
• Total	\$5,727,000 to \$5,824,000	\$5,727,000 to \$5,824,000	\$5,727,000 to \$5,824,000	\$5,727,000 to \$5,824,000
Construction Funding Secured or Pending Award to Date¹⁸				
• Ecology Streamflow Restoration (for Reservoir and Appurtenances)	\$3,955,699	\$3,955,699	\$3,955,699	\$3,955,699
• FEMA Hazard Mitigation (for Reservoir and Appurtenances)	\$29,986,688	\$29,986,688	\$29,986,688	\$29,986,688
• U.S. Bureau of Reclamation WaterSMART (for Intake, Settling Basin, Inlet)	\$2,417,700	\$2,417,700	\$2,417,700	\$2,417,700
• Natural Resources Conservation Service (for HID Main Canal Pipeline)	\$2,727,870	\$2,727,870	\$2,727,870	\$2,727,870
• Total Construction Funding (Reservoir and Appurtenances)	\$33,942,387	\$33,942,387	\$33,942,387	\$33,942,387
• Total Construction Funding (Intake, Settling Basin, Inlet Pipelines)	\$5,145,570	\$5,145,570	\$5,145,570	\$5,145,570
• Total Construction Funding (Downstream Irrigation Pipelines)	\$0	\$0	\$0	\$0

Notes:

1. The reservoir bottom of Option E4 is sloped. This represents the approximate average bottom elevation.
2. The ground elevation was estimated from LiDAR under the embankment near where the low-level outlet pipeline crosses the north embankment. Existing ground elevations vary across the reservoir and embankment area.
3. The ground elevation was estimated from LiDAR under the embankment near where the inlet pipeline crosses the south embankment. Existing ground elevations vary across the reservoir and embankment area.
4. The interior and exterior slopes shown may change based on analysis and recommendations that will be presented in the final geotechnical engineering reports.
5. The volumes of storage above and below the ground elevation at the north end of the reservoir were estimated based on the elevation listed as the "Approximate Existing Ground Elevation at North Embankment."
6. The area and volume of till that would be disturbed or removed by the excavation was based on a comparison of the bottom of the reservoir with an assumed till layer that is only based on data from the Phase 1 borings. A refined till surface layer will need to be developed from additional data and will be used as the design progresses beyond the preliminary design stage to refine these numbers.
7. The total estimated excess material represents the difference between the total estimated cut or excavation required and the total estimated fill required. The opinion of probable costs assumes that the excess material will be excavated, placed, and compacted somewhere on site. The exact method for handling excess material (placement on-site, hauling away, or marketing to someone else for processing) will need to be addressed as the design progresses.
8. The items listed below this row summarize the costs associated with the reservoir, inlet structure, outlet structure, spillway facilities, outlet pipelines, site improvements, and other key elements associated with work on the reservoir site. Funding for construction of these improvements has been identified through a FEMA Hazard Mitigation Grant Program (HMGP). FEMA HMGP funding amounts and applicability will need to be confirmed.
9. The items listed below this row summarize the costs associated with HID Headgate Structure improvements, HID Screening Facility improvements, installation of a settling basin at the upstream end of the HID Main Canal, replacement of the HID Main Canal from the HID Screening Facility to the split with the HID H1 Later with a pipeline, installation of a flow control structure at the split between the HID Main Canal and the HID H1 Lateral, and replacement of the HID H1 Lateral from the HID Main Canal to the reservoir with a pipeline. Funding for construction of these improvements has been secured through grants from the U.S. Bureau of Reclamation WaterSMART program (Intake, Screening, Settling Basin, Flow Control, and H1 Lateral Pipeline) and the NRCS (HID Main Canal Pipeline).
10. The items listed below this row summarize the costs associated with pipelines that will replace or enhance the downstream irrigation delivery systems, as needed to delivery reservoir water to water users east of the Dungeness River. Costs are likely to change depending on the extent and type of upgrades that are selected for design and implementation. Funding for the design and construction of these pipelines has not yet been identified.
11. Costs listed in this row are based on the unit costs used developed for the preliminary design cost analysis in February 2022. Unit costs reflect our understanding of what materials and labor costs were at that time and are only provided for comparison against the preliminary design costs and costs for other project options that are based on February 2022 unit costs. Costs will be updated as the design progresses to reflect materials and labor costs at the time of each deliverable. Costs include an allowance for items not yet identified, a 15% contingency, and sales tax (8.5%).
 - a. Costs were included for rebuild of River Road around the toe of the embankment for Option E3. Relocation of River Road and associated utilities was estimated as \$1.47 of the total cost shown (in 2022 dollars).

- b. An allowance of \$500,000 was included in Option E4 for relocation or reconstruction of BPA power transmission lines through the site. The cost and extent or need for relocation or rebuild of BPA power transmission lines has not been confirmed with BPA yet.
12. Costs listed in this row were originally developed as part of the preliminary design of downstream irrigation pipelines completed for Clallam Conservation District in June 2021. Unit costs reflect our understanding of what materials and labor costs were at that time. Opinions of cost have not been updated or revised since the preliminary design was completed in June 2021. Costs will be updated as the design progresses to reflect materials and labor costs at the time of each deliverable. Costs include a 30% contingency and sales tax (8.5%).
 13. Costs were inflated to June 2024 dollar values based on the Engineering News Record Construction Cost Index for Seattle, with some rounding up. The ENR Construction Cost Index for Seattle indicates an increase in overall construction costs from February 2022 to June 2024 of nearly 7.5%. The ENR Construction Cost Index for Seattle indicates an increase in overall construction costs from June 2021 to June 2024 of nearly 10%. Local increases and increases in specific material and labor costs may likely be higher than the index indicates.
 14. Additional design and permitting work has been and will be required to complete the design and permitting of the reservoir beyond the amount that has been contracted to date. The amount shown represents the anticipated range of additional costs that will be incurred, beyond what has already been contracted, to complete the design and permitting work.
 15. No additional costs are currently projected for completion of the design of the intake, settling basin, and inlet pipeline improvements.
 16. Work needed to complete the detailed design and permitting of the delivery pipelines needed downstream of the reservoir to deliver reservoir water to water users east of the Dungeness River has not yet been scoped, funded, or approved. The amount shown in this row is an estimate based on a draft scope of work and budget prepared by Anchor QEA in April 2024. Funding will need to be secured to complete the design and permitting work.
 17. The range listed in this row includes an allowance of 8 to 10 percent of the opinion of probable construction costs for construction administration and management. A more detailed budget for this work will need to be developed and approved as the design of the reservoir nears completion.
 18. Clallam County has applied for and secured funding for the reservoir in the amounts noted.
 - a. The Ecology Streamflow Restoration Grant is intended to fund construction of the reservoir and appurtenances. Some of the funding is also earmarked for project management. A portion of the funding may need to be reallocated to complete the design and permitting.
 - b. The FEMA Hazard Mitigation Grant is also intended to fund construction of the reservoir and appurtenances. The funding requires a 5% match.
 - c. The U.S. Bureau of Reclamation WaterSMART Grant is intended to fund construction of the HID intake/head gate structure upgrades, upgrades to the HID fish screening facilities, the settling basin at the upstream end of the HID Main Canal, the flow control structure on the HID Main Canal, and the inlet pipeline from the HID Main Canal to the reservoir. The funding requires a 25% match.
 - d. The Natural Resources Conservation Service Grant is intended to fund construction of the pipeline that will replace the HID Main Canal from the settling basin to the control structure at the split with the H1 Lateral.

Reservoir Configuration Summary: Option E1	
Key Design Parameters:	
• Maximum Water Surface Elevation/Overflow Elevation	435.0 feet
• Top of Embankment Elevation	440.0 feet
• Low-Level Outlet Invert Elevation	381.5 feet
• Approximate Existing Ground Elevation at North Embankment	415 feet±
• Approximate Embankment Height at North End of Reservoir	25 feet±
• Maximum Depth of Water Above Ground at North End of Reservoir	20 feet±
• Interior Embankment Slope	4H:1V
• Exterior Embankment Slope	3H:1V, With Toe Berm
• Estimated Storage Capacity	959 acre-feet
• Anticipated Flow Benefit	Up to 25 cfs for 19.3 days, or Up to 15.1 cfs for 32.0 days
• Percent of Storage Capacity Below Existing Ground Elevation	67% (North Reservoir) 77% (South Reservoir)
• Percent of Storage Capacity Above Existing Ground Elevation	33% (North Reservoir) 23% (South Reservoir)
• Total Estimated Cut Required	1,107,452 CY
• Total Estimated Fill Required	395,657 CY
• Total Excess Material to be Placed On-Site or Hauled Away	711,795 CY
Summary:	
<p>Option E1 would result in the reservoir footprint being shifted to the south to avoid overlap with the Secondary Deformation Zone that was identified by the recently completed Phase 1 Seismic Fault Study. The reservoir would include two separate sections of reservoir connected by pipe through the BPA easement; one section of reservoir would be located north of the BPA easement but entirely south of the Secondary Deformation Zone and the other would be located south of the BPA easement.</p> <p>Option E1 is similar to Option D in the constraints applied, except that the reservoir was configured such that the entire embankment, toe berm, and reservoir are completely within the Low Probability of Deformation Zone that was recently mapped as part of the Phase 1 Seismic Fault Study. Portions of the Option D reservoir would have overlapped with the Secondary Deformation Zone. The reservoir configuration was developed to avoid impact to River Road on the east, avoid encroachment on the BPA easement, and maintain a 150 to 200 feet of distance between stored water and the bluff on the west side of the site to protect bluff stability.</p> <p>This option also assumes that the discharge pipelines from the reservoir would be extended beyond the north property boundary and lowered to allow the bottom of the reservoir to be lower than it would be if the outlet had to daylight at the north property boundary. For this option, the full reservoir elevation was set at 435.0 feet (the same as the preliminary design). The low-level outlet invert elevation would be approximately 381.5 feet. It was assumed that the 36-inch discharge pipeline from the reservoir would branch near the north property boundary and the following pipelines would be added to extend the discharge system:</p> <ul style="list-style-type: none"> • An 18-inch pipeline would extend northeast in the Eureka Canal to an existing culvert at River Road. The invert at the discharge location at River Road would be the same as the existing culvert (377.5 feet). • A 30-inch pipeline would extend west parallel to the north property boundary to convey water to the Independent Canal. The invert at the discharge location at the Independent Canal would be 358.1 feet. • A 12-inch pipeline would extend approximately 1,100 north of the property boundary in the HID H-1 Lateral. That pipeline would discharge at an invert elevation of 367.9 feet. 	

Reservoir Configuration Summary: Option E1

For the reservoir to release water by gravity, the low-level outlet at the reservoir would need to be higher than the elevations at the three points of discharge identified above. The highest of those would be the 18-inch pipe in the Eureka Canal, with a discharge outlet invert elevation of 377.5 feet. To ensure that there would be capacity to release reservoir water when the reservoir is low and allow for pressure losses in the discharge pipelines, the low-level outlet at the reservoir was set at an invert elevation of 381.5 feet.

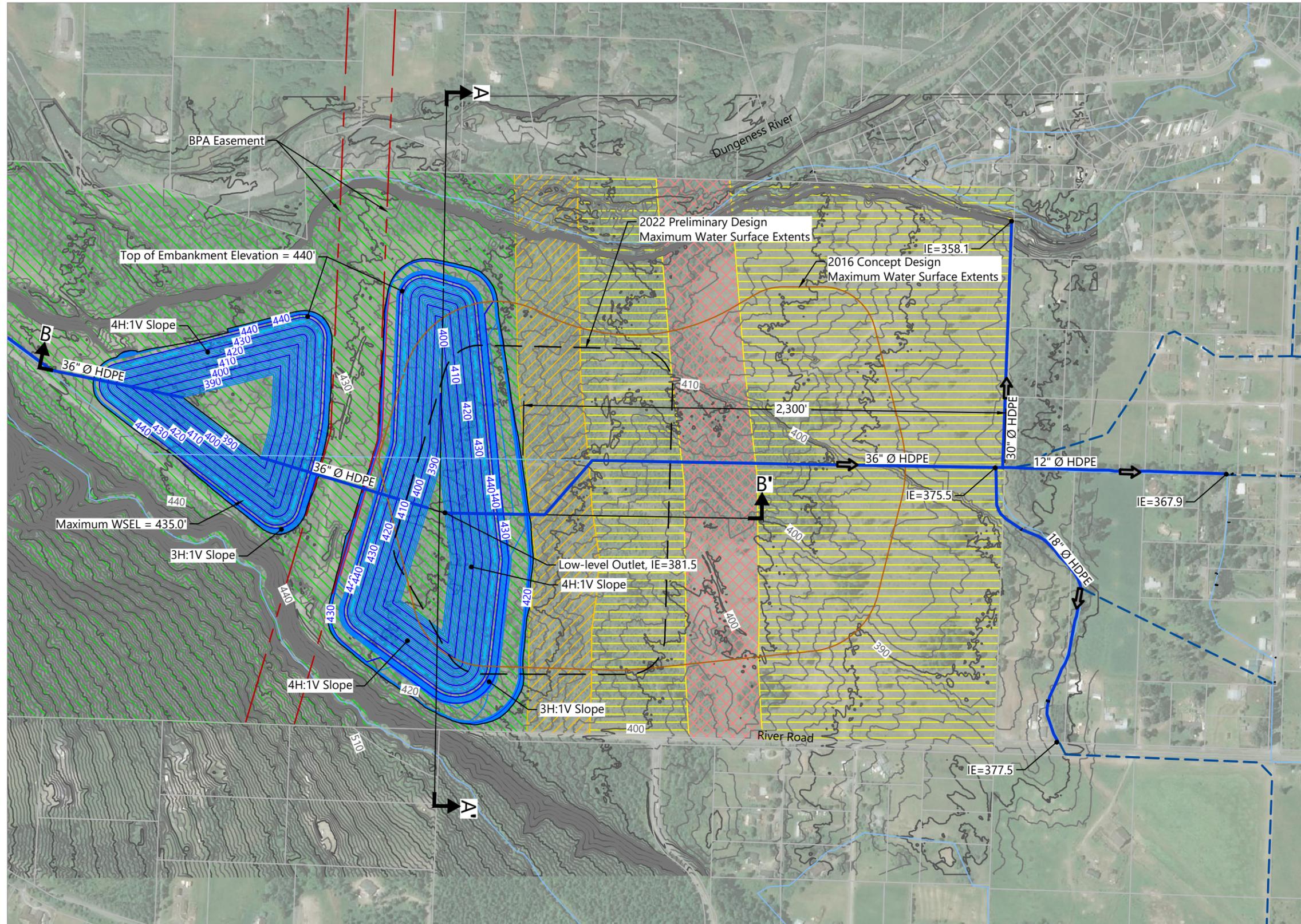
Due to new seismic information and the need to do additional analysis to inform slope stability and the impact of seismic activity on freeboard, the embankment slopes and freeboard were increased from the values that were used for preliminary design and prior analyses of other reservoir configurations. A 4H:1V slope was used for all interior embankment slopes and a 3H:1V slope was used for all exterior embankment slopes. A freeboard of 5 feet was incorporated into this analysis. Embankment slopes may be steepened, and freeboard may be reduced if further slope stability, seismic, and hydraulic analyses suggest that steeper slopes and less freeboard are appropriate. That additional analyses will be completed during the detailed (60 percent) design phase.

The analysis of Option E1 resulted in a 959-acre-foot reservoir, which is smaller than the other options considered. The capacity of the reservoir could be increased by raising the top elevation, lowering the bottom elevation further, allowing the toe berm to extend into the Secondary Deformation Zone, or allowing for additional impacts within the BPA easement. If justified by further analysis, the reservoir capacity could also be increased by steepening the embankment slopes and reducing the freeboard provided. The top of the embankment would extend to a top elevation of 440 feet and the reservoir would be designed to maintain a full water surface at an elevation of 435 feet. Based on the existing ground surface elevation at the north end of the reservoir, where the embankment crosses the existing Highland Irrigation District (HID) H-1 Lateral, the north side of the embankment would be approximately 25 feet tall above the existing ground. The height of the embankment would vary around the reservoir and would generally decrease from north to south. The depth of water stored above the existing ground at that location would be approximately 20 feet. The top of the embankment would be located approximately 2,390 feet south of the north property boundary.

The project would include the following key elements:

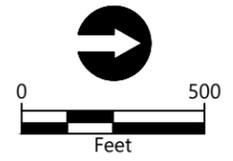
- The 959-acre-foot reservoir.
- Upgrades to HID intake and screening facilities near the Dungeness River
- A settling basin downstream of the HID intake and screening facilities.
- A 36-inch pipeline that would replace the existing HID Main Canal between the settling basin and a new flow control structure at the upstream end of the H-1 Lateral.
- A 36-inch inlet pipeline that would replace the H-1 Lateral from the HID Main Canal to the reservoir.
- A 36-inch outlet pipeline that would replace the H-1 Lateral from the reservoir to a discharge point in the H-1 Lateral near the north property boundary.
- The discharge pipelines listed earlier in this summary, branching from the 36-inch outlet pipeline near the north property boundary.
- An 18-inch bypass pipeline that would convey water around the reservoir during construction and when the reservoir is down for maintenance.
- An emergency spillway structure with a crest elevation of 435 feet and 36-inch discharge pipeline to the river.
- Other structures, controls, and appurtenances needed to control the flow of water to and from the reservoir.

Opinion of Cost – Key Elements of Reservoir Project	\$36.3 to \$37.3 million
Opinion of Cost – Key Elements of HID Intake, Screen, and Canal Upgrades	\$4.1 to \$4.2 million
Opinion of Cost – Key Elements of Downstream Irrigation Pipelines	\$5.7 to \$5.8 million



SOURCE: Aerial ©2021 Microsoft Corporation
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HORIZONTAL DATUM: Washington State Plane
 North Zone, NAD83, U.S. Survey Feet
VERTICAL DATUM: NAVD88

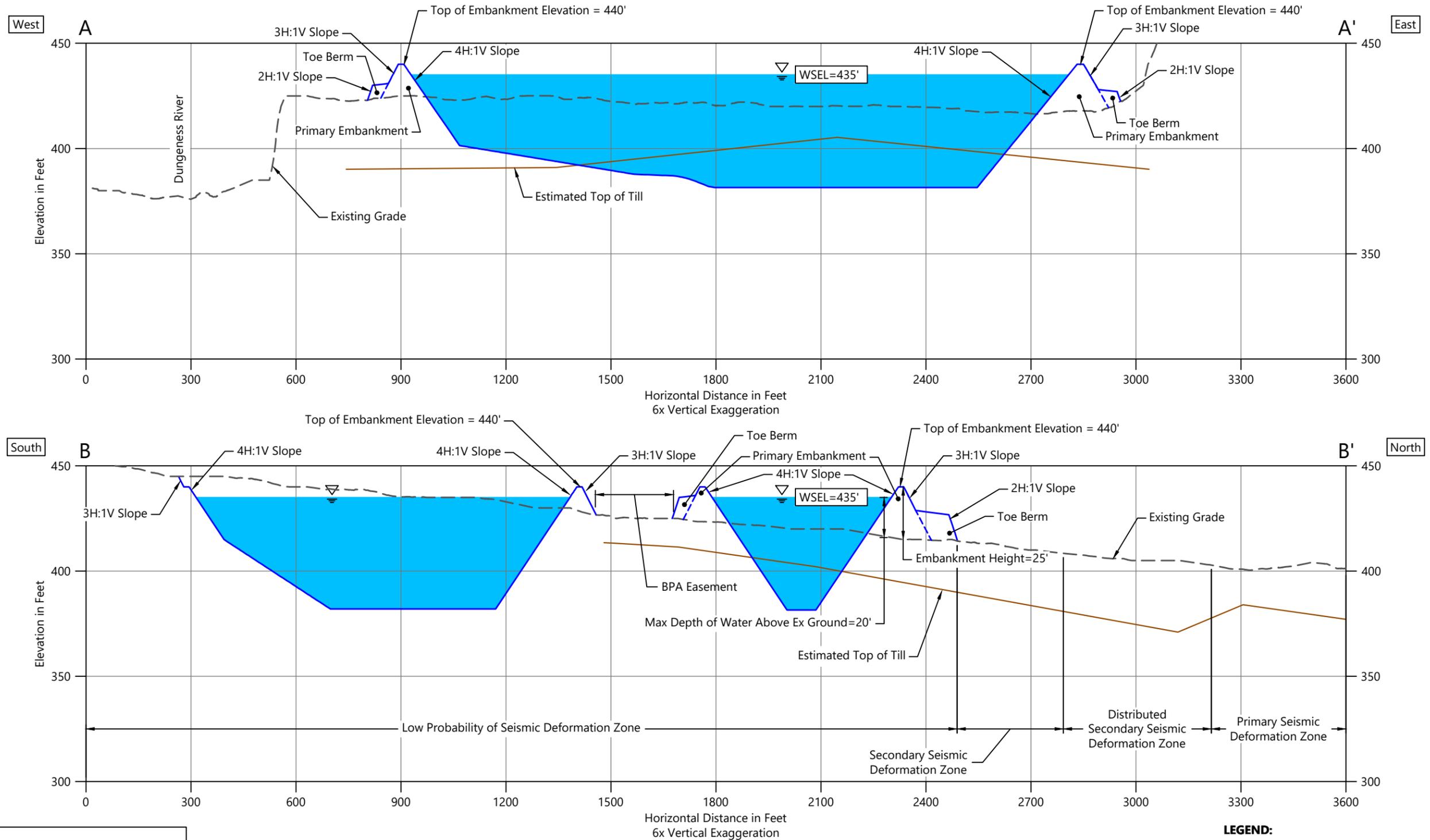
- LEGEND:**
- Parcels (Clallam County GIS)
 - Existing Irrigation Ditches and Laterals (GIS 2013)
 - Existing Irrigation Pipelines (GIS 2013)
 - Existing Contours (2' & 10' Intervals)
 - Proposed Contours (2' & 10' Intervals)
 - Existing BPA Easement
 - Primary Seismic Deformation Zone
 - Secondary Seismic Deformation Zone
 - Distributed Secondary Seismic Deformation Zone
 - Low Probability of Seismic Deformation Zone
 - Proposed Irrigation Pipeline
 - Proposed Full Reservoir Water Surface for Option E1
 - Proposed Full Reservoir Water Surface from 2016 Concept Design
 - Proposed Full Reservoir Water Surface from 2021 30% Design
 - Cross Section Location and Designation



Publish Date: 2024/06/18 10:47 PM | User: tgriga
 Filepath: K:\Projects\1439-Clallam County\Dungeness Off-Channel Reservoir\1439-WK-018 Design Charrette-OptionE1.dwg Figure E1-1



Figure E1-1
Plan View: Option E1
 Dungeness Off-Channel Reservoir



NOTE:
Vertical scales on all sections have been exaggerated 6x larger than the horizontal scale to allow the sections to fit within the dimensions of the page. The slopes appear steeper and heights appear larger than they would if the vertical and horizontal scales were equal.

- LEGEND:**
- Existing Grade
 - Proposed Grade
 - ▽ Proposed Water Surface Elevation
 - Estimated Till



Reservoir Configuration Summary: Option E2	
Key Design Parameters:	
• Maximum Water Surface Elevation/Overflow Elevation	435.0 feet
• Top of Embankment Elevation	440.0 feet
• Low-Level Outlet Invert Elevation	381.5 feet
• Approximate Existing Ground Elevation at North Embankment	415 feet±
• Approximate Embankment Height at North End of Reservoir	25 feet±
• Maximum Depth of Water Above Ground at North End of Reservoir	20 feet±
• Interior Embankment Slope	4H:1V
• Exterior Embankment Slope	3H:1V, With Toe Berm
• Estimated Storage Capacity	1,236 acre-feet
• Anticipated Flow Benefit	Up to 25 cfs for 24.9 days, or Up to 19.5 cfs for 32.0 days
• Percent of Storage Capacity Below Existing Ground Elevation	76%
• Percent of Storage Capacity Above Existing Ground Elevation	24%
• Total Estimated Cut Required	1,513,551 CY
• Total Estimated Fill Required	420,620 CY
• Total Excess Material to be Placed On-Site or Hauled Away	1,092,931 CY
Summary:	
<p>Option E2 would result in the reservoir footprint being shifted to the south to avoid overlap with the Secondary Deformation Zone that was identified by the recently completed Phase 1 Seismic Fault Study. The reservoir would be similar to Option E1, except that the north and south reservoir sections would be connected by excavating through the BPA easement under the BPA powerlines between River Road and the power poles near the center of the site. In addition, as allowed by the recommendations provided in the recently completed Phase 1 Seismic Fault Study, the toe berm at the north end of the reservoir would be allowed to extend into the Secondary Deformation Zone because the toe berm is not part of the structural embankment. The structural embankment and reservoir storage volume would be entirely within the Low Probability of Deformation Zone, as recommended by the Phase 1 Seismic Fault Study. The reservoir configuration was developed to avoid impact to River Road on the east and maintain a 150 to 200 feet of distance between stored water and the bluff on the west side of the site to protect bluff stability.</p> <p>This option also assumes that the discharge pipelines from the reservoir would be extended beyond the north property boundary and lowered to allow the bottom of the reservoir to be lower than it would be if the outlet had to daylight at the north property boundary. For this option, the full reservoir elevation was set at 435.0 feet (the same as the preliminary design). The low-level outlet invert elevation would be approximately 381.5 feet. It was assumed that the 36-inch discharge pipeline from the reservoir would branch near the north property boundary and the following pipelines would be added to extend the discharge system:</p> <ul style="list-style-type: none"> • An 18-inch pipeline would extend northeast in the Eureka Canal to an existing culvert at River Road. The invert at the discharge location at River Road would be the same as the existing culvert (377.5 feet). • A 30-inch pipeline would extend west parallel to the north property boundary to convey water to the Independent Canal. The invert at the discharge location at the Independent Canal would be 358.1 feet. • A 12-inch pipeline would extend approximately 1,100 north of the property boundary in the HID H-1 Lateral. That pipeline would discharge at an invert elevation of 367.9 feet. <p>For the reservoir to release water by gravity, the low-level outlet at the reservoir would need to be higher than the elevations at the three points of discharge identified above. The highest of those would be the 18-inch pipe in the Eureka Canal, with a discharge outlet invert elevation of 377.5 feet. To ensure that there would be capacity to</p>	

Reservoir Configuration Summary: Option E2

release reservoir water when the reservoir is low and allow for pressure losses in the discharge pipelines, the low-level outlet at the reservoir was set at an invert elevation of 381.5 feet.

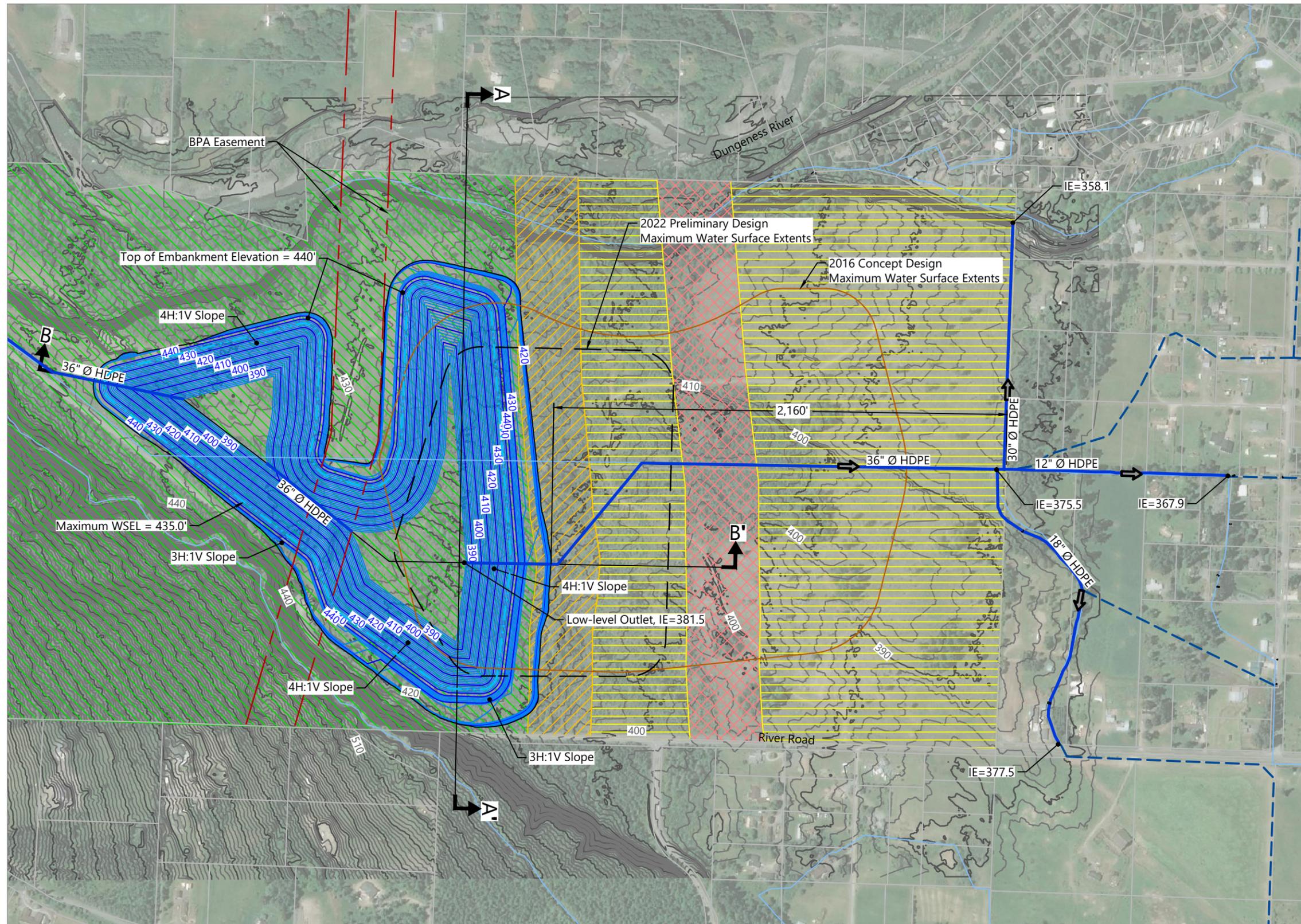
Due to new seismic information and the need to do additional analysis to inform slope stability and the impact of seismic activity on freeboard, the embankment slopes and freeboard were increased from the values that were used for preliminary design and prior analyses of other reservoir configurations. A 4H:1V slope was used for all interior embankment slopes and a 3H:1V slope was used for all exterior embankment slopes. A freeboard of 5 feet was incorporated into this analysis. Embankment slopes may be steepened, and freeboard may be reduced if further slope stability, seismic, and hydraulic analyses suggest that steeper slopes and less freeboard are appropriate. That additional analyses will be completed during the detailed (60 percent) design phase.

The analysis of Option E2 resulted in a 1,236-acre-foot reservoir, which is smaller than Options E3 and E4, but larger than Option E1. The capacity of the reservoir could be increased by raising the top elevation, lowering the bottom elevation further, or allowing for additional impacts within the BPA easement. If justified by further analysis, the reservoir capacity could also be increased by steepening the embankment slopes and reducing the freeboard provided. The top of the embankment would extend to a top elevation of 440 feet and the reservoir would be designed to maintain a full water surface at an elevation of 435 feet. Based on the existing ground surface elevation at the north end of the reservoir, where the embankment crosses the existing Highland Irrigation District (HID) H-1 Lateral, the north side of the embankment would be approximately 25 feet tall above the existing ground. The height of the embankment would vary around the reservoir and would generally decrease from north to south. The depth of water stored above the existing ground at that location would be approximately 20 feet. The top of the embankment would be located approximately 2,320 feet south of the north property boundary.

The project would include the following key elements:

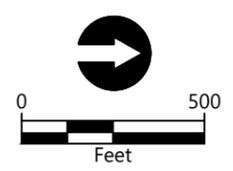
- The 1,236-acre-foot reservoir.
- Upgrades to HID intake and screening facilities near the Dungeness River
- A settling basin downstream of the HID intake and screening facilities.
- A 36-inch pipeline that would replace the existing HID Main Canal between the settling basin and a new flow control structure at the upstream end of the H-1 Lateral.
- A 36-inch inlet pipeline that would replace the H-1 Lateral from the HID Main Canal to the reservoir.
- A 36-inch outlet pipeline that would replace the H-1 Lateral from the reservoir to a discharge point in the H-1 Lateral near the north property boundary.
- The discharge pipelines listed earlier in this summary, branching from the 36-inch outlet pipeline near the north property boundary.
- An 18-inch bypass pipeline that would convey water around the reservoir during construction and when the reservoir is down for maintenance.
- An emergency spillway structure with a crest elevation of 435 feet and 36-inch discharge pipeline to the river.
- Other structures, controls, and appurtenances needed to control the flow of water to and from the reservoir.

Opinion of Cost – Key Elements of Reservoir Project	\$40.1 to \$41.1 million
Opinion of Cost – Key Elements of HID Intake, Screen, and Canal Upgrades	\$4.1 to \$4.2 million
Opinion of Cost – Key Elements of Downstream Irrigation Pipelines	\$5.7 to \$5.8 million



SOURCE: Aerial ©2021 Microsoft Corporation
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HORIZONTAL DATUM: Washington State Plane
 North Zone, NAD83, U.S. Survey Feet
VERTICAL DATUM: NAVD88

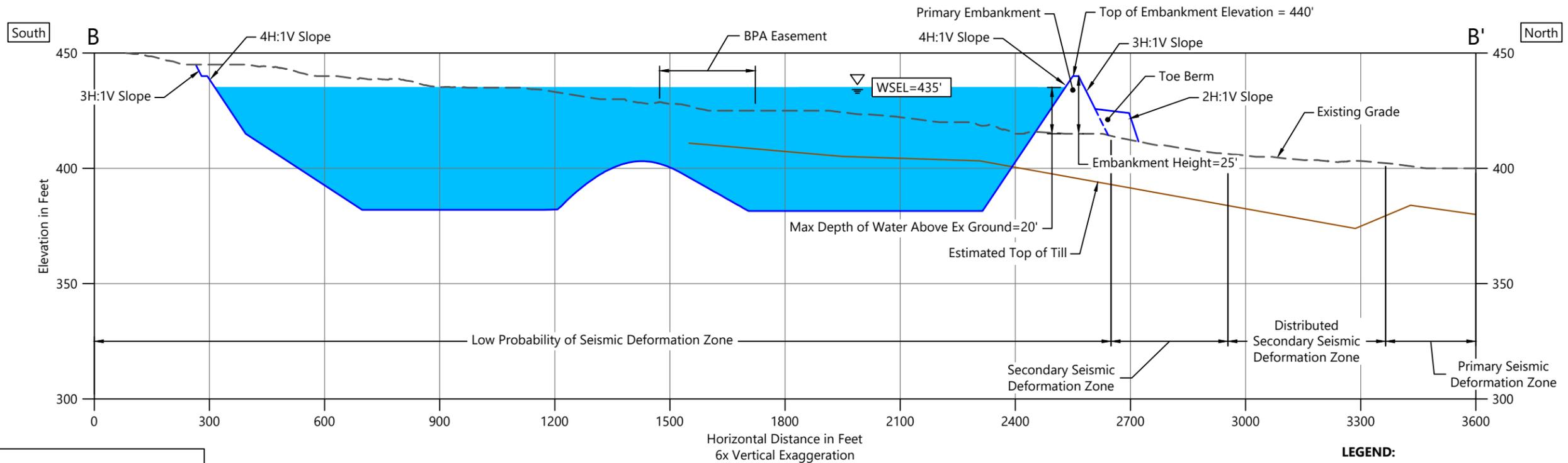
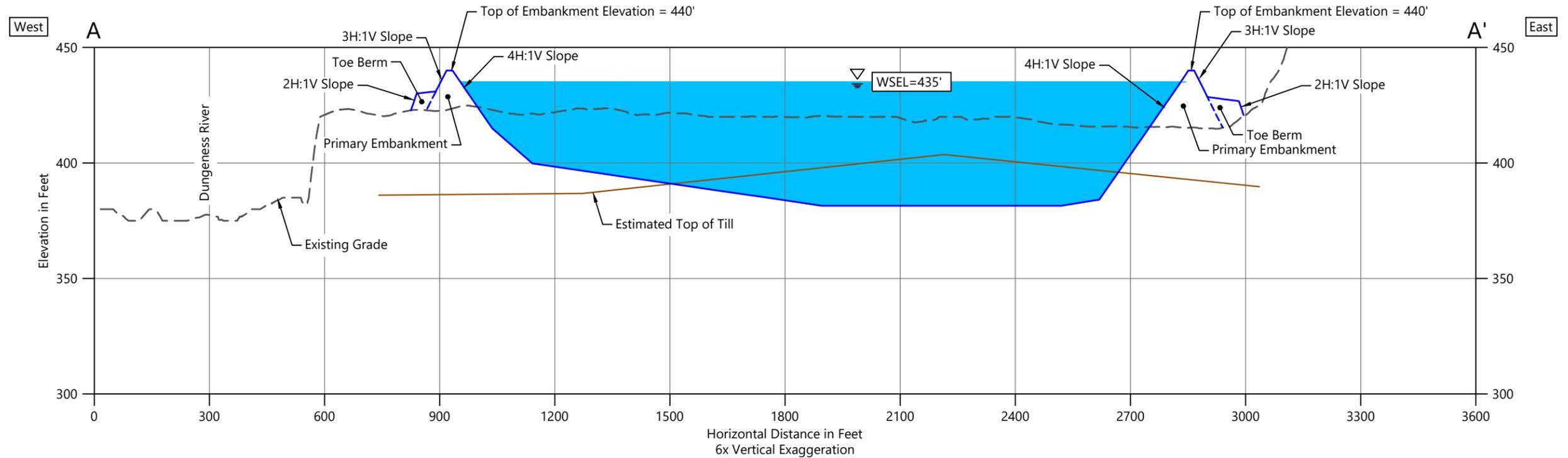
- LEGEND:**
- Parcels (Clallam County GIS)
 - Existing Irrigation Ditches and Laterals (GIS 2013)
 - Existing Irrigation Pipelines (GIS 2013)
 - Existing Contours (2' & 10' Intervals)
 - Proposed Contours (2' & 10' Intervals)
 - Existing BPA Easement
 - Primary Seismic Deformation Zone
 - Secondary Seismic Deformation Zone
 - Distributed Secondary Seismic Deformation Zone
 - Low Probability of Seismic Deformation Zone
 - Proposed Irrigation Pipeline
 - Proposed Full Reservoir Water Surface for Option E2
 - Proposed Full Reservoir Water Surface from 2016 Concept Design
 - Proposed Full Reservoir Water Surface from 2021 30% Design
 - Cross Section Location and Designation



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 Filepath: K:\Projects\1439-Clallam County\Dungeness Off-Channel Reservoir\1439-WK-019 Design Charrette-OptionE2.dwg Figure E2-1



Figure E2-1
Plan View: Option E2
 Dungeness Off-Channel Reservoir



NOTE:
Vertical scales on all sections have been exaggerated 6x larger than the horizontal scale to allow the sections to fit within the dimensions of the page. The slopes appear steeper and heights appear larger than they would if the vertical and horizontal scales were equal.

- LEGEND:**
- Existing Grade
 - Proposed Grade
 - ▽ Proposed Water Surface Elevation
 - Estimated Till

Reservoir Configuration Summary: Option E3	
Key Design Parameters:	
• Maximum Water Surface Elevation/Overflow Elevation	435.0 feet
• Top of Embankment Elevation	440.0 feet
• Low-Level Outlet Invert Elevation	381.5 feet
• Approximate Existing Ground Elevation at North Embankment	415 feet±
• Approximate Embankment Height at North End of Reservoir	25 feet±
• Maximum Depth of Water Above Ground at North End of Reservoir	20 feet±
• Interior Embankment Slope	4H:1V
• Exterior Embankment Slope	3H:1V, With Toe Berm
• Estimated Storage Capacity	1,465 acre-feet
• Anticipated Flow Benefit	Up to 25 cfs for 29.5 days, or Up to 23.1 cfs for 32.0 days
• Percent of Storage Capacity Below Existing Ground Elevation	79%
• Percent of Storage Capacity Above Existing Ground Elevation	21%
• Total Estimated Cut Required	1,875,689 CY
• Total Estimated Fill Required	408,010 CY
• Total Excess Material to be Placed On-Site or Hauled Away	1,467,679 CY
Summary:	
<p>Option E3 would result in the reservoir footprint being shifted to the south to avoid overlap with the Secondary Deformation Zone that was identified by the recently completed Phase 1 Seismic Fault Study. The reservoir would be similar to Option E2, with the north and south reservoir sections connected by excavating through the BPA easement under the BPA powerlines between River Road and the power poles near the center of the site. However, this option assumes that the segment of River Road along the east side of the reservoir would be relocated and reconstructed along the toe of the reservoir embankment to allow the east edge of the reservoir to shift further to the east. Like Option E2 and as allowed by the recommendations provided in the recently completed Phase 1 Seismic Fault Study, the toe berm at the north end of the reservoir would be allowed to extend into the Secondary Deformation Zone because the toe berm is not part of the structural embankment. The structural embankment and reservoir storage volume would be entirely within the Low Probability of Deformation Zone, as recommended by the Phase 1 Seismic Fault Study. The reservoir configuration was developed to maintain a 150 to 200 feet of distance between stored water and the bluff on the west side of the site to protect bluff stability.</p> <p>This option also assumes that the discharge pipelines from the reservoir would be extended beyond the north property boundary and lowered to allow the bottom of the reservoir to be lower than it would be if the outlet had to daylight at the north property boundary. For this option, the full reservoir elevation was set at 435.0 feet (the same as the preliminary design). The low-level outlet invert elevation would be approximately 381.5 feet. It was assumed that the 36-inch discharge pipeline from the reservoir would branch near the north property boundary and the following pipelines would be added to extend the discharge system:</p> <ul style="list-style-type: none"> • An 18-inch pipeline would extend northeast in the Eureka Canal to an existing culvert at River Road. The invert at the discharge location at River Road would be the same as the existing culvert (377.5 feet). • A 30-inch pipeline would extend west parallel to the north property boundary to convey water to the Independent Canal. The invert at the discharge location at the Independent Canal would be 358.1 feet. • A 12-inch pipeline would extend approximately 1,100 north of the property boundary in the HID H-1 Lateral. That pipeline would discharge at an invert elevation of 367.9 feet. <p>For the reservoir to release water by gravity, the low-level outlet at the reservoir would need to be higher than the elevations at the three points of discharge identified above. The highest of those would be the 18-inch pipe in the Eureka Canal, with a discharge outlet invert elevation of 377.5 feet. To ensure that there would be capacity to</p>	

Reservoir Configuration Summary: Option E3

release reservoir water when the reservoir is low and allow for pressure losses in the discharge pipelines, the low-level outlet at the reservoir was set at an invert elevation of 381.5 feet.

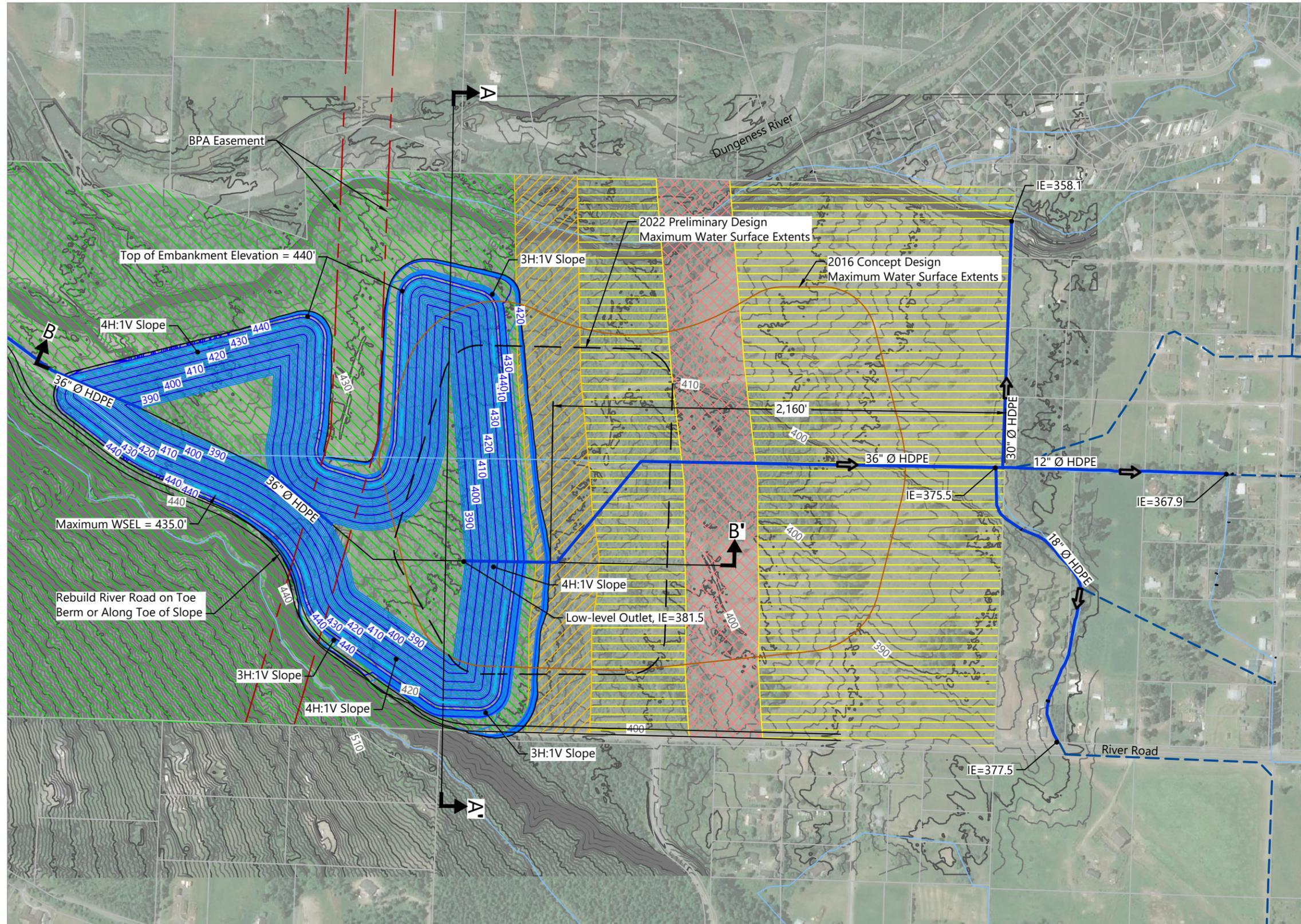
Due to new seismic information and the need to do additional analysis to inform slope stability and the impact of seismic activity on freeboard, the embankment slopes and freeboard were increased from the values that were used for preliminary design and prior analyses of other reservoir configurations. A 4H:1V slope was used for all interior embankment slopes and a 3H:1V slope was used for all exterior embankment slopes. A freeboard of 5 feet was incorporated into this analysis. Embankment slopes may be steepened, and freeboard may be reduced if further slope stability, seismic, and hydraulic analyses suggest that steeper slopes and less freeboard are appropriate. That additional analyses will be completed during the detailed (60 percent) design phase.

The analysis of Option E3 resulted in a 1,465-acre-foot reservoir, which is smaller than Option E4, but larger than Options E1 and E2. The capacity of the reservoir could be increased by raising the top elevation, lowering the bottom elevation further, or allowing for additional impacts within the BPA easement. If justified by further analysis, the reservoir capacity could also be increased by steepening the embankment slopes and reducing the freeboard provided. The top of the embankment would extend to a top elevation of 440 feet and the reservoir would be designed to maintain a full water surface at an elevation of 435 feet. Based on the existing ground surface elevation at the north end of the reservoir, where the embankment crosses the existing Highland Irrigation District (HID) H-1 Lateral, the north side of the embankment would be approximately 25 feet tall above the existing ground. The height of the embankment would vary around the reservoir and would generally decrease from north to south. The depth of water stored above the existing ground at that location would be approximately 20 feet. The top of the embankment would be located approximately 2,320 feet south of the north property boundary.

The project would include the following key elements:

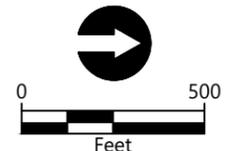
- The 1,465-acre-foot reservoir.
- Relocation and reconstruction of River Road along the toe of the east reservoir embankment.
- Upgrades to HID intake and screening facilities near the Dungeness River
- A settling basin downstream of the HID intake and screening facilities.
- A 36-inch pipeline that would replace the existing HID Main Canal between the settling basin and a new flow control structure at the upstream end of the H-1 Lateral.
- A 36-inch inlet pipeline that would replace the H-1 Lateral from the HID Main Canal to the reservoir.
- A 36-inch outlet pipeline that would replace the H-1 Lateral from the reservoir to a discharge point in the H-1 Lateral near the north property boundary.
- The discharge pipelines listed earlier in this summary, branching from the 36-inch outlet pipeline near the north property boundary.
- An 18-inch bypass pipeline that would convey water around the reservoir during construction and when the reservoir is down for maintenance.
- An emergency spillway structure with a crest elevation of 435 feet and 36-inch discharge pipeline to the river.
- Other structures, controls, and appurtenances needed to control the flow of water to and from the reservoir.

Opinion of Cost – Key Elements of Reservoir Project	\$44.9 to \$46.0 million
Opinion of Cost – Key Elements of HID Intake, Screen, and Canal Upgrades	\$4.1 to \$4.2 million
Opinion of Cost – Key Elements of Downstream Irrigation Pipelines	\$5.7 to \$5.8 million



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HORIZONTAL DATUM: Washington State Plane
 North Zone, NAD83, U.S. Survey Feet
VERTICAL DATUM: NAVD88

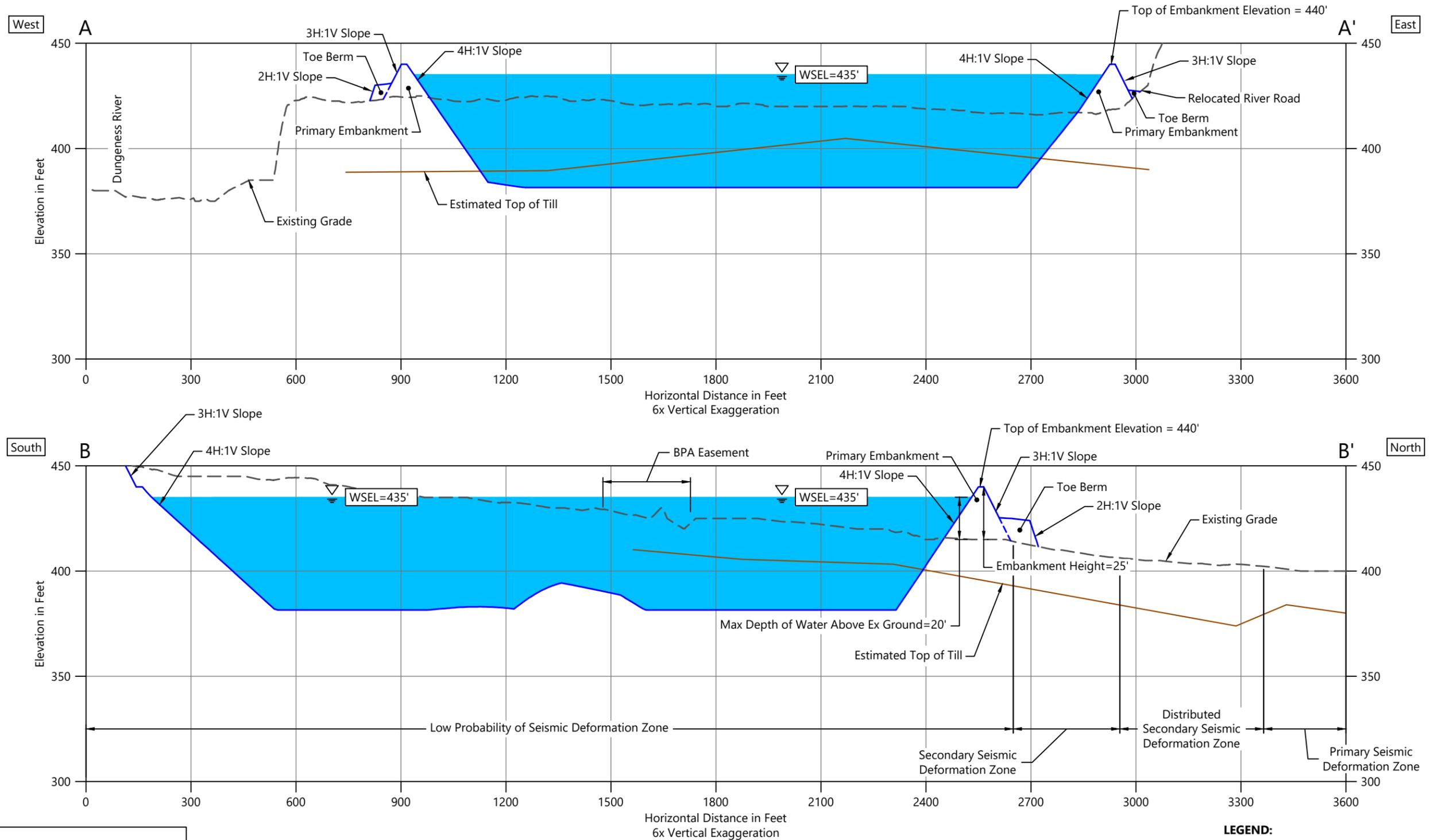
- LEGEND:**
- Parcels (Clallam County GIS)
 - Existing Irrigation Ditches and Laterals (GIS 2013)
 - Existing Irrigation Pipelines (GIS 2013)
 - Existing Contours (2' & 10' Intervals)
 - Proposed Contours (2' & 10' Intervals)
 - Existing BPA Easement
 - Primary Seismic Deformation Zone
 - Secondary Seismic Deformation Zone
 - Distributed Secondary Seismic Deformation Zone
 - Low Probability of Seismic Deformation Zone
 - Proposed Irrigation Pipeline
 - Proposed Full Reservoir Water Surface for Option E1
 - Proposed Full Reservoir Water Surface from 2016 Concept Design
 - Proposed Full Reservoir Water Surface from 2021 30% Design
 - Cross Section Location and Designation



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Figure E3-1
Plan View: Option E3
 Dungeness Off-Channel Reservoir



NOTE:
 Vertical scales on all sections have been exaggerated 6x larger than the horizontal scale to allow the sections to fit within the dimensions of the page. The slopes appear steeper and heights appear larger than they would if the vertical and horizontal scales were equal.

LEGEND:
 - - - Existing Grade
 - - - Proposed Grade
 ▽ Proposed Water Surface Elevation
 - - - Estimated Till

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Figure E3-2
Cross Sections: Option E3
 Dungeness Off-Channel Reservoir

Reservoir Configuration Summary: Option E4	
Key Design Parameters:	
• Maximum Water Surface Elevation/Overflow Elevation	432.0 feet
• Top of Embankment Elevation	437.0 feet
• Low-Level Outlet Invert Elevation	385.0 feet
• Approximate Existing Ground Elevation at North Embankment	415 feet±
• Approximate Embankment Height at North End of Reservoir	22 feet±
• Maximum Depth of Water Above Ground at North End of Reservoir	17 feet±
• Interior Embankment Slope	4H:1V
• Exterior Embankment Slope	3H:1V, With Toe Berm
• Estimated Storage Capacity	1,610 acre-feet
• Anticipated Flow Benefit	Up to 25 cfs for 32.5 days, or Up to 25.4 cfs for 32.0 days
• Percent of Storage Capacity Below Existing Ground Elevation	85%
• Percent of Storage Capacity Above Existing Ground Elevation	15%
• Total Estimated Cut Required	2,215,977 CY
• Total Estimated Fill Required	257,931 CY
• Total Excess Material to be Placed On-Site or Hauled Away	1,958,046 CY
Summary:	
<p>Option E4 would result in the reservoir footprint being shifted to the south to avoid overlap with the Secondary Deformation Zone that was identified by the recently completed Phase 1 Seismic Fault Study. This reservoir configuration assumes that revisions could be made to the BPA powerlines, such as raising the lines and replacing or relocating the poles, to allow for construction of the reservoir through the BPA easement. Like Options E2 and E3 and as allowed by the recommendations provided in the recently completed Phase 1 Seismic Fault Study, the toe berm at the north end of the reservoir would be allowed to extend into the Secondary Deformation Zone because the toe berm is not part of the structural embankment. The structural embankment and reservoir storage volume would be entirely within the Low Probability of Deformation Zone, as recommended by the Phase 1 Seismic Fault Study. The reservoir configuration was developed to avoid impact to River Road on the east and maintain a 150 to 200 feet of distance between stored water and the bluff on the west side of the site to protect bluff stability.</p> <p>This option also assumes that the discharge pipelines from the reservoir would be extended beyond the north property boundary and lowered to allow the bottom of the reservoir to be lower than it would be if the outlet had to daylight at the north property boundary. For this option, the full reservoir elevation was set at 432.0 feet (3 feet lower than the preliminary design and other "Option E" configurations). The low-level outlet invert elevation would be approximately 385.0 feet. The larger reservoir configuration allows for more flexibility in lower the top of the embankment and raising the bottom elevation of the reservoir. It was assumed that the 36-inch discharge pipeline from the reservoir would branch near the north property boundary and the following pipelines would be added to extend the discharge system:</p> <ul style="list-style-type: none"> • An 18-inch pipeline would extend northeast in the Eureka Canal to an existing culvert at River Road. The invert at the discharge location at River Road would be the same as the existing culvert (377.5 feet). • A 30-inch pipeline would extend west parallel to the north property boundary to convey water to the Independent Canal. The invert at the discharge location at the Independent Canal would be 358.1 feet. • A 12-inch pipeline would extend approximately 1,100 north of the property boundary in the HID H-1 Lateral. That pipeline would discharge at an invert elevation of 367.9 feet. <p>For the reservoir to release water by gravity, the low-level outlet at the reservoir would need to be higher than the elevations at the three points of discharge identified above. The highest of those would be the 18-inch pipe in the Eureka Canal, with a discharge outlet invert elevation of 377.5 feet. The low-level outlet at the reservoir was set at</p>	

Reservoir Configuration Summary: Option E4

an invert elevation of 385.0 feet, which would allow for more than enough drop in the pipeline to ensure adequate release capacity from the reservoir storage at all water surface elevations.

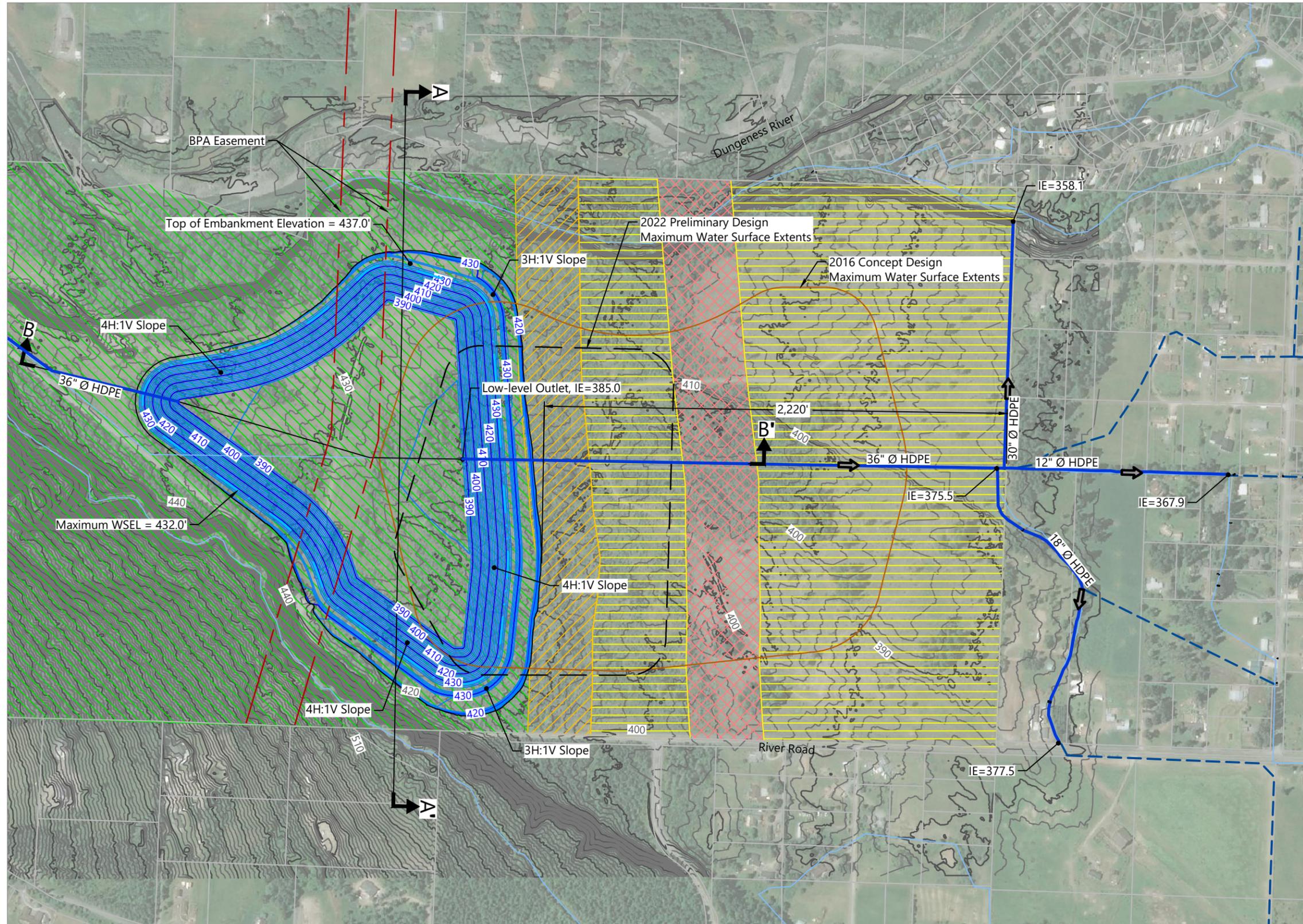
Due to new seismic information and the need to do additional analysis to inform slope stability and the impact of seismic activity on freeboard, the embankment slopes and freeboard were increased from the values that were used for preliminary design and prior analyses of other reservoir configurations. A 4H:1V slope was used for all interior embankment slopes and a 3H:1V slope was used for all exterior embankment slopes. A freeboard of 5 feet was incorporated into this analysis. Embankment slopes may be steepened, and freeboard may be reduced if further slope stability, seismic, and hydraulic analyses suggest that steeper slopes and less freeboard are appropriate. That additional analyses will be completed during the detailed (60 percent) design phase.

The analysis of Option E4 resulted in a 1,610-acre-foot reservoir, which is largest of the “Option E” reservoir configurations considered. The capacity of the reservoir is contingent on extension of the reservoir through the BPA easement. Limitations on the BPA easement and ability to work with BPA to adjust their infrastructure to allow for reservoir construction through the BPA easement have not yet been confirmed with BPA. If justified by further analysis, the reservoir capacity could also be increased by steepening the embankment slopes and reducing the freeboard provided. The top of the embankment would extend to a top elevation of 437 feet and the reservoir would be designed to maintain a full water surface at an elevation of 432 feet. Based on the existing ground surface elevation at the north end of the reservoir, where the embankment crosses the existing Highland Irrigation District (HID) H-1 Lateral, the north side of the embankment would be approximately 22 feet tall above the existing ground. The height of the embankment would vary around the reservoir and would generally decrease from north to south. The depth of water stored above the existing ground at that location would be approximately 17 feet. The top of the embankment would be located approximately 2,320 feet south of the north property boundary.

The project would include the following key elements:

- The 1,610-acre-foot reservoir.
- Relocation and reconstruction of BPA powerlines and poles within the reservoir area to allow for construction of the reservoir through the BPA easement.
- Upgrades to HID intake and screening facilities near the Dungeness River
- A settling basin downstream of the HID intake and screening facilities.
- A 36-inch pipeline that would replace the existing HID Main Canal between the settling basin and a new flow control structure at the upstream end of the H-1 Lateral.
- A 36-inch inlet pipeline that would replace the H-1 Lateral from the HID Main Canal to the reservoir.
- A 36-inch outlet pipeline that would replace the H-1 Lateral from the reservoir to a discharge point in the H-1 Lateral near the north property boundary.
- The discharge pipelines listed earlier in this summary, branching from the 36-inch outlet pipeline near the north property boundary.
- An 18-inch bypass pipeline that would convey water around the reservoir during construction and when the reservoir is down for maintenance.
- An emergency spillway structure with a crest elevation of 435 feet and 36-inch discharge pipeline to the river.
- Other structures, controls, and appurtenances needed to control the flow of water to and from the reservoir.

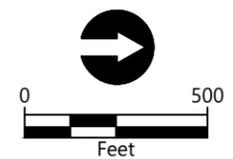
Opinion of Cost – Key Elements of Reservoir Project	\$44.5 to \$45.6 million
Opinion of Cost – Key Elements of HID Intake, Screen, and Canal Upgrades	\$4.1 to \$4.2 million
Opinion of Cost – Key Elements of Downstream Irrigation Pipelines	\$5.7 to \$5.8 million



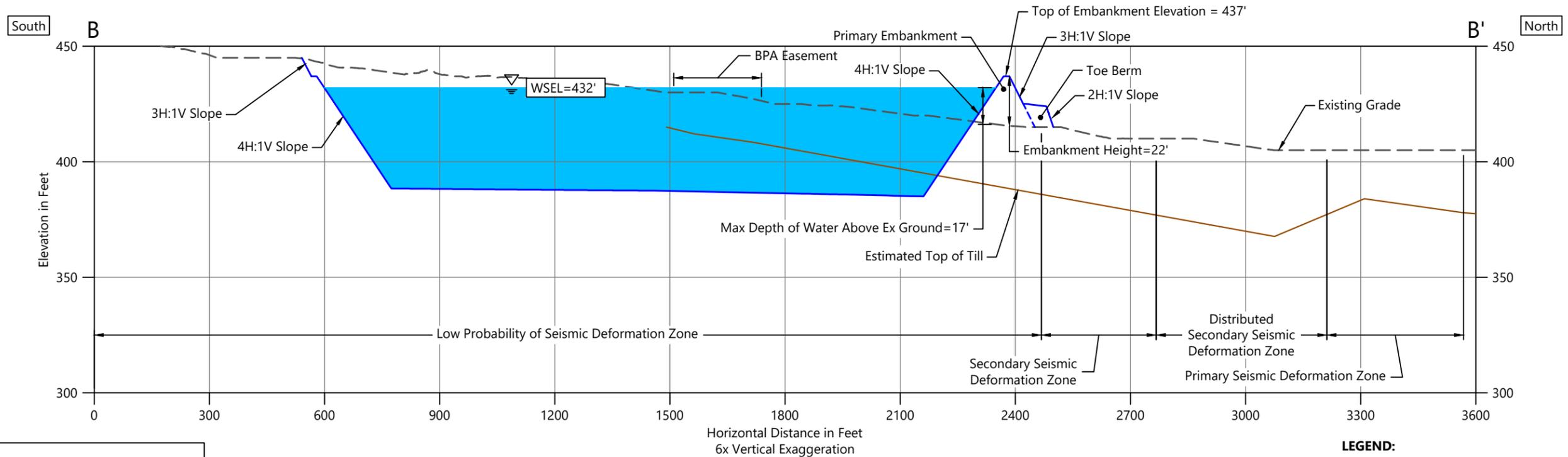
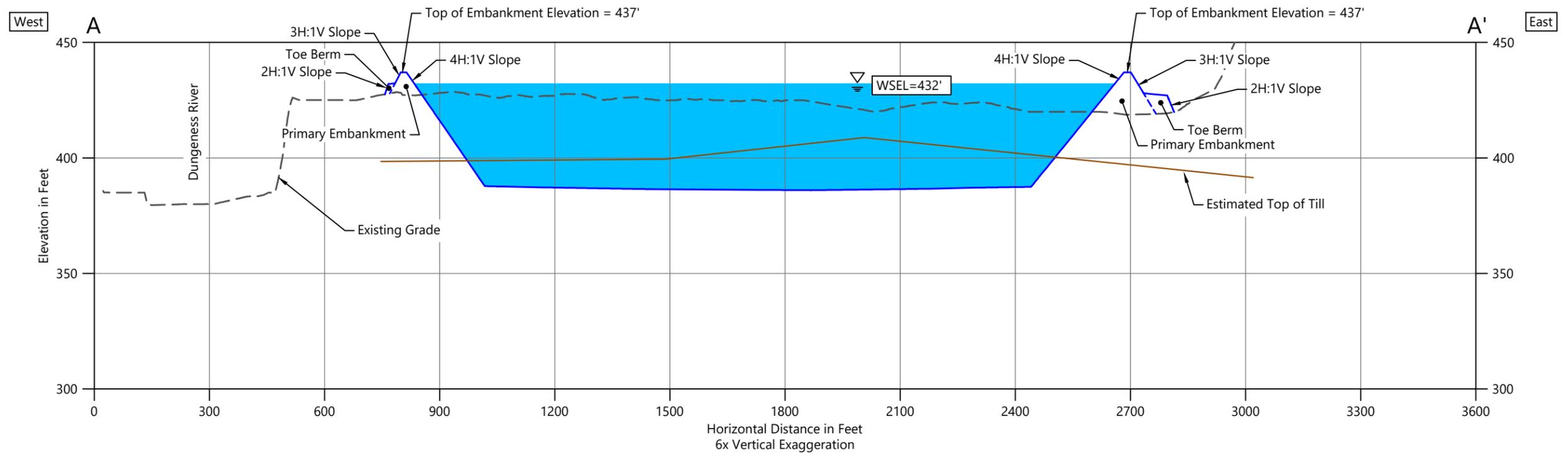
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HORIZONTAL DATUM: Washington State Plane
 North Zone, NAD83, U.S. Survey Feet
VERTICAL DATUM: NAVD88

LEGEND:

- Parcels (Clallam County GIS)
- Existing Irrigation Ditches and Laterals (GIS 2013)
- Existing Irrigation Pipelines (GIS 2013)
- Existing Contours (2' & 10' Intervals)
- Proposed Contours (2' & 10' Intervals)
- Existing BPA Easement
- Primary Seismic Deformation Zone
- Secondary Seismic Deformation Zone
- Distributed Secondary Seismic Deformation Zone
- Low Probability of Seismic Deformation Zone
- Proposed Irrigation Pipeline
- Proposed Full Reservoir Water Surface for Option E1
- Proposed Full Reservoir Water Surface from 2016 Concept Design
- Proposed Full Reservoir Water Surface from 2021 30% Design
- Cross Section Location and Designation



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NOTE:
Vertical scales on all sections have been exaggerated 6x larger than the horizontal scale to allow the sections to fit within the dimensions of the page. The slopes appear steeper and heights appear larger than they would if the vertical and horizontal scales were equal.

- LEGEND:**
- Existing Grade
 - Proposed Grade
 - ▽ Proposed Water Surface Elevation
 - Estimated Till