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CVSID LAKE SEQUOYAH DAM ENGINEERING EVALUATION & CONCEPTUAL DESIGN

Public Meeting - November 17, 2025

Olsson Design Team

Jeremy A. Brooks, PE - Civil Design, Project Coordination

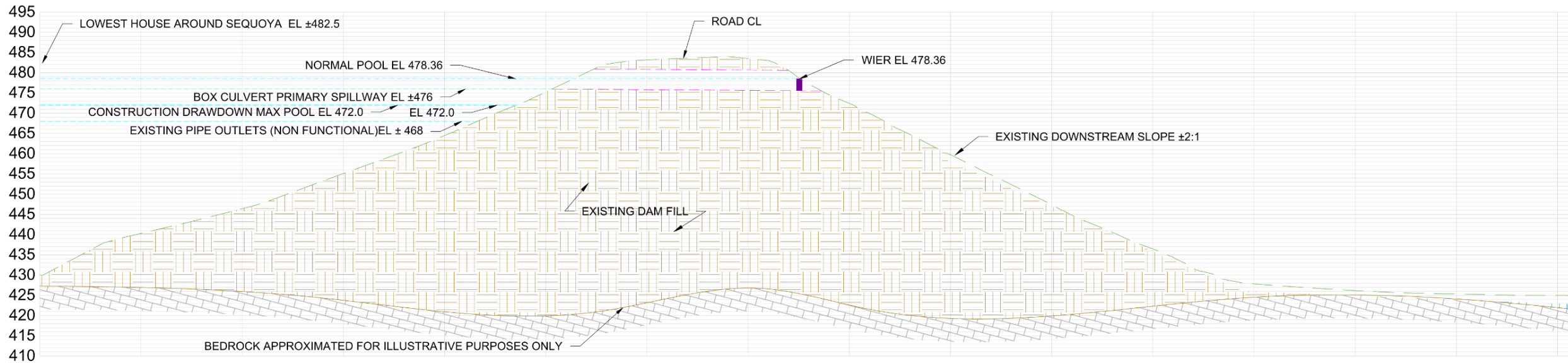
Keith Sikes, PLS - Surveying

Andrew Beekman, PE – Geotechnical Design

Kapil Dhital, PE – Hydrology and Hydraulic Design

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EXISTING SEQUOYAH DAM PROFILE



EXISTING DAM SECTION

Existing downstream slope $\pm 2:1$ (H:V)

Normal Pool 478.36 – Set by wooden weir

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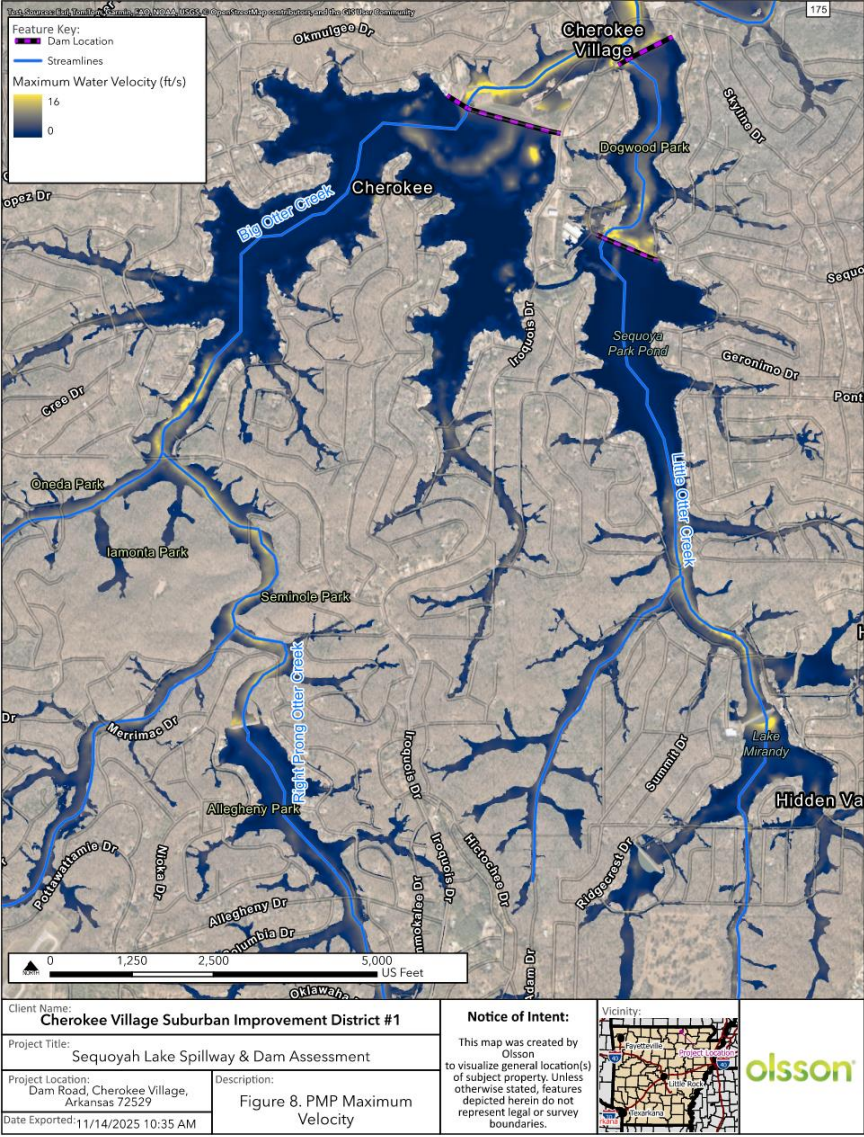
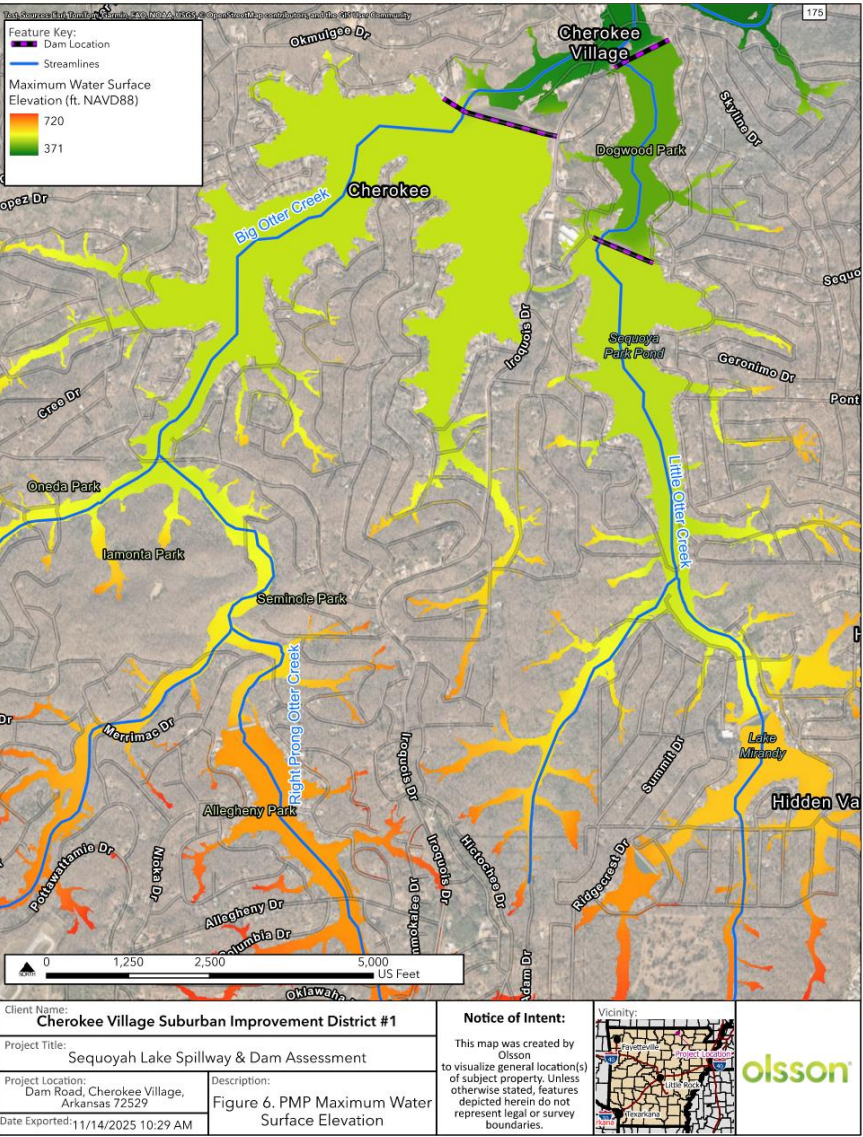


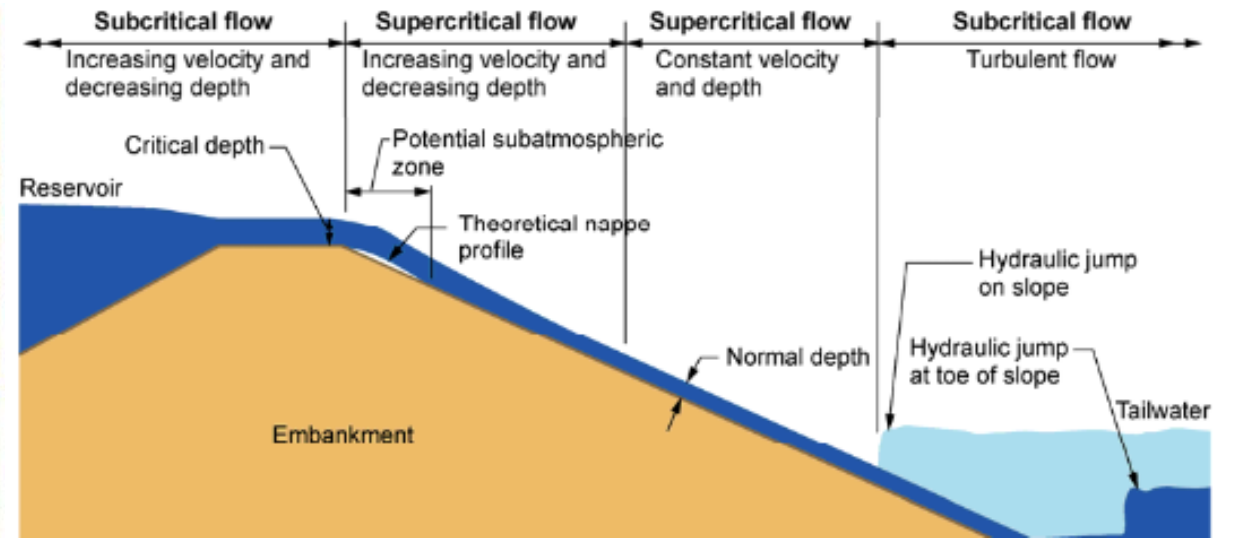
Hydraulics and Hydrology

- Hazard classification based upon intermediate size and high hazard based on downstream residences
 - Spillway must pass the 100 percent of the probable maximum flood (PMF).
 - ANRD 2019 Dam Safety PMP tool evaluates three event types, Local, General and Tropical – Worst case governs.

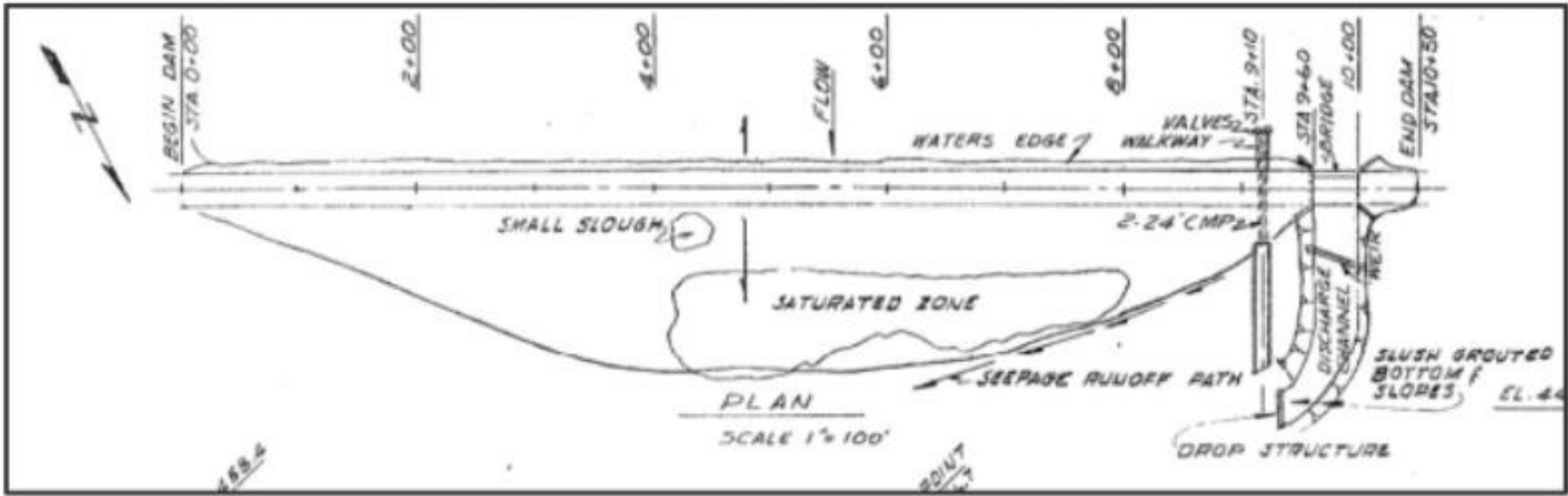
Source	Probable Maximum Precipitation (Depth in Inches)			
	6-hr	24-hr	48-hr	72-hr
State-Local Event	23.4	-	-	-
State-General Event	-	25.2	30.1	30.5
State-Tropical Event	-	32.9	34.9	35.0

- Approximately 21,300 CFS total
 - ± 4,000 CFS passes through existing spillway.
 - ± 17,300 CFS overtops the dam and abutments with a depth of up to 3.8 feet maximum over dam face.
 - Flow over abutments is manageable but flow over earthen dam can be catastrophic.





Example breach Hanson et al. 2005



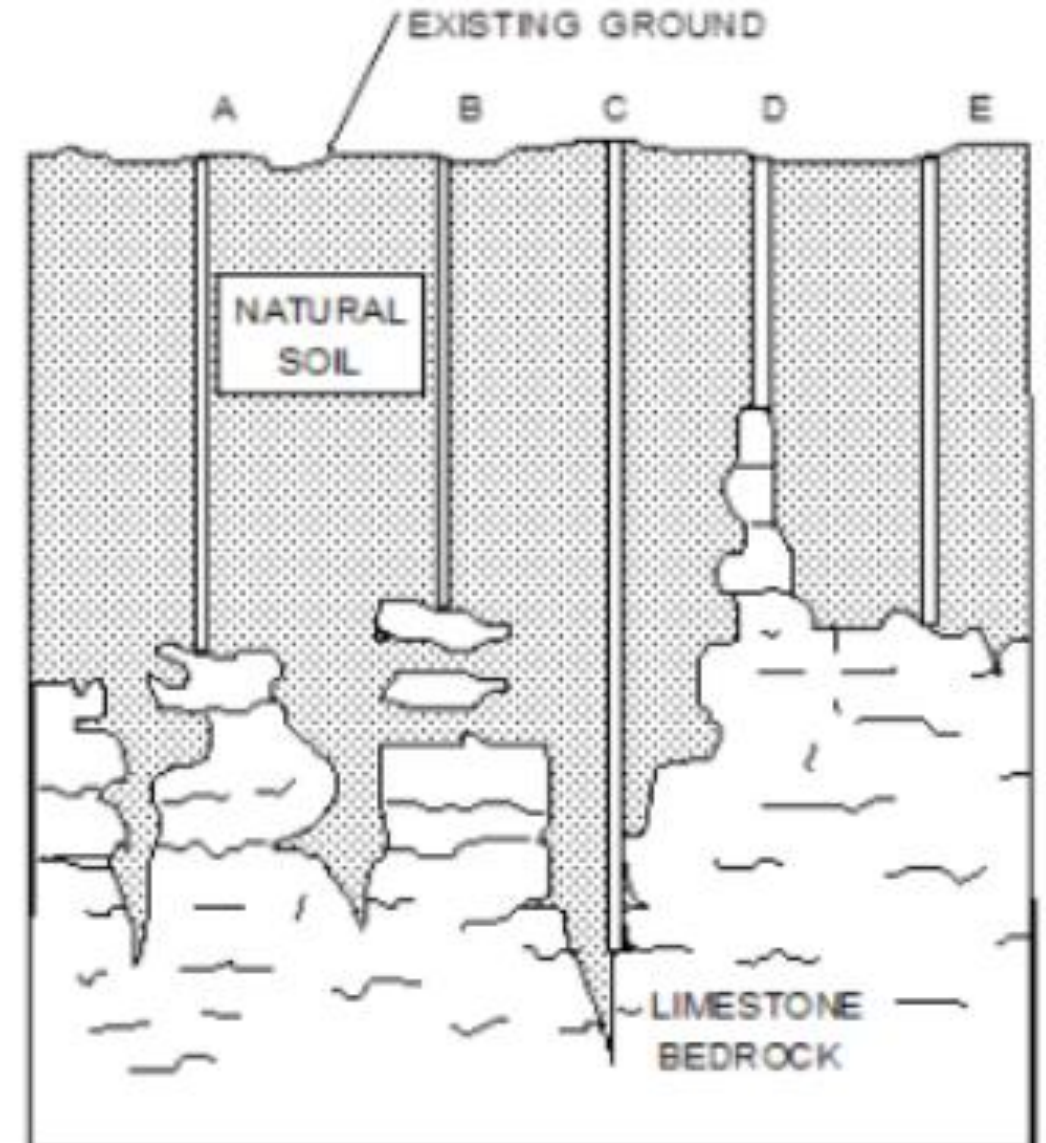
Geotechnical Conditions

Dam has a long history of geotechnical distress dating back to at least 1979 including sloughs and seepage which are still recurring today.

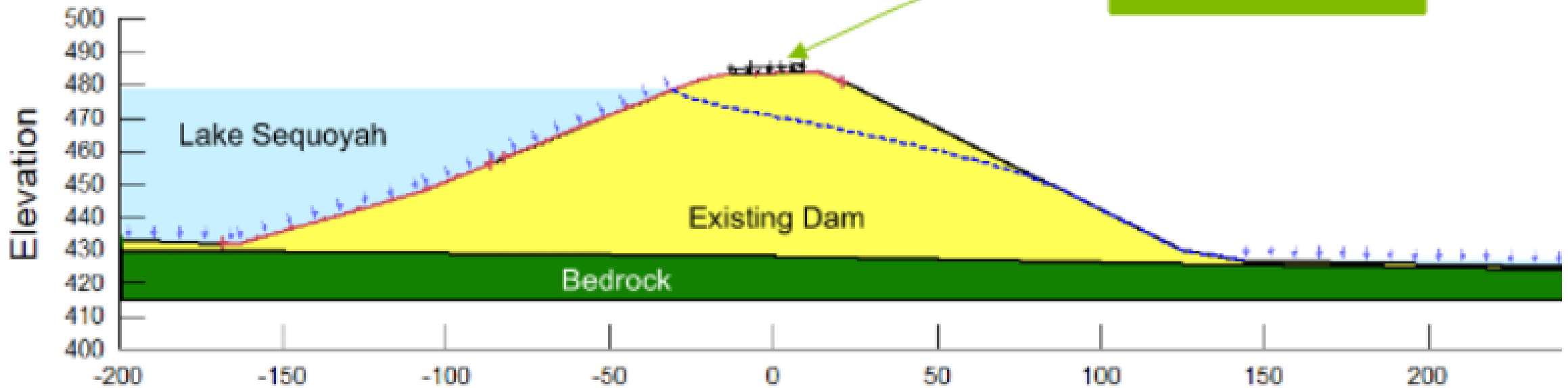
Requirements are much more stringent now than when originally constructed, especially seismic requirements.

Karst Geology

- Significant factor in seepage is likely karst topography.
- No apparent keyway in dam which could exaggerate seepage below dam.



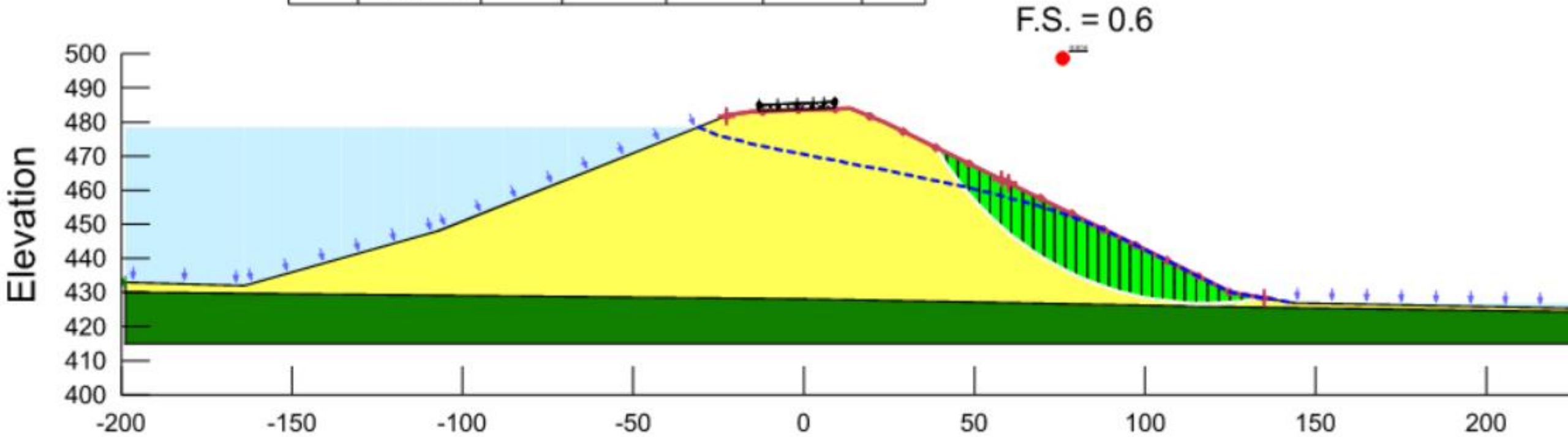
Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
■	Bedrock	135	0	45
■	Dam Embankment	120	100	20



Geotechnical Evaluation

- Primary Considerations
 - Dam materials - primarily low strength, low permeability clays with some deleterious inclusions
 - Foundation materials – Limestone and chert, fractured and karst
 - Lake levels (upstream and downstream) and surcharge loads from roadway traffic.

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Cohesion R (psf)	Phi R (°)
■	Bedrock	135	0	45	0	0
■	Dam Embankment	120	100	28	500	16



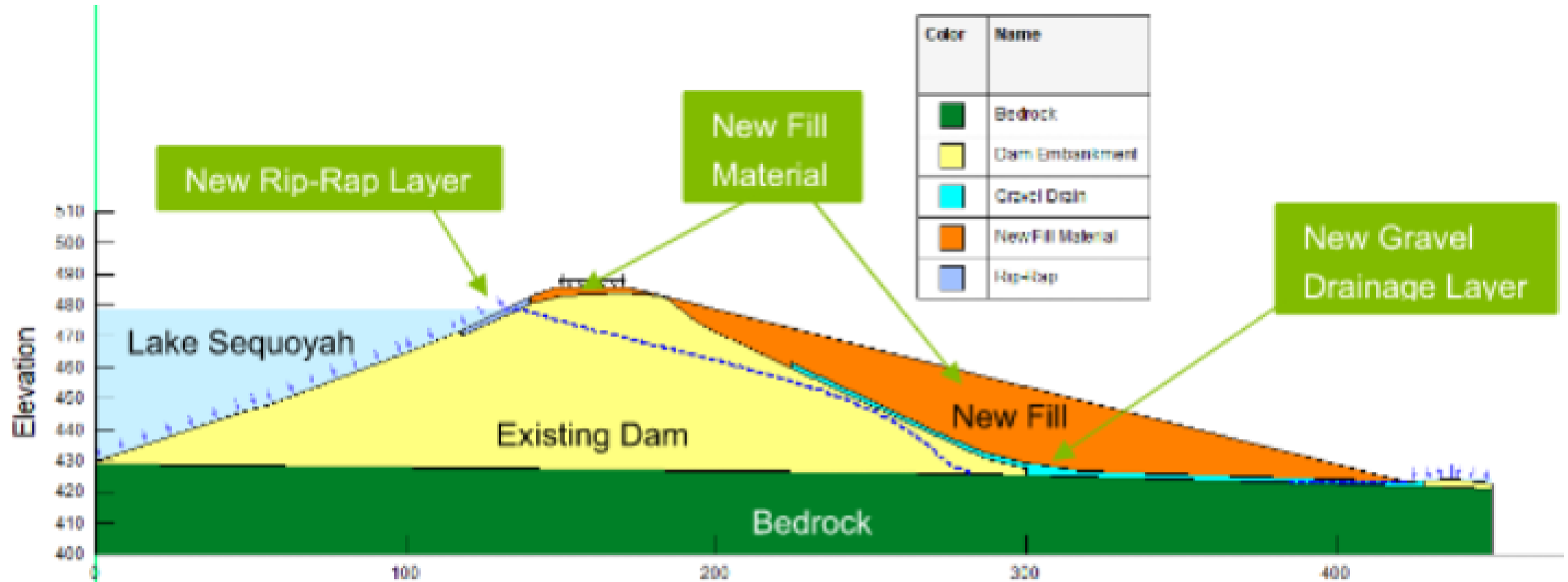
Geotechnical Evaluation

- Conditions modeled to evaluate seismic loading, static conditions, steady state seepage, and multiple rapid drawdown scenarios from flood events and intentional releases.

Condition	Calculated Factor of Safety	Recommended Minimum Factors of Safety		
		USACE	USDA	NRCS
Steady-State Seepage, Normal Reservoir – downstream face	0.9*	1.5	1.5	1.5
Steady-State Seepage, Maximum Reservoir – downstream face	0.8*	1.4	1.2	1.4
Rapid Drawdown, Normal Reservoir – upstream face	1.7	1.3	1.3	1.2
Rapid Drawdown, Maximum Reservoir – upstream face	1.3	1.1	1.2	1.2
Seismic, Normal Reservoir – downstream face	0.6*	1.0	1.0	1.0
*The calculated factor of safety does not meet the recommended minimum factors of safety				

EXISTING CONDITIONS CONCLUSIONS

- Current conditions are unsatisfactory from multiple aspects
 - Hydraulics and Hydrology
 - Geotechnical
 - Operations and Maintenance
- Potential improvements
 - Increase spillway capacity and overflow capacity
 - Harden downstream face of dam for overflow protection
 - Flatten slope and collect seepage to stabilize geotechnically and improve O&M.

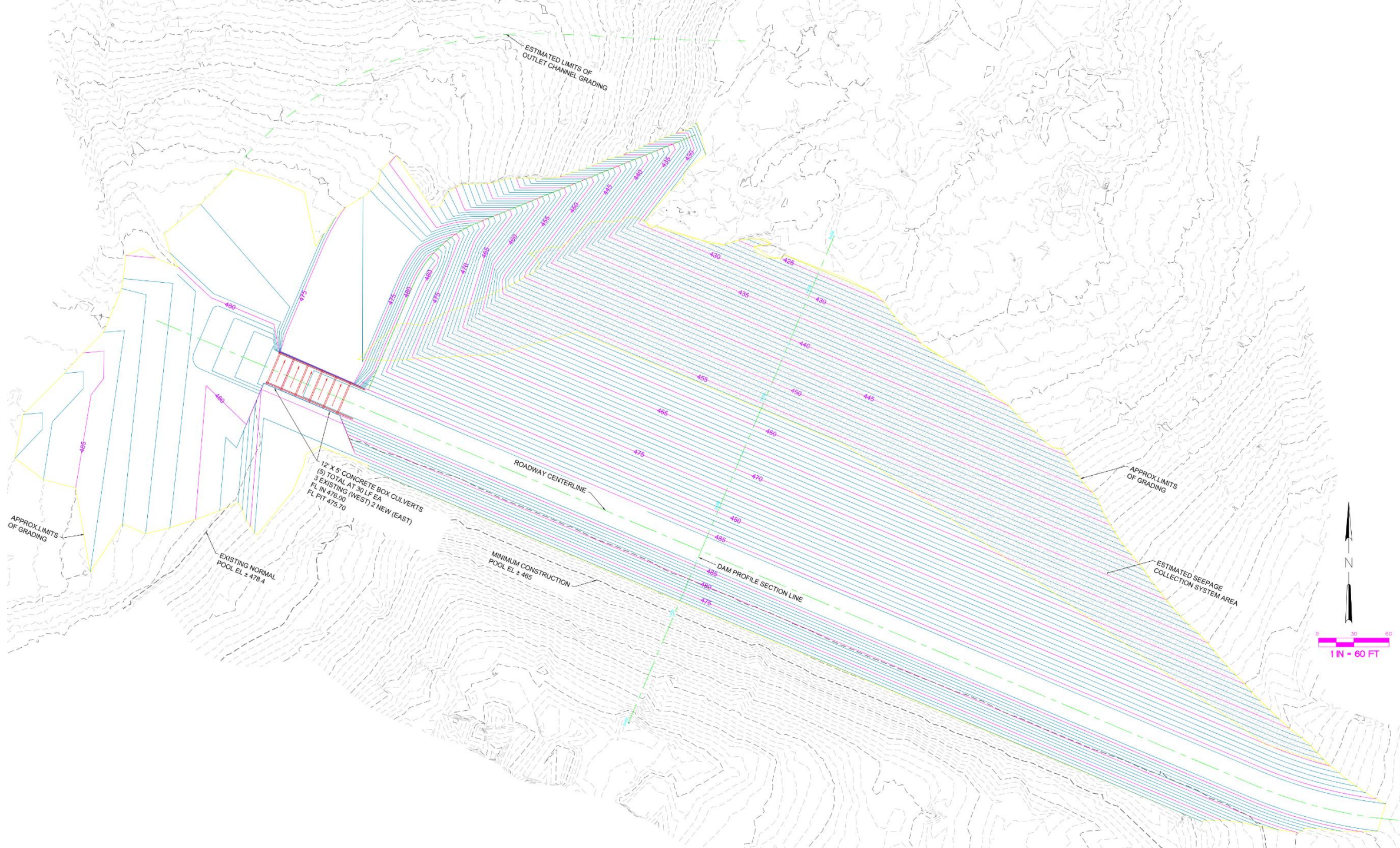


Geotechnical Evaluation of Proposed Conditions

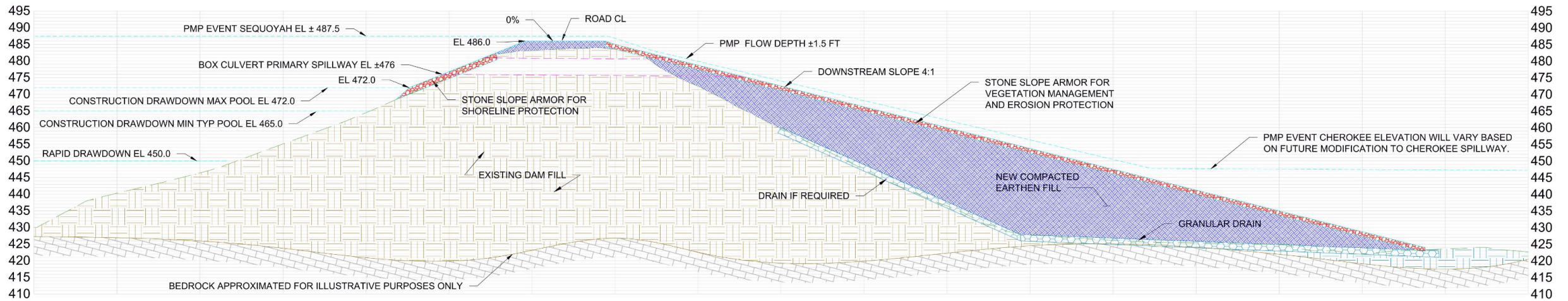
- Small increase in height and roadway improvements
- Down stream 4:1 slope with underdrain system
- Up slope armoring for shoreline protection

Condition	Calculated Factor of Safety	Recommended Minimum Factors of Safety		
		USACE	USDA	NRCS
Steady-State Seepage, Normal Reservoir – downstream face	2.3	1.5	1.5	1.5
Steady-State Seepage, Maximum Reservoir – downstream face	2.2	1.4	1.2	1.4
Rapid Drawdown, Normal Reservoir – upstream face	1.5	1.3	1.3	1.2
Rapid Drawdown, Maximum Reservoir – upstream face	1.2	1.1	1.2	1.2
Seismic, Normal Reservoir – downstream face	1.2	1.0	1.0	1.0

Note: Some Factor of Safety values higher than required by rule. The final design could value engineer the improvements to reduce costs by iterating designs to minimize overbuild.



SEQUOYAH DAM PROFILE



PROPOSED DAM SECTION

Existing downstream slope ± 4:1 (H:V) with stone slope armoring for erosion control protection

Earth and rock fill from spillway excavation on west side of site

Normal Pool ± 478.4 – Set by pneumatically controlled gate



Example photographs courtesy of Obermeyer Hydro, Inc.



SEQUOYAH LAKE DAM - CONCEPT LEVEL

Engineer's Opinion of Probable Cost - (11/17/2025)

Olsson Project No. 025-00244

Bid Item #	Description	Estimated Quantity	Units	Estimated Unit Rate	Estimated Total Cost	Quantity Rationale
1	Mob/Demob	1	LS	\$ 350,000.00	\$ 350,000	±5.5% of Total
2	Site Preperation	1	LS	\$ 50,000.00	\$ 50,000	Experience based estimate
3	Clearing and Grubbing	7	AC	\$ 15,000.00	\$ 105,000	All areas within the limits of grading
4	Demolition & Disposal	1	LS	\$ 100,000.00	\$ 100,000	Existing channel and Headwalls, guard rails, pavements, outlet pipes.
5	Temp. Slope Protection and Erosion Control	1	LS	\$ 20,000.00	\$ 20,000	BMPs associated with SWPPP planning including silt fencing, ditch checks, etc.
6	Control of Water	1	LS	\$ 150,000.00	\$ 150,000	Isolation of Sequoyah from Thunderbird at channel, dewatering to low level drawdown and maintaining Sequoyah at construcion pool.
7	12' x 5' Box Culvert	60	LF	\$ 4,000.00	\$ 240,000	2 x 30 LF barrels adjacent to existing
8	Cast-in-Place Reinforced Concrete (Vertical)	100	CY	\$ 2,500.00	\$ 250,000	headwalls, wingwalls, hydraulic structures
9	Cast-in-Place Reinforced Concrete (Flatwork)	200	CY	\$ 1,500.00	\$ 300,000	Spillway appropach aprons, submerged roads, channels, C&G
10	Rubber Bladder Weir	1	LS	\$ 200,000.00	\$ 200,000	Removable barrier across primary outlet
11	Subgrade Preperation and Underdrain	75,000	SF	\$ 8.00	\$ 600,000	All areas of fill adjacent to dam
12	Earthwork (Fill in Place)	80,000	CY	\$ 15.00	\$ 1,200,000	Modeled Embankment fill required at 4:1 with earthen berm diverting flow from dam
13	Earthwork (Cut)	60,000	CY	\$ 20.00	\$ 1,200,000	Overflow spillway excavaton and undercut (estimated)
14	Stone Slope Armoring	13,500	Ton	\$ 45.00	\$ 607,500	180000 SF @1 FT Thick *150 lb/cf =13500 ton
15	Riprap Channels and Letdowns	5,000	Ton	\$ 60.00	\$ 300,000	505+1110+590+2150 @ 1.5' @ 125 PCF = 409T say 425 T
16	Riprap Grouting	200	CY	\$ 500.00	\$ 100,000	1950+1280= 3230 @125 PCF= 201.9T say 225 Tons
17	Hot Mix Asphalt Paving	7,000	SY	\$ 20.00	\$ 140,000	Roadway Areas
18	Crushed Stone Surfacing (Road Base Gravel)	3,500	Ton	\$ 35.00	\$ 122,500	8 in below roadways and parking entrances
SUBTOTAL					\$ 6,035,000	
20% Contingency					\$ 1,207,000	
Estimated Total Cost					\$ 7,242,000	

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