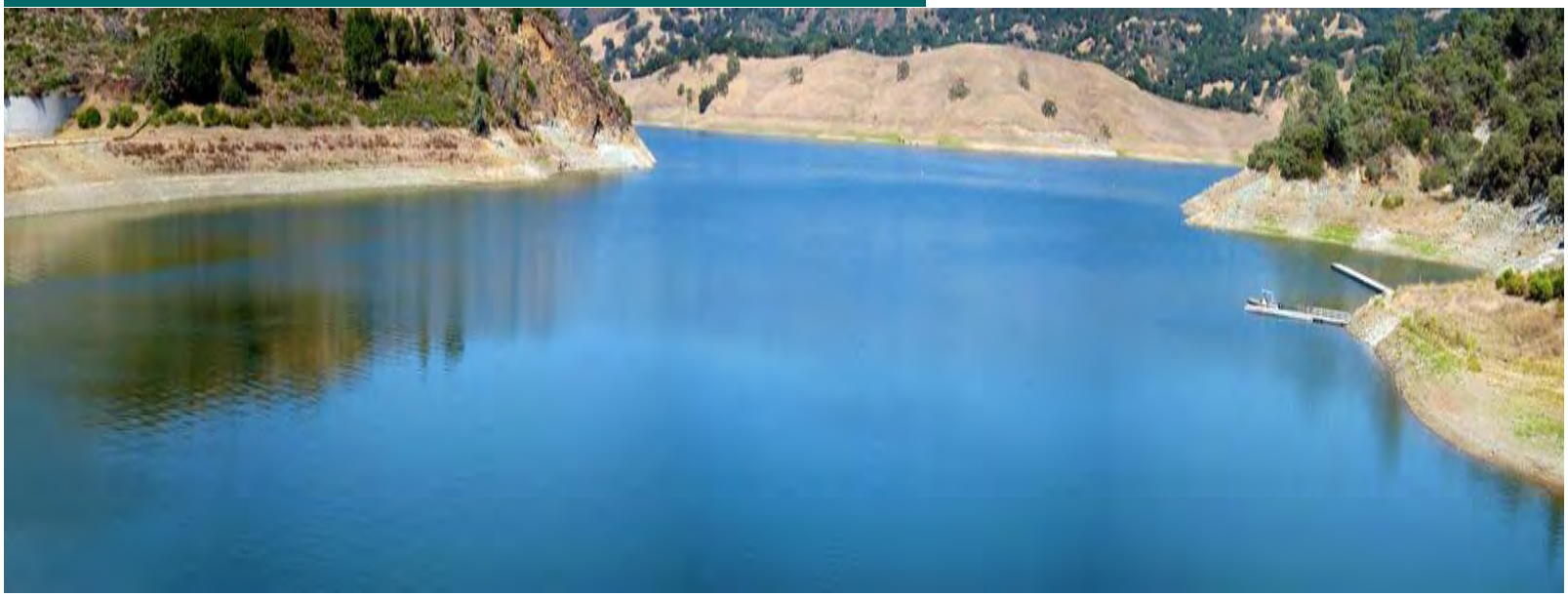
Planning Study Report

Anderson Dam Seismic Retrofit Project

Prepared For:

Santa Clara Valley Water District

Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118-3686



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July 9, 2013

Anderson Dam Seismic Retrofit Project
Short-Term Phase 1B Project

Project No. 91864005

PLANNING STUDY REPORT

I have reviewed and concur with the alternative analysis and recommendation presented in this Planning Study Report for the Anderson Dam Seismic Retrofit Project and recommend proceeding with design to implement the project as recommended.

Katherine Oven 7/19/13

Katherine Oven, P.E. Date

Deputy Operating Officer

Water Utility Capital Division

I have reviewed and approve with the alternative analysis and recommendation presented in this Planning Study Report for the Anderson Dam Seismic Retrofit Project and approve proceeding with design to implement the project as recommended.

acting DOO. 7/19/2013

Frank Maitski, P.E. Date

Deputy Operating Officer

Water Utility Technical Support Division

ANDERSON DAM SEISMIC RETROFIT PROJECT
PROJECT NO. 91864005
PLANNING STUDY REPORT

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This Planning Study Report has been prepared under the direct supervision of the undersigned, who hereby certifies that he is a Registered Civil Engineer in the State of California

July 9, 2013

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Anderson Dam Seismic Retrofit Project
Santa Clara Valley Water District

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Executive Summary

Anderson Reservoir is the largest of the ten reservoirs owned and operated by the Santa Clara Valley Water District (District) and provides more storage than the rest of the nine reservoirs combined. It is thus a critical facility to the District and to the communities it serves. The Anderson Dam Seismic Retrofit Project (ADSRP) was initiated in 2011 to address several dam safety issues that had been recently identified at the dam. These deficiencies include:

- The presence of liquefiable materials in the embankment and foundation of the dam that could result in slope instability and failure of the embankment following a large earthquake,
- The presence of *conditionally active* faults in the foundation that could rupture the existing low level outlet,
- A spillway that is inadequate to safely pass potentially large future floods, and
- Limitations in being able to quickly draw down the reservoir during floods or other emergency events.

Since December 2008, the District has voluntarily restricted the reservoir capacity to maintain the surface of the reservoir no higher than 45 feet below the crest of the dam. This restriction has been implemented as an interim risk reduction measure to temporarily address the deficiencies.

This Planning Phase is the first phase of the ADSRP and was performed to establish the existing conditions and to develop and evaluate alternatives to efficiently and effectively resolve the above deficiencies. This report summarizes the planning work to date, including the formulation and evaluation of alternatives and the eventual selection of the recommended alternative.

The evaluation of alternatives was based on a variety of criteria including project quality, cost, environmental impacts, public impact and relations, schedule, and project risks. The selected alternative ranked highest after the analysis and evaluation using both a traditional deterministic evaluation of the criteria, and using a risk-based approach. The recommended project includes:

- Upstream and downstream embankment excavation and buttresses to improve seismic stability,
- A new low-level outlet carrier pipe in an oversized tunnel to accommodate fault rupture,
- A high-level outlet tunnel that will discharge in the spillway to provide the ability to draw down the reservoir quickly,
- Raised spillway walls and dam crest to safely pass the Probable Maximum Flood (PMF), and
- Construction of the project with a fully drained reservoir during the second of the planned three-year construction period.

The project schedule is a 3-year construction period beginning in 2016 and completing at the end of 2018. The construction cost estimate at the planning level is approximately $122 million (in 2013 Dollars). Additional costs associated with completing the designs, administering construction, real estate, and environmental mitigation and restoration will also be incurred.

The Planning Study Report presents and summarizes all of the major efforts, including studies, analyses, and evaluations performed during the Planning Phase of the project and provides the District's official approval of the proposed project to be carried forward into the Design Phase.

The Federal Energy Regulatory Commission (FERC) commented on the Staff-Recommended Alternative in their May 28, 2013 letter, "We find the methodology, process, and criteria for evaluating the various alternatives including the staff-recommended alternative (Alternative No. 15) to be appropriate and well presented."

The Board of Consultants (BOC), a panel of experts and specialists in dam safety remediation, design and construction, brought together as a FERC requirement, noted in the BOC Meeting #3 letter report dated June 10, 2013 that, "The Planning Team's recommended alternative Number 15, appears to be a well engineered concept and one that can meet the dam safety requirements of both DSOD and FERC."

The BOC also noted, that "In general, this project is just about where it should be at this juncture, and it is ready for the transition to design-level studies. We look forward to that next phase of the process."

1.0 Introduction and Background

Anderson Dam and Reservoir is a major water supply facility located about 18 miles southeast of San Jose, California (Figure 1) and is owned and operated by the District. The dam was completed in 1950 as a zoned, rockfill embankment, has a maximum height of approximately 240 feet, and retains approximately 90,373 acre-feet of water at its maximum reservoir operating elevation. It is subject to dam safety regulation by both the California Division of Safety of Dams (DSOD) and the Federal Energy Regulatory Commission (FERC).

The dam is located in a highly seismic environment lying only about 1 mile from the Calaveras Fault and on top of the Coyote Creek-Range Front Fault Zone. There are several traces of the conditionally active Coyote Creek-Range Front Fault Zone that exist in the rock beneath the dam. Each of these fault traces is assumed to be capable of up to 4 feet of discrete fault offset.

Figure 1. Location of Anderson Dam

As a result of a 2008 Seismic Stability Evaluation that identified potential embankment instability as a result of seismic shaking and liquefaction, the Anderson Dam Seismic Retrofit Project (ADSRP) was initiated. A reservoir restriction to approximately 45 feet below the crest of the dam (equivalent to approximately 61,000 acre-feet of reservoir storage) was voluntarily established by the District in December 2008. Between 2008 and 2012, several dam safety deficiencies associated with seismic shaking, fault offset, and emergency drawdown capabilities were identified. The ADSRP consists of planning, design, and construction activities associated with correcting seismic, and reservoir drawdown deficiencies at Anderson Dam. The ADSRP is being conducted by the District in coordination with resource agencies, stakeholders, and the public. The DSOD has established a target date of December 31, 2018 for the completion of all necessary remedial work to correct the identified deficiencies.

1.1 Purpose and Objectives

Project objectives were established by the District and various alternatives were formulated to address specific aspects of each objective. The objectives are considered to have equal priority, with each pursued to the maximum practicable extent without adversely affecting the others. The District's objectives for the ADSRP are to make improvements necessary to:

- Stabilize the dam embankment for the maximum credible earthquakes on the Calaveras and Coyote Creek Faults,

- Modify or replace the outlet works to protect against potential fault rupture risk from the maximum credible earthquake on the Coyote Creek-Range Front fault zone, and
- Incorporate other measures to address safety deficiencies, including potential spillway modifications that are determined to be necessary.

In addition to the above objectives, the Project, where possible, should:

- Minimize short-term and long-term impacts to the environment, reservoir and water operations, and recreational use of the reservoir, and
- Provide for inspection and maintenance of the embankment, outlet works, and spillway, without significantly affecting dam and reservoir operations.

1.2 Report Organization

This report is organized to present the findings of the Anderson Dam Planning Study. The planning study included establishing the Problem Definition, Alternative Formulation and Analysis, as well as the selection of the Recommended Project. In completing this effort, the Planning Study has resulted in a number of reports including:

1. Problem Definition Memorandum (Section 2.0)
2. Conceptual Alternatives Report (Section 3.0)
3. Feasible Alternatives Matrix (Section 3.0)
4. Staff Recommended Alternative Report (Section 4.0), and
5. This Planning Study Report.

The Project Cost, and Funding and Schedule, are discussed in Section 5.0.

2.0 Problem Definition

This section describes the problems and deficiencies including seismic, flood, and other safety deficiencies identified at the dam and its appurtenant facilities. These problems and deficiencies are described in detail in the project Problem Definition Memorandum (HDR, 2013a) and are briefly summarized in the following subsections.

2.1 Seismic Deficiencies

Potential seismic deficiencies identified at the existing facilities include:

- Liquefiable soil layers of the embankment's lower fine fill (LFF) and alluvium exist beneath both the upstream and downstream slopes of the dam embankment that make the dam potentially unstable following a large earthquake (AMEC, 2011a). During very strong earthquake shaking, major slumping and cracking of the dam would be expected. Subsequently, this could lead to a failure of the dam by either overtopping or piping through large cracks resulting in an uncontrolled release of reservoir water. This condition does not meet District dam safety requirements, nor does it meet the requirements of state and Federal dam safety regulatory agencies (i.e., DSOD and FERC).
- Fault traces that are considered conditionally active exist in and around the foundation beneath the dam. These fault traces are potentially capable of both seismogenic and sympathetic fault offsets during a large, nearby earthquake that could result in as much as 4 feet of sharp, discrete offset along any of the fault traces (AMEC, 2011b and HDR, 2012). The existing 49-inch outlet pipe would not be able to accommodate such an offset, and this potential pipe displacement would likely result in an inability to draw down the reservoir. This condition also does not meet District, DSOD, or FERC dam safety requirements with respect to piping or internal erosion into or along a severely damaged outlet pipe.

2.2 Restricted Storage due to Risk Reduction Measures

Since December 2008, Anderson Reservoir has been restricted to a maximum operating elevation of 602 feet, approximately 45 feet below the crest of the dam. This restriction significantly reduces available storage in the reservoir and impacts District operations. Dam safety modifications are needed to be able to remove the operational restrictions. This restriction was voluntarily initiated by the District as a temporary risk reduction measure for the seismic risks associated with the existing dam. With this reservoir restriction in place, the risk of uncontrolled release of water from the reservoir has been significantly reduced. However, the District needs to be able to utilize the full dam storage for water supply operations.

2.3 Probable Maximum Flood Deficiency

In addition to the seismic deficiencies present at the dam, the spillway at Anderson Dam also lacks the capacity to safely pass the flood flows associated with a recent update of the Probable Maximum Flood (PMF). The PMF evaluation updated previous work based on standard HMR 36 to current HMR 58/59 standards. This updated PMF evaluation was recently completed by the HDR team (HDR, 2013c) and predicts a peak spillway discharge of 95,700 cubic feet per second (cfs) at a reservoir stage at elevation 652.5 feet during the PMF. These peak PMF flows exceed

the current capacity of the spillway by 50 percent and would also overtop the existing embankment dam by several feet. Such an event could lead to a potential failure of the dam. This also exceeds District, DSOD, and FERC dam safety criteria with respect to the requirements to safely pass PMF flows through a reservoir without significant impact to the dam.

2.4 Regulatory Requirements for Emergency Reservoir Drawdown

DSOD requires that outlets at major dams have the capacity to draw down the reservoir during an emergency. The DSOD requirements include the capability of drawing down 10 percent of the reservoir height in 7 days, and 100 percent of the reservoir volume within 120 days. Anderson Dam's outlet does not currently meet the first requirement. Commonly, DSOD does not require an existing dam to meet these criteria if the dam was constructed many years ago under different standards. However, construction of new dams, or new outlet works at existing facilities, as will be required at Anderson Dam due to the potential for fault offset as described in 2.1 above, must employ current criteria. As a result, a new replacement outlet at Anderson Dam will need to have increased capacity to meet these emergency drawdown requirements.

2.5 Other Flood Capacity Benefits

Downstream of Anderson Dam along Coyote Creek there are several reaches where the 100-year (1% annual chance of exceedance) flood is not reliably contained within the flood channel and presents a significant flood risk to the community. Improvements to the dam to reduce flood risk associated with downstream channel containment are not included in ADSRP. However, the high-level outlet required to meet the DSOD 7-day emergency drawdown criteria may also be able to be utilized for flood protection operations in the future. Flood protection benefits are not part of this project, and a separate project will be required to evaluate the impacts before such an action is implemented.

3.0 Alternatives Analysis

This section describes the range of alternatives considered, the methodology and process used to determine the recommended alternative (project).

3.1 Conceptual Alternatives Evaluation

As detailed in the Conceptual Alternatives Report (HDR, 2013b), the conceptual alternatives were developed to meet the project requirements established by the District, the DSOD and the FERC for the ADSRP. These alternatives were then evaluated and scored to determine which alternatives would be considered as a Feasible Alternative and evaluated further.

3.2 Alternatives Considered in Conceptual Alternatives Report

Pre-conceptual alternatives were developed and screened using the Project Requirements. Those that did not meet all of the Project Requirements were considered infeasible and were screened out. Pre-conceptual alternatives that met all of the Project Requirements then became conceptual alternatives.

During the conceptual alternatives evaluation, one of the most important factors differentiating the alternatives was the reservoir water surface elevation (WSEL) that would be maintained during construction. All of the alternatives that were carried from the Conceptual Alternatives Evaluation to the Feasible Alternatives Matrix Evaluation call for a fully drawn down reservoir to facilitate construction of the upstream buttress, the new outlet works tunnel and the new outlet works intake structure. Although it was recognized that completely dewatering the reservoir during the project construction would have temporary impacts on the community, the potential drawbacks of attempting the construction with a filled reservoir were judged too significant to overcome from design, construction, verification and regulatory perspectives. The benefits of utilizing a fully drawn down reservoir during construction include:

1. Increased public safety. By constructing the dam improvements in a dry reservoir, the public safety is improved both during and after construction by reducing the chance of an uncontrolled reservoir release during construction, and by improving the assurance of quality construction by increased ability for inspection and verification, and by the ability to use conventional designs and earthwork techniques that have been proven to be reliable and suitable for the project conditions.
2. Straightforward construction ease and reduced cost. By constructing the dam improvement with a dry reservoir, jet grouting, high tech concrete, and other methods that are expensive, are difficult to verify construction quality, are uncertain to be effective, and are uncertain to be approved by dam safety regulators, are not required.
3. Limited impact to the environment and community and improved efficiency. The alternatives that utilize a dry embankment minimize the project footprint, borrow excavation volumes, haul distances, truck trips, impacts to nearby parks, groundwater pumping and treatment required for tunnel excavations, and shortens the length of construction. Many of these benefits are realized by utilizing an additional construction staging area on the reservoir bottom that becomes available by lowering the reservoir.

4. Improved construction safety. By lowering the reservoir, groundwater will also be lowered; reducing the risk of tunneling safety issues during the outlet works construction.

Each pre-conceptual alternative is composed of various individual rehabilitation/replacement measures to address deficiencies associated with the embankment, outlet works, and spillway. Different measures are used in different combinations as building blocks to form the pre-conceptual alternatives for a range of reservoir elevations considered during construction. Nineteen pre-conceptual alternatives were developed. These included a combination of measures that considered the following:

- Six different potential reservoir elevations during construction (i.e., elevations 582, 550, 525, 495, 480, and 450 feet),
- Different types of potential cofferdams for upstream remediation work,
- In situ treatment (e.g., jet grouting) vs. remove-and-replace approaches to remediate liquefiable LFF and alluvium,
- Underwater dredging excavation for upstream construction work vs. working in the dry behind cofferdams,
- Varying sizes of upstream and downstream buttresses,
- Existing intake modification for lower outlet works vs. construction of new intake,
- Potential for use of steel pipelines in an enlarged tunnel to address potential fault offsets for the lower outlet works,
- Potential for use of an upper level outlet for reservoir drawdown capacities,
- Left vs. right abutment alignments for the lower level outlet works, and
- Potential for raising the spillway walls and dam to accommodate increased PMF flows vs. widening or deepening the spillway.

After screening the pre-conceptual alternatives to determine if the alternatives fully met the Project Requirements established by the District, the DSOD and the FERC, three of the pre-conceptual alternatives were screened out. This left sixteen alternatives that became the conceptual alternatives.

3.3 Evaluation and Scoring Criteria

Seven criteria were used to compare and evaluate conceptual alternatives. The evaluation criteria and their relative weighting are summarized below:

- Capital Construction Costs (15%)
- Construction Risks/Impacts (18%)
- Project Schedule (16%)
- Impacts to Reservoir Operations (15%)
- Quality of the Project/Ease of Construction (16%)
- Environmental Impacts (15%)
- Community & Stakeholder Relations (5%)

(100%)

A qualitative score of 1 (least favorable), 2, or 3 (most favorable) relative to the other alternatives was assigned to each conceptual alternative for each criterion. The scores for the criteria were then weighted using the percentages shown above and summed for each alternative.

3.4 Evaluation and Scoring Results

Following the evaluation and scoring of the conceptual alternatives, the six highest scoring alternatives were considered to be the most feasible alternatives and selected to be carried forward for detailed evaluation as Feasible Alternatives. The ranking of the six highest scoring conceptual alternatives is shown below in Table 1 along with each of their overall weighted scores.

Table 1. Summary Results of Conceptual Alternative Ranking (from HDR, 2013b)

Rank	Conceptual Alternative	Weighted Scores for Individual Criteria							Total Score
		Capital Construction Costs	Construction Risks / Impacts	Project Schedule	Impacts to Reservoir Operations	Quality of the Project	Environmental Impacts	Community/ Stakeholder Relations	
1	15	45	54	32	30	48	30	10	249
2	10	30	36	16	30	32	30	15	189
2	11	30	36	16	30	32	30	15	189
2	12	30	36	16	30	32	30	15	189
5	19	45	18	16	30	48	15	15	187
6	9	30	36	16	30	32	30	10	184

3.5 Feasible Alternatives Matrix

The six alternatives that were carried forward from the conceptual alternative analysis and evaluation were further developed, analyzed, evaluated, and ranked using both deterministic and risk-based approaches. Those approaches served as the basis for selecting the recommended alternative, as described in the Feasible Alternatives Matrix Report (HDR, 2013c).

3.5.1 Alternatives Carried Forward

Each of the six Alternatives carried forward incorporated the following measures:

- Embankment seismic remediation consisting of excavating portions of both the upstream and downstream slopes of the dam, removing potentially liquefiable LFF and alluvium exposed in the excavations, replacing the excavated material with compacted rockfill, and constructing buttresses on both sides of the dam.
- Upstream construction for the embankment remediation and the construction of new or modified intakes for outlet works would be completed in the dry behind either a small or large cofferdam within one construction season. From a construction viewpoint it is preferred to have a dry reservoir; however, several of the alternatives consider a 4,000 acre-foot storage level to maintain a fish pool, if required. Reservoir pool elevation during the one-year construction season would be either at elevation 495 feet to allow for a 4,000 acre-foot fish pool (Alternatives 9, 10, 11, and 12), or at elevation 450 feet (Alternatives 15 and 19) which results in a mostly dry reservoir (essentially no storage). The cofferdam for the elevation 495-foot reservoir alternatives is expected to be approximately 60 feet high, while the cofferdam for the elevation 450-foot (dry reservoir) alternatives is expected to be only about 10 feet high.
- To minimize the potential for inducing landslides along the reservoir rim during construction, the reservoir drawdown for all six of the Technically Feasible Alternatives would need to begin in the year prior to the upstream work and must be limited to a drawdown rate corresponding to a net outflow of 100 cfs or less.
- To accommodate potential fault offsets, a new low level conduit would be constructed using a steel pipeline within an enlarged tunnel.
- To provide emergency reservoir drawdown and future flood risk reduction capacities, a new high level outlet would be constructed that would consist of a steel-lined tunnel that would discharge to the spillway.
- To accommodate a higher PMF event, most of the Alternatives (five out of six) include raising the dam and spillway walls by 7 feet. Alternative 12 calls for widening or deepening the spillway without raising the crest of the dam.
- To allow for the construction of a downstream buttress, most of the Alternatives (five out of six) require additional permanent property acquisition. Alternative 19, however, would require the use of higher strength, processed borrow material (e.g.; Select Rockfill) within the downstream buttress to reduce its size so that it would remain within existing District property.

3.5.2 Methodology and Process for Evaluating Alternatives

The two approaches for alternative evaluation (deterministic) and (risk-based) were performed in parallel and summarized in two matrices to support the alternative selection. The approaches utilized the same seven criteria developed in the conceptual alternatives analysis (Capital Construction Cost, Construction Risks and Impacts, Project Schedule, Impacts to Reservoir Operations, Quality of the Project and Ease of Construction, Environmental Impacts, and Community Stakeholder Relations), to refine design, estimate baseline costs and estimate baseline schedules for each of the alternatives. A risk analysis using the estimated levels of uncertainty for the major elements of the cost and schedule estimates was performed. Values and assumptions taken from baseline cost and schedule estimates were used to determine values for each of the criterion for each alternative in the deterministic evaluation. Similarly, results from the risk analysis were used to estimate values for each evaluation criterion for each alternative in the risk-based evaluation.

3.5.3 Design Refinements, Baseline Cost and Schedule Estimates

The design refinements included spillway line drawings to support concrete quantities and construction methods, material requirements, evaluation of potential borrow sources and other design assumptions. Baseline costs estimates completed for the conceptual level comparisons correspond to Class 4/Class 3 level estimates as defined by the Association for Advancement of Cost Engineering (AACE). A general schedule was developed to meet the project requirement for completion of the construction by December 2018.

3.5.4 Risk Analyses

A risk-based estimate of construction costs and schedule was performed for each of the six Alternatives. The risk estimates included an elicitation process in which technical subject specialists identified various uncertainties and events that may impact the project, described their occurrence probability distributions, and described the impact distributions. Forty-five event risks were identified and compiled in a risk register. The risk register included estimated probabilities of occurrence of such events as well as potential ranges in cost and schedule consequences. After the risks were defined, simulation of the impacts to construction costs and schedule was performed using Monte Carlo methodology. The results of the simulations provide distributions of cost and schedule for each alternative.

3.5.5 Feasible Alternative Matrices

For both deterministic and risk-based approaches, each alternative was ranked based on the value of the evaluation criteria measure (i.e. cost, months, etc.). The results of the rankings are shown in Tables 2 and 3 as Feasible Alternatives Matrices for the deterministic and risk-based approaches.

In both Table 2 and Table 3, it is clear that Alternative 15 ranks number (1) for multiple criteria and by inspection, appears to be the best ranked alternative overall.

Table 2. Feasible Alternatives Matrix (Using Deterministic Baseline Values)

	Criteria	Feasible Alternative Ranks					
		Alt. 9	Alt.10	Alt.11	Alt.12	Alt.15	Alt.19
1	Capital Construction Cost	5	4	3	6	1	2
2	Construction Risks and Impacts	5	4	3	6	1	2
3	Project Schedule	1	1	1	1	1	1
4	Impacts to Reservoir Operations	1	1	1	1	1	1
5	Quality of the Project and Ease of Construction	2	2	1	2	1	2
6	Environmental Impacts	1	1	1	1	2	1
7	Community and Stakeholder Relations	3	2	2	2	2	1

Table 3. Feasible Alternatives Matrix (Using Risk-based Values)

	Criteria	Feasible Alternative Ranks					
		Alt. 9	Alt.10	Alt.11	Alt.12	Alt.15	Alt.19
1	Capital Construction Cost	5	4	3	6	1	2
2	Construction Risks and Impacts	5	4	3	6	1	2
3	Project Schedule	2	2	2	2	1	2
4	Impacts to Reservoir Operations	2	1	1	1	1	2
5	Quality of the Project and Ease of Construction	-	-	-	-	-	-
6	Environmental Impacts	3	1	1	1	2	4
7	Community and Stakeholder Relations	2	1	1	1	1	3

3.5.6 Recommendation for Staff Recommended Alternative

As described in the other sections, various evaluation processes were performed to screen the recommended alternative.

From the qualitative analysis and ranking first performed during the Conceptual Alternatives Evaluation, Alternative 15 was the highest ranked alternative. Secondly, while using conventional deterministic cost and schedule estimating techniques, Alternative 15 ranked (1) in five of the seven evaluation criteria, and by inspection, was the overall highest ranked alternative. Finally, while using a risk-based cost and schedule estimating technique, Alternative 15 ranked (1) in all but one of the seven evaluation criteria, and again was the overall highest ranked alternative.

In all of the three ranking processes, using different methodology and measures for the seven evaluation criteria, Alternative 15 ranked the highest. Therefore, it was recommended that Alternative 15 be carried to design as the recommended alternative. This recommendation is supported by the following:

- Alternative 15 had the highest qualitative score during the initial ranking of Conceptual Alternatives,

- Alternative 15 was the highest ranked alternative in the Feasible Alternatives Matrix Report using deterministic methods,
- Alternative 15 was the highest ranked alternative in the Feasible Alternatives Matrix Report using risk-based methods,
- Alternative 15 had the lowest estimated construction cost using conventional deterministic cost estimating methods,
- Alternative 15 had the lowest risk-based probabilistic project cost for both expected (median) and severe overrun (90th percentile) scenarios,
- Alternative 15 had the least chance of exceeding the targeted project completion date, and was the only alternative that had a reasonable chance (45%) of meeting the District's target date for project completion in 2018, and
- Alternative 15 was the only alternative that did not have a significant chance of project completion being delayed to 2020.

From the above results and rationales, it was recommended that Alternative 15 be carried forward as the recommended alternative.

4.0 Recommended Project

This section summarizes the recommended project (alternative) and its elements. The project has been developed to identify the preliminary design of the elements and the preliminary estimate of the costs, as well as the preliminary general construction activities. These are detailed in the Staff Recommended Alternative Report (HDR, 2013k).

4.1 Alternative Description

The conceptual plan view of Alternative 15 is shown in Figure 2. It includes: 1) upstream and downstream embankment modifications to improve seismic stability, 2) a new intake structure and primary (low-level) outlet designed to cross faults that have the potential for rupture, 3) raised spillway walls and an increase in the dam crest elevation to safely pass the PMF, and 4) a new high level outlet pipe sized to meet DSOD 7-Day drawdown criteria, that will discharge to the spillway and potentially provide future increased flood management functionality. It will increase the dam footprint which will likely require the re-alignment of a portion of Cochrane Road and additional property along the downstream side of the project.

It is anticipated that an almost full draw down of the reservoir will be required for upstream and downstream work. The reservoir drawdown effort will include the construction of a temporary cofferdam of about 10-feet high and bypass pumping of reservoir inflows to the existing dam outlet. For the planning phase, the maximum net drawdown rate was assumed to be 100 cfs to reduce the chances of reservoir rim instability, which is consistent with previous limitations.

Appendix A contains planning-level drawings providing preliminary detail on the designs for the recommended alternative. It should be emphasized that the preliminary designs prepared for the Planning Phase represent pre-design levels of work.

4.2 Embankment Design for Seismic Stability

The planned embankment remediation measures to seismic stability are intended to address the liquefiable LFF and alluvium beneath the dam. The planned embankment modifications consist of excavation of portions of both the upstream and downstream rockfill shells, and downstream liquefiable alluvium, and replacement with compacted, non-liquefiable rockfill. In addition, additional rockfill will be placed on both the upstream and downstream sides of the dam to buttress the slopes.

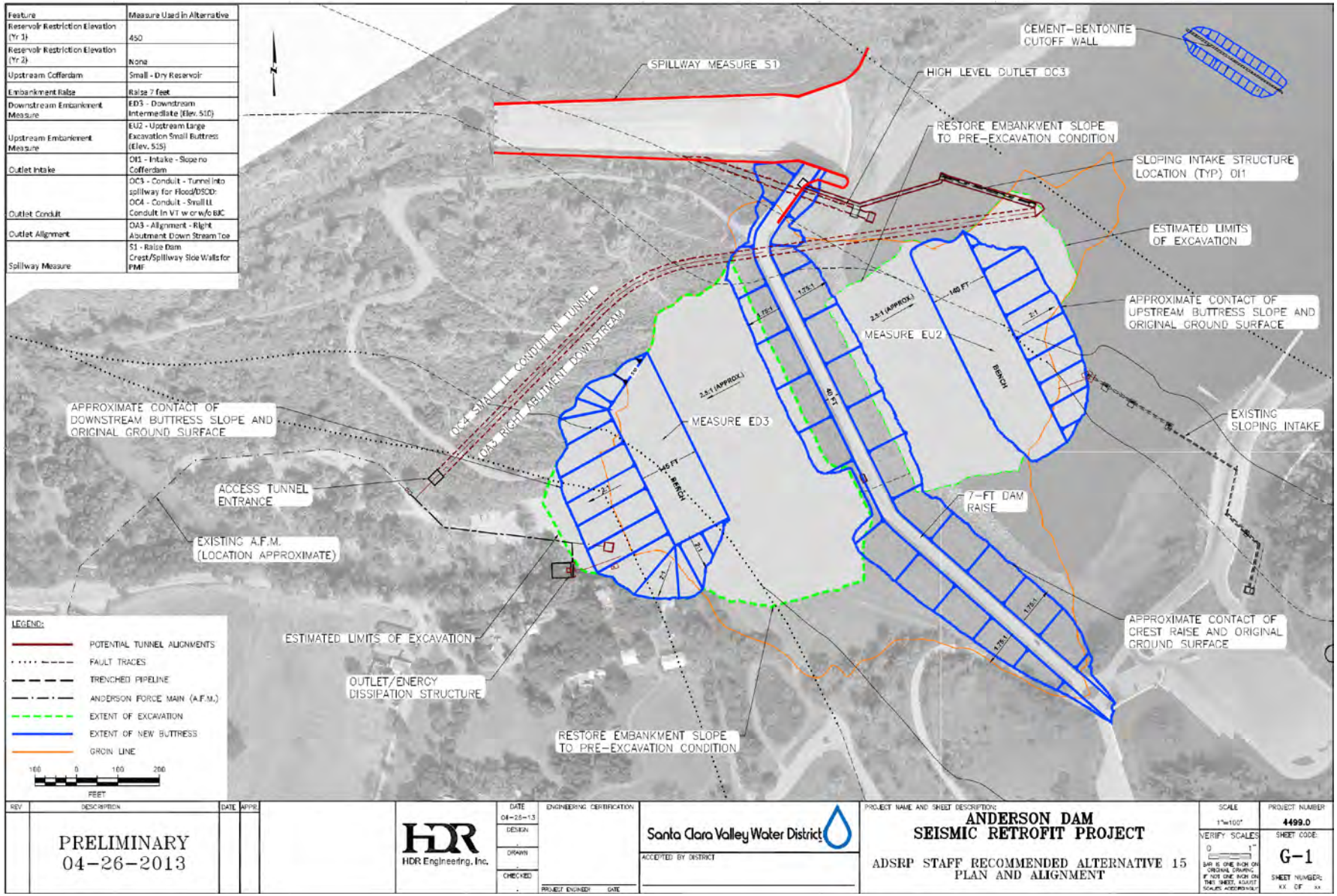

Figure 2. Plan View of Alternative 15

The upstream excavation will begin at elevation 610 feet and extend at a slope of 1.5H:1V to elevation 390 feet. The base of the excavation will extend in plan view approximately 100 feet upstream of the dam toe. Rockfill will be placed and compacted to form a new buttress and to replace the excavated embankment materials. The completed buttress will have a slope of about 2H:1V from the reservoir bottom to an elevation of approximately 515 feet. The buttress will be 140-feet wide at elevation 515 feet, and embankment excavation will be replaced with compacted rockfill with geometry similar to the existing dam up to elevation 610 feet.

Downstream, the embankment excavation is planned to begin at elevation 615 feet and proceed down to elevations of 390 to 400 feet at a slope of about 1.5H:1V. The bottom of the excavation will be at around 390 feet and will extend about 100 feet beyond the downstream toe. Similar to the upstream buttress design, the downstream slope will include a 145-foot-wide buttress with 2H:1V slopes and a top elevation at about 510 feet. Above elevation 510 feet, the dam slope will be re-constructed to approximately match the existing dam slopes. In addition to compacted rockfill, the downstream construction will also include a graded filter and blanket drainage system to control dam seepage and prevent piping. Figure 3 illustrates the typical embankment measure design concept.

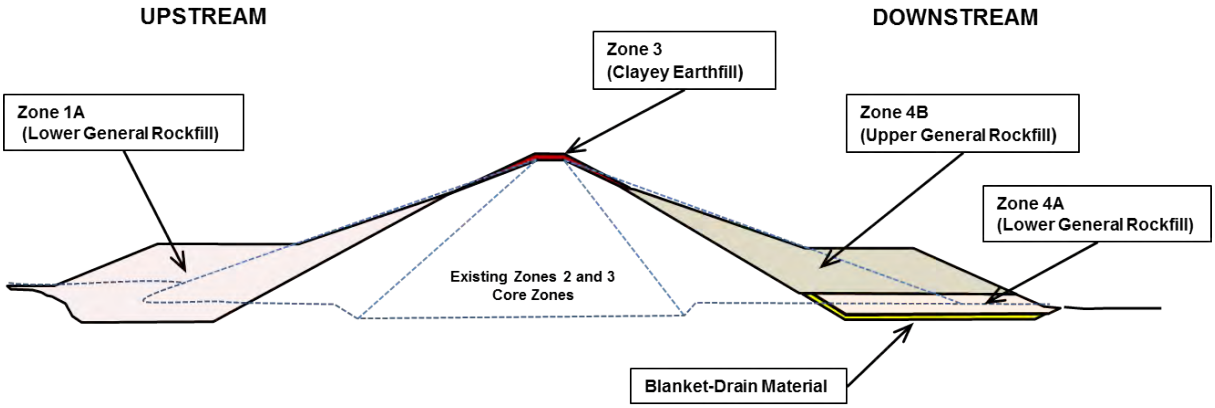

Figure 3. Illustration of Typical Section for Embankment Measures

Construction on both the upstream and downstream sides of the embankment will be performed when the reservoir is dry to afford optimal construction conditions and to ensure adequate excavation slope stability. Other than the drainage filter and blanket material, which will be imported, all other fill is anticipated to come from embankment excavation or onsite borrow sources. Exhibit Drawings E-1 through E-4 in Appendix A detail the planned embankment modifications.

4.3 Low Level Outlet Designed for Fault Rupture

The existing outlet works cross fault traces that are conditionally active and may rupture causing offset, damage to the existing outlet pipe, and potential inability to safely drawdown the reservoir after a seismic event. A new low level outlet is planned to be located within the right abutment of the dam to be able to safely use the outlet pipe and lower the reservoir after a fault rupture event. The new outlet will consist of a new intake control building, a 350-foot

long submerged access way, a 270-foot-long inclined intake conduit, a 1,630-foot-long conveyance tunnel, and 535 feet of cut-and-cover pipe terminating at an outlet structure with control valves and energy dissipation chambers near the downstream toe of the dam.

The new outlet pipe is planned to be an approximately 60-inch diameter steel pipe located within a horseshoe-shaped concrete tunnel, with inside dimension of approximately 11 feet by 11 feet. The tunnel lining will be designed to be at least 4 feet thick to prevent soil erosion in the tunnel after a seismic rupture event. The large oversized tunnel will allow inspection and maintenance, and will allow the outlet carrier pipe to deform safely after a seismic event within the tunnel. Exhibit Drawing O-8 in Appendix A illustrates the design concept to accommodate fault rupture hazards. The tunnel for the outlet works is planned to be constructed using road header equipment. The upstream end of the tunnel would be constructed with a thick concrete plug of about 20 to 40 feet to prevent reservoir water from entering the tunnel. Concepts for water control within the low level outlet tunnel should be developed during final design. Additionally, it is suggested that ancillary utilities within the tunnel be kept to a minimum, and those that are installed be appropriate for a wet environment. Figure 4 illustrates the design concept for the low level outlet.

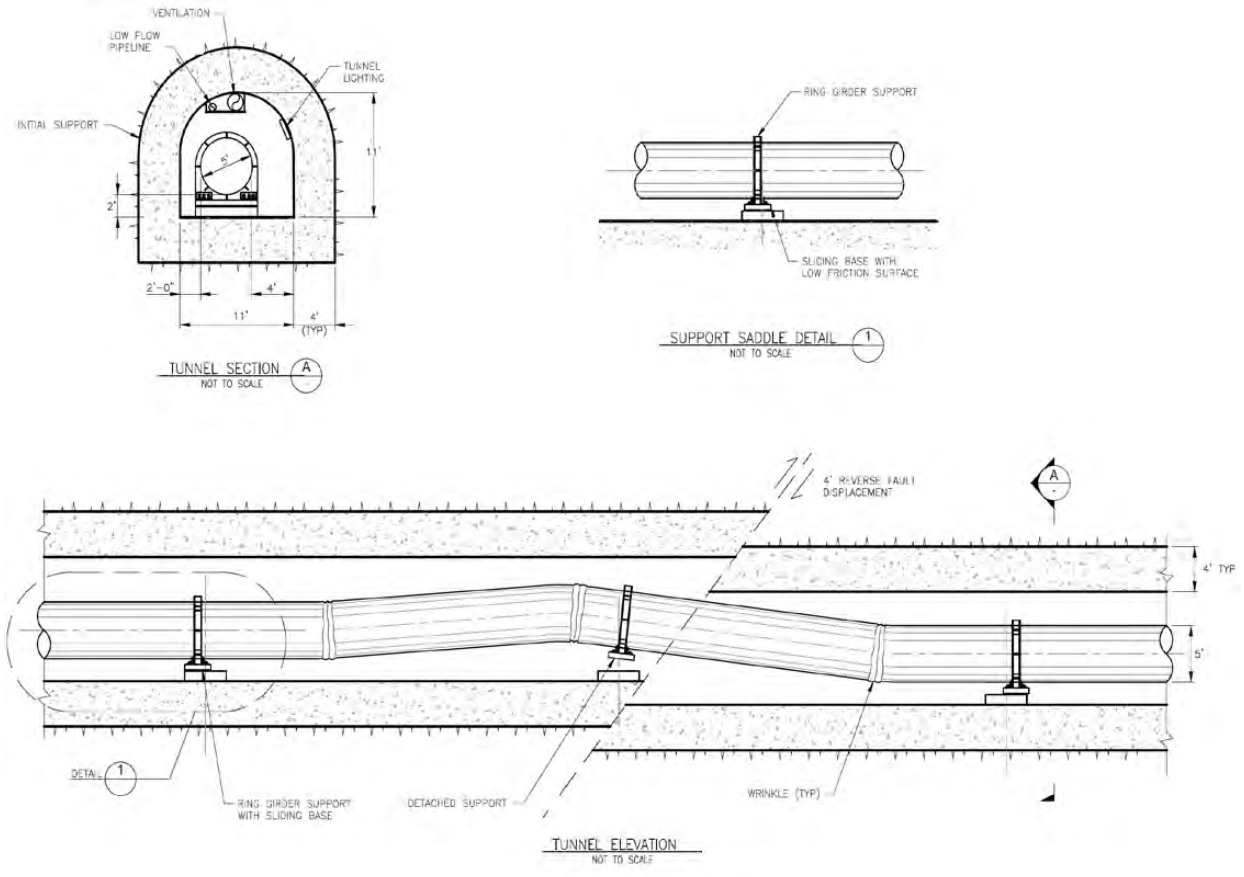

Figure 4. Access Tunnel and Conduit Elevation; Section Views for Low Level Outlet

The new intake structure will be constructed of an inclined steel pipeline with three intake ports to match the existing intake port elevations. Each intake port will include a trash rack and 48-inch butterfly isolation valve. Access will be provided via a new watertight concrete access way that leads from the top of the right abutment, adjacent to the dam crest, down the slope to connect with the intake. The intake structure is located on the right abutment and will share a common access way with the proposed high level outlet. The access way will be designed for inspection, maintenance, air ventilation, and to house the control lines for the valves. Exhibit Drawing O-6 in Appendix A shows the preliminary design. The intake structure will be constructed with a drawn down reservoir.

The new 60-inch low level outlet pipe will tie into the existing 54-inch Anderson Force Main (AFM) approximately 65 feet southwest of the tunnel portal. A new discharge structure is proposed to provide flexibility in flow releases to Coyote Creek in the range of 0 - 450 cfs and is shown in Exhibit Drawing O-9 of Appendix A. It would contain isolation and energy dissipation valves of various sizes in order to control releases to Coyote Creek over a range of flows.

4.4 High Level Outlet

A new high level outlet is planned to be constructed within the right dam abutment, on the south side of the existing spillway, as shown in Exhibit Drawings O-1 through O-3 of Appendix A. The outlet conduit would be approximately 350 feet long and 12.5 feet in diameter, with a maximum discharge of approximately 5,200 cfs at a reservoir level of 627 feet. The outlet is sized to exceed the minimum DSOD 7-day drawdown capacity requirement. The outlet would have upstream control and would discharge freely to the existing spillway.

The new high level intake structure would include a single 12.5-foot gate valve located at the upstream end of the outlet at approximately elevation 578 feet in order to provide adequate driving head. Flow control through the intake structure could be regulated through partial opening of the slide gate. The conduit shown in Figure 5 is not designed to accommodate large fault offsets. Instead, this relatively short conduit has been located so that it avoids mapped fault traces. The alignment of the high level outlet must be verified during design and construction to ensure that it does not cross active fault traces.

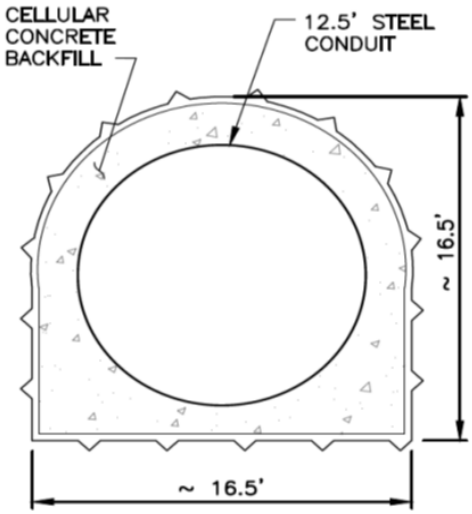

Figure 5. Typical Cross Section for High Level Outlet Tunnel

Access to the valve structure would be via a new watertight shared concrete access way that leads from the top of the abutment, adjacent to the dam crest, down the slope to connect with the intake. The access way would have internal dimensions of approximately 8 feet high by 5 feet wide, and would continue beyond the high level intake location to provide access to the sloping intake structure for the low level outlet.

4.5 Preliminary Design for Spillway Capacity Increase to Safely Pass PMF

Updated PMF analyses indicate that the spillway capacity needs to be increased from 63,200 to approximately 94,800 cfs. The preliminary design includes raising the spillway walls by 7 feet. This increase, in conjunction with the 7-foot dam raise, is intended to safely convey the much greater PMF flows.

The existing spillway is comprised of two sections, the upstream convergence section and the downstream spillway chute. The convergence section extends from the spillway crest to the beginning of the chute and is approximately 175 feet long. The convergence section has vertical training walls with supporting crib walls behind them together with interior cross supports. Class II backfill was placed within the interior crib wall matrix. The downstream chute is approximately 725 feet long and has sloping training walls that simply lay against either an excavated slope or a compacted earth backfill foundations. The 7-foot raise would apply to both types of spillway walls. The new concrete wall extensions for both types of walls would most likely connect to the existing sections by doweling and the addition of reinforced steel. The extended wall thickness would be about 1 foot for both types of wall, equivalent to the current thicknesses at the existing tops of the walls. Exhibit Drawing S-4 in Appendix A illustrates the proposed methods and quantities of materials necessary for raising both types of spillway. Figure 6 shows the preliminary spillway design. Hydraulic performance and structural adequacy will need to be verified during design, as several key assumptions regarding performance were made during planning.

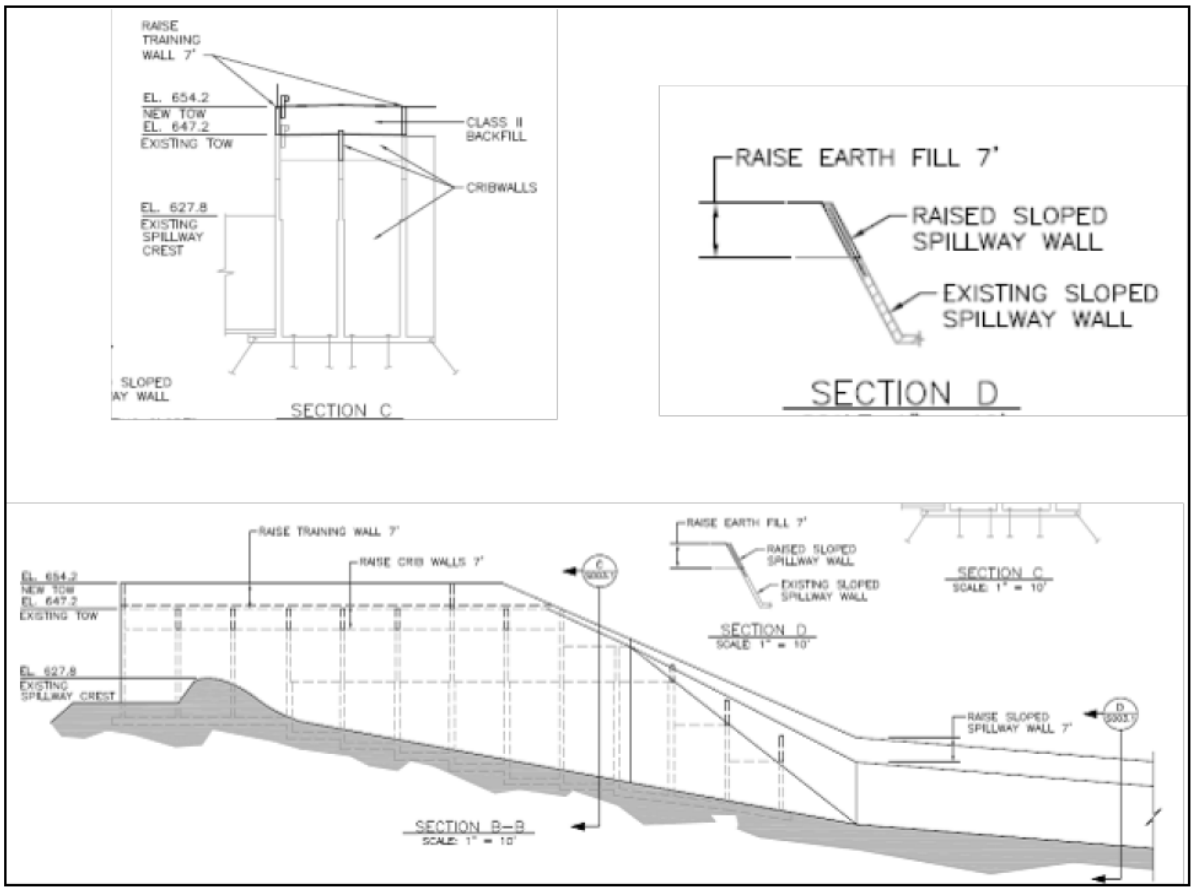

Figure 6. Proposed 7-foot Raise of Spillway Training and Sloping Walls

4.6 Preliminary Cost Estimates

The preliminary cost estimate for the recommended alternative was produced in accordance with guidelines established by the Association for the Advancement of Cost Engineering (AACE) as a Class 3 Estimate. Assumptions made in developing the construction costs included a 20-percent cost for unlisted items and a 30-percent general contingency (not applied to unlisted items). Costs are based on March 2013 dollars and escalation should be applied for future year construction costs as appropriate.

The estimated construction cost at the planning level is approximately $122 million including unlisted items and contingencies. Table 4 summarizes the estimated construction costs.

Table 4. Estimated Construction Costs

Item	Cost
Mobilization, Demobilization, & General Conditions, and Develop Borrow	$ 12,200,000
Install/Remove Cofferdam	$ 326,850
Upstream Embankment Stabilization	$ 6,768,400
Downstream Embankment Stabilization	$ 11,137,100
Embankment Crest Raise	$ 396,800
Low Level Outlet Intake and Tunnel	$ 37,476,060
High Level Outlet into Spillway	$ 8,001,200
Spillway Improvements	$ 1,650,000
Other (Instrumentation, Restoration, NOA, etc...)	$ 3,130,000
Unlisted Items (20% of above items)	$ 16,217,282
Contingency (30% of above items minus Unlisted Items)	$ 24,325,923
Construction SUBTOTAL	$121,629,615

4.7 Construction Schedule

The general construction schedule calls for construction work to begin in 2016 and be completed at the end of 2018, allowing three full construction seasons (approximately April through October) to complete the work. One of the important findings was the need to complete the bulk of the work within Year 2 (2017). Additionally, all the efforts in the initial year (2016) should be oriented towards preparing for the work in 2017. This would include beginning the drawdown of the reservoir (estimated to require 10 to 12 months), development of borrow areas for the embankment work, construction of haul roads, and initiation of the lower level outlet tunnel from the downstream side. The schedule developed for the Staff Recommended Project includes the following assumptions:

- Construction Year 1 (2016)
  - Contractor mobilizes in April
  - Site, staging areas, and haul roads are identified, procured, and upgraded, as necessary
  - Borrow areas are developed and initial stockpiles are created
  - Tunneling for the low level outlet works is initiated from downstream
  - Reservoir drawdown for construction work in Year 2 is initiated.

- Construction Year 2 (2017)
  - Reservoir drawdown to prescribed level concludes by April 15th
  - Upstream and downstream embankment work is completed by October 15th

- New intake for low level outlet is constructed and connected with completed tunnel
- High level outlet tunnel leading to spillway is completed.

◈ Construction Year 3 (2018)

- Spillway enlargement is completed
- Dam crest is raised as designed
- Site restoration is complete or nearly complete.

The generalized schedule listed above is also provided graphically in Figure 7.

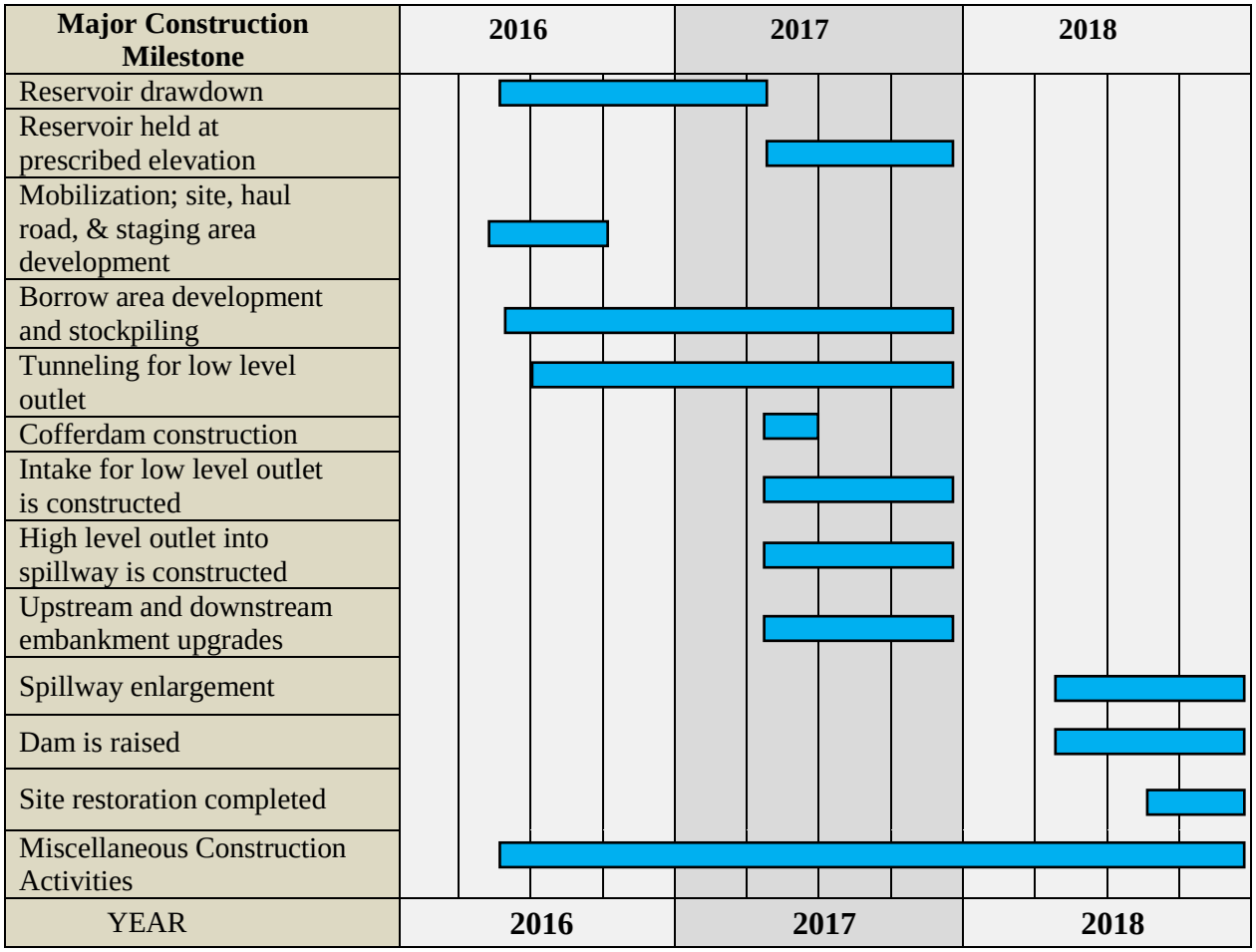

Figure 7. Construction Schedule for Recommended Alternative

4.8 Real Estate Needs

Figure 8 illustrates the temporary borrow, stockpile, and staging areas, and the permanent spoil areas identified for the recommended alternative. The vast majority of these areas were assumed to be on District and adjoining County Park Land. No cost was assumed for the use of this land. Costs for the restoration and mitigation of this property were assumed to be included

in other cost assumptions and categories. There is likely to be a need for new temporary and permanent rights-of-way and real estate costs. Real estate costs were included in the project cost estimates detailed in the Staff Recommended Alternative Report (HDR, 2013k).

4.9 Environmental Impacts

Environmental impacts will be assessed and covered under the California Environmental Quality Act (CEQA) and National Environmental Protection Act (NEPA) processes to be undertaken soon.

4.10 Environmental Mitigation

The District finalized the Santa Clara Valley Habitat Plan (VHP) in August of 2012, and the document has been adopted. The VHP provides coverage for special-status wildlife and plants impacted by dam seismic safety retrofit projects, including the Anderson Dam Seismic Retrofit Project. The VHP also provides coverage for borrow sites and dewatering associated with project construction.

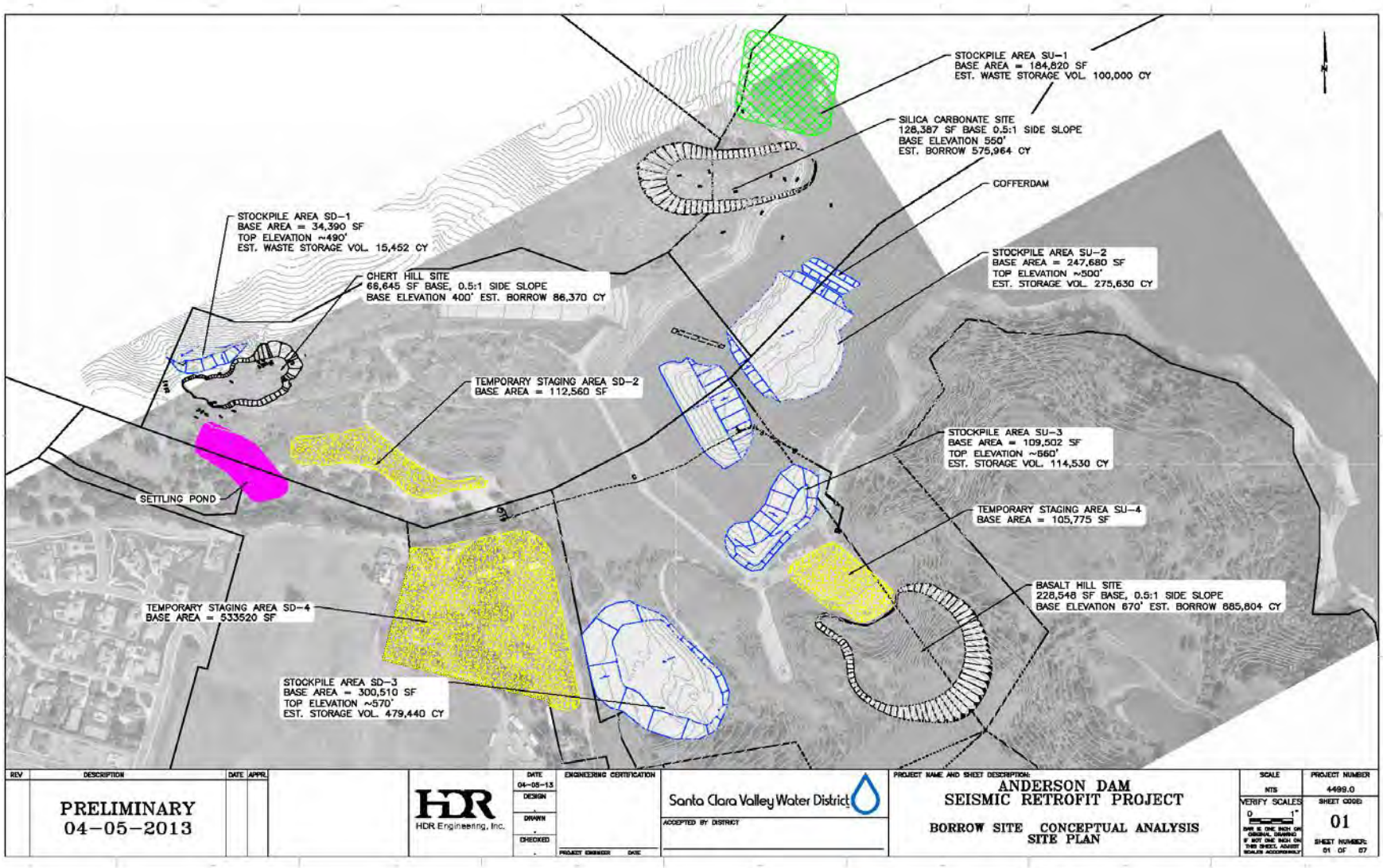

Figure 8. Conceptual Borrow Plan

4.11 Issues Recommended for Consideration in the Future Design Phase

Issues to be considered in the Design Phase that is scheduled to follow this Planning Study include the following:

- Significant geotechnical and geologic studies must be completed in the borrow areas, along the tunnel alignments, in embankment remediation areas, at the outlet intakes and outfalls, and along the cofferdam alignment. These need to be completed expeditiously in order to inform the Design process in a timely manner.
- The high level outlet and the intake and outlet structures for the low level outlet were not designed to accommodate large fault offset. The locations of these structures must be investigated and verified, or moved, so as to not lie on potentially or conditionally active faults.
- The design of the low level outlet conduit assumes that it reacts in a beam buckling failure mode during fault offset in order to allow it to deform in the tunnel without tearing or rupturing. Numerical modeling will likely be required to investigate the behavior of the conduit and support system beyond the initial onset of buckling.
- The sizes and footprints of the embankment excavations and buttresses developed during the Planning Phase were calculated using conservative assumptions and approaches. The Planning Team believes that there are opportunities to reduce the sizes of the upstream and downstream buttresses if less conservative assumptions and more sophisticated analysis methods can be used. Potential assumptions that could be re-examined during the Design Phase include static and residual shear strength parameters, the method of analysis (e.g. Newmark versus FLAC), and three-dimensional effects. In addition, there may be an opportunity to reduce real estate acquisition requirements for the downstream buttress.
- The plan for addressing the dam safety deficiency associated with passing the higher PMF flow is to raise the dam and spillway walls by 7 feet. Physical modeling is recommended to verify the design and capacity of the spillway associated with such a raise, and to also help design the connection between the high level outlet and the spillway.
- A review of the available information (HDR, 2013i) indicates that pre-existing landslides around the reservoir rim will likely be activated in the drawdown planned for the ADSRP construction. During the Design phase, measures should be developed to mitigate landslide risks such as installing instrumentation in the landslide areas, unloading material at one or more of the potential landslide locations, and/or scheduling drawdowns before and after the peak rain season (January 1 to February 28).

5.0 Construction Costs, Funding and Schedule

The construction cost estimate at the planning level is approximately $122 million (in 2013 dollars). Additional costs associated with completing the designs, construction administration, real estate acquisition, and environmental mitigation and restoration will also be incurred. The project schedule is a three year construction period beginning in 2016 and completing at the end of 2018. The project is currently funded with 11.5% from South County Zone W-5 and 88.5 % from the North County Zone W-2 based on the average municipal and industrial water use.

HDR

6.0 References

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HDR Engineering, Inc. (2013k), "*Staff Recommended Alternative Report, Anderson Dam Seismic Retrofit Project*," Technical Memorandum, June 28, 2013.

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APPENDIX A - Exhibits

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GENERAL	DRAWING NUMBER
SHEET INDEX	G–0
ADSRP STAFF RECOMMENDED ALTERNATIVE 15 – PLAN AND ALIGNMENT	G–1
EMBANKMENT	
ADSRP STAFF RECOMMENDED ALTERNATIVE 15 – TEMPORARY COFFER DAM	C–1
ADSRP STAFF RECOMMENDED ALTERNATIVE 15 – EXCAVATION PLAN	E–1
ADSRP STAFF RECOMMENDED ALTERNATIVE 15 – EXCAVATION SECTIONS	E–2
ADSRP STAFF RECOMMENDED ALTERNATIVE 15 – BUTTRESS AND CREST RAISE PLAN	E–3
ADSRP STAFF RECOMMENDED ALTERNATIVE 15 – FINAL CROSS SECTION	E–4
OUTLET WORKS	
OUTLET WORKS – GENERAL PLAN	O–1
INTAKE – GENERAL PLAN	O–2
HIGH LEVEL OUTLET – PLAN AND PROFILE	O–3
HIGH LEVEL OUTLET – INTAKE PLAN AND SECTIONS	O–4
LOW LEVEL OUTLET – PLAN AND PROFILE	O–5
LOW LEVEL OUTLET – SLOPING INTAKE PLAN AND SECTION	O–6
LOW LEVEL OUTLET – SLOPING INTAKE SECTIONS	O–7
LOW LEVEL OUTLET – TUNNEL AND CONDUIT SECTIONS	O–8
LOW LEVEL OUTLET – ENERGY DISSIPATION STRUCTURE PLAN AND SECTION	O–9
SPILLWAY	
SPILLWAY PLAN	S–1
SPILLWAY SECTION AND DAM ELEVATION	S–2
SPILLWAY MODIFICATION	S–3
SPILLWAY MODIFICATION QUANTITIES	S–4

DOCUMENT NUMBER:

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HDR Engineering, Inc.

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ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

PROJECT NAME AND SHEET DESCRIPTION:
ANDERSON DAM SEISMIC RETROFIT PROJECT

SHEET INDEX

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PROJECT NUMBER 4499.0

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SHEET NUMBER: OF xx

Feature	Measure Used in Alternative
Reservoir Restriction Elevation (Yr 1)	450
Reservoir Restriction Elevation (Yr 2)	None
Upstream Cofferdam	Small - Dry Reservoir
Embankment Raise	Raise 7 feet
Downstream Embankment Measure	ED3 - Downstream Intermediate (Elev. 510)
Upstream Embankment Measure	EU2 - Upstream Large Excavation Small Buttress (Elev. 515)
Outlet Intake	OI1 - Intake - Slope no Cofferdam
Outlet Conduit	OC3 - Conduit - Tunnel into spillway for Flood/DSOD: OC4 - Conduit - Small LL Conduit in VT w or w/o BJC
Outlet Alignment	OA3 - Alignment - Right Abutment Down Stream Toe
Spillway Measure	S1 - Raise Dam Crest/Spillway Side Walls for PMF

SPILLWAY MEASURE S1

CEMENT–BENTONITE CUTOFF WALL

HIGH LEVEL OUTLET OC3

RESTORE EMBANKMENT SLOPE TO PRE–EXCAVATION CONDITION

SLOPING INTAKE STRUCTURE LOCATION (TYP) OI1

ESTIMATED LIMITS OF EXCAVATION

APPROXIMATE CONTACT OF UPSTREAM BUTTRESS SLOPE AND ORIGINAL GROUND SURFACE

MEASURE EU2

MEASURE ED3

OC4–SMALL LL CONDUIT IN TUNNEL

OA3–RIGHT ABUTMENT DOWNSTREAM

APPROXIMATE CONTACT OF DOWNSTREAM BUTTRESS SLOPE AND ORIGINAL GROUND SURFACE

EXISTING SLOPING INTAKE

ACCESS TUNNEL ENTRANCE

EXISTING A.F.M. (LOCATION APPROXIMATE)

7–FT DAM RAISE

ESTIMATED LIMITS OF EXCAVATION

APPROXIMATE CONTACT OF CREST RAISE AND ORIGINAL GROUND SURFACE

OUTLET/ENERGY DISSIPATION STRUCTURE

RESTORE EMBANKMENT SLOPE TO PRE–EXCAVATION CONDITION

LEGEND:

- POTENTIAL TUNNEL ALIGNMENTS
- FAULT TRACES
- TRENCHED PIPELINE
- ANDERSON FORCE MAIN (A.F.M.)
- EXTENT OF EXCAVATION
- EXTENT OF NEW BUTTRESS
- GROIN LINE

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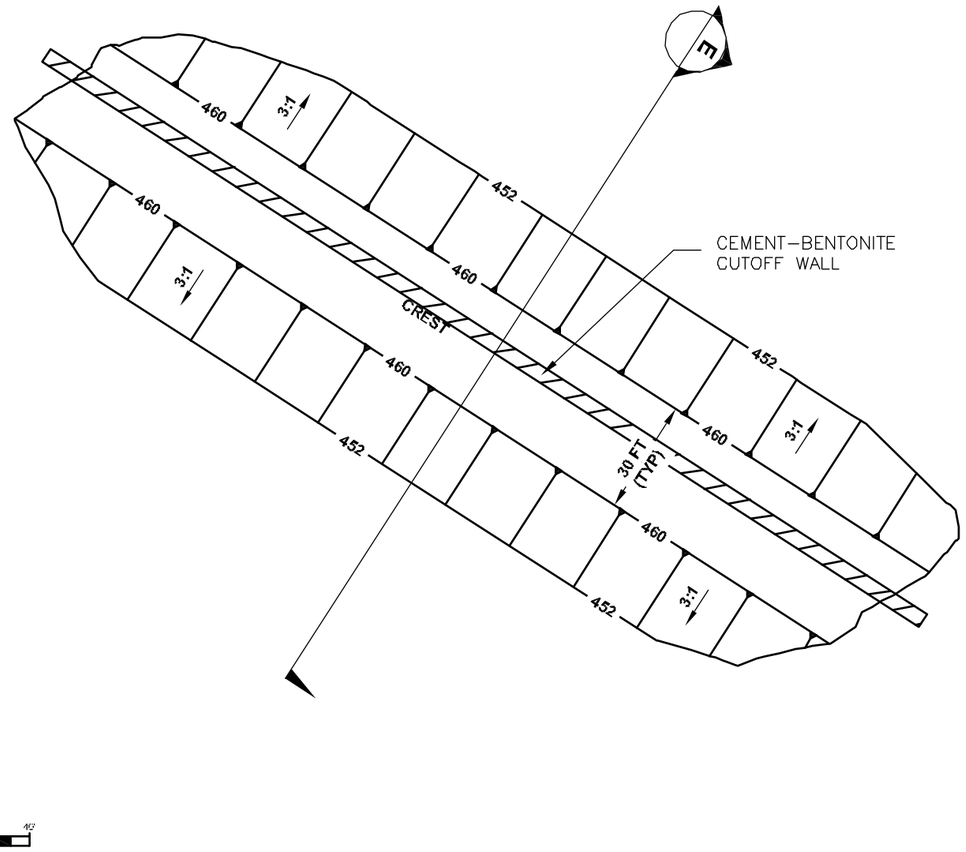

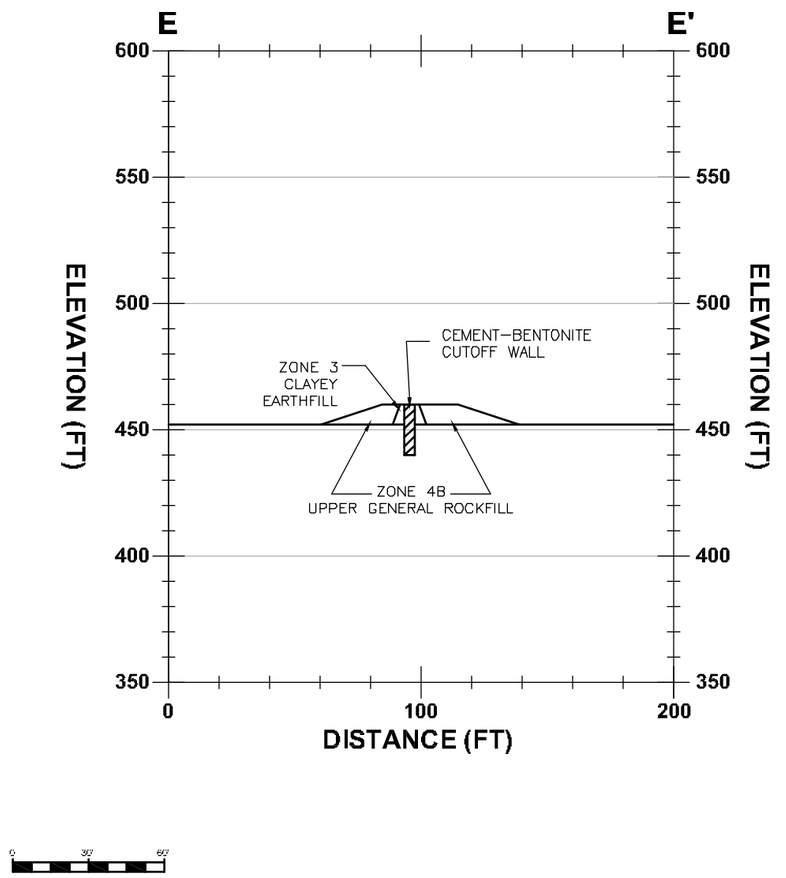

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Santa Clara Valley Water District

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TEMPORARY COFFER DAM

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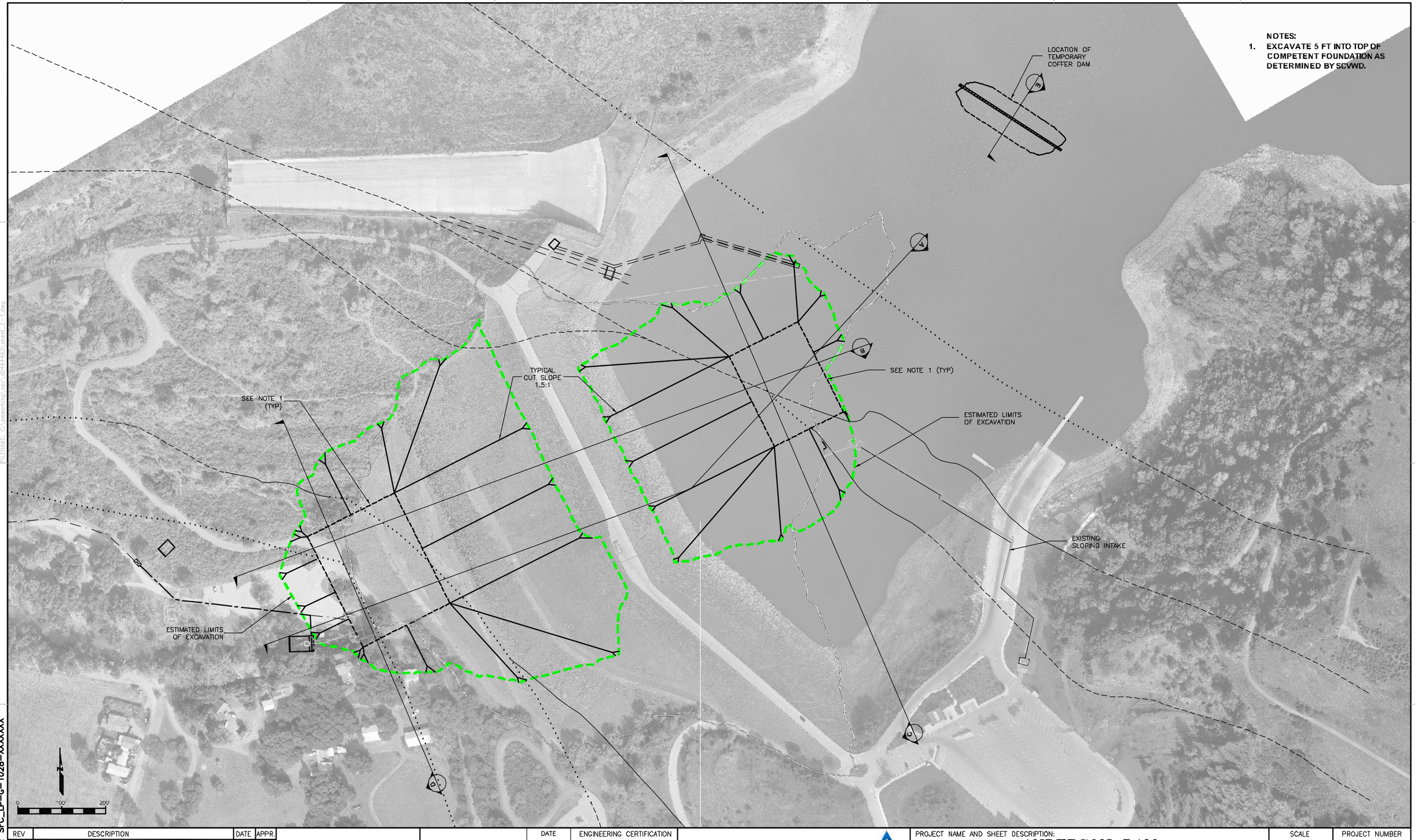

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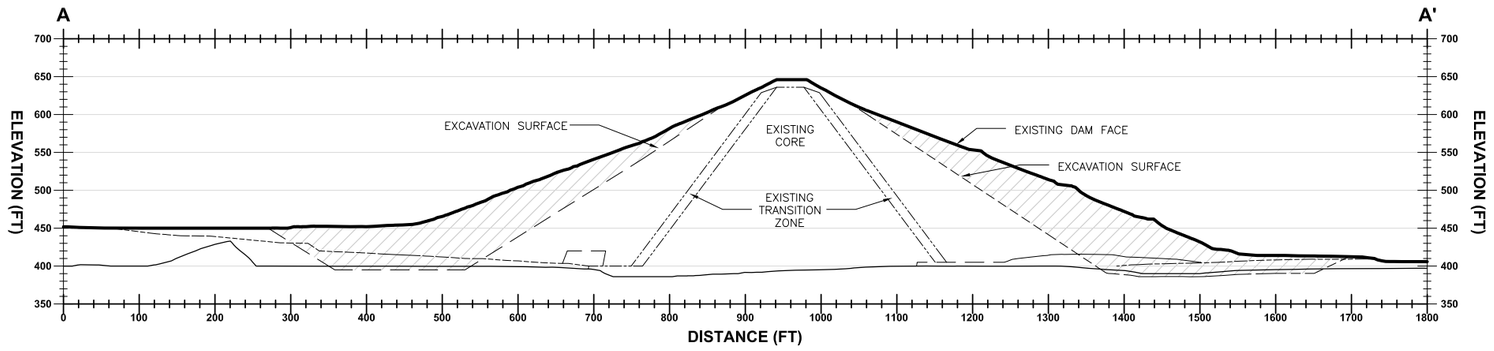

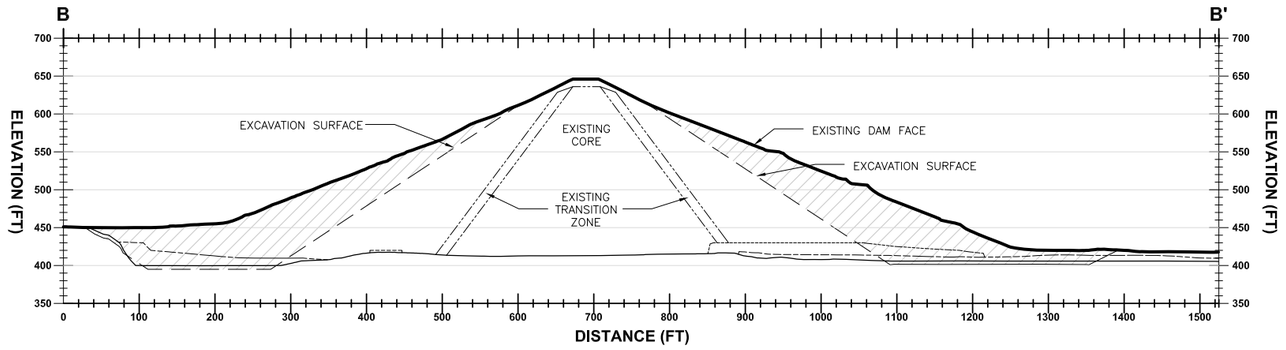

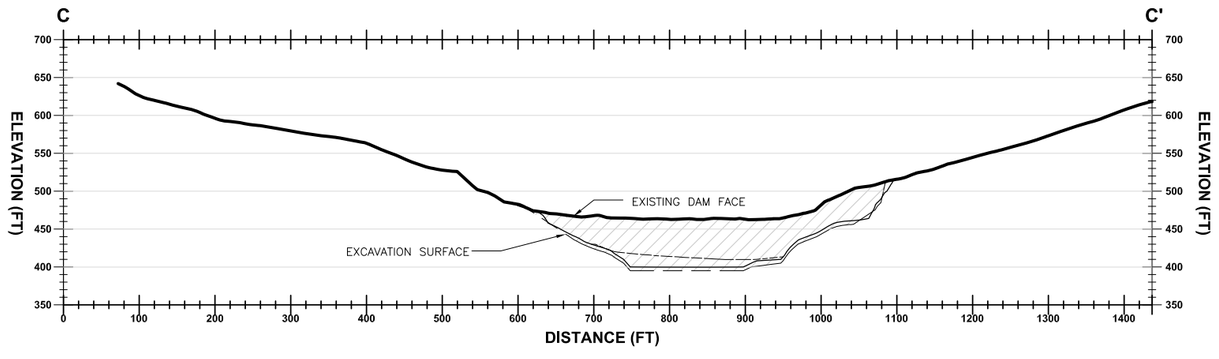

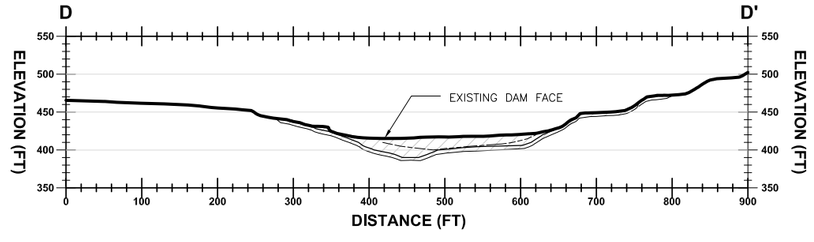

LEGEND

- EXISTING GRADE
- TOP OF LOWER FINER FILL
- TOP OF ALLUVIUM
- TOP OF COMPETENT FOUNDATION
- BOTTOM OF EXCAVATION
- BOUNDARY OF TRANSITION ZONES AND CORE
- ZONE OF EXCAVATION

0 100' 200'

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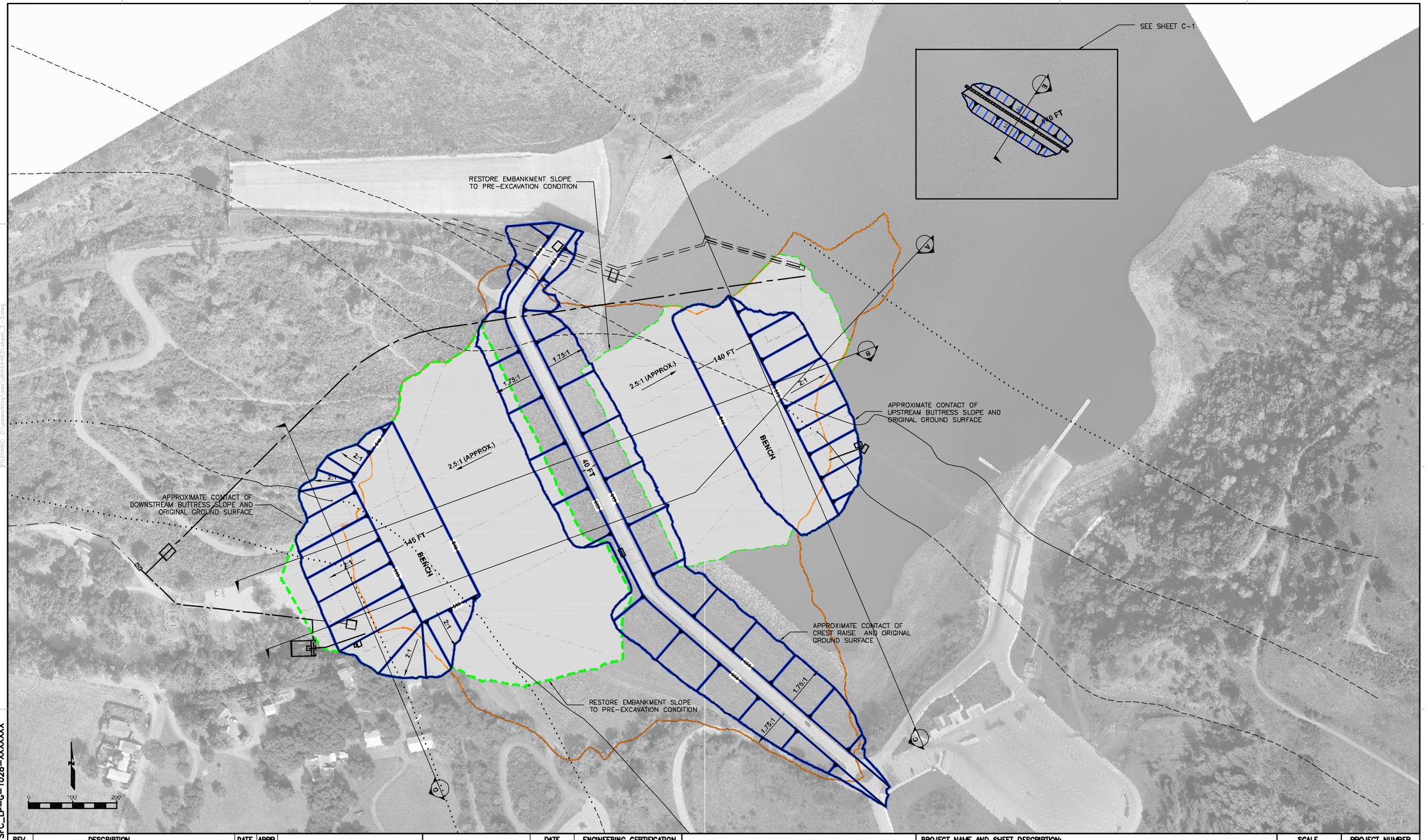


REV	DESCRIPTION	DATE	APPR.
	PRELIMINARY 04-26-2013		

HDR Engineering, Inc.

DATE	04-26-13
DESIGN	NAME
DRAWN	NAME
CHECKED	NAME

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

ACCEPTED BY DISTRICT

PROJECT NAME AND SHEET DESCRIPTION:

ANDERSON DAM SEISMIC RETROFIT PROJECT

ADSRP STAFF RECOMMENDED ALTERNATIVE 15
BUTTRESS AND CREST RAISE PLAN

SCALE 1" = 100'

VERIFY SCALES 0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

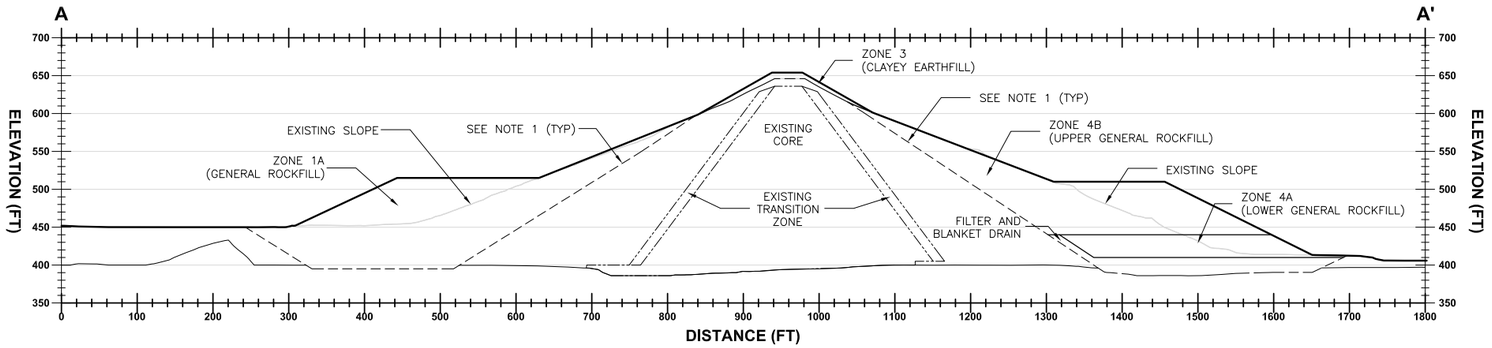
PROJECT NUMBER 26284002

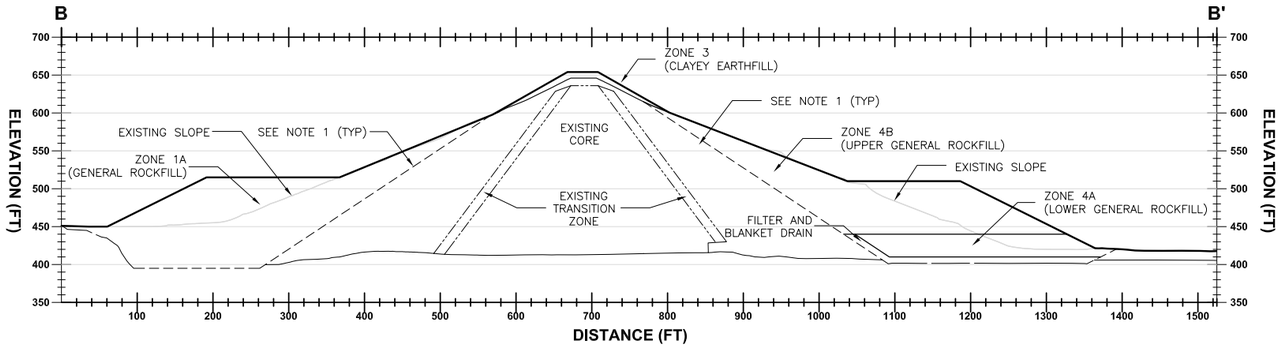
SHEET CODE: E-3

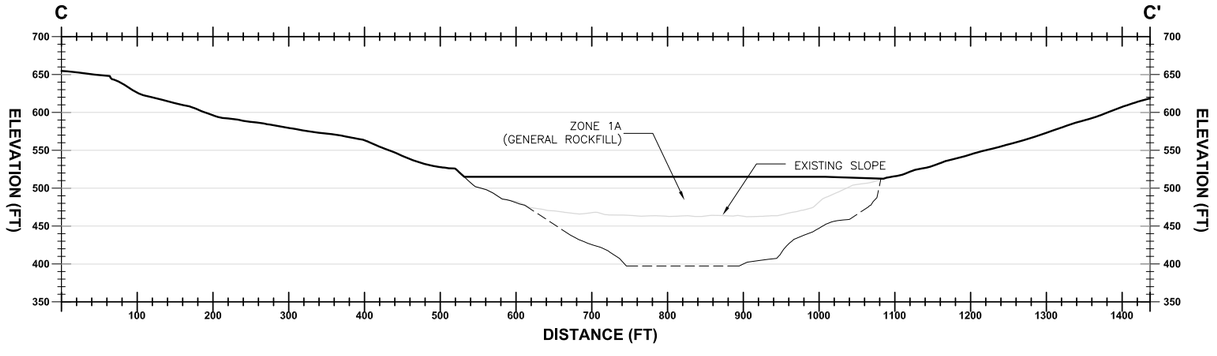
SHEET NUMBER: OF 5

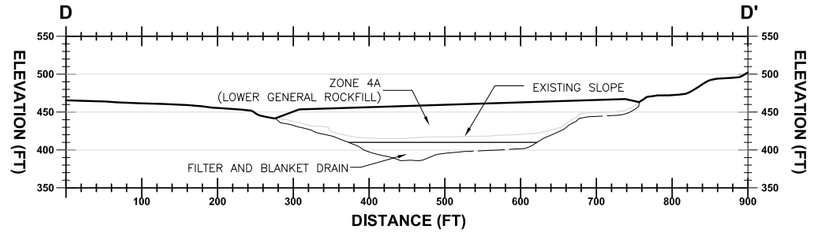
DOCUMENT NUMBER: SFC_LP-G-1028-XXXXXX

NOTES:
1. BENCH EXCAVATED SLOPE FACE. PLACE NEW FILL IN HORIZONTAL LIFTS









0 100' 200'

REV	DESCRIPTION	DATE	APPR.
	PRELIMINARY 06-28-2013		

HDR Engineering, Inc.

DATE	03-15-13
DESIGN	NAME
DRAWN	NAME
CHECKED	NAME

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

ACCEPTED BY DISTRICT

PROJECT NAME AND SHEET DESCRIPTION:

ANDERSON DAM SEISMIC RETROFIT PROJECT

FINAL CROSS SECTIONS CONCEPTUAL ALTERNATIVE 15

SCALE: 1" = 100'

VERIFY SCALES: 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26284002

SHEET CODE: E-4

SHEET NUMBER: OF 5

DOCUMENT NUMBER: SFC_LP-G-1028-XXXXXXX

USERNAME: dave.oshea 07/10/13 - 4:02pm
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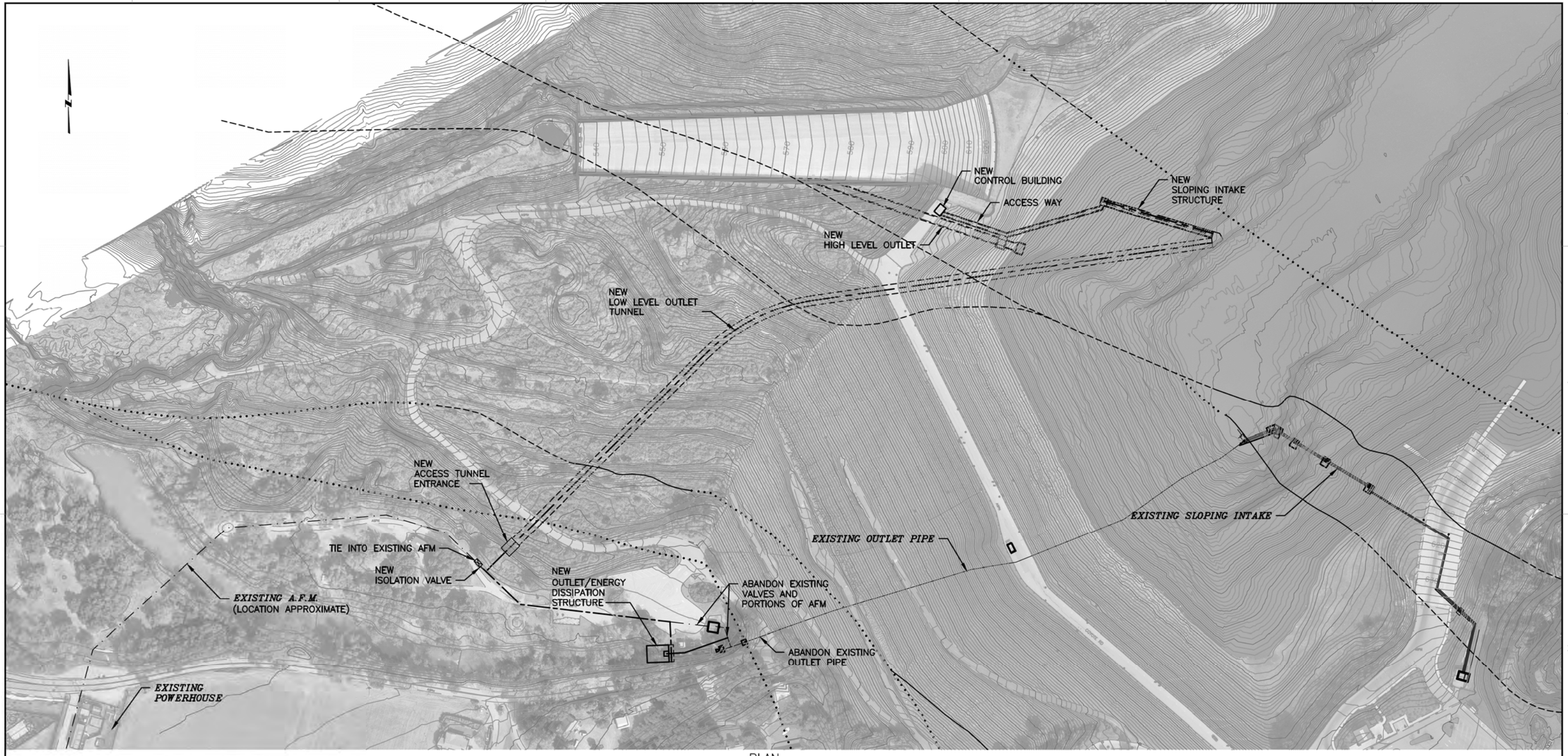


PLAN
SCALE: 1" = 100'

LEGEND:

- FAULT TRACES
- ANDERSON FORCE MAIN (A.F.M.)
- NEW LOW LEVEL OUTLET

100 0 100 200
FEET

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY		

JACOBS ASSOCIATES
Engineers/Consultants

HDR Engineering, Inc.

DATE	ENGINEERING CERTIFICATION
03-21-13	
DESIGN SPS	
DRAWN JAC	
CHECKED NAME	
PROJECT ENGINEER DATE	

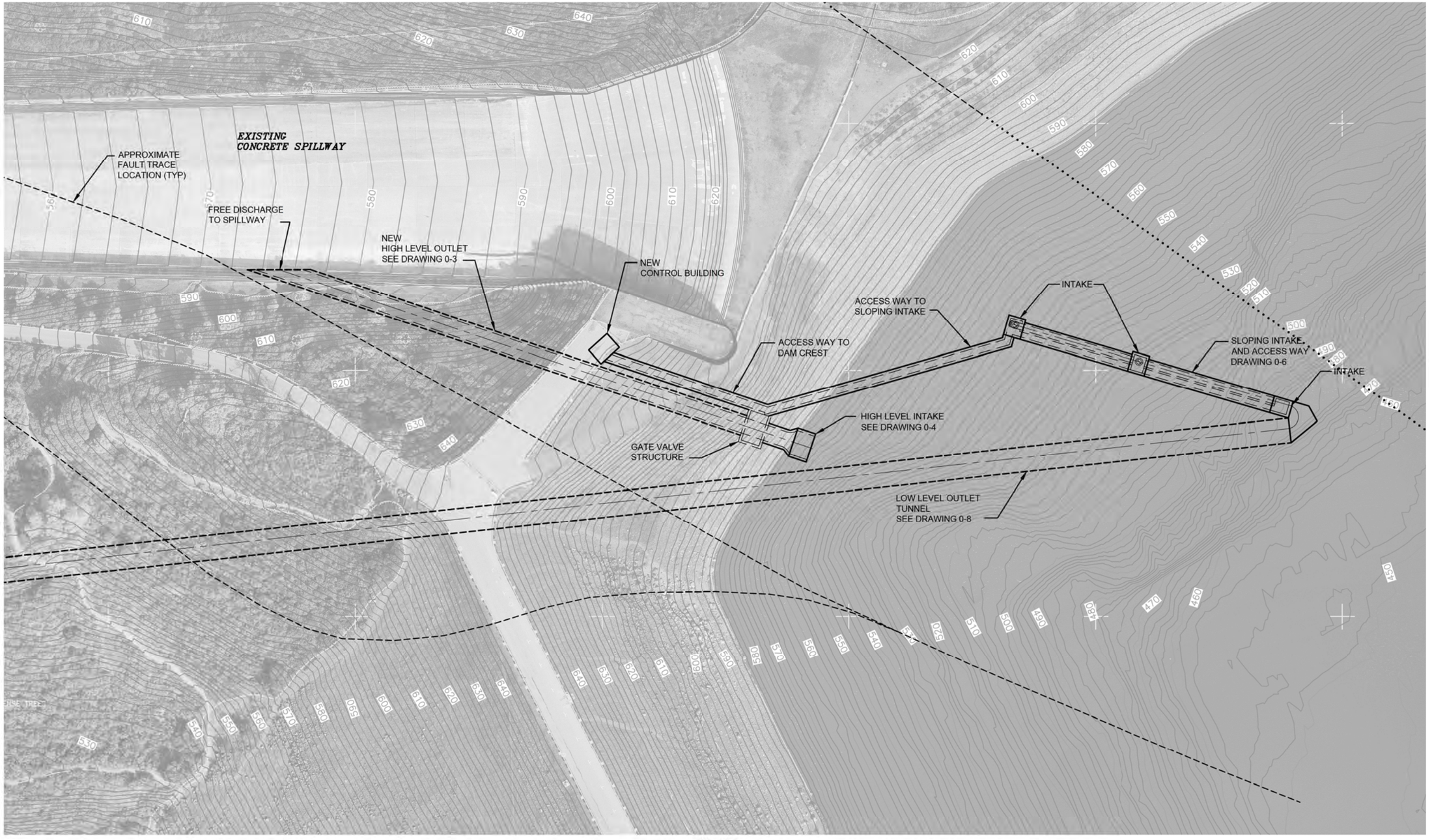
Santa Clara Valley Water District

ACCEPTED BY DISTRICT

PROJECT NAME AND SHEET DESCRIPTION:
ANDERSON DAM
SEISMIC RETROFIT PROJECT

OUTLET WORKS
GENERAL PLAN

SCALE	PROJECT NUMBER
1"=100'	4499.0
VERIFY SCALES: 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	SHEET CODE: 0-1
	SHEET NUMBER: OF



PLAN
SCALE: 1" = 40'

40 0 40 80
FEET

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY		

JACOBS ASSOCIATES
Engineers/Consultants

HDR Engineering, Inc.

DATE	03-21-13
DESIGN	SPS
DRAWN	EGB
CHECKED	NAME

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

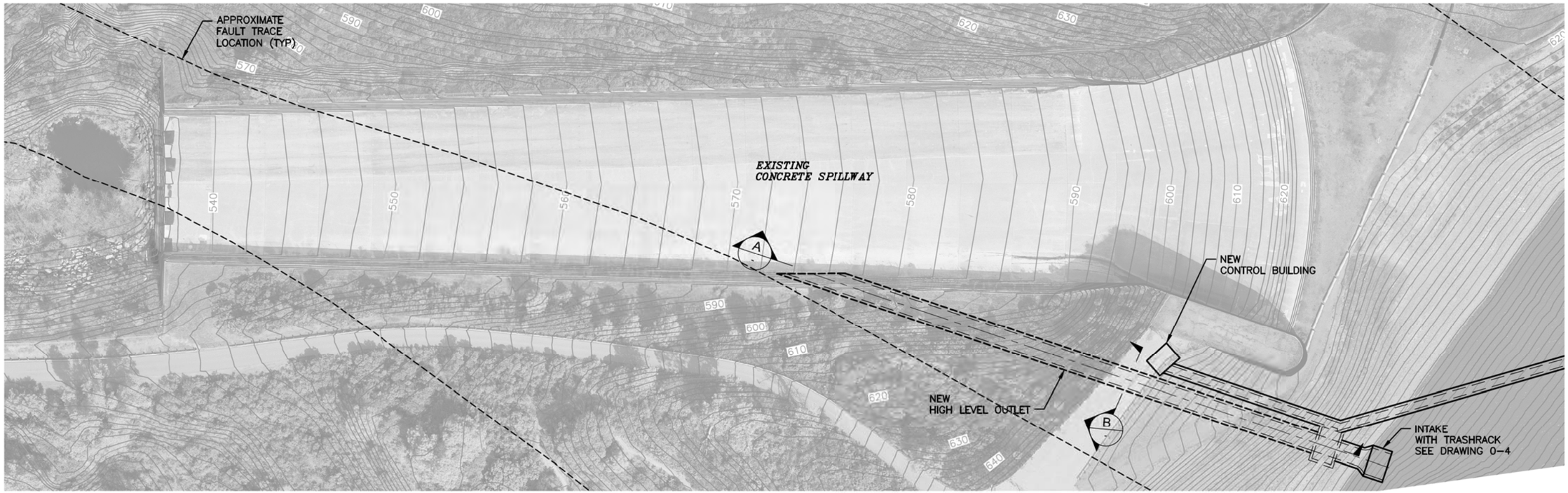
Santa Clara Valley Water District

ACCEPTED BY DISTRICT

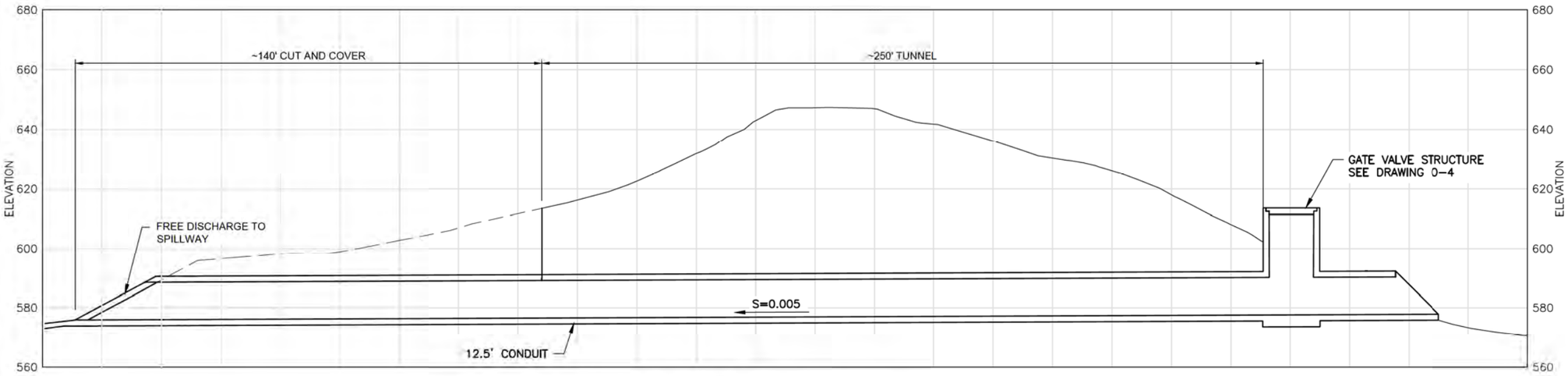
PROJECT NAME AND SHEET DESCRIPTION:
ANDERSON DAM
SEISMIC RETROFIT PROJECT

INTAKE
GENERAL PLAN

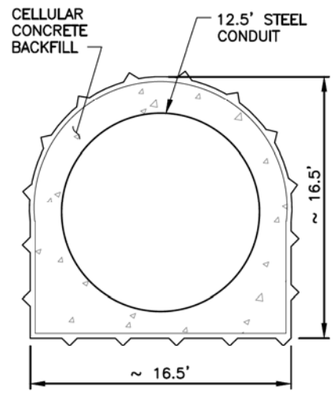
SCALE	PROJECT NUMBER
AS NOTED	4499.0
VERIFY SCALES 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	SHEET CODE: 0-2 SHEET NUMBER: OF



HIGH LEVEL OUTLET PLAN
SCALE: 1" = 40'
40 0 40 80
FEET



HIGH LEVEL OUTLET PROFILE (A)
SCALE: 1" = 20'
20 0 20 40
FEET



HIGH LEVEL OUTLET TUNNEL
SECTION (B)
SCALE: 1"=5'

REV	DESCRIPTION	DATE	APPR.
	PRELIMINARY		

JACOBS ASSOCIATES
Engineers/Consultants

HDR Engineering, Inc.

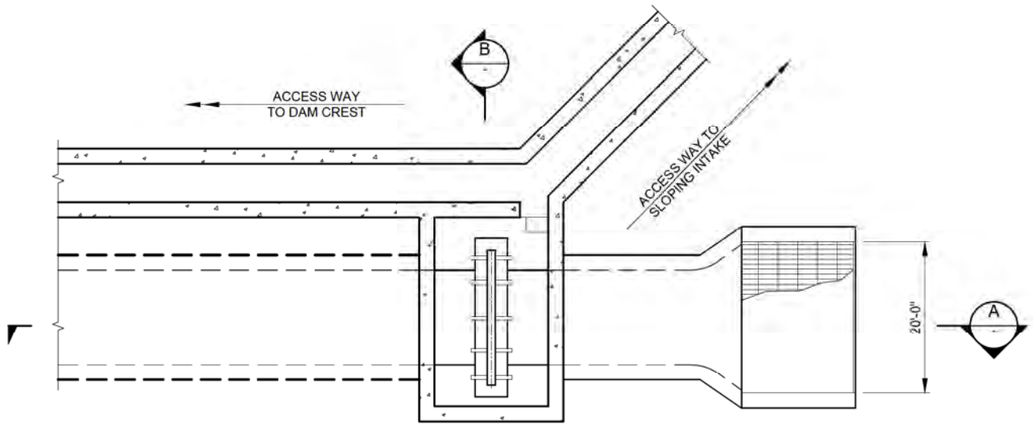
DATE	03-21-13
DESIGN	SPS
DRAWN	JAC
CHECKED	NAME

ENGINEERING CERTIFICATION
PROJECT ENGINEER DATE

Santa Clara Valley Water District
ACCEPTED BY DISTRICT

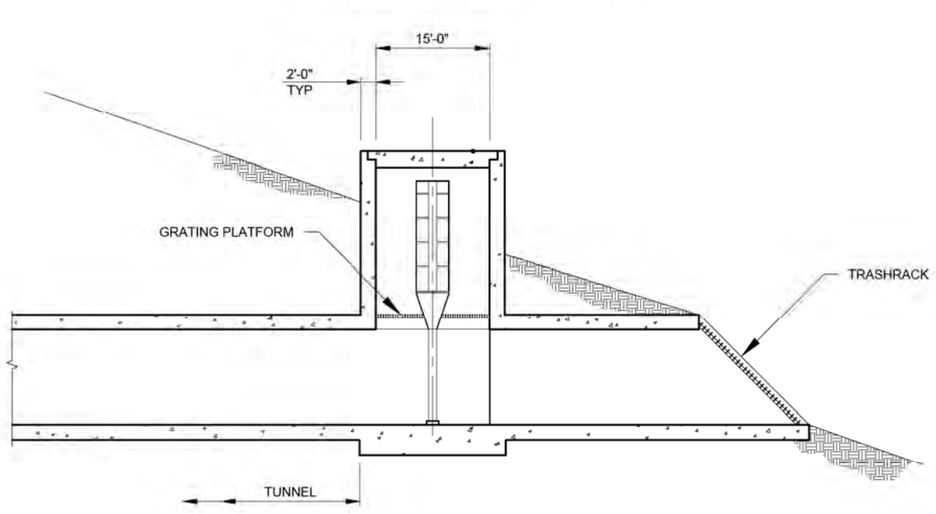
PROJECT NAME AND SHEET DESCRIPTION:
ANDERSON DAM SEISMIC RETROFIT PROJECT
HIGH LEVEL OUTLET PLAN AND PROFILE

SCALE	AS NOTED
VERIFY SCALES	0 1"
	BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
PROJECT NUMBER	4499.0
SHEET CODE:	0-3
SHEET NUMBER:	OF



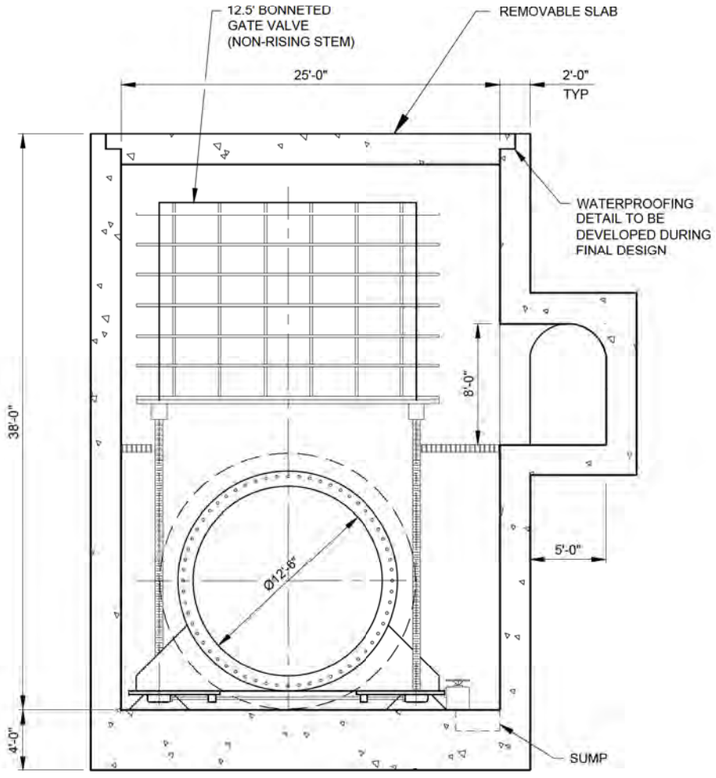
GATE VALVE STRUCTURE PLAN

SCALE: 1"=10'



SECTION A

SCALE: 1"=10"



SECTION B

SCALE: 1"=5"

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY		

JACOBS ASSOCIATES
Engineers/Consultants

HDR Engineering, Inc.

DATE	03-21-13
DESIGN	SPS
DRAWN	RHS
CHECKED	NAME

ENGINEERING CERTIFICATION

PROJECT ENGINEER PGR

Santa Clara Valley Water District

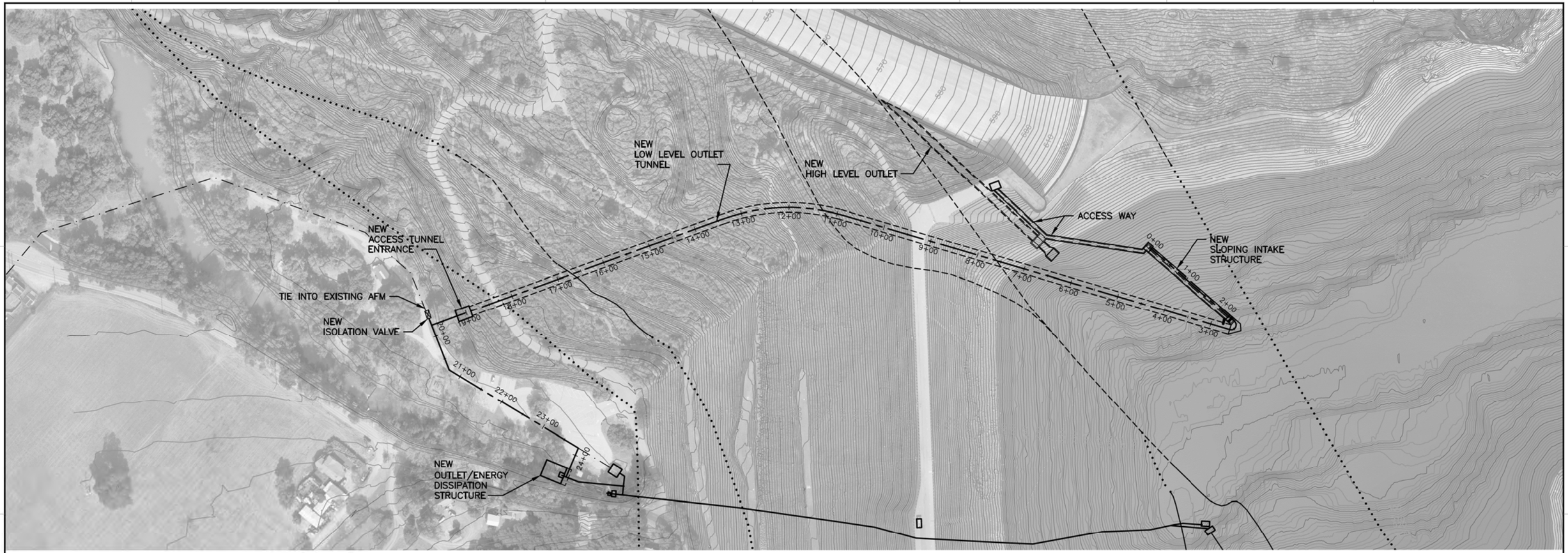
ACCEPTED BY DISTRICT

PROJECT NAME AND SHEET DESCRIPTION:

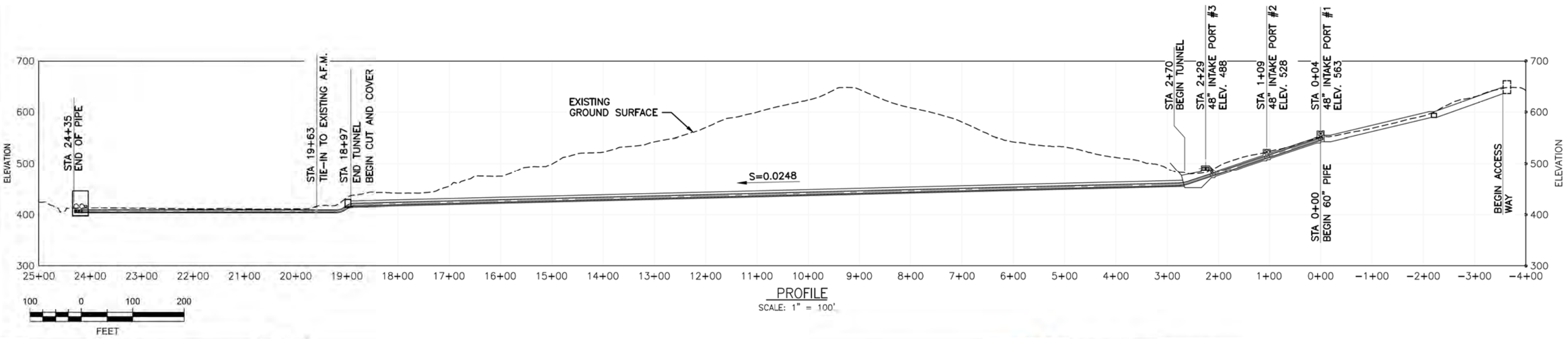
ANDERSON DAM
SEISMIC RETROFIT PROJECT

HIGH LEVEL OUTLET
INTAKE PLAN AND SECTIONS

SCALE	PROJECT NUMBER
AS NOTED	4499.0
VERIFY SCALES	SHEET CODE:
0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	0-4
	SHEET NUMBER: OF



PLAN
SCALE: 1" = 100'



PROFILE
SCALE: 1" = 100'

100 0 100 200
FEET

REV	DESCRIPTION	DATE	APPR.
	PRELIMINARY		

JACOBS ASSOCIATES
Engineers/Consultants

HDR Engineering, Inc.

DATE	ENGINEERING CERTIFICATION
03-21-13	
DESIGN: SPS	
DRAWN: JAC	
CHECKED: NAME	PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

PROJECT NAME AND SHEET DESCRIPTION:
ANDERSON DAM SEISMIC RETROFIT PROJECT

LOW LEVEL OUTLET
PLAN AND PROFILE

SCALE	PROJECT NUMBER
1"=100'	4499.0
VERIFY SCALES: 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	SHEET CODE: 0-5
	SHEET NUMBER: OF

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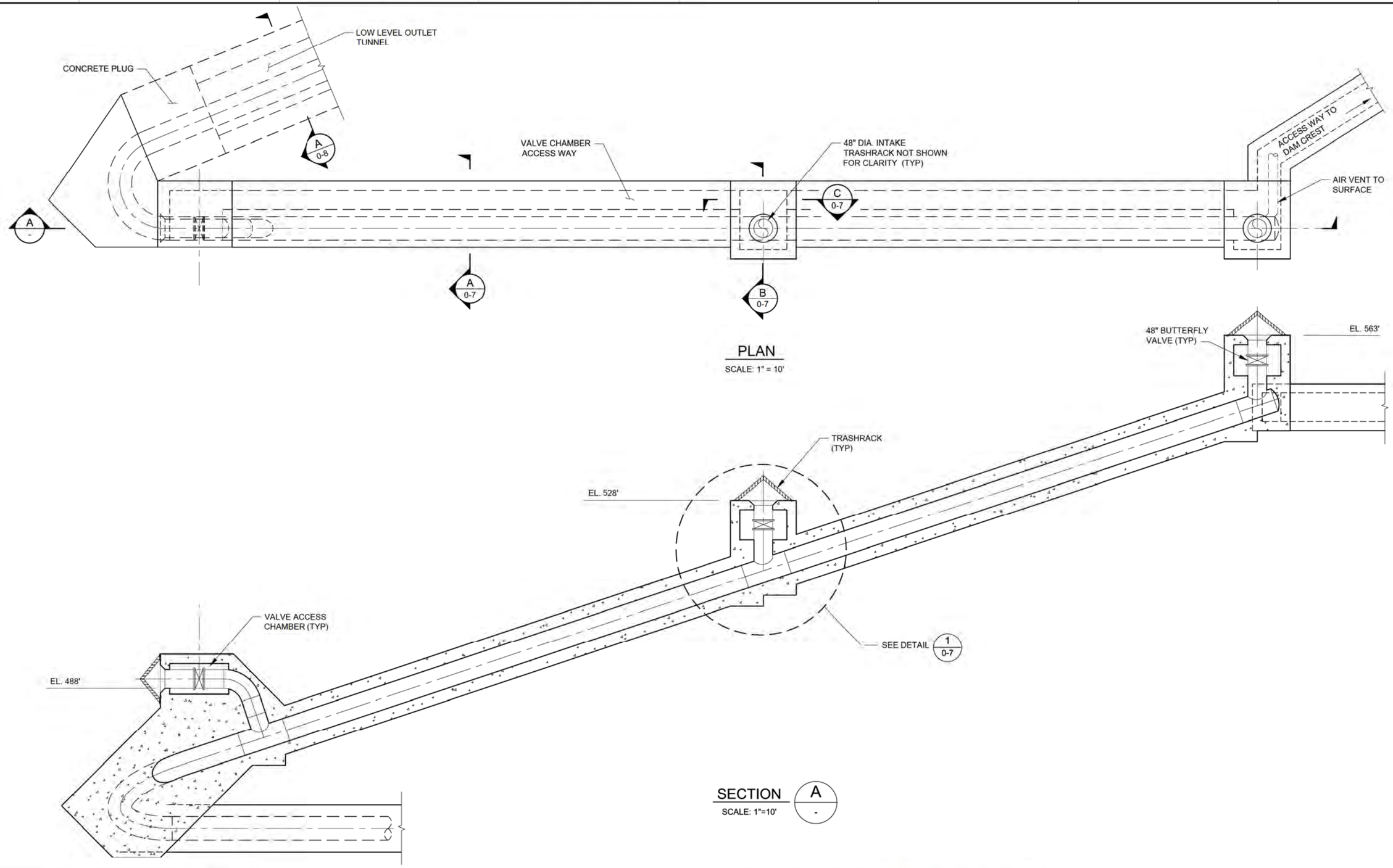


REV	DESCRIPTION	DATE	APPR.
	PRELIMINARY		

JACOBS ASSOCIATES
Engineers/Consultants

HDR Engineering, Inc.

DATE	03-21-13
DESIGN	SPS
DRAWN	RHS
CHECKED	
NAME	

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

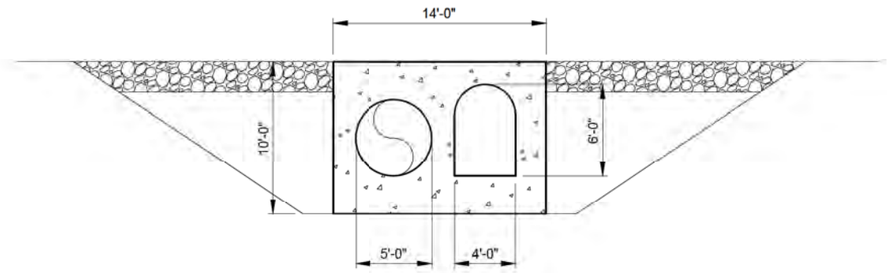
ACCEPTED BY DISTRICT

PROJECT NAME AND SHEET DESCRIPTION:

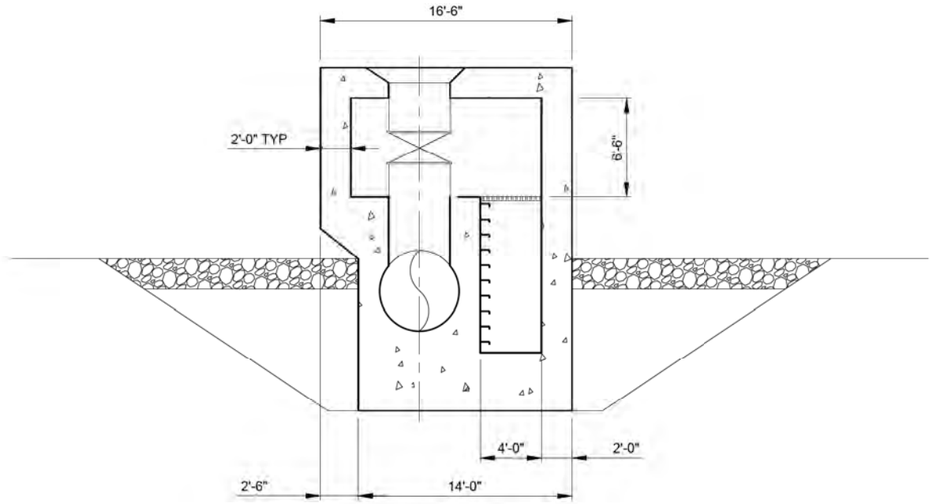
ANDERSON DAM SEISMIC RETROFIT PROJECT

LOW LEVEL OUTLET
SLOPING INTAKE
PLAN AND SECTION

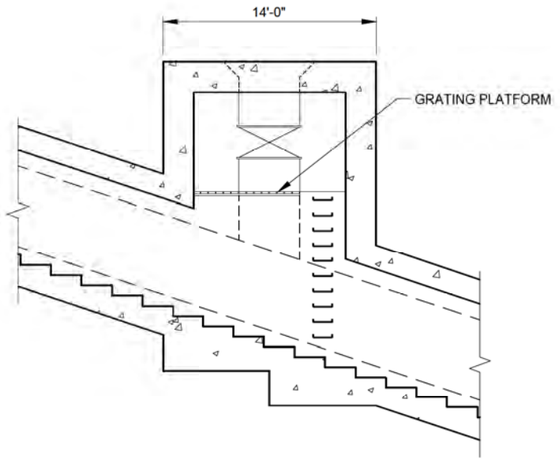
SCALE	PROJECT NUMBER
AS NOTED	4499.0
VERIFY SCALES	SHEET CODE:
0 1"	0-6
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	SHEET NUMBER: OF



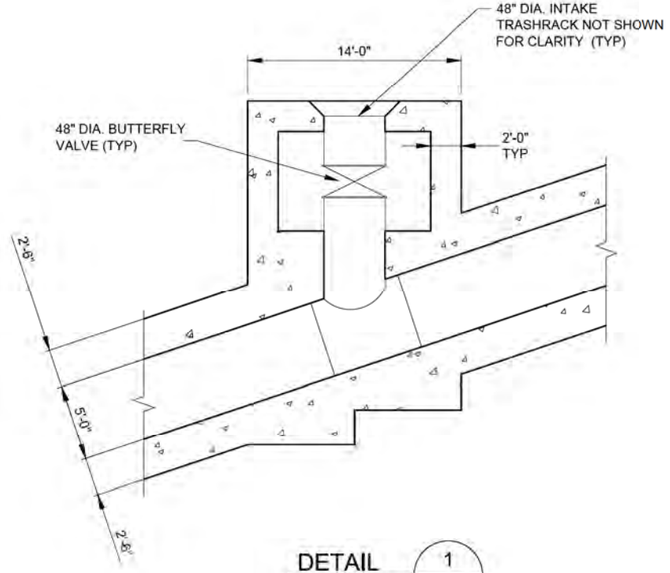
SECTION A
SCALE: 1"=5'
0-6



SECTION B
SCALE: 1"=5'
0-6



SECTION C
SCALE: 1"=5'
0-6



DETAIL 1
SCALE: 1"=5'
0-6

REV	DESCRIPTION	DATE	APPR.
	PRELIMINARY		

JACOBS ASSOCIATES
Engineers/Consultants

HDR Engineering, Inc.

DATE	03-21-13
DESIGN	SPS
DRAWN	RHS
CHECKED	
NAME	

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

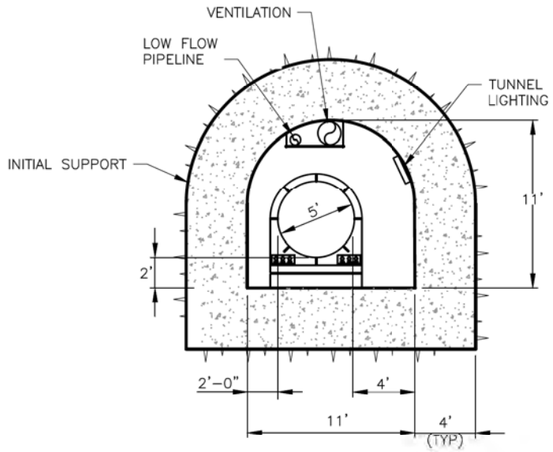
Santa Clara Valley Water District

ACCEPTED BY DISTRICT

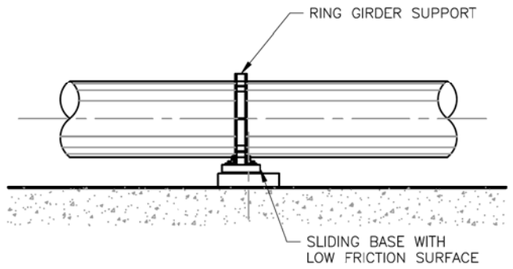
PROJECT NAME AND SHEET DESCRIPTION:
ANDERSON DAM SEISMIC RETROFIT PROJECT

LOW LEVEL OUTLET
SLOPING INTAKE
SECTIONS AND DETAIL

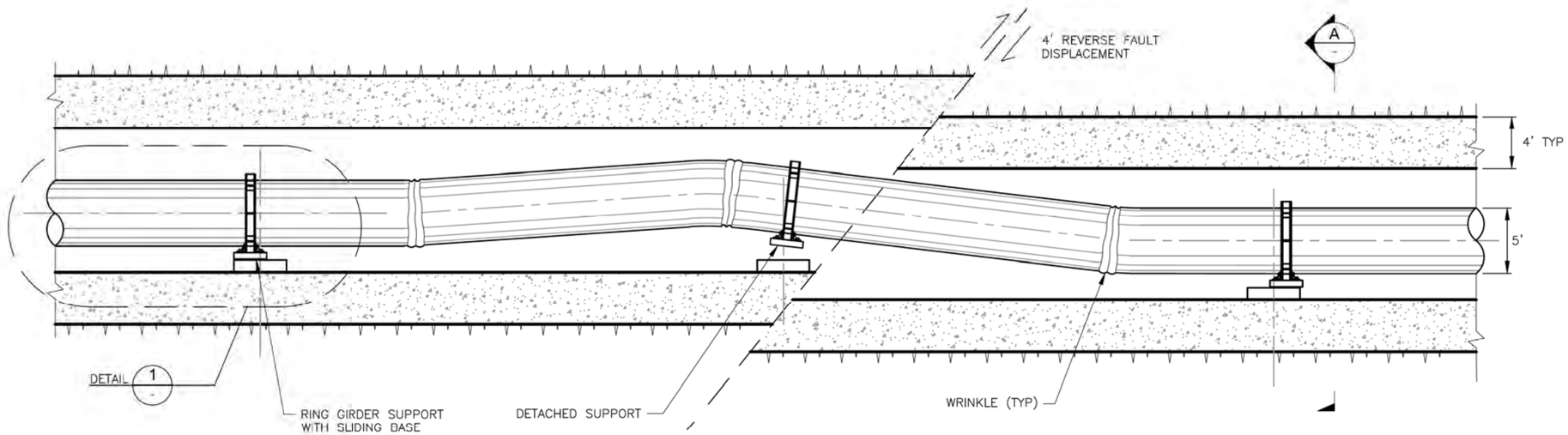
SCALE	PROJECT NUMBER
AS NOTED	4499.0
VERIFY SCALES	SHEET CODE:
0 1"	0-7
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	SHEET NUMBER: OF



TUNNEL SECTION A
NOT TO SCALE



SUPPORT SADDLE DETAIL 1
NOT TO SCALE



TUNNEL ELEVATION
NOT TO SCALE

REV	DESCRIPTION	DATE	APPR.
	PRELIMINARY		

JACOBS ASSOCIATES
Engineers/Consultants

HDR Engineering, Inc.

DATE	03-21-13
DESIGN	SPS
DRAWN	JAC
CHECKED	NAME

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

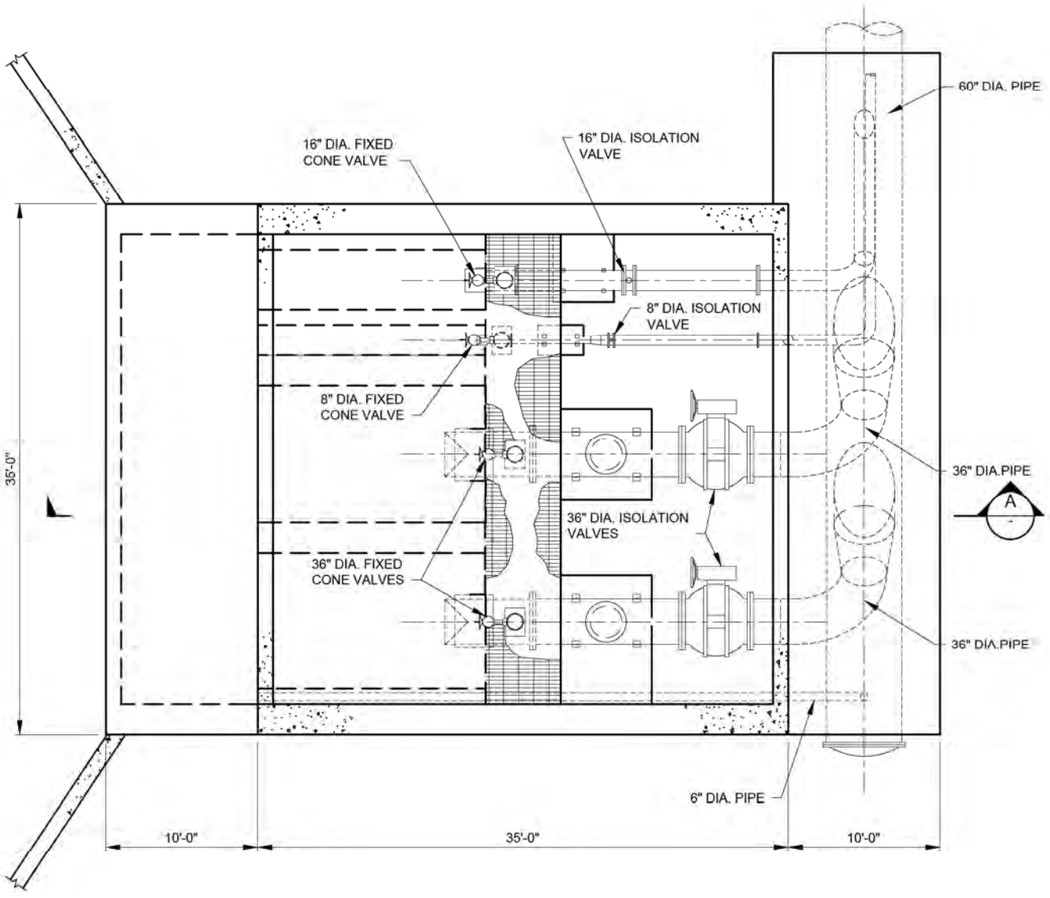
ACCEPTED BY DISTRICT

PROJECT NAME AND SHEET DESCRIPTION:

ANDERSON DAM SEISMIC RETROFIT PROJECT

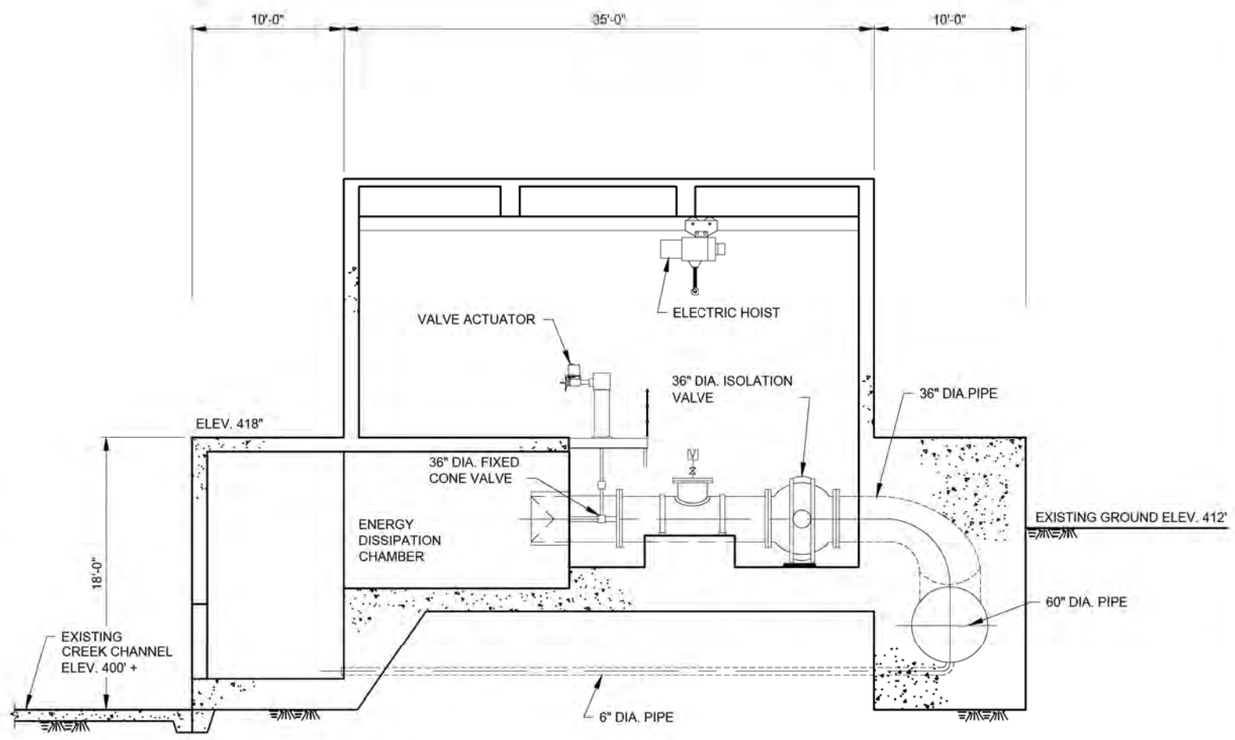
LOW LEVEL OUTLET TUNNEL AND CONDUIT SECTIONS

SCALE	NOT TO SCALE
VERIFY SCALES	0 1"
	BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
PROJECT NUMBER	4499.0
SHEET CODE:	0-8
SHEET NUMBER:	OF



PLAN AT ELEV. 418'

SCALE: 1"=5'



SECTION A

SCALE: 1"=5"

REV	DESCRIPTION	DATE	APPR.
	PRELIMINARY		

JACOBS ASSOCIATES
Engineers/Consultants

HDR Engineering, Inc.

DATE	ENGINEERING CERTIFICATION
03-21-13	
DESIGN SPS	
DRAWN RHS	
CHECKED NAME	
PROJECT ENGINEER EGB	

Santa Clara Valley Water District

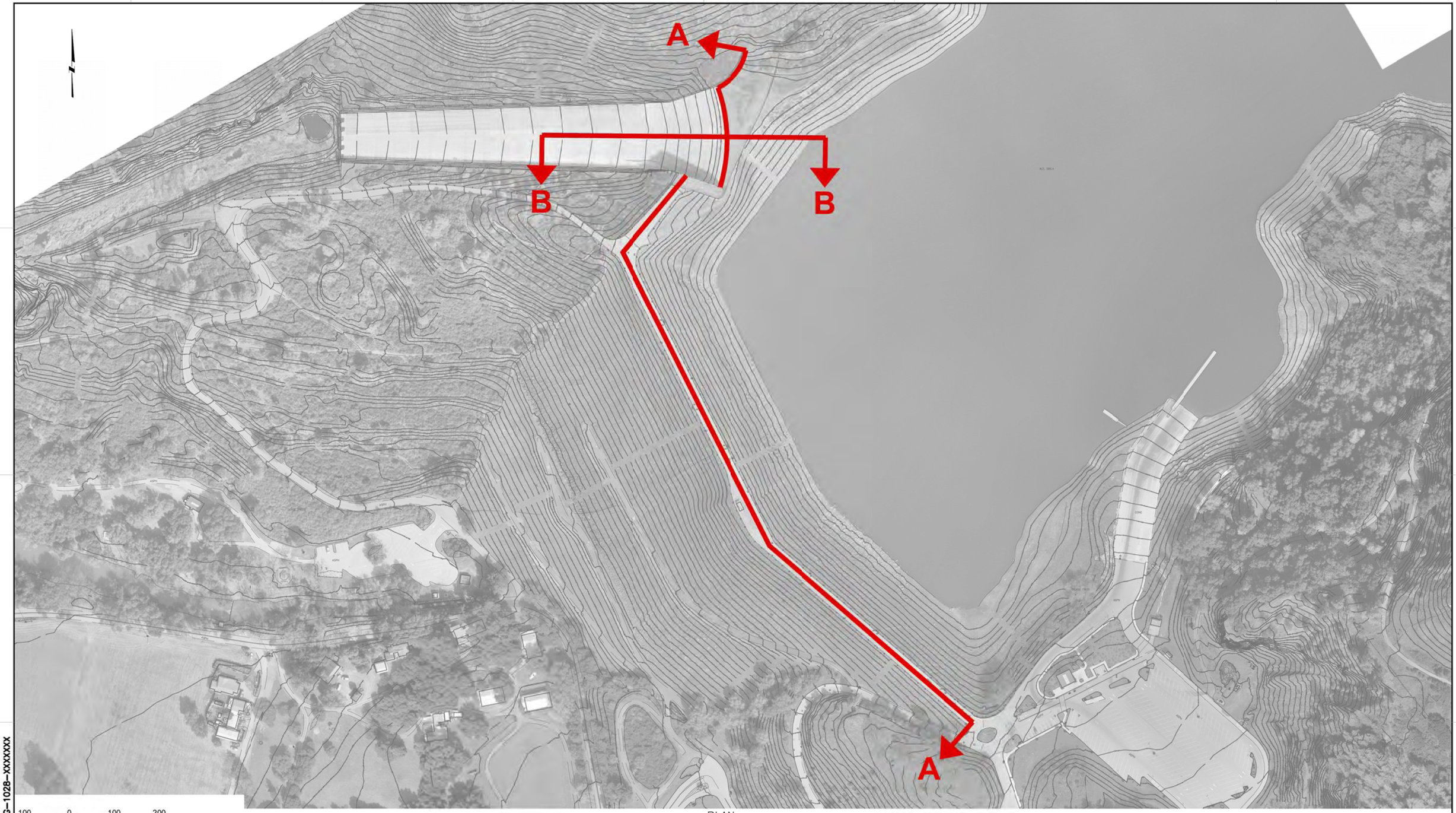
ACCEPTED BY DISTRICT

PROJECT NAME AND SHEET DESCRIPTION:

ANDERSON DAM SEISMIC RETROFIT PROJECT

LOW LEVEL OUTLET
ENERGY DISSIPATION STRUCTURE
PLAN AND SECTION

SCALE	PROJECT NUMBER
AS NOTED	4499.0
VERIFY SCALES 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	SHEET CODE: 0-9 SHEET NUMBER: OF



100 0 100 200
FEET

PLAN
SCALE: 1" = 100'

SFC_LP-G-1028-XXXXXXX

REV	DESCRIPTION	DATE	APPR.
	PRELIMINARY 09-10-2012		

HDR Engineering, Inc.

DATE	08-31-12
DESIGN	SPS
DRAWN	JAC
CHECKED	NAME

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

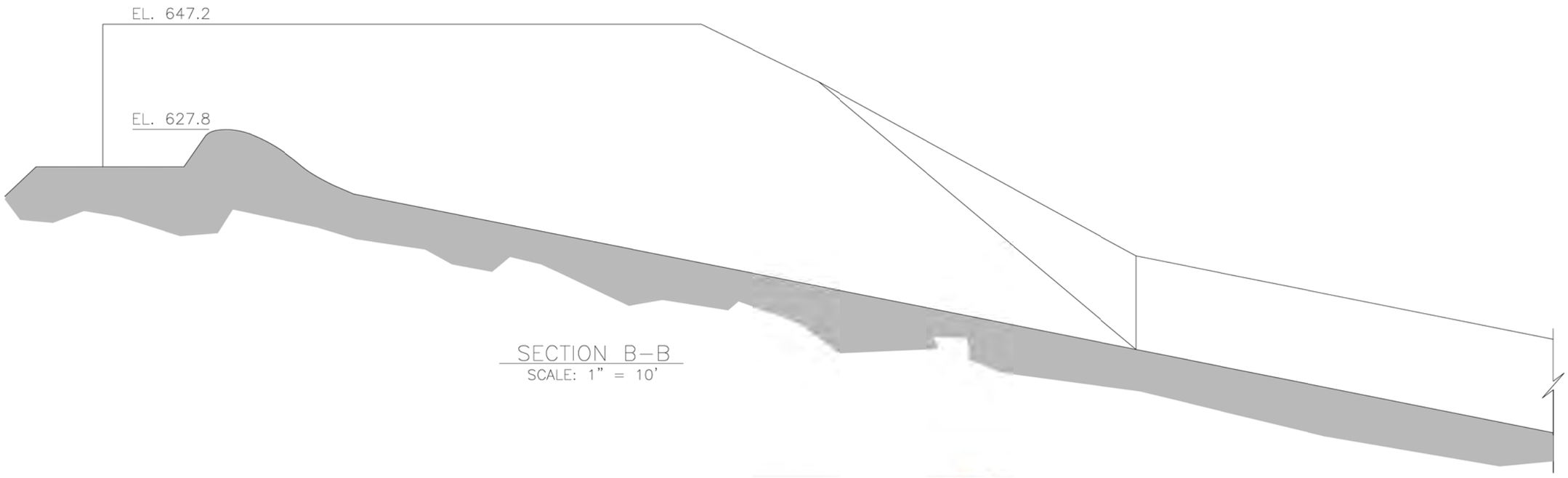
ACCEPTED BY DISTRICT

PROJECT NAME AND SHEET DESCRIPTION:
ANDERSON DAM SEISMIC RETROFIT PROJECT

SPILLWAY MODIFICATION ALTERNATIVES
PLAN VIEW

SCALE	PROJECT NUMBER
1"=100'	4499.0
VERIFY SCALES 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	SHEET CODE: S-1
	SHEET NUMBER: OF 19

ELEVATION A–A
SCALE: 1" = 60'



SECTION B–B
SCALE: 1" = 10'

SFC_LP–G–1028–XXXXXX

REV	DESCRIPTION	DATE	APPR.
	QUANTITIES 11–5–2012		

HDR Engineering, Inc.

DATE	08–31–12
DESIGN	SPS
DRAWN	JAC
CHECKED	NAME

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

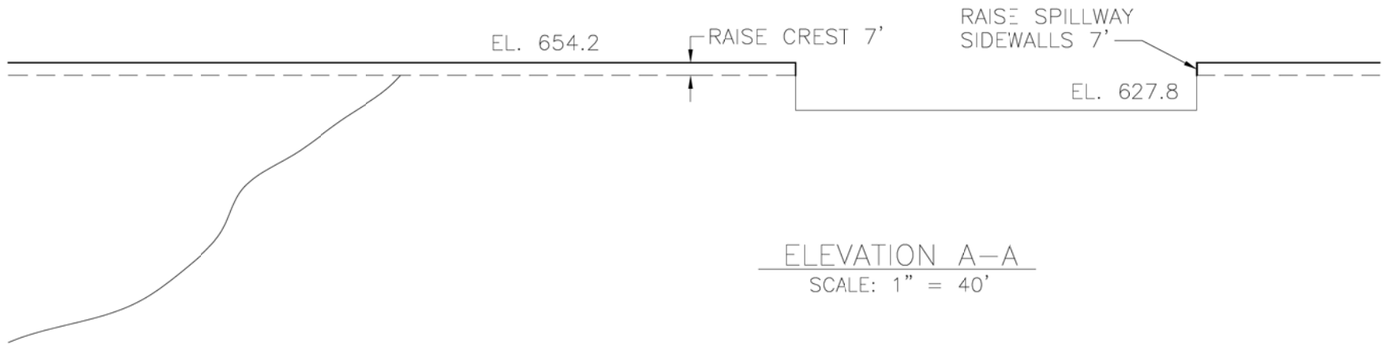
ACCEPTED BY DISTRICT

PROJECT NAME AND SHEET DESCRIPTION:
ANDERSON DAM SEISMIC RETROFIT PROJECT

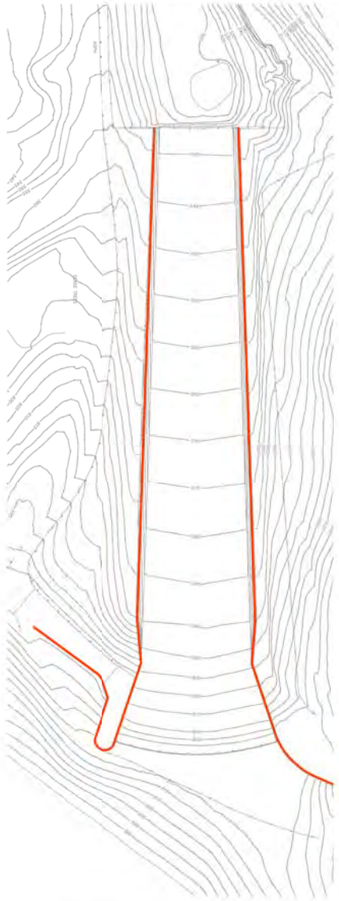
SPILLWAY MODIFICATION ALTERNATIVES
EXISTING DAM ELEVATION & SPILLWAY SECTION

SCALE: AS NOTED
VERIFY SCALES: 0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

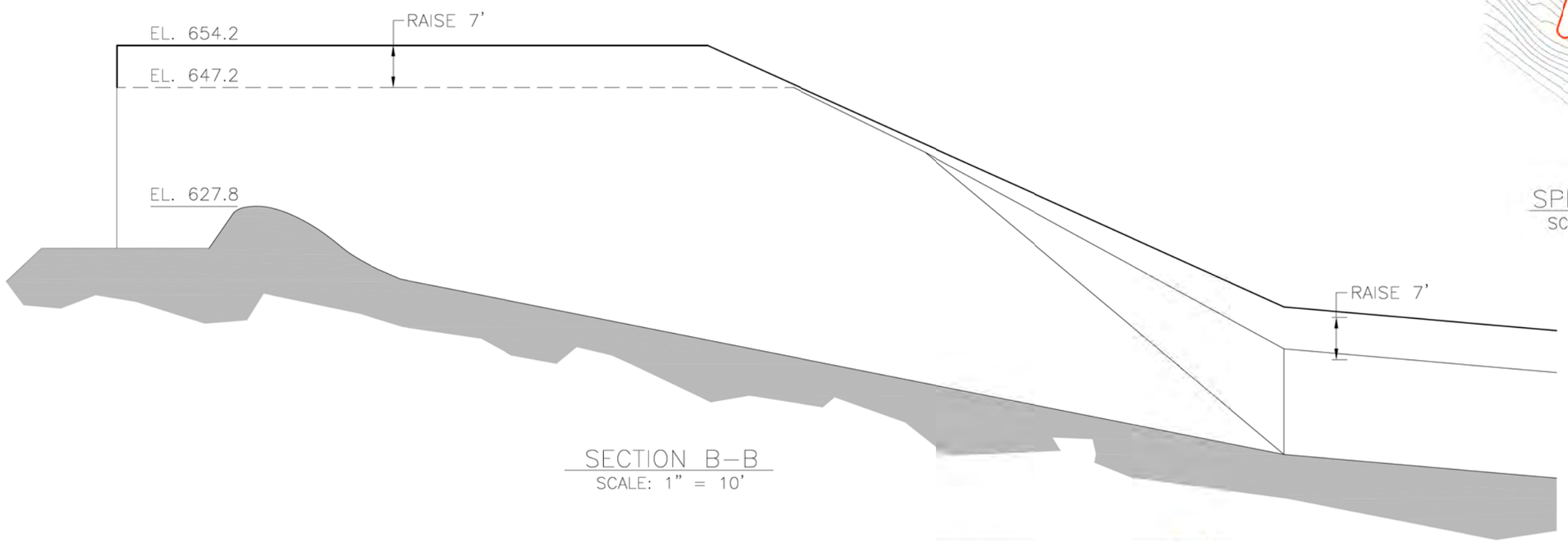
PROJECT NUMBER: 4499.0
SHEET CODE: S-2
SHEET NUMBER: OF 19



ELEVATION A–A
SCALE: 1" = 40'



SPILLWAY PLAN
SCALE: 1" = 100'



SECTION B–B
SCALE: 1" = 10'

SFC_LP–G–1028–XXXXXXX

REV	DESCRIPTION	DATE	APPR.
	QUANTITIES 11–5–2012		

HDR Engineering, Inc.

DATE 08–31–12
DESIGN SPS
DRAWN JAC
CHECKED NAME

ENGINEERING CERTIFICATION
PROJECT ENGINEER DATE

Santa Clara Valley Water District
ACCEPTED BY DISTRICT

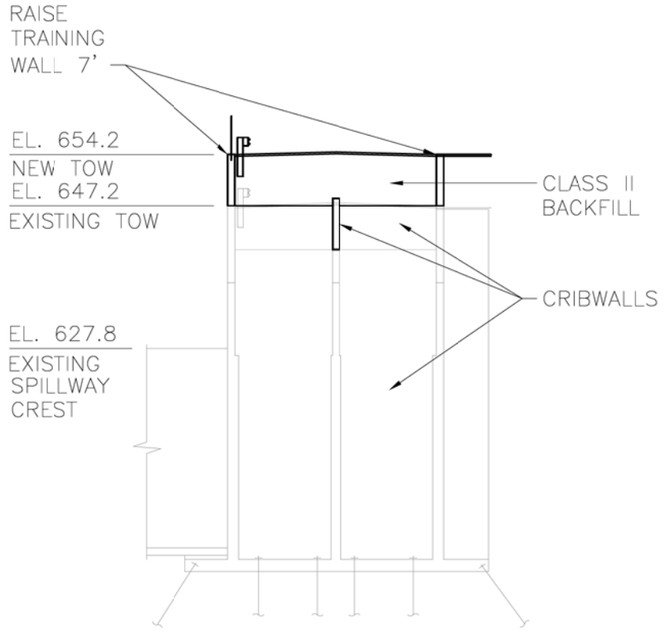
PROJECT NAME AND SHEET DESCRIPTION:
ANDERSON DAM SEISMIC RETROFIT PROJECT
SPILLWAY MODIFICATION ALTERNATIVES OPTION S1

SCALE: AS NOTED
VERIFY SCALES: 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

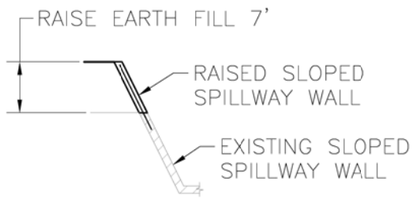
PROJECT NUMBER: 4499.0
SHEET CODE: S-3
SHEET NUMBER: OF 19

QUANTITY TABLE

	WALL AREA (ft^2)	CONCRETE VOLUME (yd^3)	REINFORCING WEIGHT (lbs)	DRILL & BOND DOWEL (ea)	D & B DOWEL WEIGHT (lbs)	CLASS II BACKFILL (yd^3)	EARTH BACKFILL (yd^3)
CRIB WALLS							
LEFT	2,718	101	7,284	858	2,395	970	–
RIGHT	2,437	90	6,532	757	2,113	662	–
TRAINING WALL							
LEFT	2,119	78	8,477	404	2,489	–	–
RIGHT	1,568	58	6,272	299	1,842	–	–
SLOPED SPILLWAY WALL							
LEFT	5,609	208	16,826	720	6,660	–	3,774
RIGHT	5,609	208	16,826	720	6,660	–	3,774
TOTAL	20,060	743	62,216	3,757	22,159	1,632	7,549



SECTION C
SCALE: 1" = 10'



SECTION D
SCALE: 1" = 10'

SECTION B–B
SCALE: 1" = 10'

SFC_LP-G-1028-XXXXXXX

REV	DESCRIPTION	DATE	APPR.
	REVISED QUANTITIES 1-15-2013		

HDR Engineering, Inc.

DATE 08-31-12
DESIGN SPS
DRAWN JAC
CHECKED NAME

ENGINEERING CERTIFICATION
PROJECT ENGINEER DATE

Santa Clara Valley Water District
ACCEPTED BY DISTRICT

PROJECT NAME AND SHEET DESCRIPTION:
ANDERSON DAM SEISMIC RETROFIT PROJECT
SPILLWAY MODIFICATION ALTERNATIVES OPTION S1

SCALE: AS NOTED
VERIFY SCALES: 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 4499.0
SHEET CODE: S-4
SHEET NUMBER: OF 19