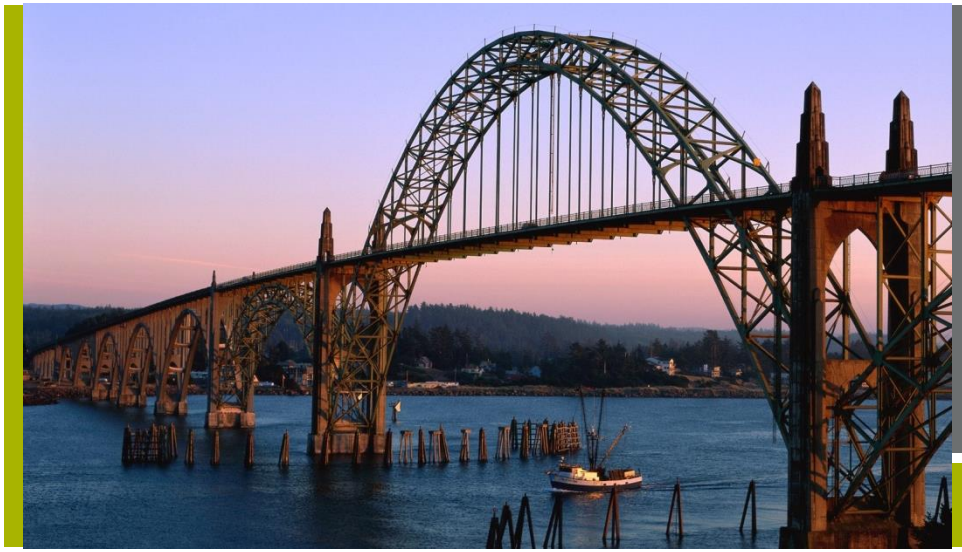
Newport Big Creek Dams

City Council Work Session
07-20-2015



Engineering Evaluation & Corrective Action Alternatives

Presented by
Verena Winter, P.E. HDR Engineering

Newport
Big Creek Dams

Overview

- Verification of Seismic Deficiencies
- Corrective Action Alternatives
- Preliminary Environmental Review
- Decision Level Cost Estimate
- Conclusions
- Recommendations

Project Timeline

Timeline		Activity
April 2011	→	1st boring sample– discovered the issue
Dec 2011	→	2nd round of sampling
Jan - May 2012	→	Laboratory testing of 2nd round samples
Feb 2013	→	Report “Geotechnical Investigation & Seismic Evaluation”
Nov 2013	→	3rd round of sampling
Jan - June 2014	→	Laboratory testing of 3rd round samples
June 2015	→	Report “Engineering Evaluation & Corrective Action Alternatives”

Engineering Analysis/Deficiency Verification

- BC-1:
  - Will fail by settlement and overtopping during a bigger earthquake (recurrence intervals of 2,475 and 4,975 years – higher magnitude quakes).
  - More frequent seismic events (475- and 975-year – lower magnitude quakes) will result in significant damage to the dam, outlet works, water supply pump station, and ability to operate the reservoir
  - Location and configuration of the foundation material is very deep. Remediation is challenging and expensive.
  - Small amount of storage in the reservoir and the very large anticipated remediation costs, rehabilitation of this dam is judged as non-feasible.

Engineering Analysis/Deficiency Verification

- BC-2:
  - Unacceptable deformations (settlement) during the 4,975-year and 2,475 recurrence interval seismic events
  - Likely to fail due to overtopping and/or seepage through transverse cracks after the shaking
  - Significant damage during more frequent seismic events
  - The upstream slope is buttressed by some sediment that has accumulated in the reservoir which acts as a limited buttress during seismic loading
  - Analysis results indicate deformations of the upstream slope will be significant for the larger earthquakes resulting in damage or failure of the outlet works, intake structure, and discharge pipeline (similar to BC1)

Engineering Analysis/Deficiency Verification

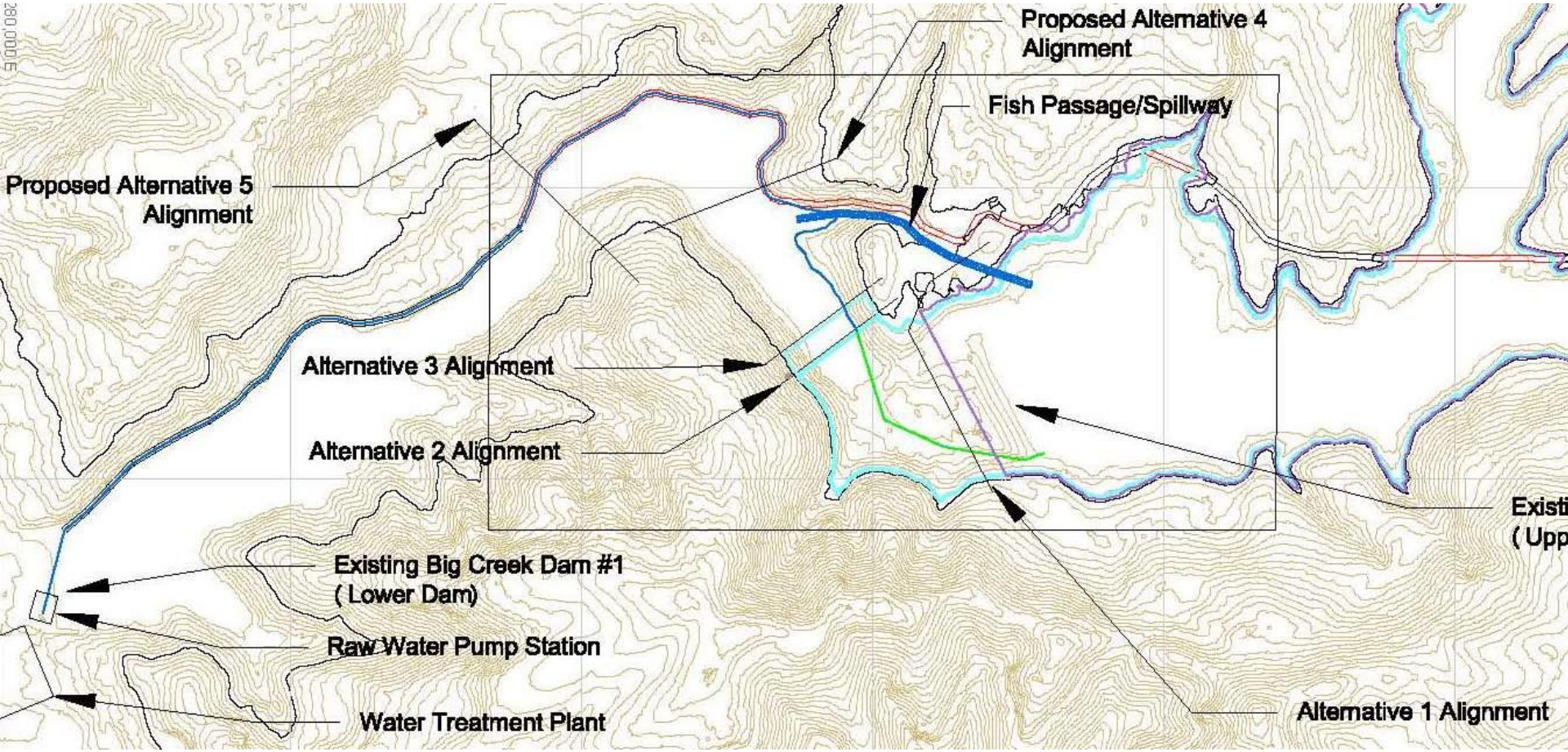
- Results:
  - The lab testing and engineering analysis show:
    - Not a stability problem
    - It's a deformation problem

Alternatives for Corrective Actions – Storage Capacity

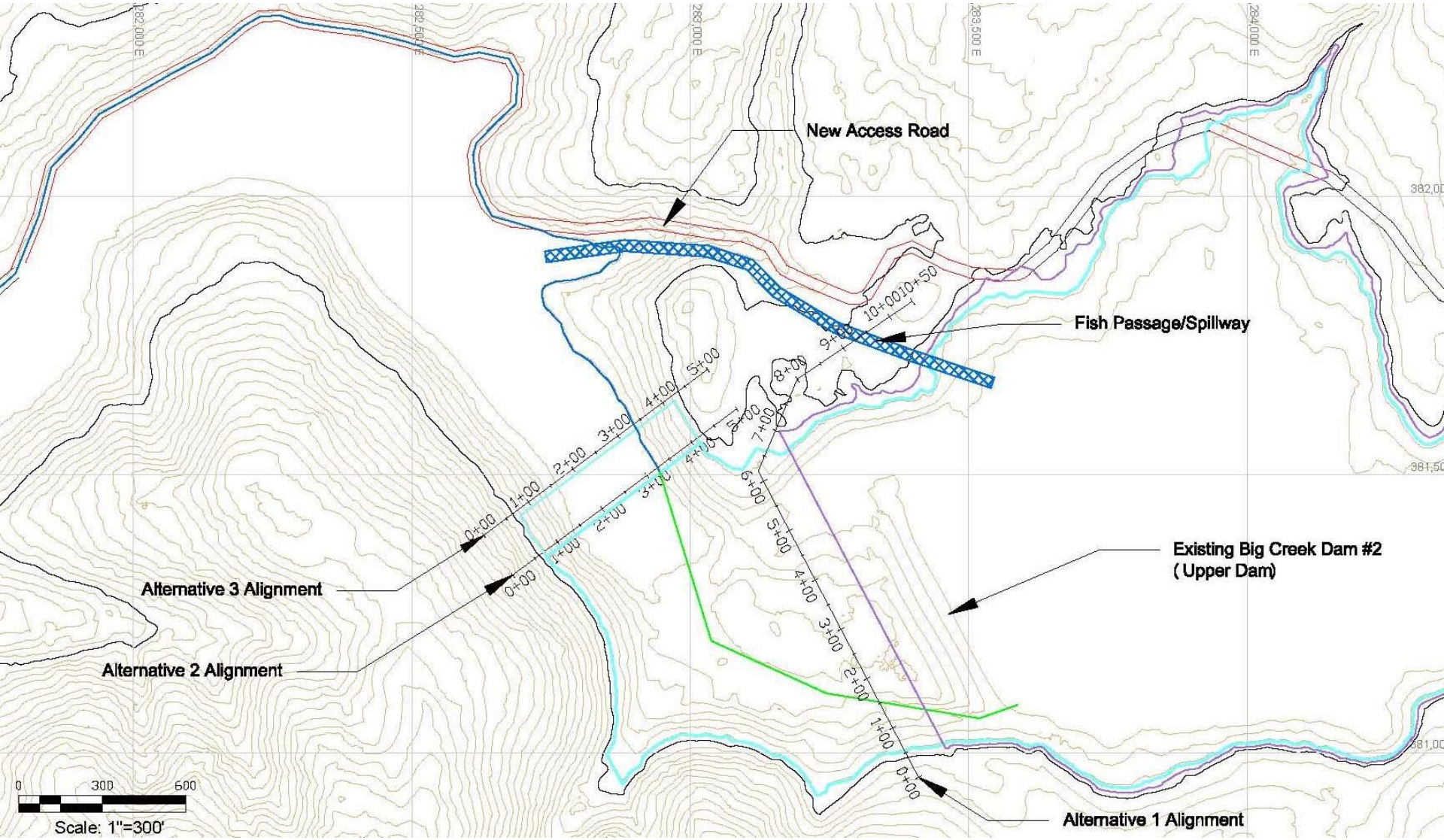
Overall Goal: provide a reliable drinking water source for Newport

- Storage capacities:
  - BC-1 = 200 acre-ft
  - BC-2 = 970 acre-ft
  - Future projection = 1000 acre-ft
  - Sediment storage = 100 acre-ft
  - **Future = 2,270 acre-ft**

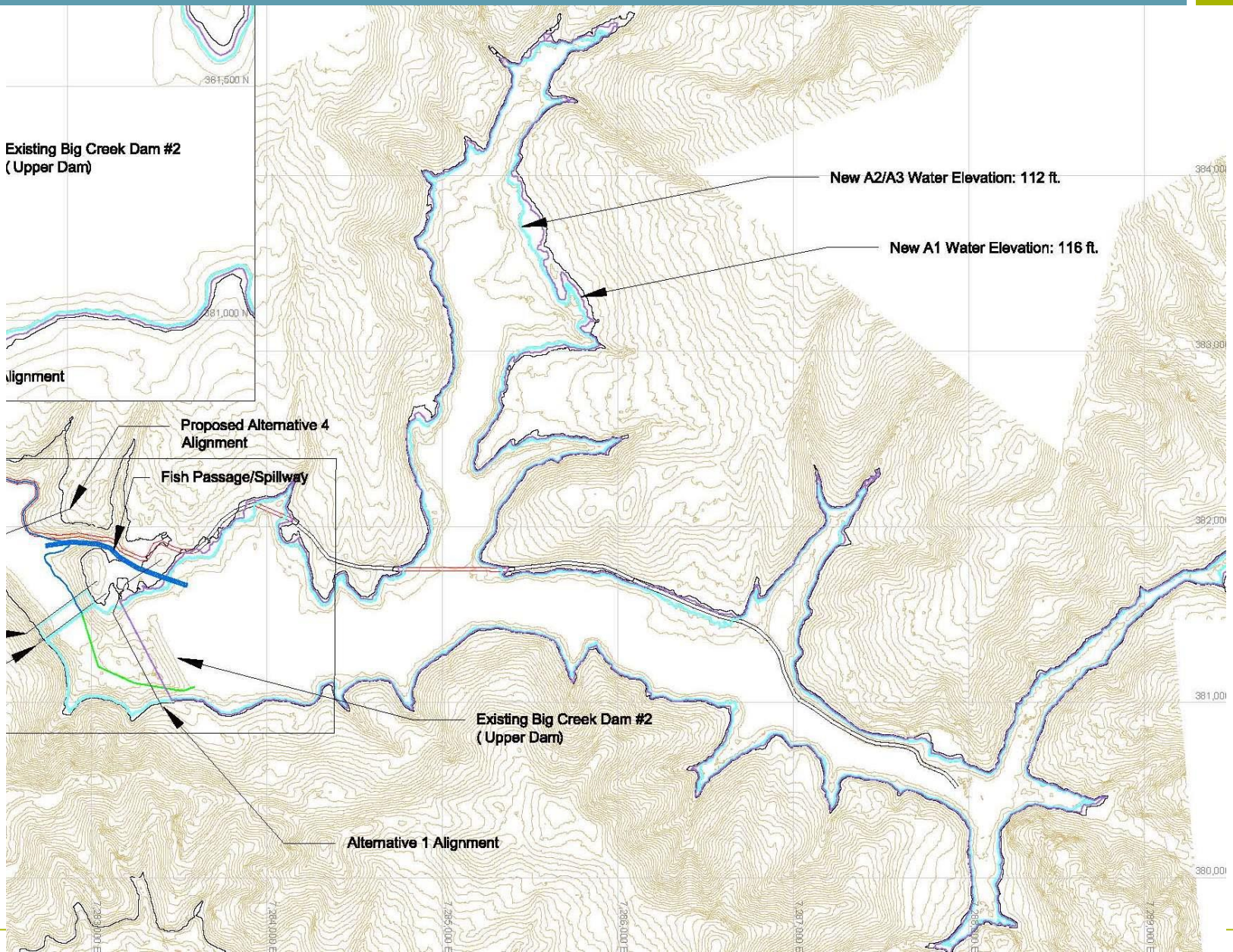
Alternatives for Corrective Actions – 5 Options



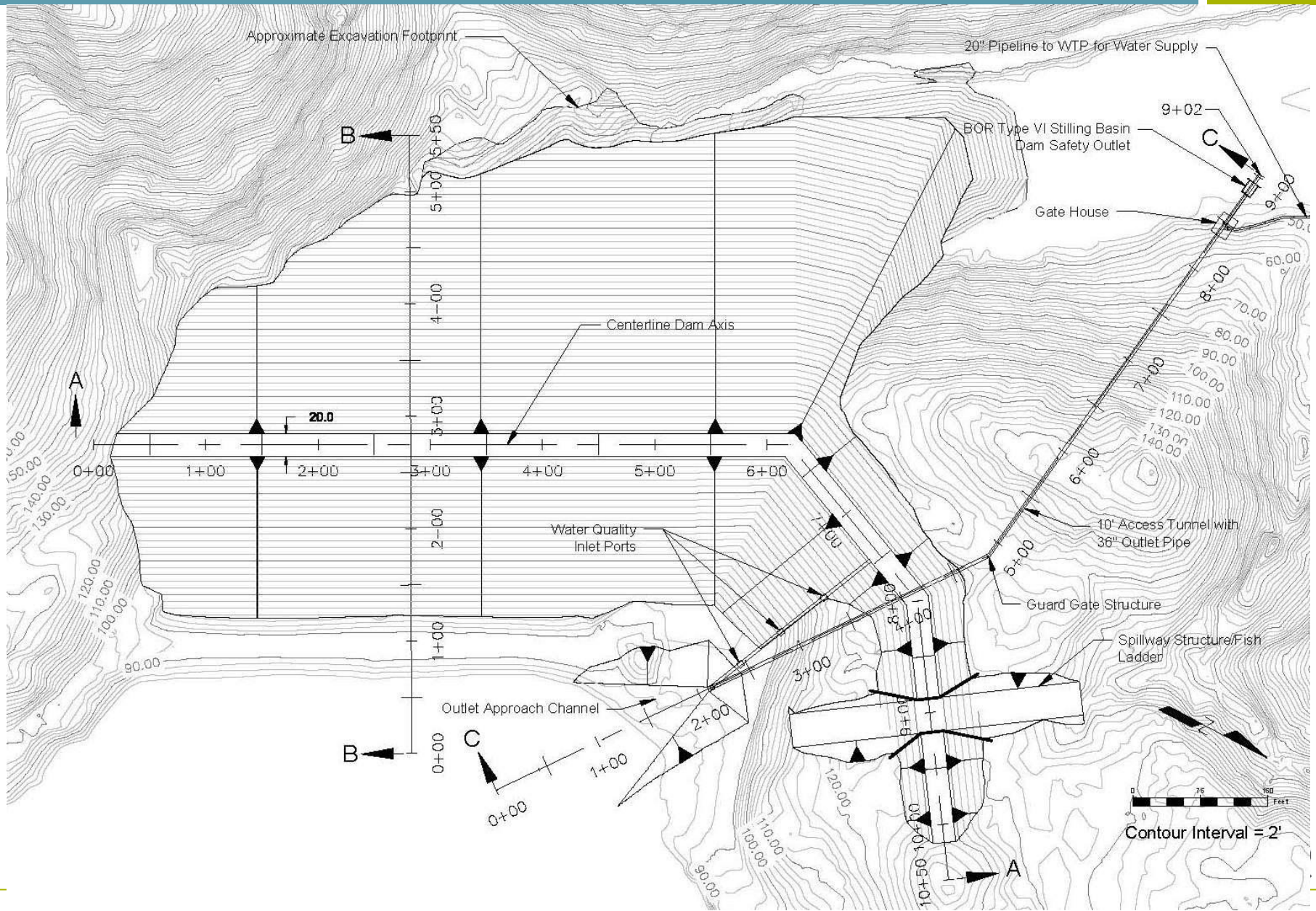
Alternatives for Corrective Actions – 3 Options



Alternatives for Corrective Actions – Inundation Area



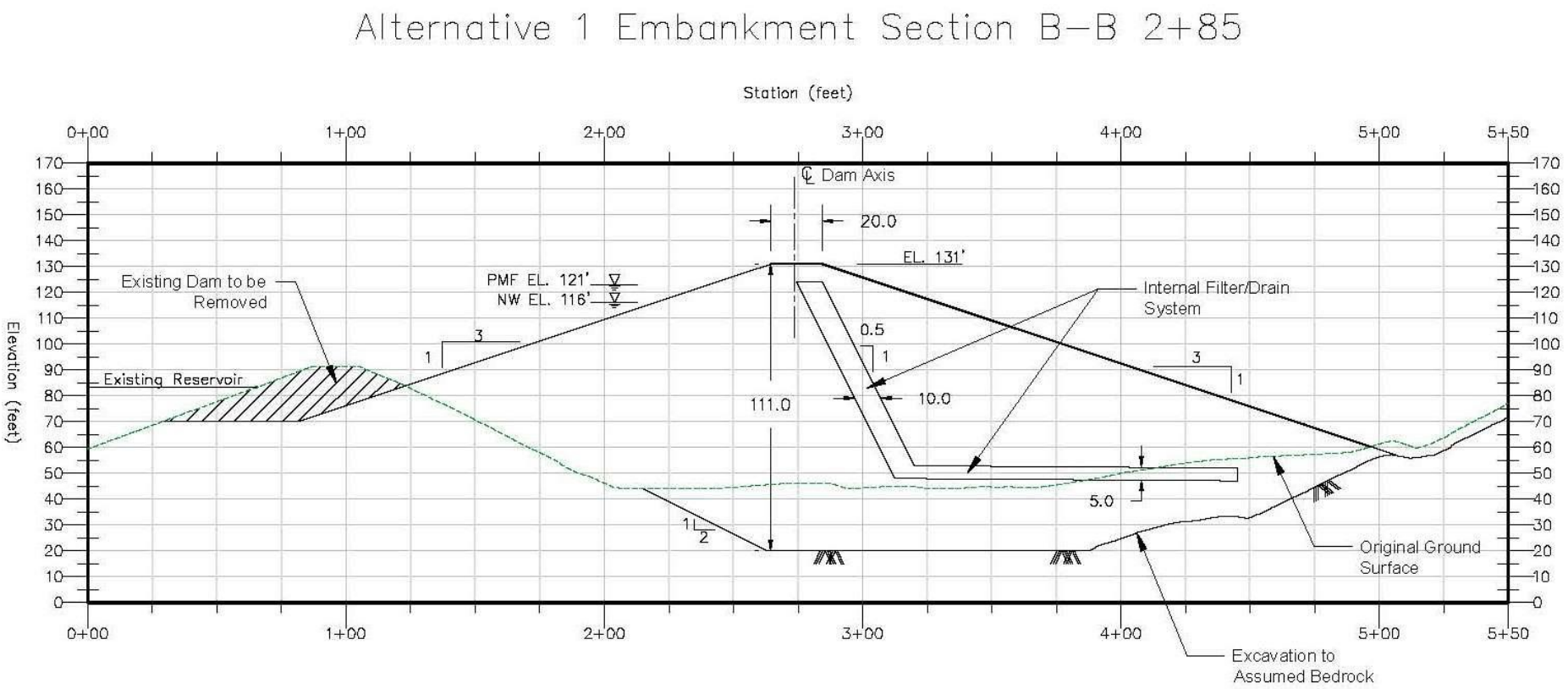
Alternatives 1 – Raising & Modifying Existing Dam



Alternatives 1 – Raising & Modifying Existing Dam

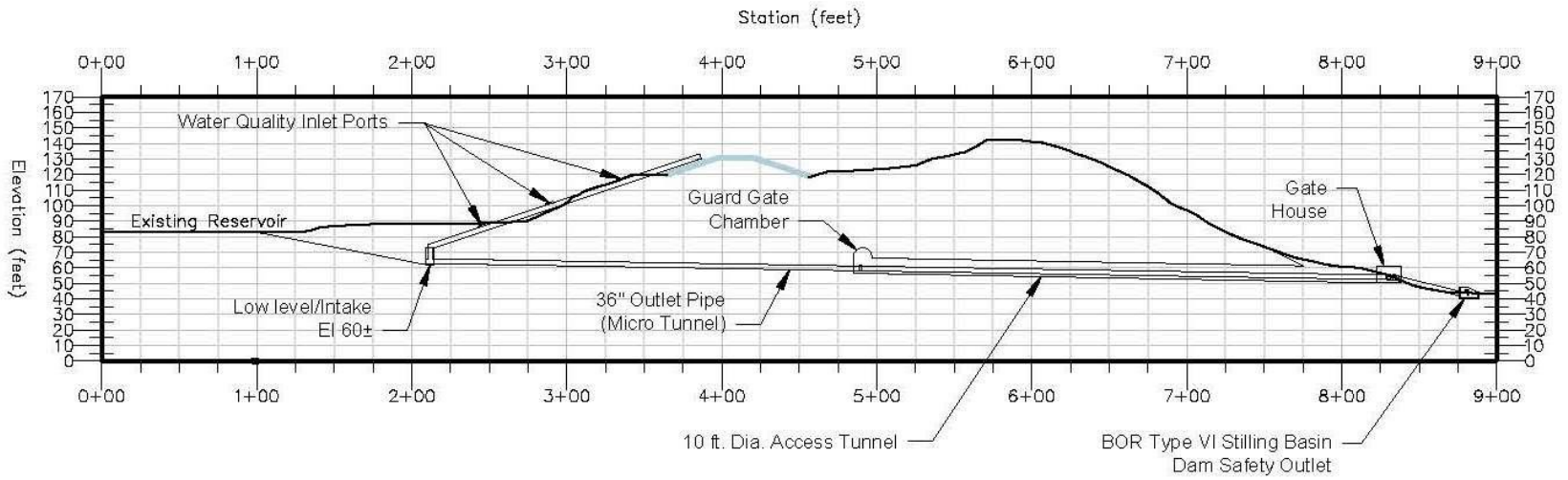
- Dam is a continuation from existing upstream slope
- Total height = 111 ft at elevation 131 ft
- New water surface elevation = elevation 116 ft
- Foundation soil of existing dam remain in place & excavation for new soil for new dam portion

Alternatives 1 – Raising & Modifying Existing Dam

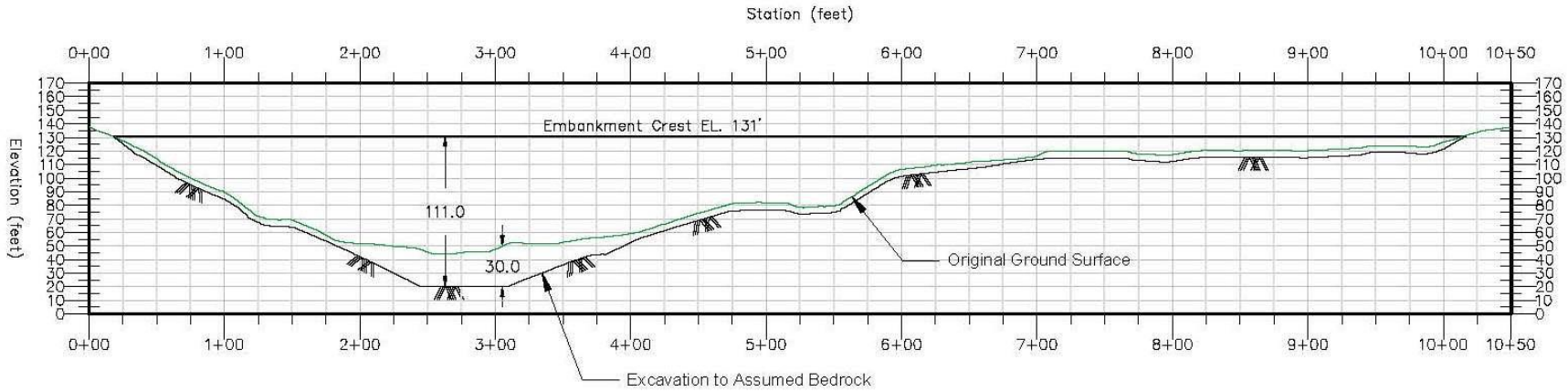


Alternatives 1 – Raising & Modifying Existing Dam

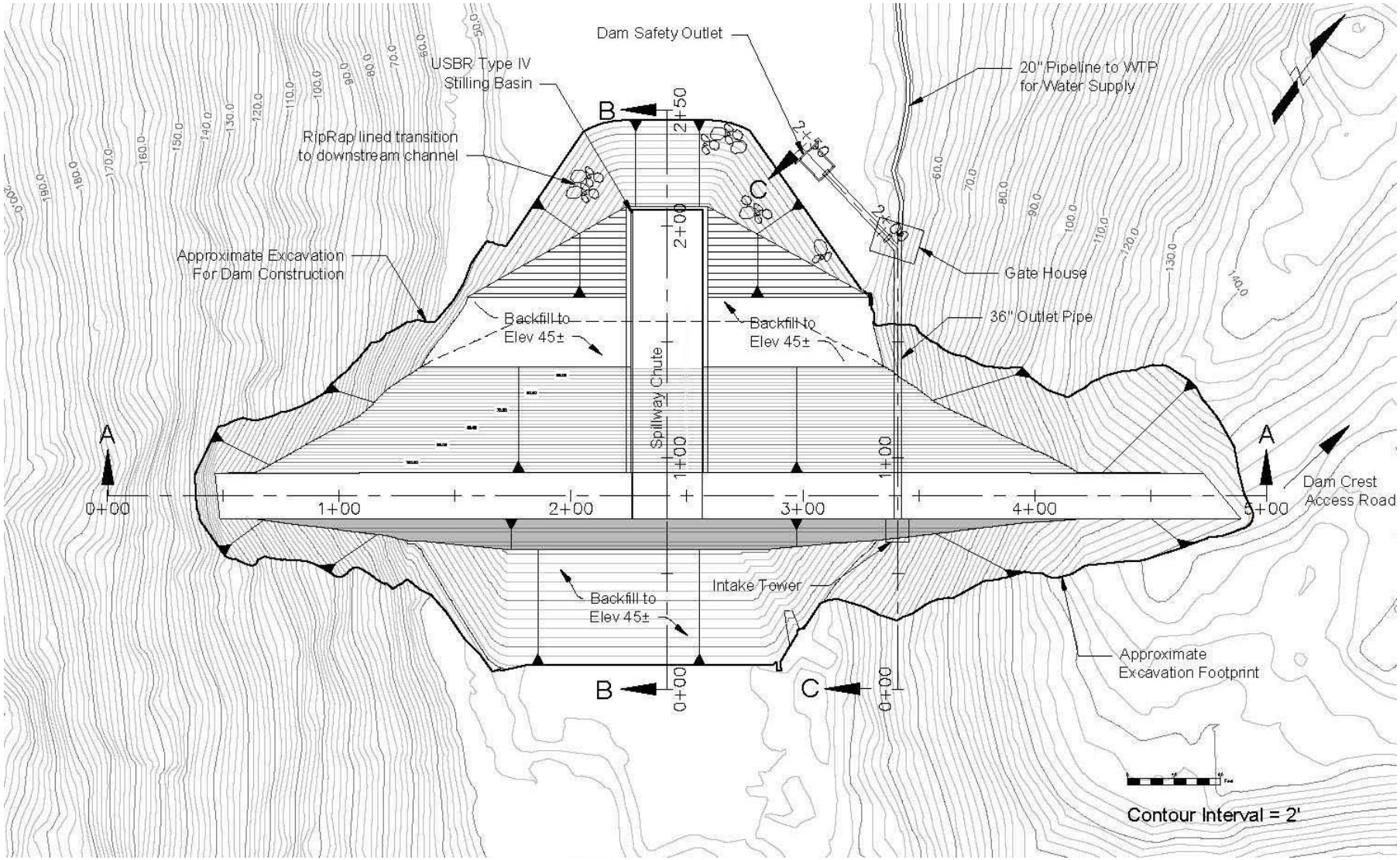
Alternative 1 Embankment Outlet Works C–C



Alternative 1 Embankment Axis Profile A–A



Alternatives 2 – RCC Dam (Roller Compacted Concrete)

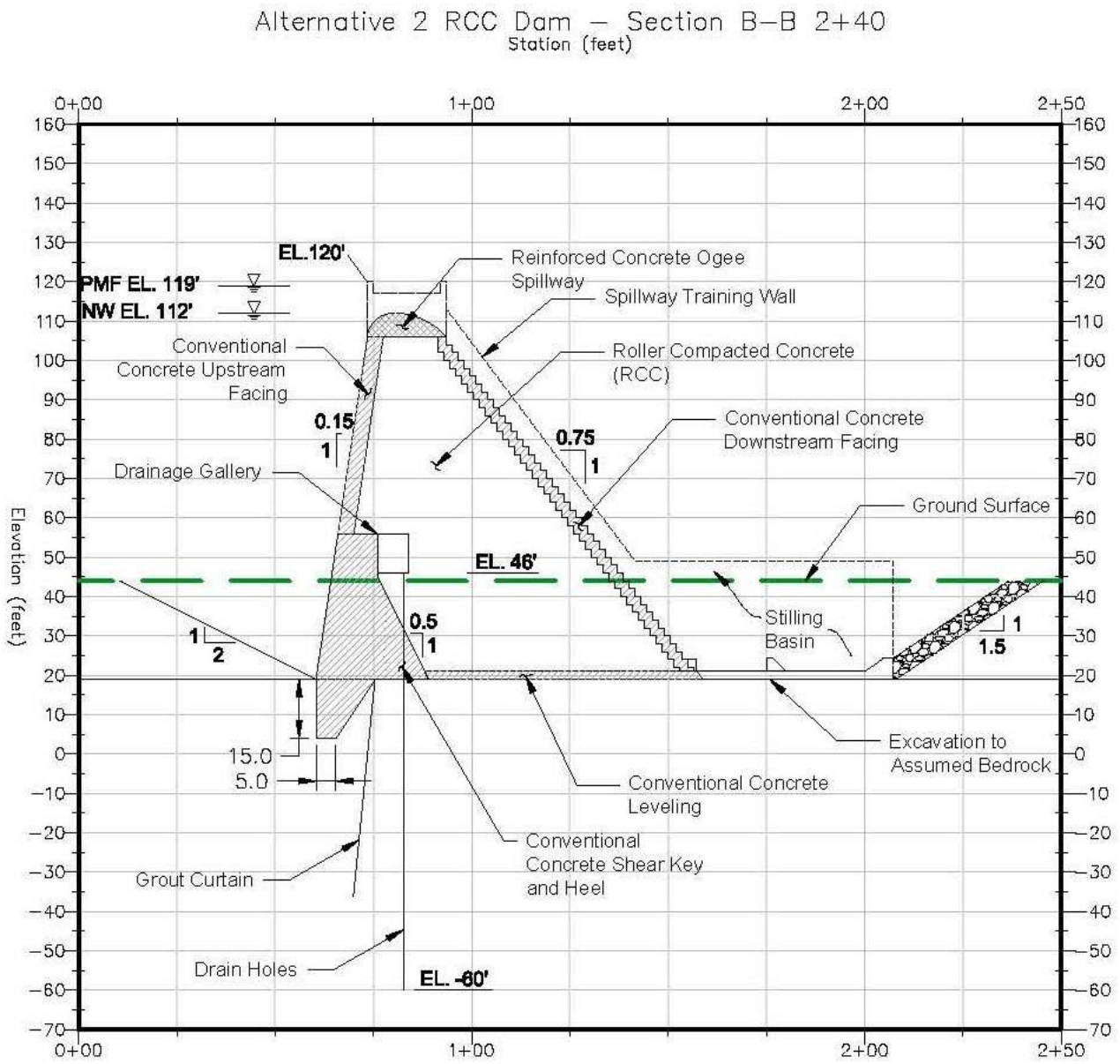


Alternatives 2 – RCC Dam (Roller Compacted Concrete)

Alternatives 2 – RCC Dam (Roller Compacted Concrete)

- Total height = 100 ft at elevation 120 ft
- New water surface elevation = elevation 112 ft
- Excavation to bedrock for new foundation soil

Alternatives 2 – RCC Dam (Roller Compacted Concrete)



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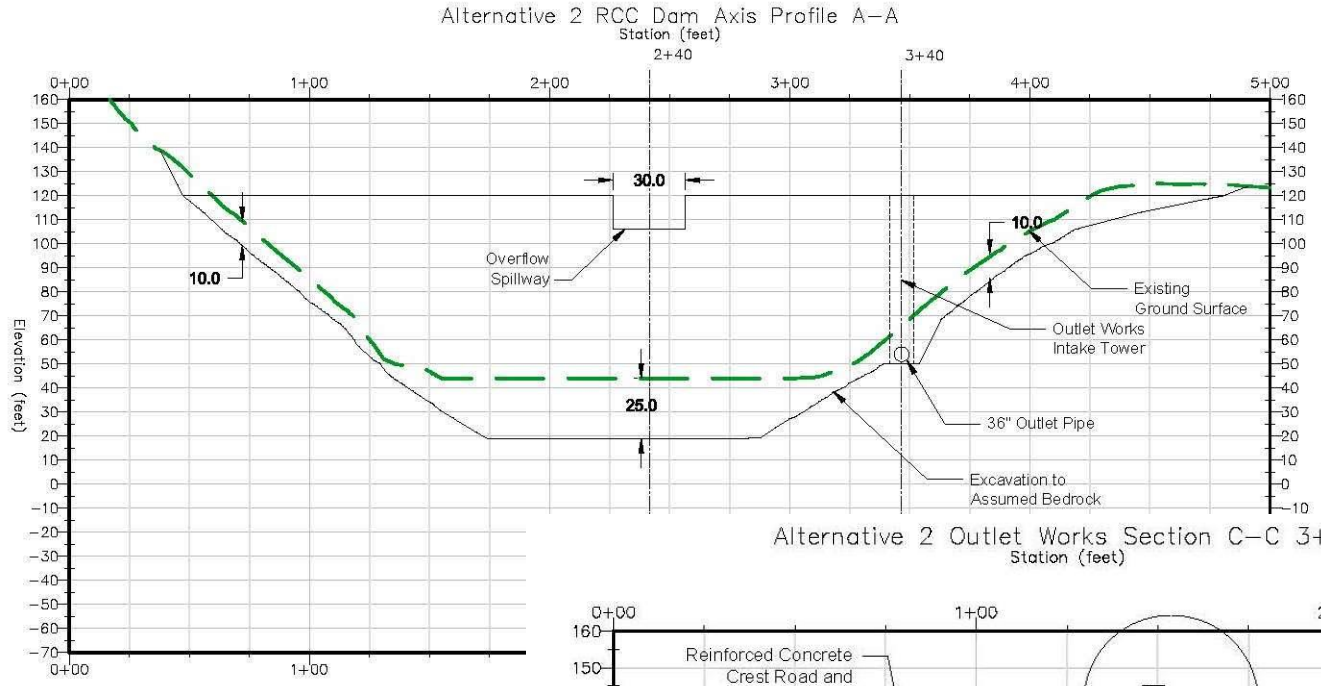
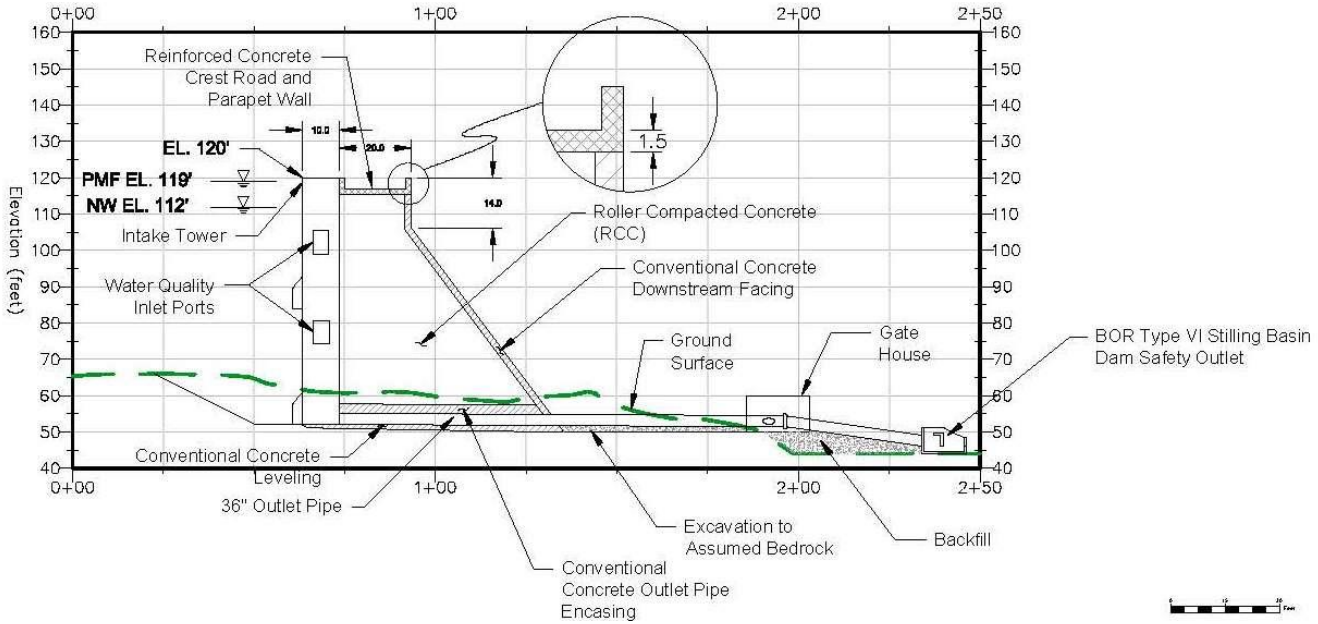
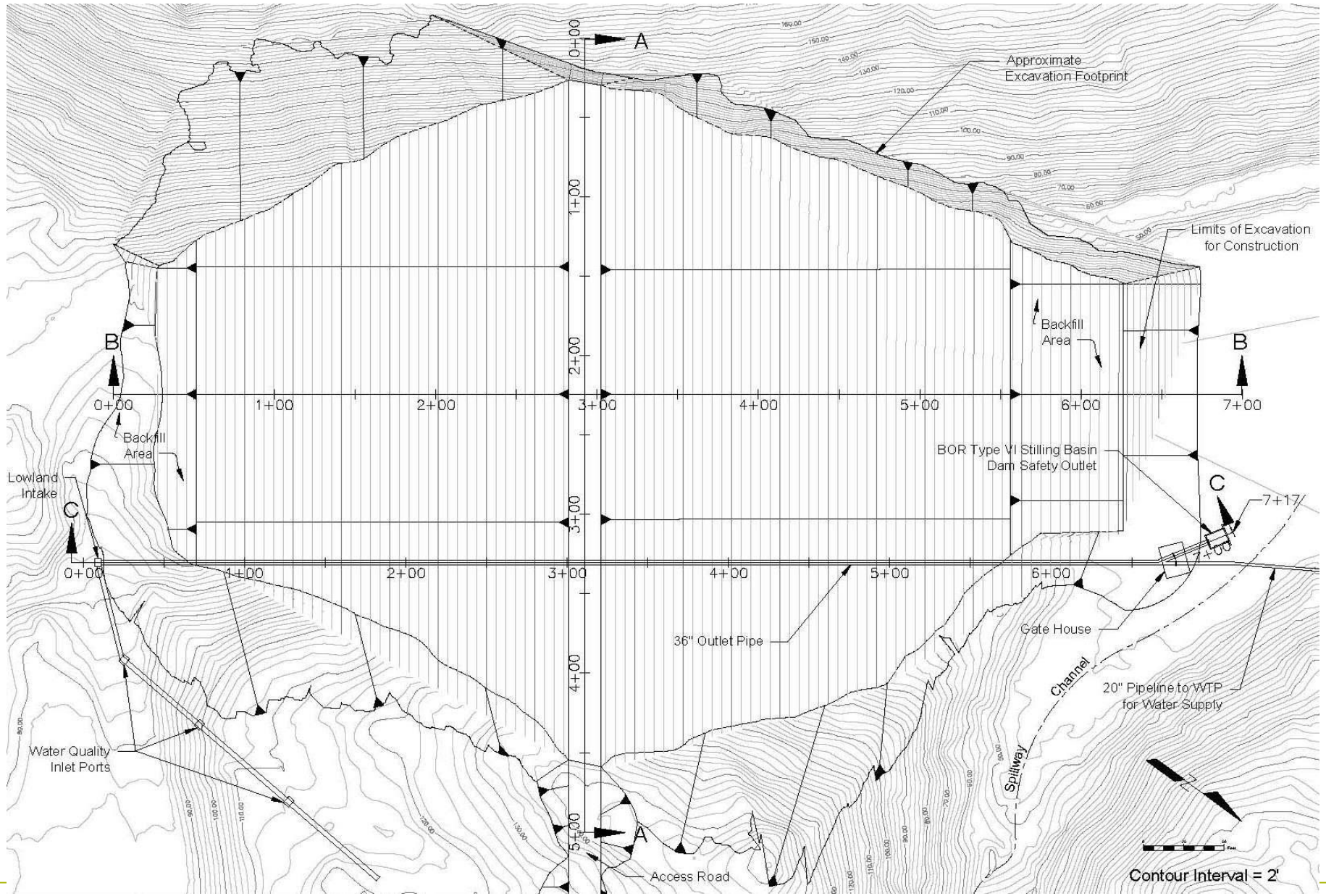




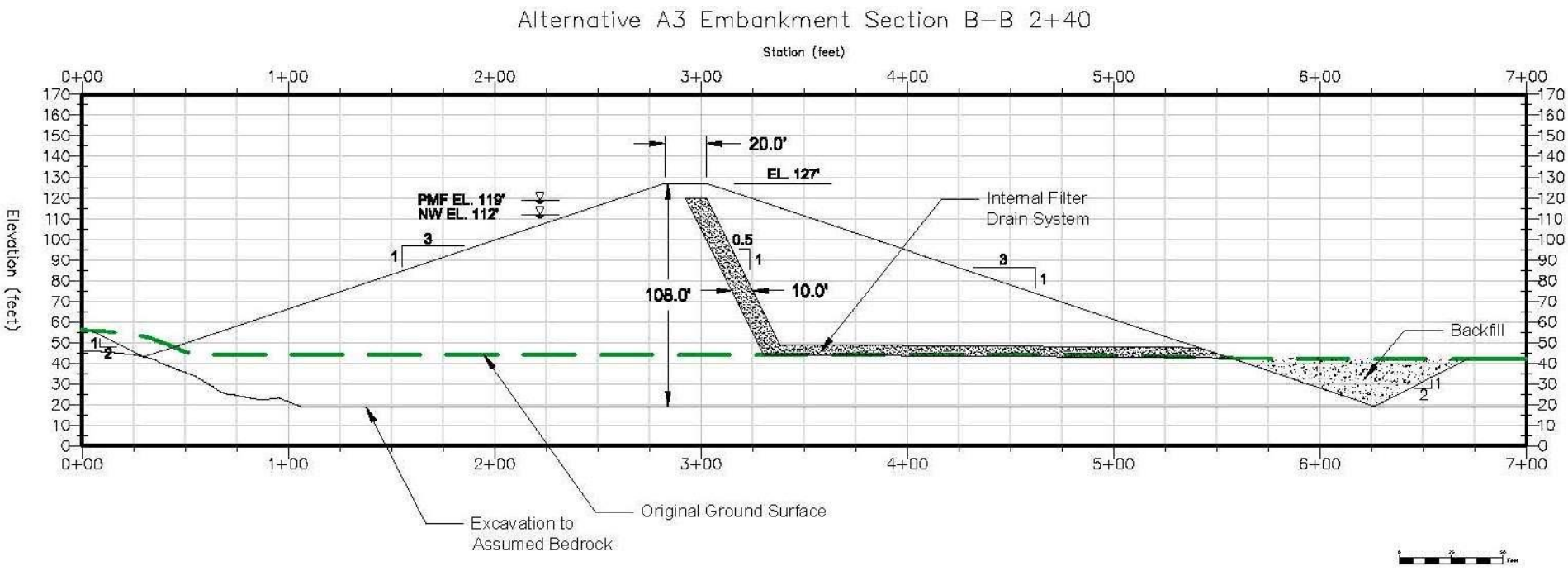
Alternatives 3 – New Embankment Dam



Alternatives 3 – New Embankment Dam

- Total height = 108 ft at elevation 128 ft
- New water surface elevation = elevation 112 ft
- Excavation to bedrock for new foundation soil

Alternatives 3 – New Embankment Dam



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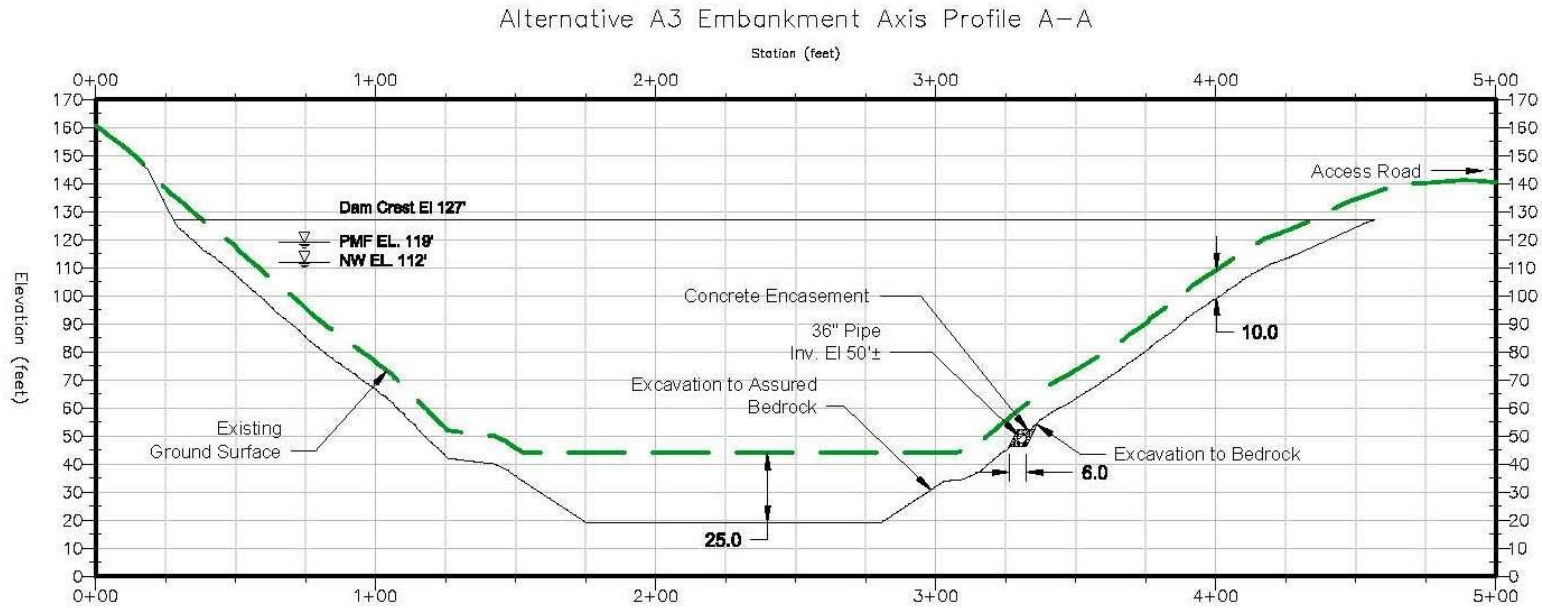
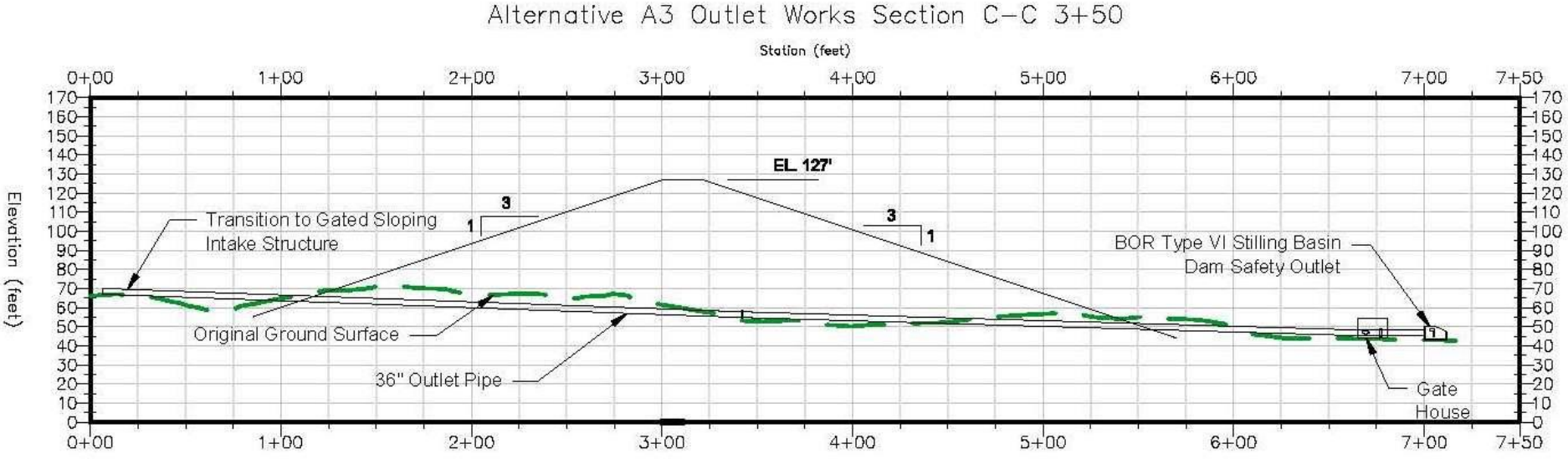




All Alternatives – Related Structures

- Intake structure/sloping intake pipe
- Low level dam safety outlet w/ stilling basin
- Raw water pipeline to Water treatment plant
- Spillway (for embankment option only)
- Fish Ladder
- Access road to and around reservoir

All Alternatives – Comparison

- Constructability
- Excavation volume
- Construction material
- Foundation conditions
- Spillway design
- Intake structure
- Outlet works
- Dewatering
- Seismic resiliency
- Hydraulic resiliency
- Environmental impacts
- Maintenance
- Total costs

Preliminary Environmental Review – Major Permits & Timelines

Required Permit	Timeline	Submittal Occurs at Engineering Design Level (approximate)
National Environmental Policy Act (NEPA)	12-18 months	15-30%
Clean Water Act Section 404/401 and Oregon Removal-Fill permit Other permits processed concurrently with applications: • Endangered Species Act Section 7 • Magnuson Stevens Fishery Conservation and Management Act (Magnuson Stevens Act) • National Historic Preservation Act (NHPA), Section 106 • Migratory Bird Treaty Act • Oregon Fish Passage • Coastal Zone Management Act	6-18 months	30%
Bald and Golden Eagle Protection Act (if required)	4-6 months	30%
Oregon Water Rights	9-12 months	30%
Clean Water Act Section 402 National Pollutant Discharge Elimination System (NPDES) 1200-C	60 days	100%
City of Newport Conditional Use Permit	30 days	60%
City of Newport Building, Electrical, Plumbing, Mechanical, Sewer/Water Permit	30 days	100%
Oregon State Engineer Design Review and Approval	2 months	100%

Preliminary Environmental Review – Major Permits & Timelines

- Anticipated environmental studies:
  - cultural resource evaluation
  - wetland and waters delineation
  - developing mitigation plans
  - updating Emergency Action Plan
  - preparing a biological assessment.

- Costs: range from 1 to 6 percent of the overall construction costs.

Alternatives – Decision Level Cost Estimates

- **Cost numbers for comparison purposes**
  NOT for budgeting purposes!
  (assist in selecting the preferred alternative)

- Items not included in cost estimate:
  - fish ladder
  - spillway (for embankment option)
  - access road to the dam
  - access road around the reservoir
  - pipeline from the dam to the water plant

Alternatives – Decision Level Cost Estimates

- Alternative 1 – no cost estimate
- Alternative 2 & 3 estimate includes:
  - Site preparation
  - Main dam work
  - Intake structure/fish screens/pipeline through dam
  - Base construction cost
  - Contingencies

Alternative 2 RCC dam = $ 19,000,000

Alternative 3 new embankment dam = $ 17,800,000 (spillway not included)

Similar costs - decision needs to be based on advantages / disadvantages

Conclusions

1. Phase 3 explorations and engineering analyses confirmed significant seismic deficiencies with both BC 1 and BC 2 dams
2. Analysis indicated both dams are unsafe due to excessive deformations
3. Lower dam (BC-1) not economically feasible to save – decommissioning is required by the state
4. Current & future water storage combined at upper/new site
5. Several alternatives have been identified – two feasible alternatives remain on the table (RCC dam & new embankment dam)
6. Configuration level studies indicate both options are reasonable for a 5000 year recurrence interval earthquake
7. This complies with state and federal requirements

Recommendations

Based on cost estimate & advantages/disadvantages:

Alternative 2 – RCC Dam

- Constructability
- Spillway included
- Less construction time
- Less footprint – less excavation
- Better intake structure
- Less environmental impacts
- Better seismic resiliency
- Less maintenance

What's Next ?

Pre-Design = Comprehensive Characterization of new dam site

- Define dam failure consequences
- Identify appropriate design criteria
- Geotechnical verification
- Budgetary Cost estimate
- Begin of environmental permitting process
- Comprehensive survey of dam site and access road site

Additional modeling per state requirements:

- To determine design requirements for dam

Update of Emergency Action Plan

Questions?

Alternatives 2 – RCC Dam (Roller Compacted Concrete)

Seismic Hazards & Time History Results

CORNFORTH CONSULTANTS

- Seismic Hazard Review – Provided Design Parameters
  - Incorporated updated USGS 2014 Seismic Hazard Maps and Applied to Regional Seismicity
  - Ground Motion Selection for Design
  - Site Specific Earthquake Characteristics
    - Magnitude
    - Distance from Epicenter
    - Return Periods
    - Response Spectra
    - Acceleration Time Histories

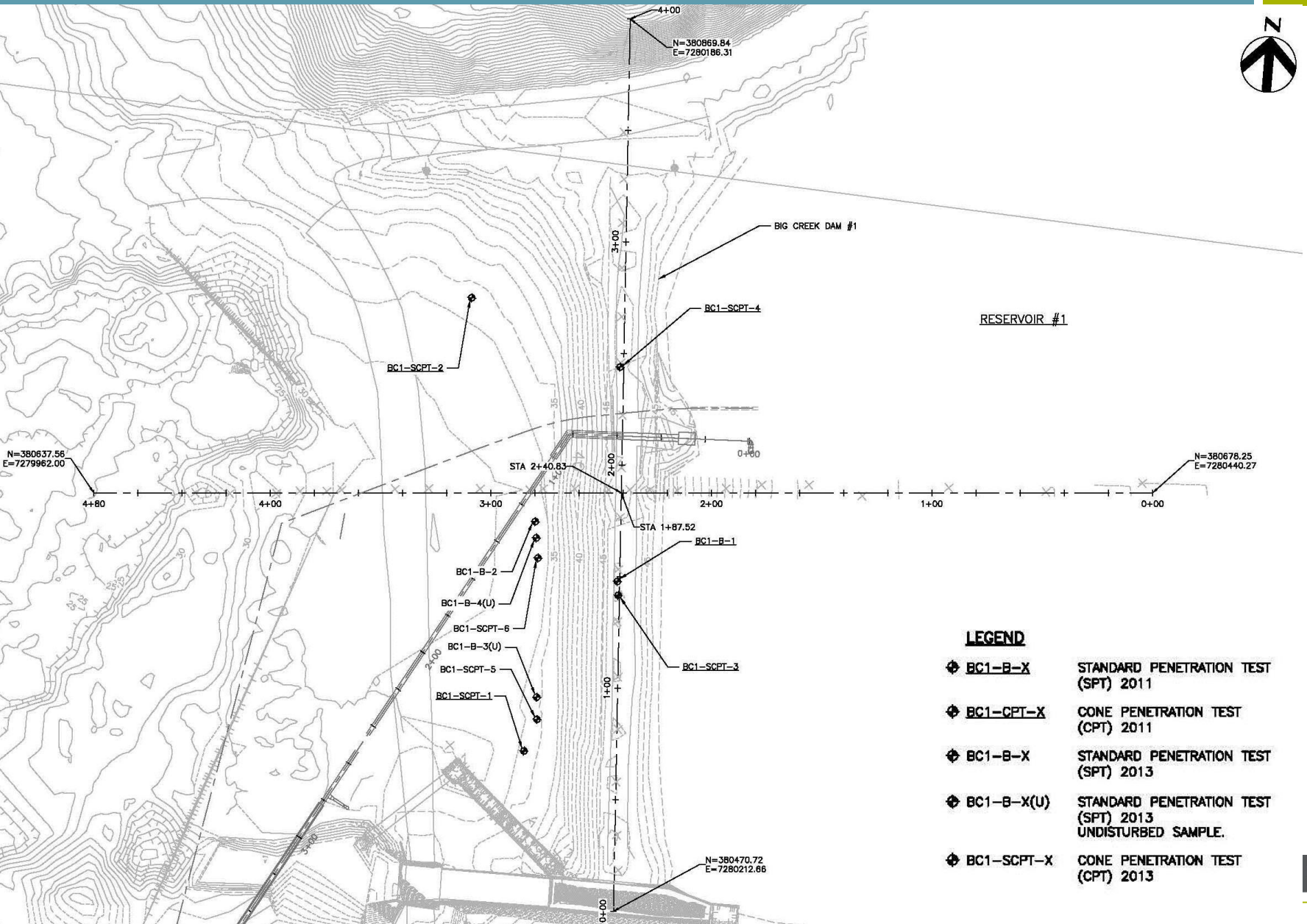
HDR

Laboratory Testing

- Correlation of lab tests with the results of the field testing to improve the overall knowledge of the material characteristics
- Testing resulted in knowing that the strength of the foundation materials is relatively constant across the depth of the materials

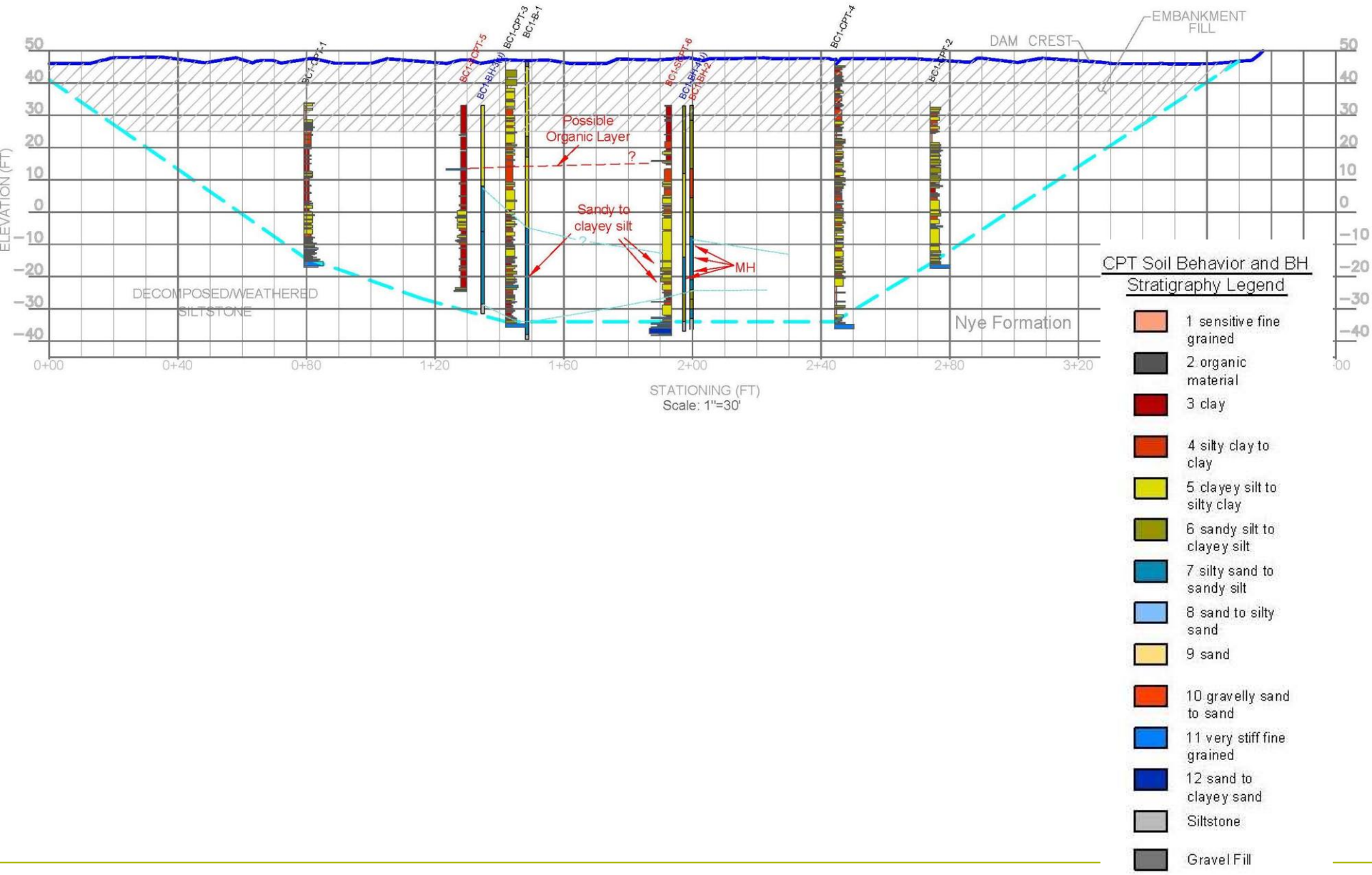
Site Explorations

Big Creek #1 – Lower Dam



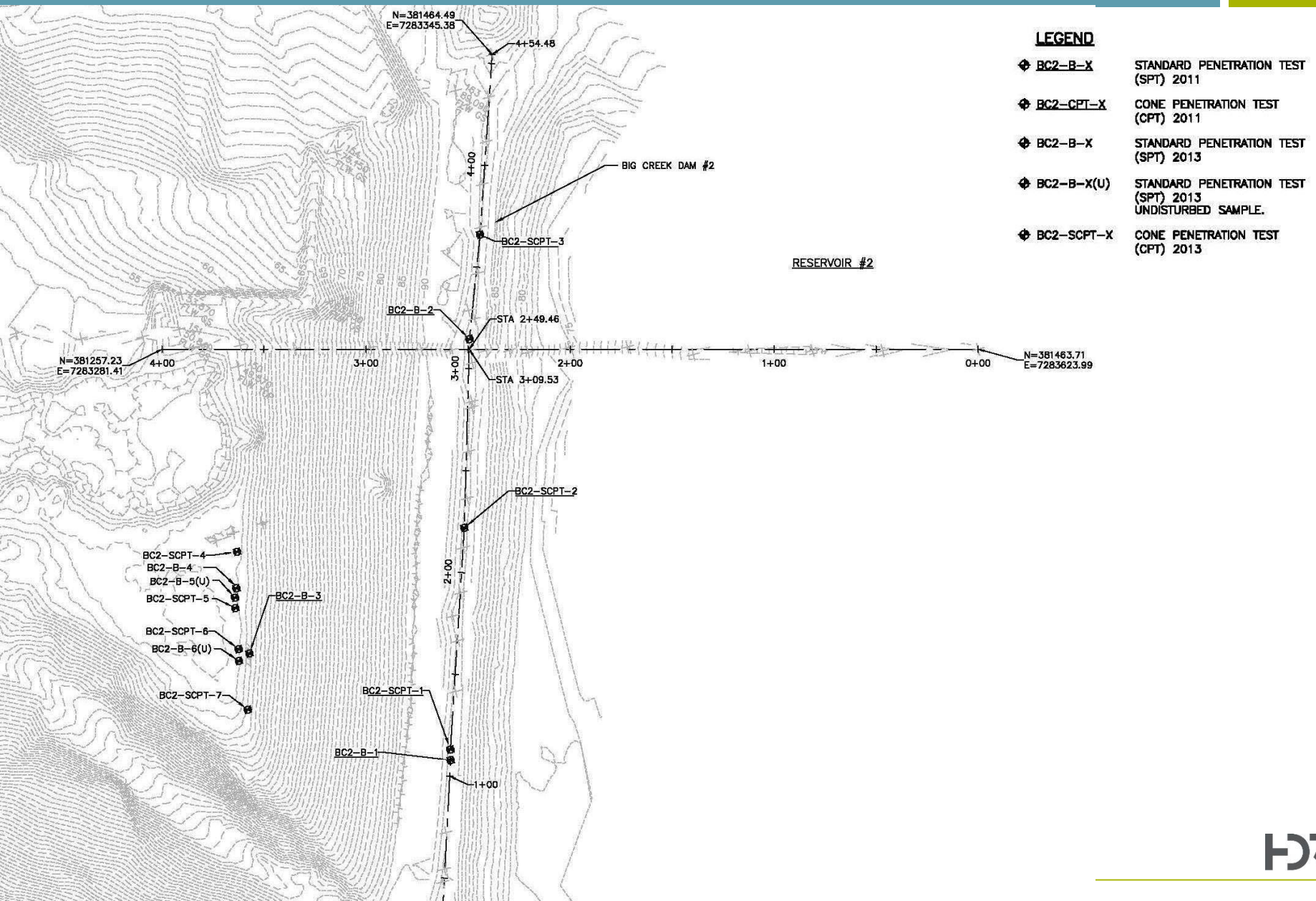
Site Explorations – Subsurface Profile

Big Creek #1 – Lower Dam



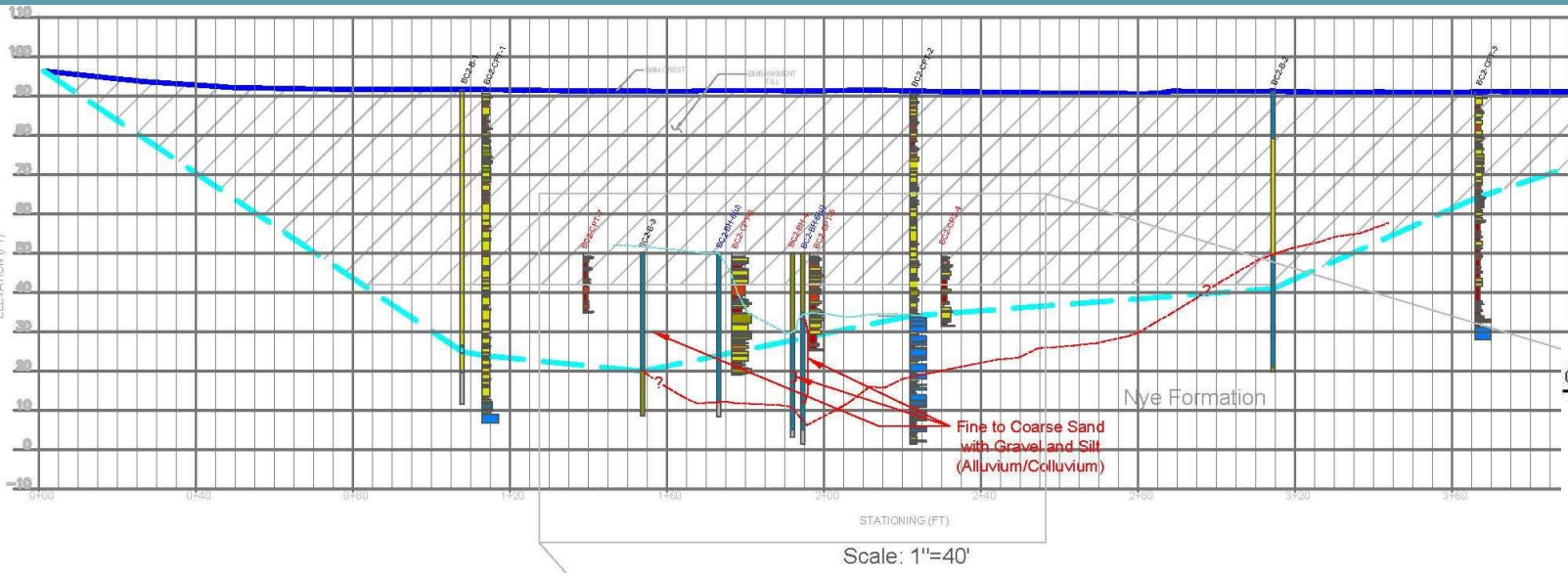
Site Explorations

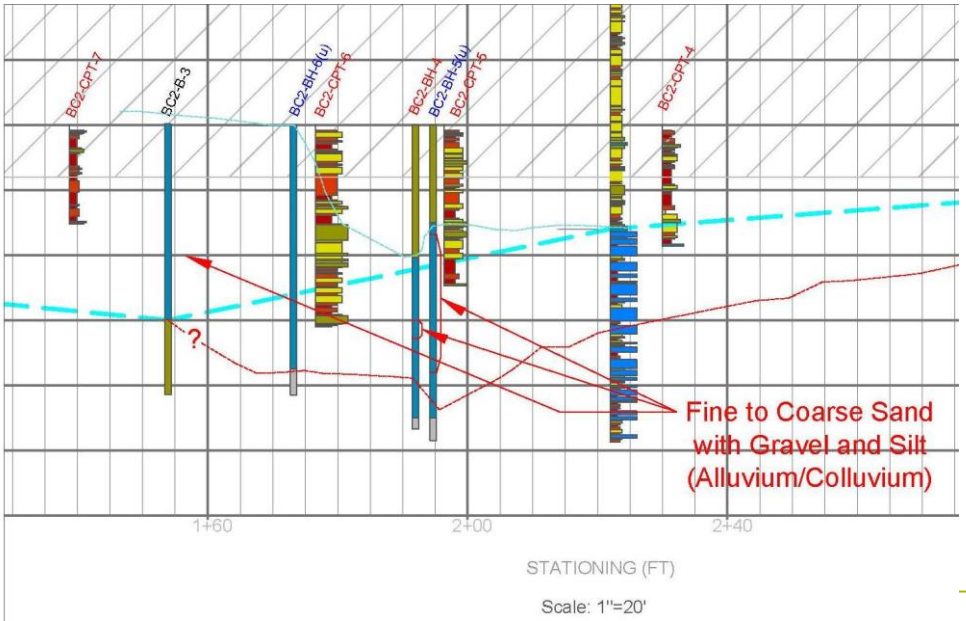
Big Creek #2 – Upper Dam



Site Explorations – Subsurface Profile

Big Creek #2 – Upper Dam



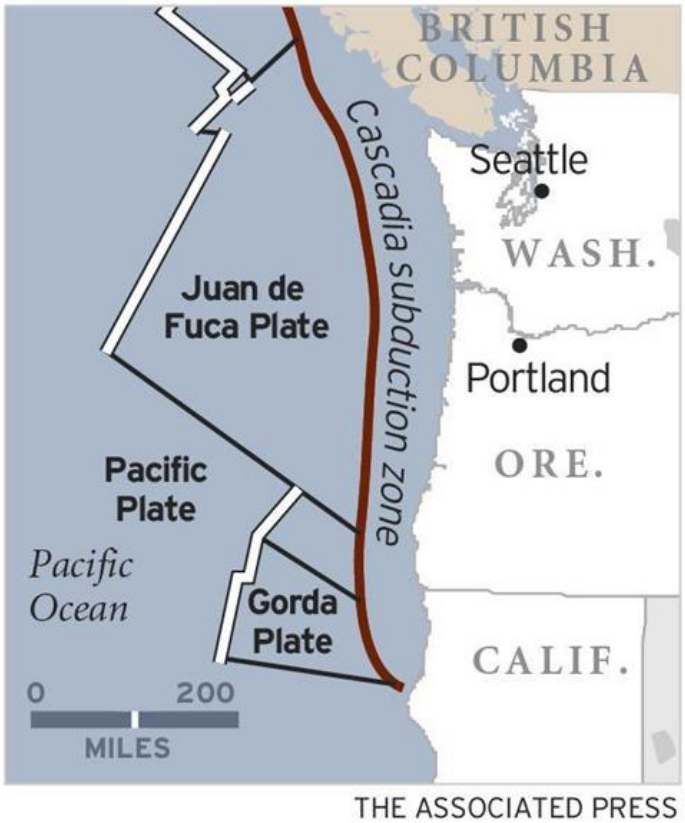


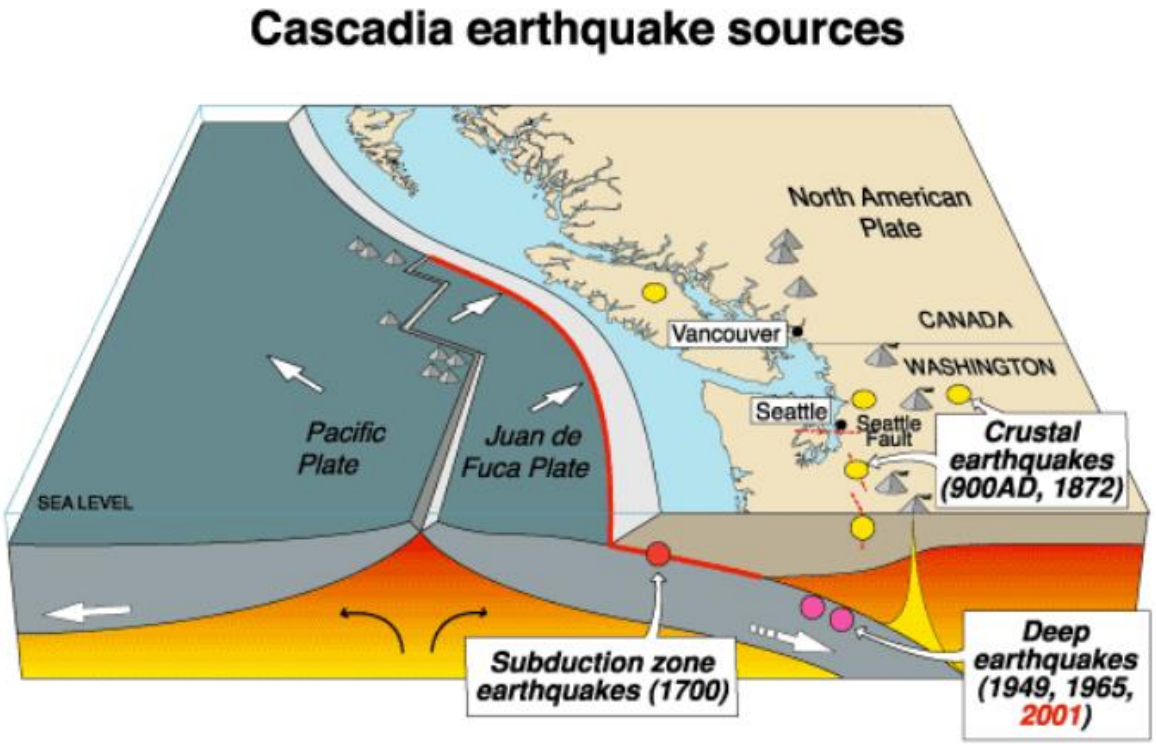
CPT Soil Behavior and BH Stratigraphy Legend

- 1 sensitive fine grained
- 2 organic material
- 3 clay
- 4 silty clay to clay
- 5 clayey silt to silty clay
- 6 sandy silt to clayey silt
- 7 silty sand to sandy silt
- 8 sand to silty sand
- 9 sand
- 10 gravelly sand to sand
- 11 very stiff fine grained
- 12 sand to clayey sand
- Siltstone
- Gravel Fill

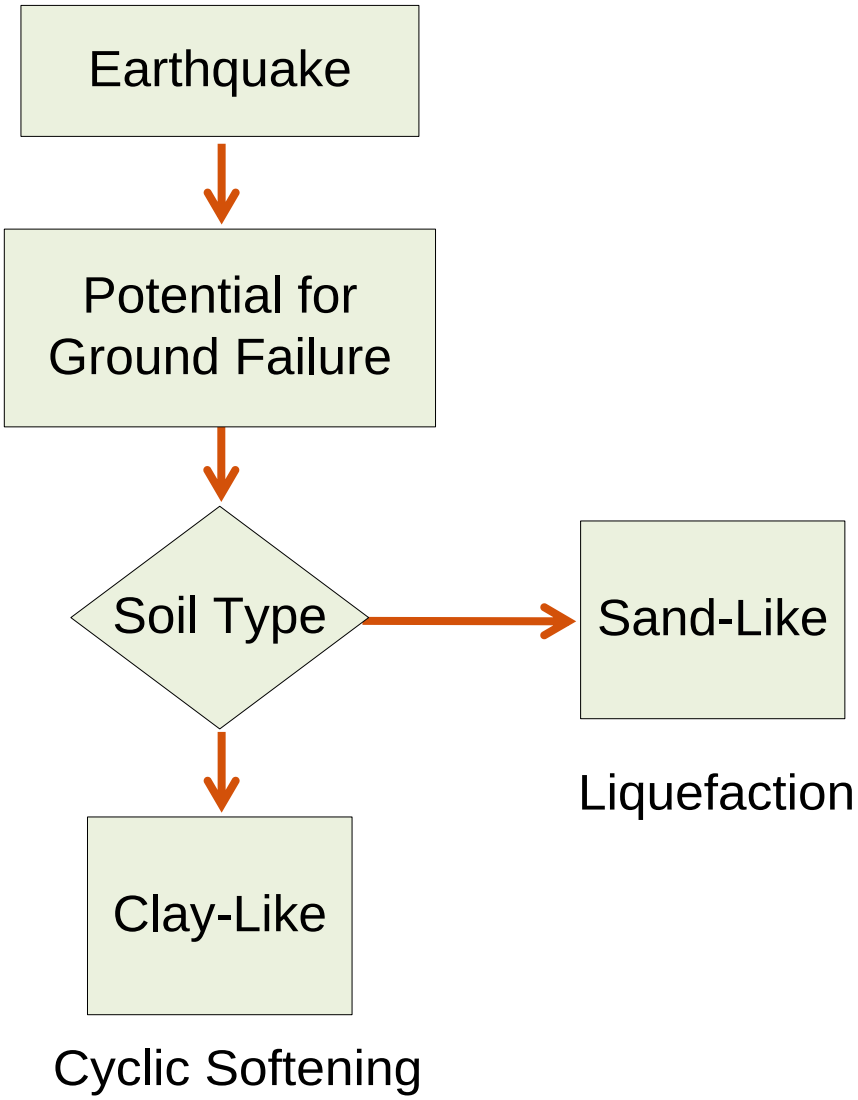
Principal Seismic Sources in Oregon

- Cascadia Subduction Zone (CSZ)
- Crustal Faults





Procedure for Ground Failure Analysis



Site Specifics – Lab Testing

Cyclic Simple Shear Testing