Nevada Irrigation District

Staff Report

TO: Board of Directors

FROM: Peter Wade, P.E., Director of Power Systems

DATE: May 13, 2026

SUBJECT: **Workshop – Combie Dam Alternatives for Repairs and Improvements**

HYDROELECTRIC

RECOMMENDATION:
Receive an informational presentation on Combie Dam, including background, geology, and hydrology.

BACKGROUND:
Combie Dam is owned by the Nevada Irrigation District (NID) and located on the Bear River in the Sierra Nevada foothills in Northern California. The dam is subject to regulations through the Federal Energy Regulatory Commission (FERC) and the California Department of Water Resources, Division of Safety of Dams (DSOD). Constructed in 1928 with a central variable-radius concrete arch that incorporates a two-stage spillway (overflow section) that is abutted by concrete gravity block (non-overflow) sections, the dam has a history of foundation scour damage downstream of the spillway and is subject to overtopping of the non-overflow abutment sections for the probable maximum flood (PMF).

Numerous repairs and improvements to address the scour damage at the spillway's base have been completed throughout the facility's service life, and further scour protections have been studied. Earlier stability concerns regarding the non-overflow section gravity blocks under PMF loading were addressed through the 1991 installation of sixteen post-tensioned rock anchors within select blocks of the dam. Subsequent stability analyses have shown that some of the abutment blocks of the dam that do not contain anchors continue to have inadequate stability during the maximum reservoir level of the PMF.

The workshop is to inform and discuss the alternatives proposed to remedy abutment stability concerns and expand the scour protection.

BUDGETARY IMPACT:
This item is considered for further planning and development in 2031 and execution in year 2032, following the completion of the Scotts Flat Spillway Repair.

The concept level construction estimate completed in 2021 estimated a $13.3 million dollar cost, excluding costs for permitting, construction oversight and administration.

PW

Attachments: (1)

- Combie Dam Status Presentation

Workshop Item

Hydroelectric Department
Dam Safety

Combie Dam Status

May 13, 2026

Agenda

Background
- Hydrology
- Geology

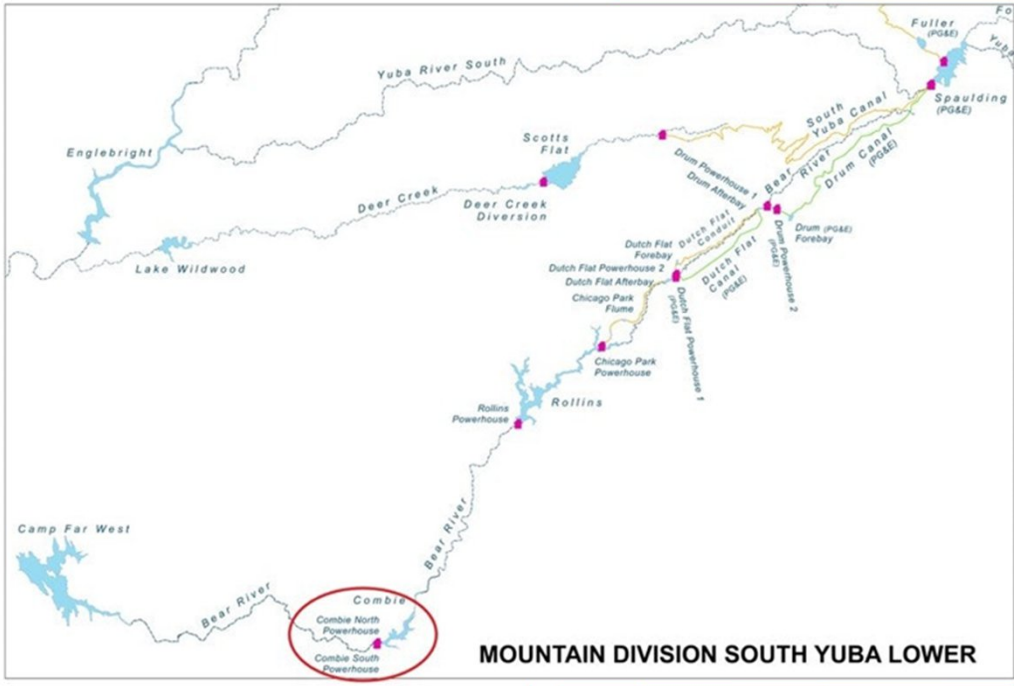
Current Status

Alternative Study

NID
Water for Life

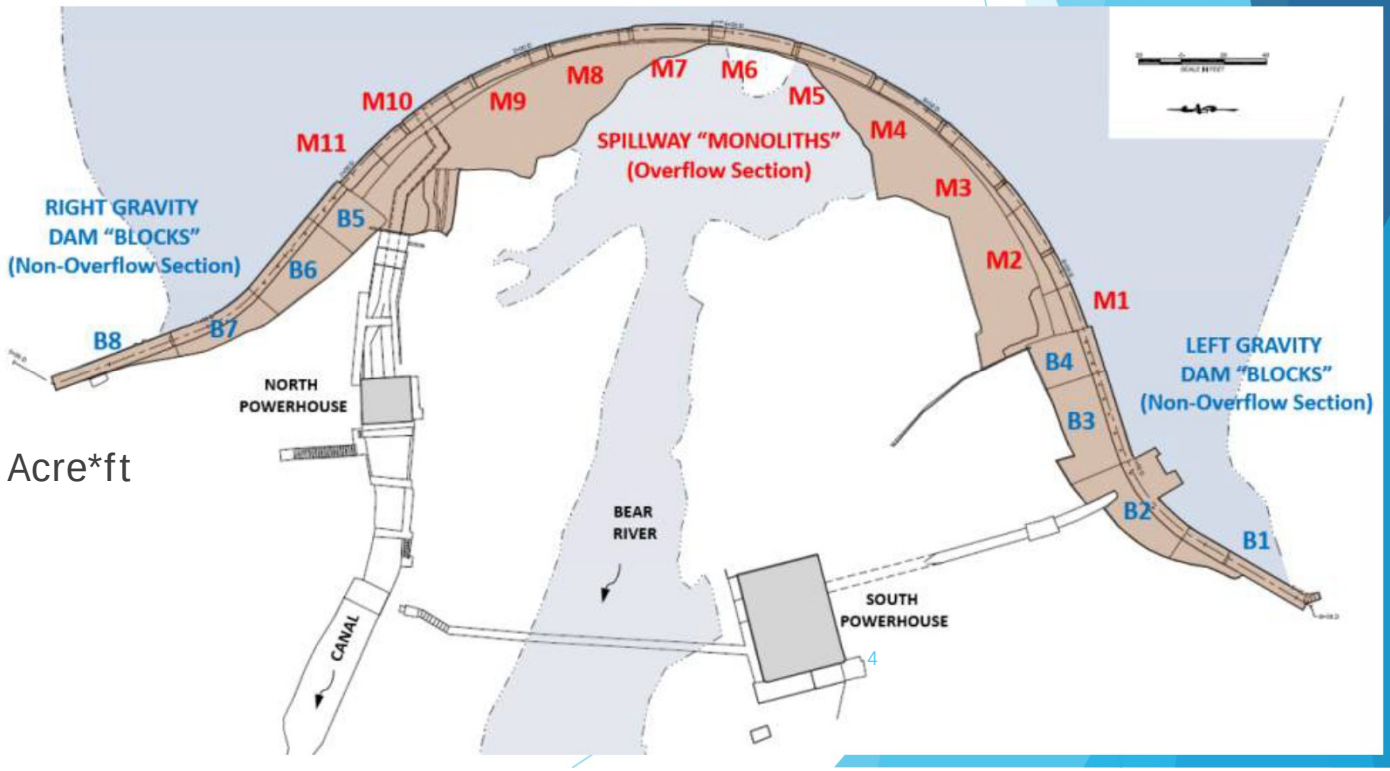
Combie Dam - Location

- On the Bear River
- Boundary between Placer and Nevada Counties
- Rollins Dam is Upstream
- Camp Far West is Downstream



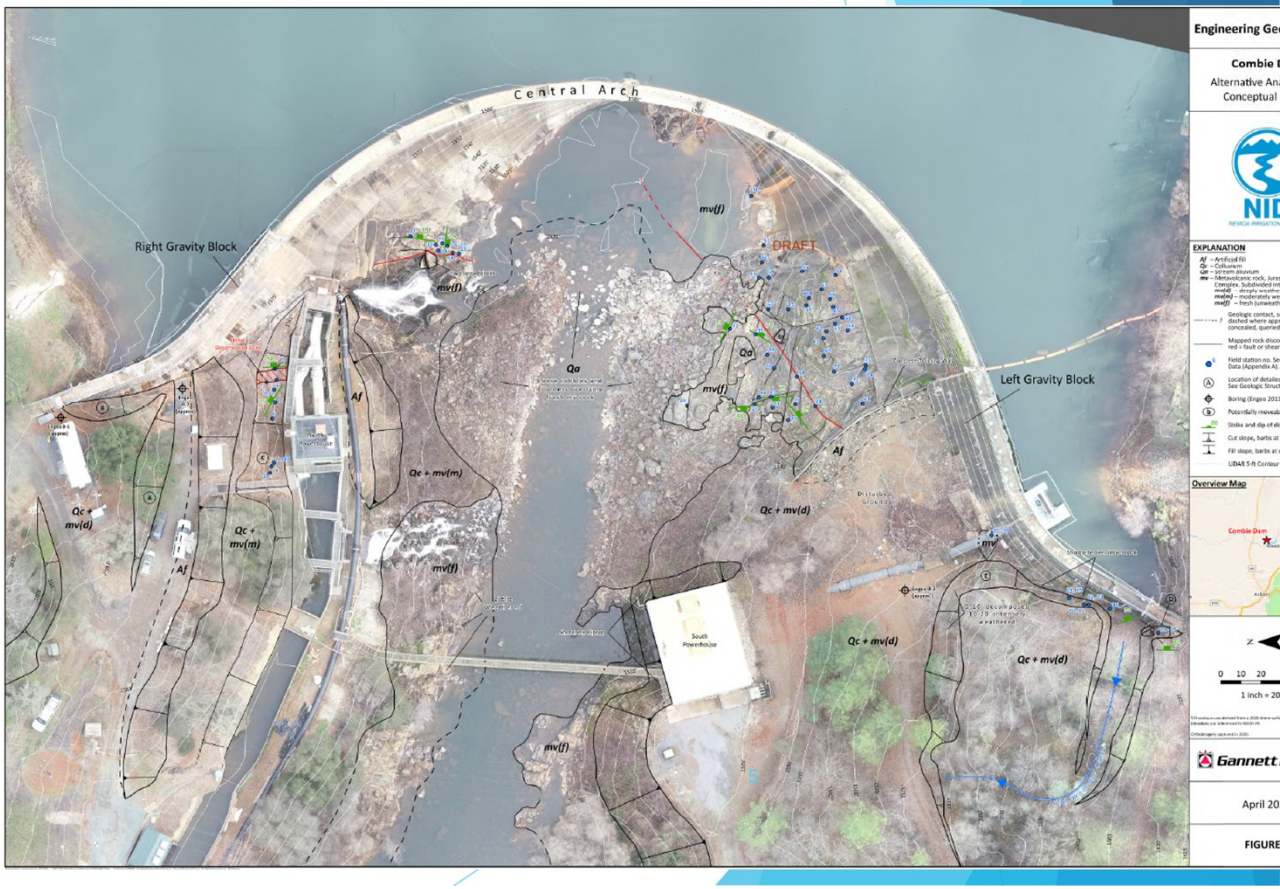
Combie Dam – facility configuration

- Concrete Arch Dam
- Overpour Spillway
- Gravity abutments
- South Powerhouse
- North Powerhouse
  - Phase 1 Canal
- 100’ high
- Lake Combie impounds 5,555 Acre*ft



Combie Dam - Geology

- Jurasic age, metamorphosed mafic igneous and sedimentary rocks
- Erodibility Analysis



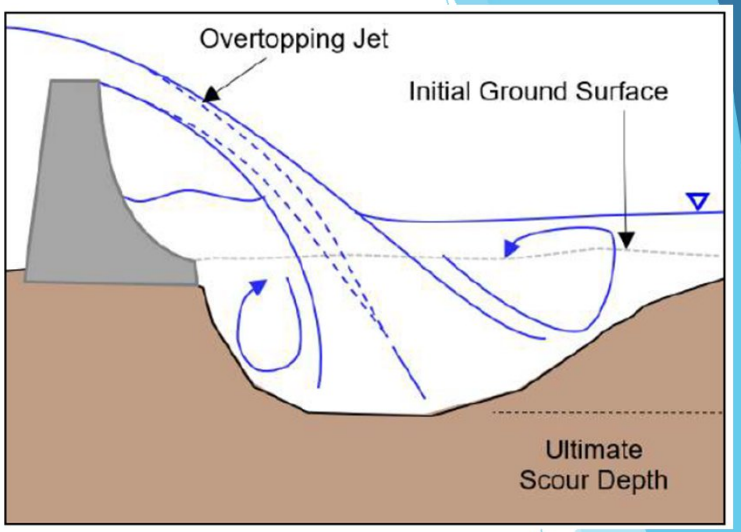
Combie Dam Spillway

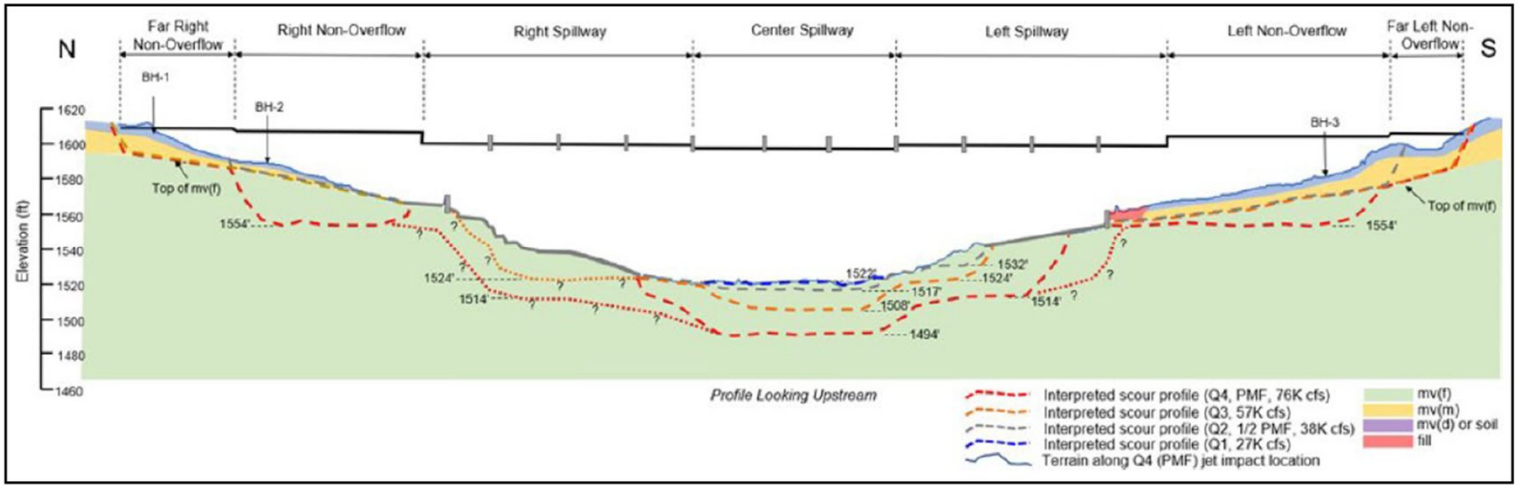
- 3 center bays
- 11 total bays
- 440’ long
- Significant spill events
  - 1982 – 15,400 cfs
  - 1986 – 22,500 cfs
  - 1997 – 34,000 cfs
  - 2005 – 25,800 cfs
- Capacity – 34,180 cfs
- PMF – 75,800 cfs

2005 high flow photos

Erodibility Analysis

- Flows, hydrograph
- Geology
- Erodibility Analysis





Combie Dam Scour History

- 18 of 98 year history show scour damage and repair in dam toe area

Combie Dam – Scour Repair History

Year(s)	Event	Action
1927-28	Original dam constructed	Construction completed
1930	B-S Canal gate jammed. Uncontrolled discharge eroded toe near left gravity section and arch	Rock and concrete backfill placed
1931	Scour from spill noted	Grouted downstream portion of right side of arch and placed reinforced gunite apron
1932-33	Modification constructed	North aqueduct outlet excavated through dam and dental work performed at excavation
1935	Scour from spill noted	Erosion of abutments repaired
1936	Modification constructed	Flashboards added
1937	Modification constructed	Footbridge added to reach pier with low level outlet operator
1937	Scour from spill noted	Right abutment and plunge pool areas repaired with lean concrete and boulders, then additional repairs made including extending left training wall
1938	Scour from spill noted	Minor repairs at toe of left gravity block
1944	Scour from spill noted	Repair made to toe of left end of arch and drains added
1945-46	Scour from spill noted	Repair made to toe of right end of arch
1951-52	Scour from spill noted	Damage noted, repairs not known
1955	Walkway to low level outlet destroyed	None
1956	Scour from spill noted	Damage noted, repairs not known
1959-60	Scour from spill noted	Minor repairs made to plunge pool and low-level outlet
1962	Damage to low level outlet noted	Damage repaired
1965	Scour from spill and damage to low level outlet noted	Replaced outlet liner and repaired damage on lower right abutment
1966	Modification constructed	Training wall reconstructed
1971	Demolition performed	Walkway to low level outlet removed
1972	Leakage at low level outlet noted	Gate opened and closed
1973	Low level outlet operated	Large volume of sediment discharged and sediment level noted as 5 ft above outlet pipe
1973-74	Modification constructed	North aqueduct outlet modified by slip lining the existing 36-in conduit with new 34-in pipe, extending new pipe downstream, installing a steel trashrack and adding a 42-in butterfly valve and minimum flow release
1975	North Powerhouse constructed	
1973	Damage to trashrack at low level outlet noted	Deferred installation of motor controlled operator
1976	Modification constructed	Log boom installed
1981	Erosion and seepage at north aqueduct outlet noted	Erosion repaired
1981	Leakage at low level outlet and erosion behind training wall noted	Unknown
1984	South Powerhouse constructed	
1985	Scour from spill noted	Repairs made to plunge pool
1986	Flood of record occurred, scour and erosion noted	Repairs made to apron at left toe of arch and training wall extended
1989	South powerhouse erosion repaired	Slush grouted riprap placed on abutments and tailrace
1990-91	Gravity abutment anchors installed	Completion report issued
1993	Gravity abutment anchors tested	Testing demonstrated that anchors retained loads
1994	New seep noted on right abutment	None
1995	Underwater inspection	North outlet trashrack and pipe through dam inspected
1997	Safety improvements against uncontrolled leakage	Canal gate opening in left abutment sealed with concrete bulkhead
1998	Safety improvements against overtopping	Toe of left gravity abutment was excavated to sound rock, drains installed, grouted rebar dowels installed in sound rock, and concrete placed to resist erosion during overtopping
2008	Sealed Low Level Outlet Gate	Low-Level Outlet Gate was abandoned and sealed.
2009	North powerhouse rehabilitation	Removed the preexisting turbine-generators replacing with new and added new piping and structures
2009/2010	Survey Data Points-Markers	Installed new survey markers to assess integrity of existing survey monuments.
2013	Dam	Repair/sealed lift joints upstream of right abutment sections. Removed brush & trees in spillway channel downstream of plunge pool.
2014	Survey monuments	Installed five new survey monuments and established new survey procedures
2014/2015	South powerhouse intake gate	Performed underwater inspection of inoperable slide gate. Replaced damaged operator stem, reinstalled wedge track fasteners, and repaired scour hole in approach apron.
2018	South powerhouse intake	Replaced trashrack

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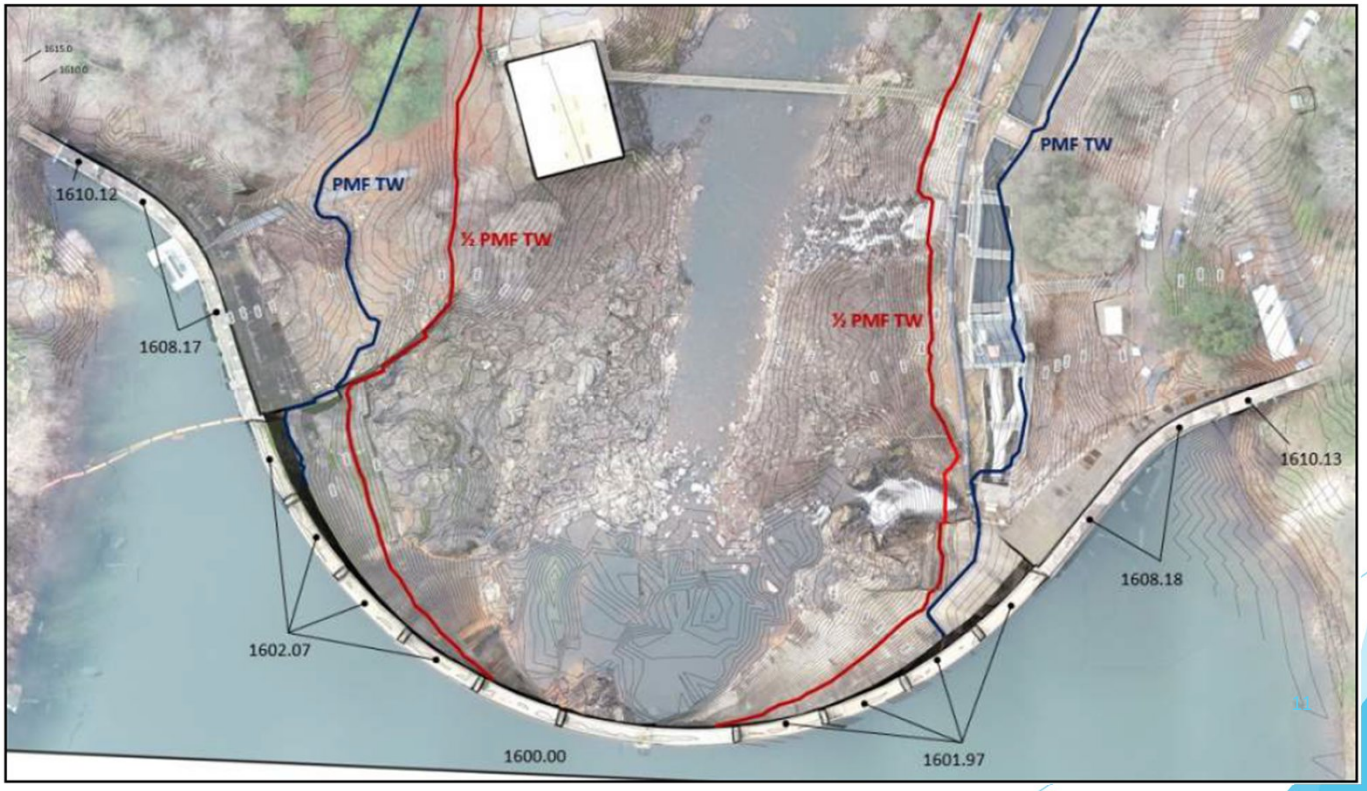
Combie Dam ½ PMF, PMF tailwater condition



Current Status

- Ongoing foundation scour damage on the downstream toe
- Overtopping flows are anticipated at the abutments during a PMF event
- Stability analysis continue to show abutment blocks previously excluded will benefit from anchoring.

2021 Alternative Analysis performed

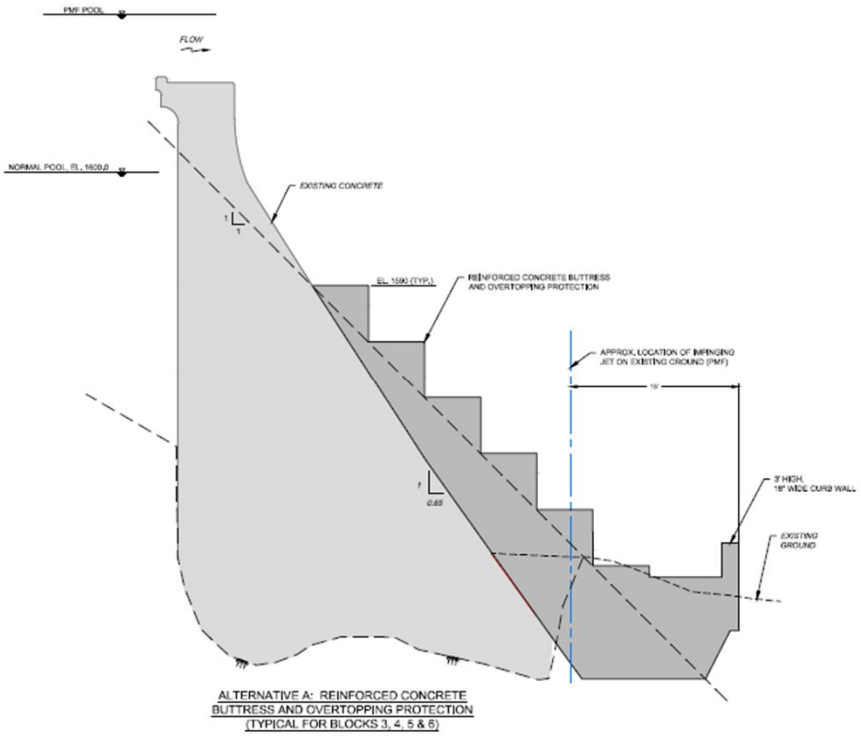
- 3 Alternatives developed

- Alternative A - Concrete Buttress with Overtopping
- Alternative B - Concrete Buttress without Overtopping
- Alternative C - Post-Tensioned Rock Anchors without Overtopping

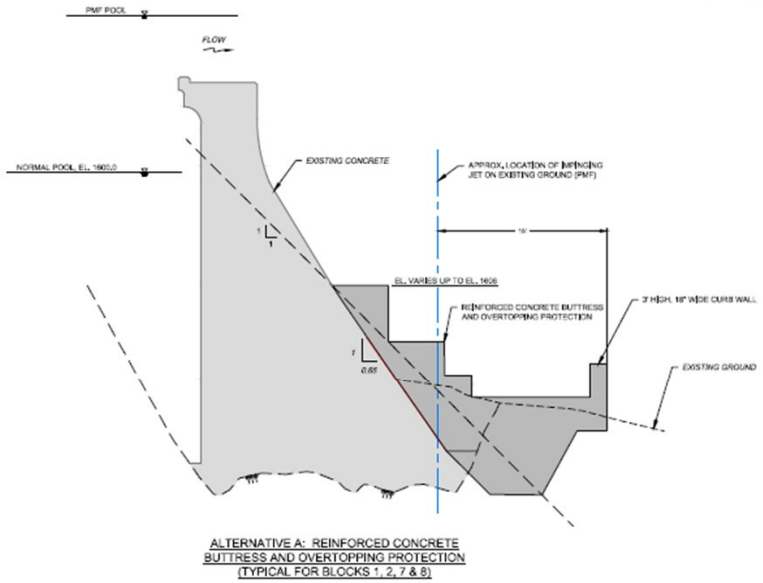
Alternative A - Concrete Buttress with Overtopping

- Overtopping of previous non-overflow sections of the dam through armoring
- No significant modifications to the crest of the existing non-overflow sections
- Concrete buttressing on the downstream face to extend the effective base width of the section
- Concrete apron for scour protection extending approximately 10 to 15 feet beyond the estimated location of the overflow jet trajectory's impact upon the existing ground surface
- Concrete curb wall at downstream end of apron to contain more frequent flood events
- Abutment armoring extending laterally above each end of the dam to prevent overtopping flows from eroding around the natural abutment areas
- Concrete armoring of foundation rock surface downstream of the spillway (common to all alternatives)

Alternative A



ALTERNATIVE A: REINFORCED CONCRETE BUTTRESS AND OVERTOPPING PROTECTION (TYPICAL FOR BLOCKS 3, 4, 5 & 6)

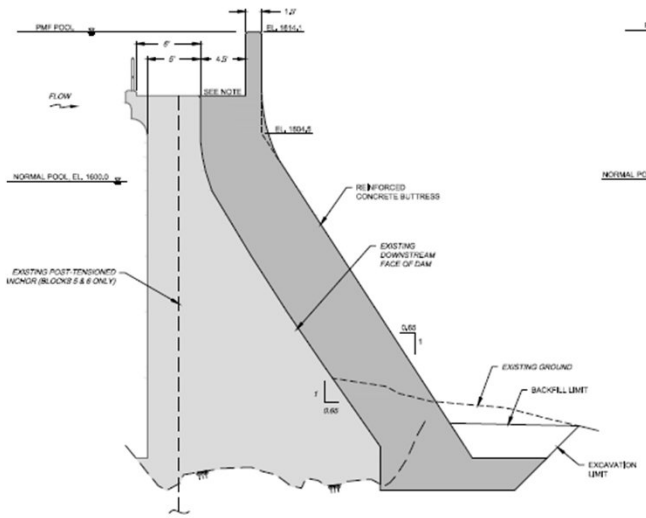


ALTERNATIVE A: REINFORCED CONCRETE BUTTRESS AND OVERTOPPING PROTECTION (TYPICAL FOR BLOCKS 1, 2, 7 & 8)

Alternative B - Concrete Buttress without Overtopping

- Top of dam “chimney” widened from 5 feet to 11 feet, including an 18-inch-wide parapet at the downstream edge that contains flood pools up to El. 1614, throughout non-overflow gravity blocks;
- Modified chimney scheme: vertical downstream face in Block Nos. B2 (north of penstock), B3 and B4, down to approximately El. 1591, where it intersects the existing downstream face of the dam;
- Full-height buttress scheme: top of dam modifications as above in Blocks Nos. B1, B2 (south of penstock) and B5 through B8, except the new downstream face also changes to slope at 0.65H:1V(parallel to existing face) beginning at El. 1604.5, providing a new concrete buttress founded at, or near, the original bottom of dam foundation grade
- Short height parapets extend laterally to high ground at each end of the dam;
- Concrete armoring of foundation rock surface downstream of the spillway (common to all Alternatives)

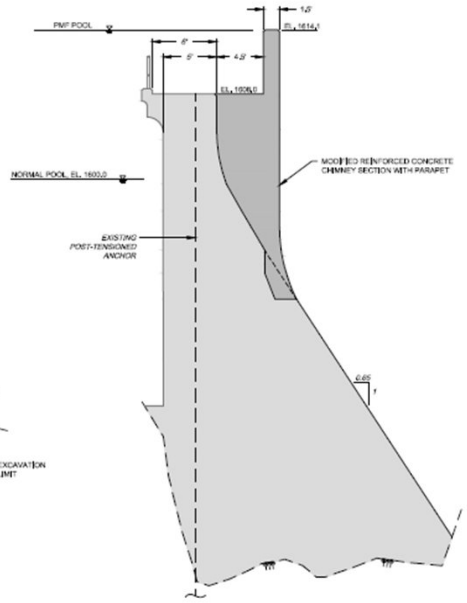
Alternative B



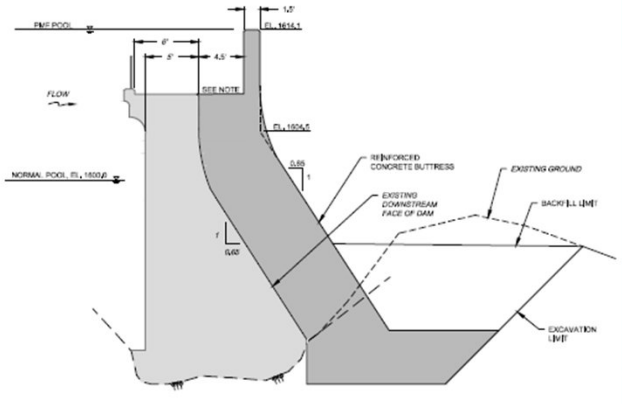
TYPICAL OF RIGHT BLOCKS 5, 6, 7, AND 8
(SECTION B SHOWN)

NOTE:

NOMINAL CREST EL. 1610, BLOCK 8
NOMINAL CREST EL. 1608, BLOCKS 5-7



TYPICAL OF LEFT BLOCKS 2 (PARTIAL), 3, AND 4
(SECTION C SHOWN)



TYPICAL OF LEFT BLOCKS 1 AND 2 (PARTIAL)
(SECTION P SHOWN)

NOTE:

NOMINAL CREST EL. 1610, BLOCK 1 (PARTIAL)
NOMINAL CREST EL. 1608, BLOCKS 2-4

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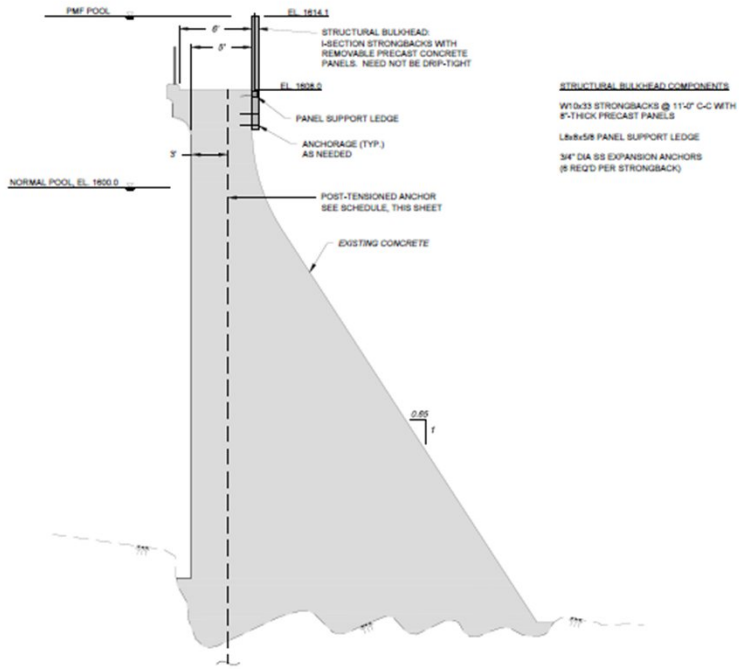
Alternative C - Post-Tensioned Rock Anchors without Overtopping

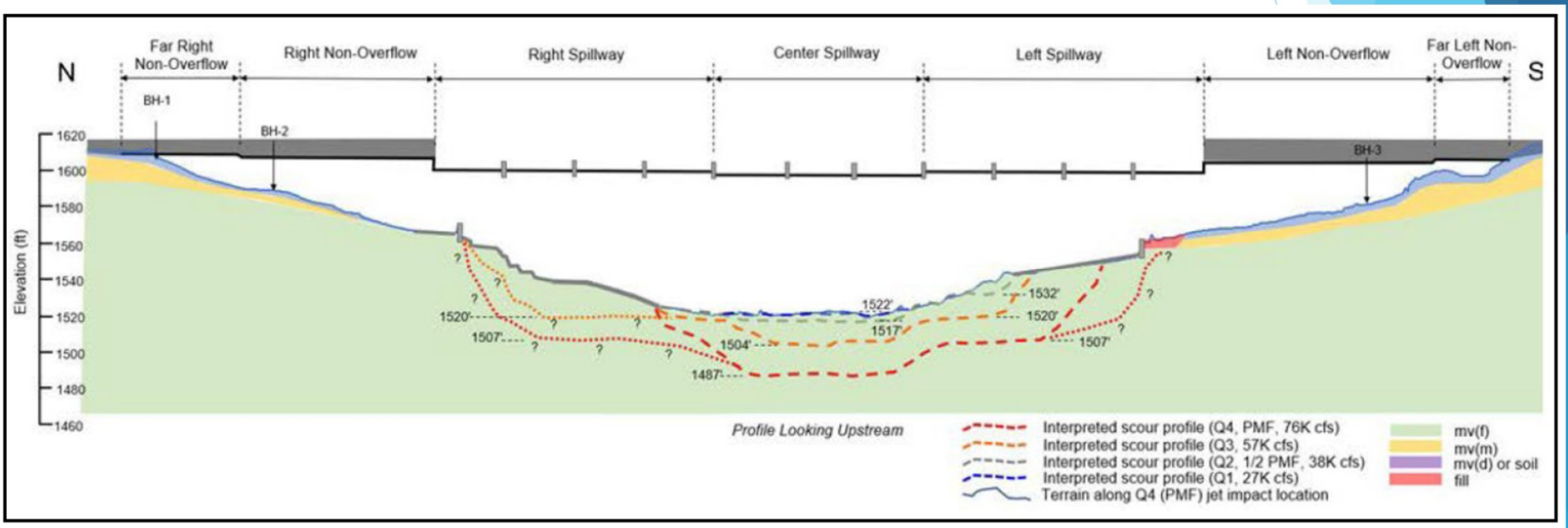
- New post-tensioned rock anchors are added to the non-overflow section blocks to improve stability
- A precast concrete parapet is added to the crest of the existing non-overflow sections at the downstream face
- A downstream concrete buttress is added to the 5-foot-wide vertical-sided section of Block No. B1 to convert it into a properly proportioned gravity section
- Short height parapets extend laterally to high ground at each end of the dam, as in Alternative B
- Concrete armoring of foundation rock surface downstream of the spillway (common to all Alternatives)

Alternative C

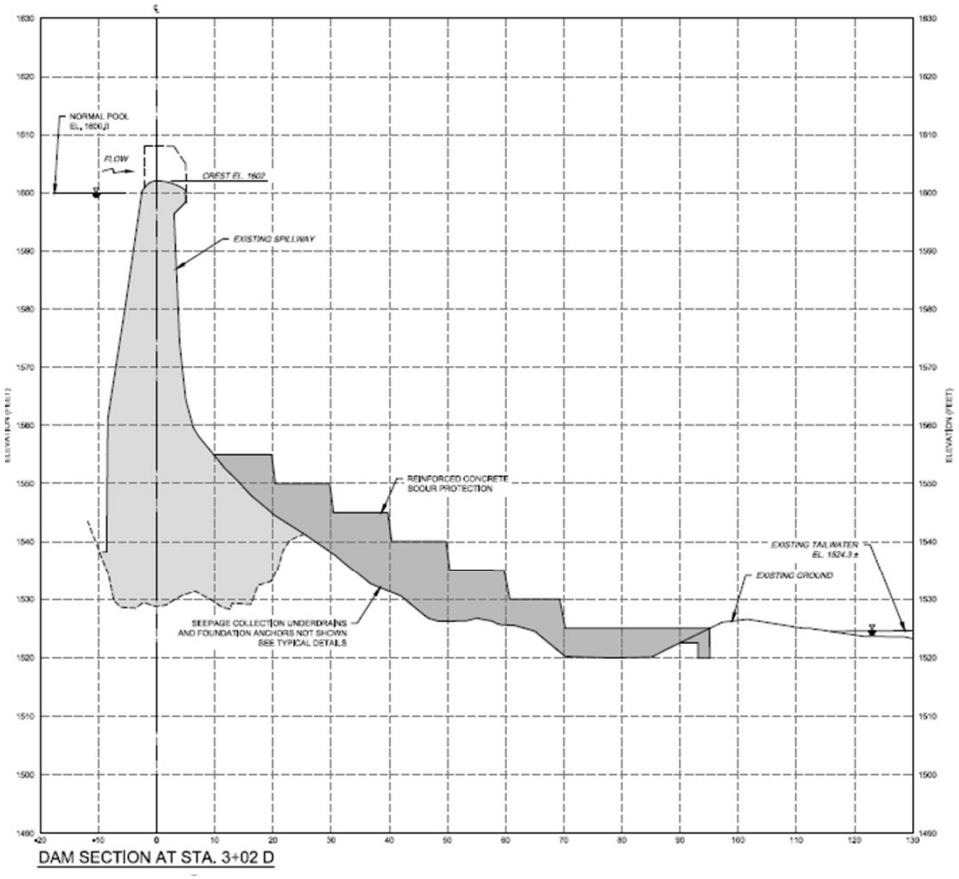


ALTERNATIVE C: POST-TENSIONED ANCHORS
WITH BULKHEAD
(TYPICAL FOR ALL BLOCKS)

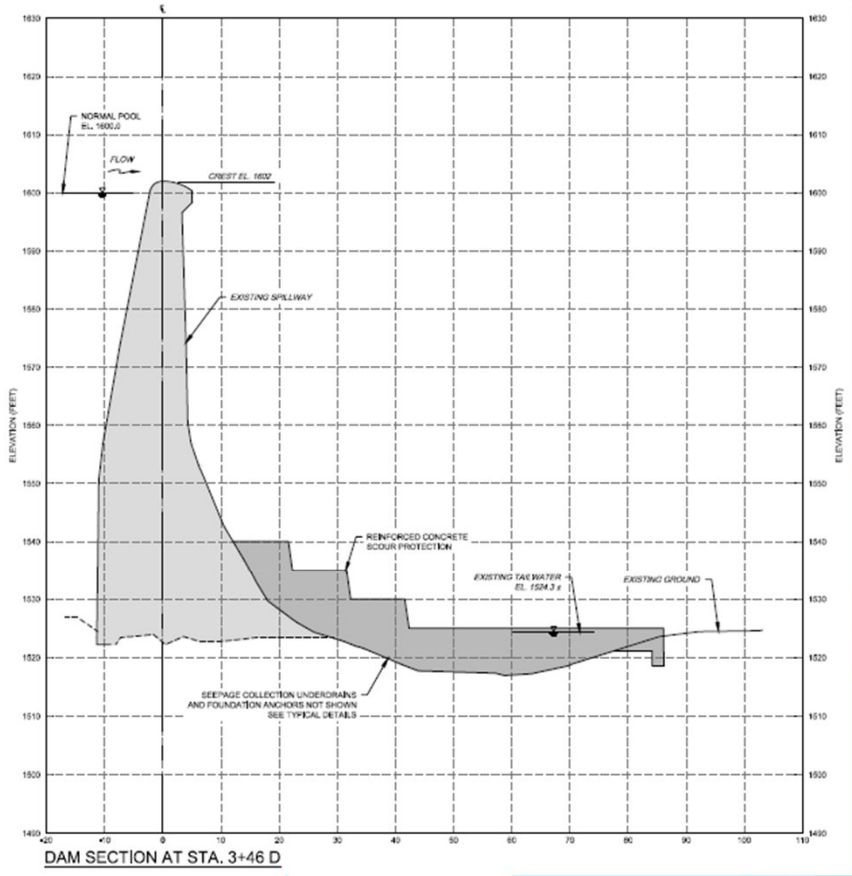
Alternative C – Scour Profile



Reinforced Downstream Scour Protection



DAM SECTION AT STA. 3+02 D



DAM SECTION AT STA. 3+46 D

Alternative Summary and Cost Comparison

Description	Gravity Blocks Stabilization Cost	Spillway Zone Armoring Cost	Total Cost
Alternative A	$7.500	$8.845	$16.345
Alternative B	$6.969	$8.845	$15.814
Alternative C	$4.442	$8.845	$13.287

* Cost in millions, 2021 dollars, excludes soft costs (permitting, construction inspection, administration)

Regulatory Commitments

- FERC Part 12D Periodic Inspection in 2026, report due 2027
- Current commitment to regulators is to begin the design in 2031 and begin construction work in 2032, following completion of the Scotts Flat Spillway work.
- Funded currently in Fund 50 Hydro

Questions