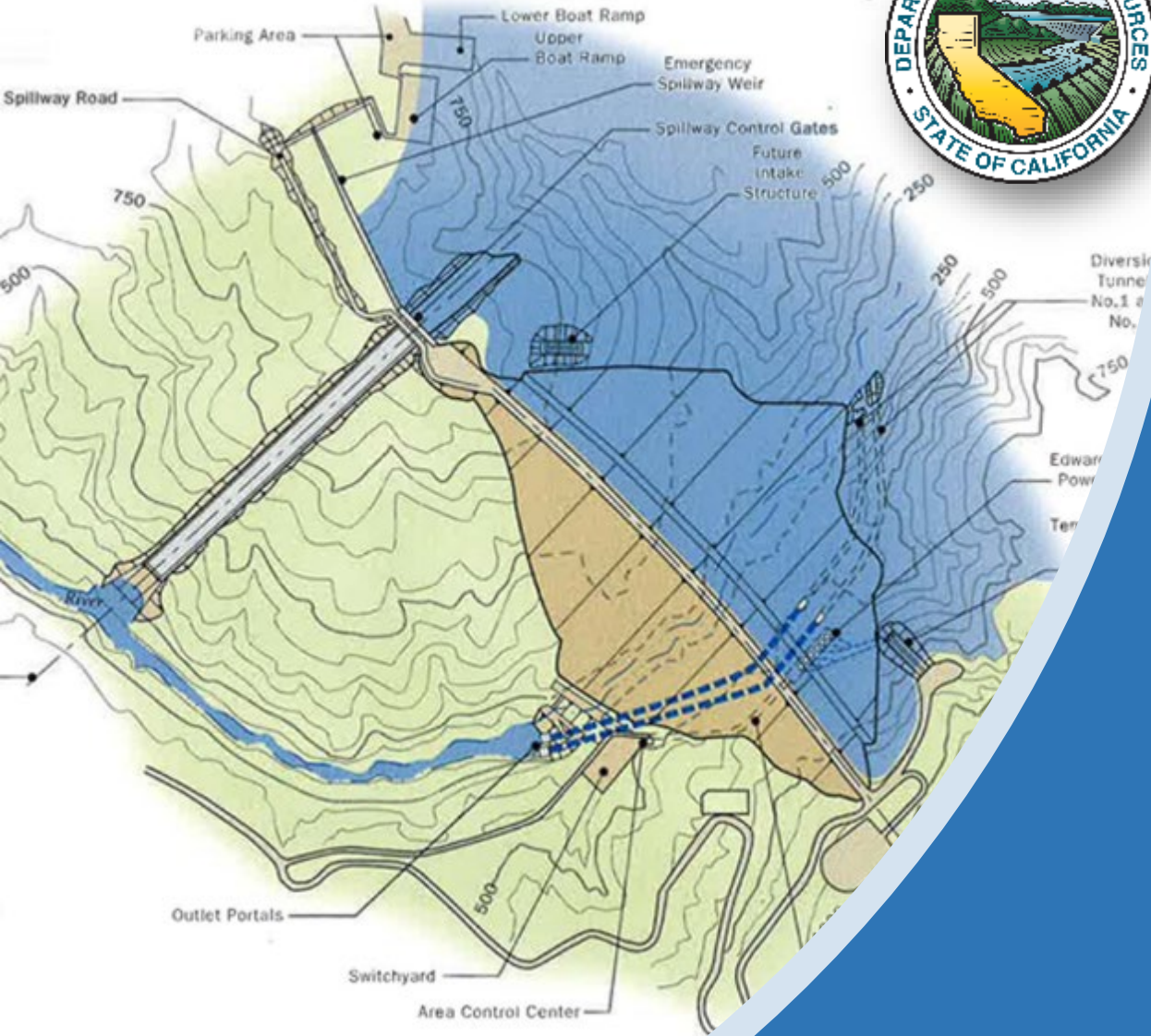




STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
OROVILLE DAM SAFETY
COMPREHENSIVE NEEDS ASSESSMENT

CNA Task 4 – Low-Level Outlet Alternatives Work Progress Briefing



Oroville Dam Safety – Ad Hoc Committee Meeting No. 3

January 10, 2019





CNA Task 4 Work Progress Briefing

Presentation Outline

- Defining Needs Statement, Objectives, Constraints
- Summary of Task 4 Objectives and Constraints
- Examples of Specific Evaluations Required
- Additional Task 4 Updates:
 - ✓ Reservoir Drawdown Calculations
 - ✓ Seismic Shaking Estimates for Hyatt PP
 - ✓ Potential Reservoir Drawdown Limitations/Benefits



CNA Planning Project Approach

1. Identify needs, constraints, and measures to address needs
2. Inventory current and forecast future conditions
3. Formulate alternative solutions (plans)
4. Evaluate alternative solutions (plans)
5. Compare alternative solutions (plans)
6. Recommend solutions (plans)



Phase I - Identify

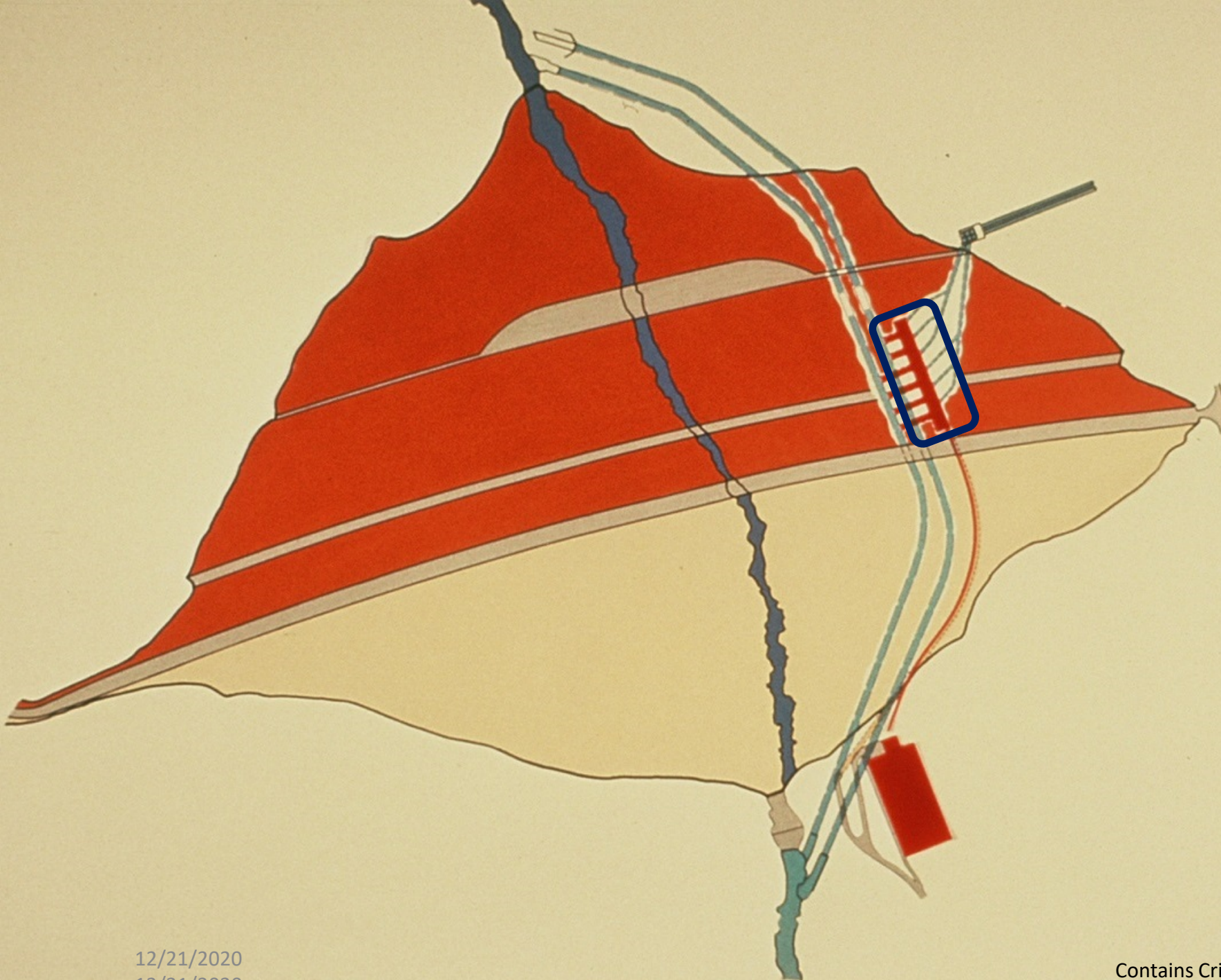
1. Needs that arise due to the baseline condition.
2. Objectives that are measurable and actionable targets to be met with measures and alternative plans (combinations of measures)
3. Constraints that limit or restrict action taken to address needs or opportunities

REVIEW

FCO Spillway
(Upper Reservoir)

12/21/2020
12/21/2020

Contains Critical Energy Infrastructure Information – DO NOT RELEASE



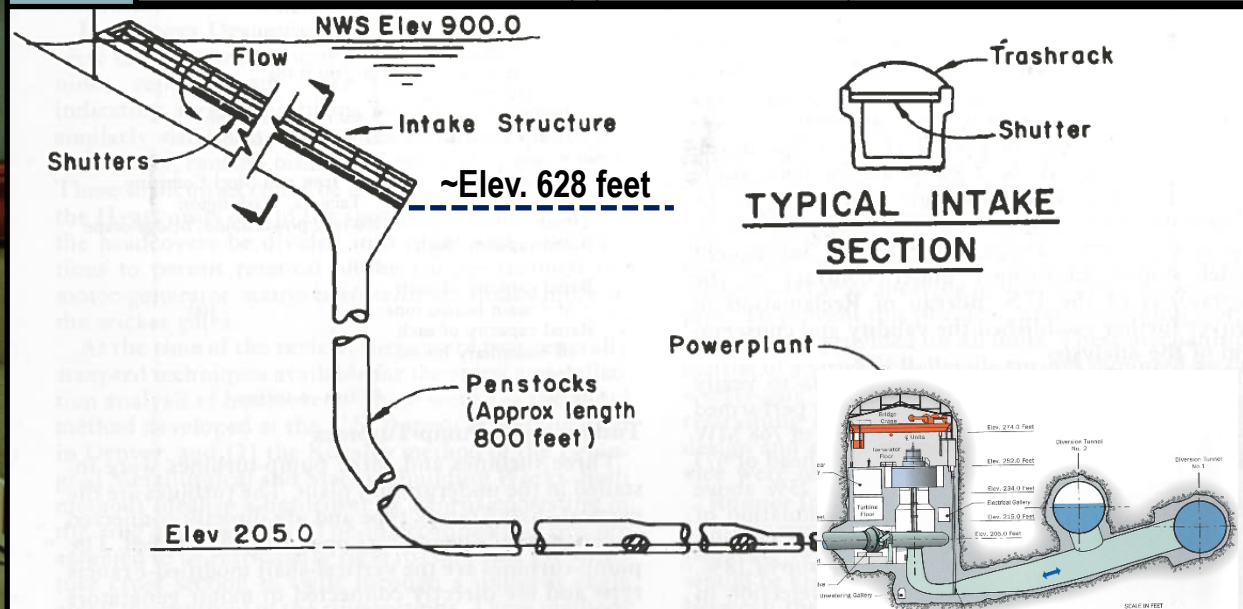
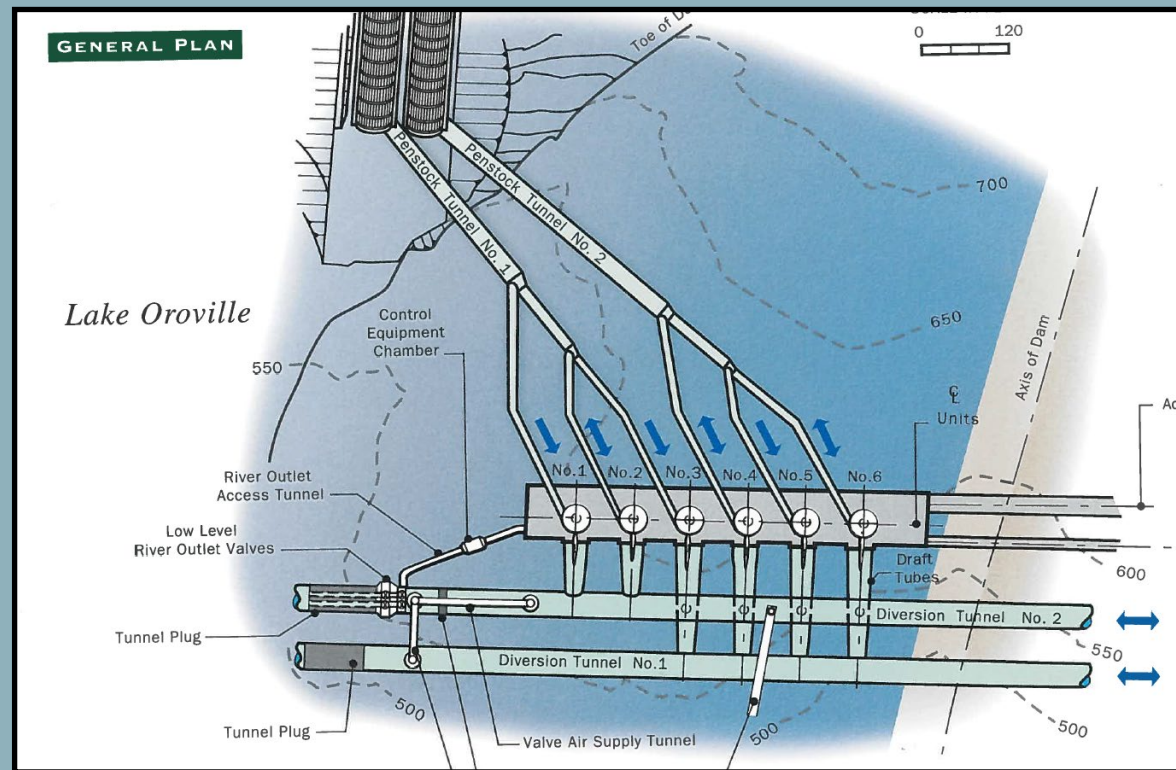
Hyatt Power Plant

- 550-foot-long,
- 137-foot high
- Excavated cavern

Hyatt Power Plant:



Effectively,
no release
capacity when
lake is below
~Elev. 640 feet



Contains Critical Energy Infrastructure Information - DO NOT RELEASE

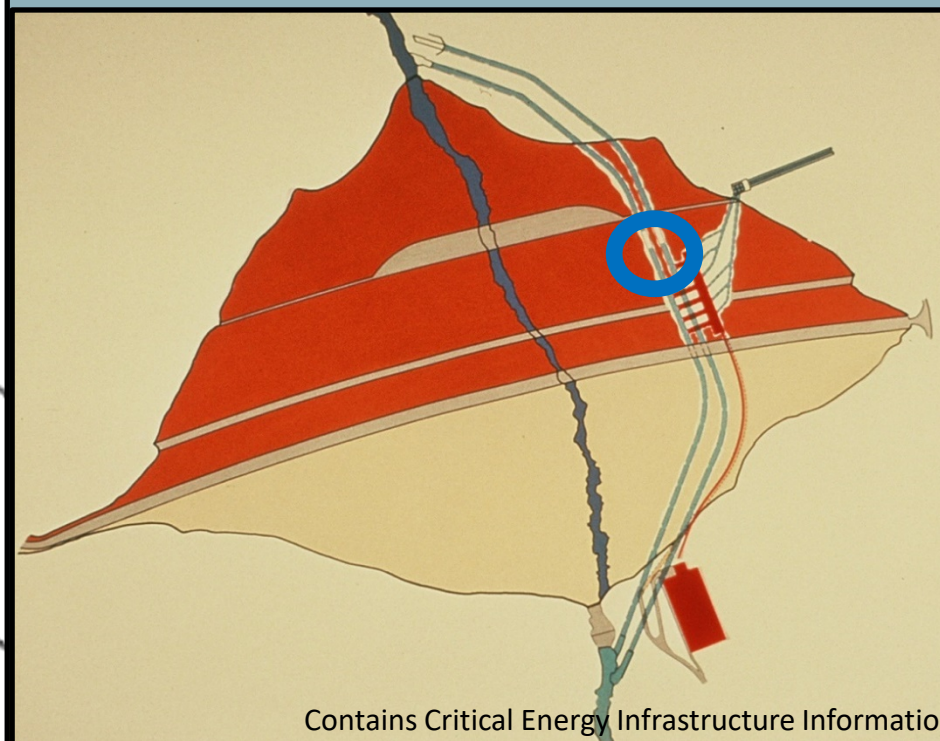
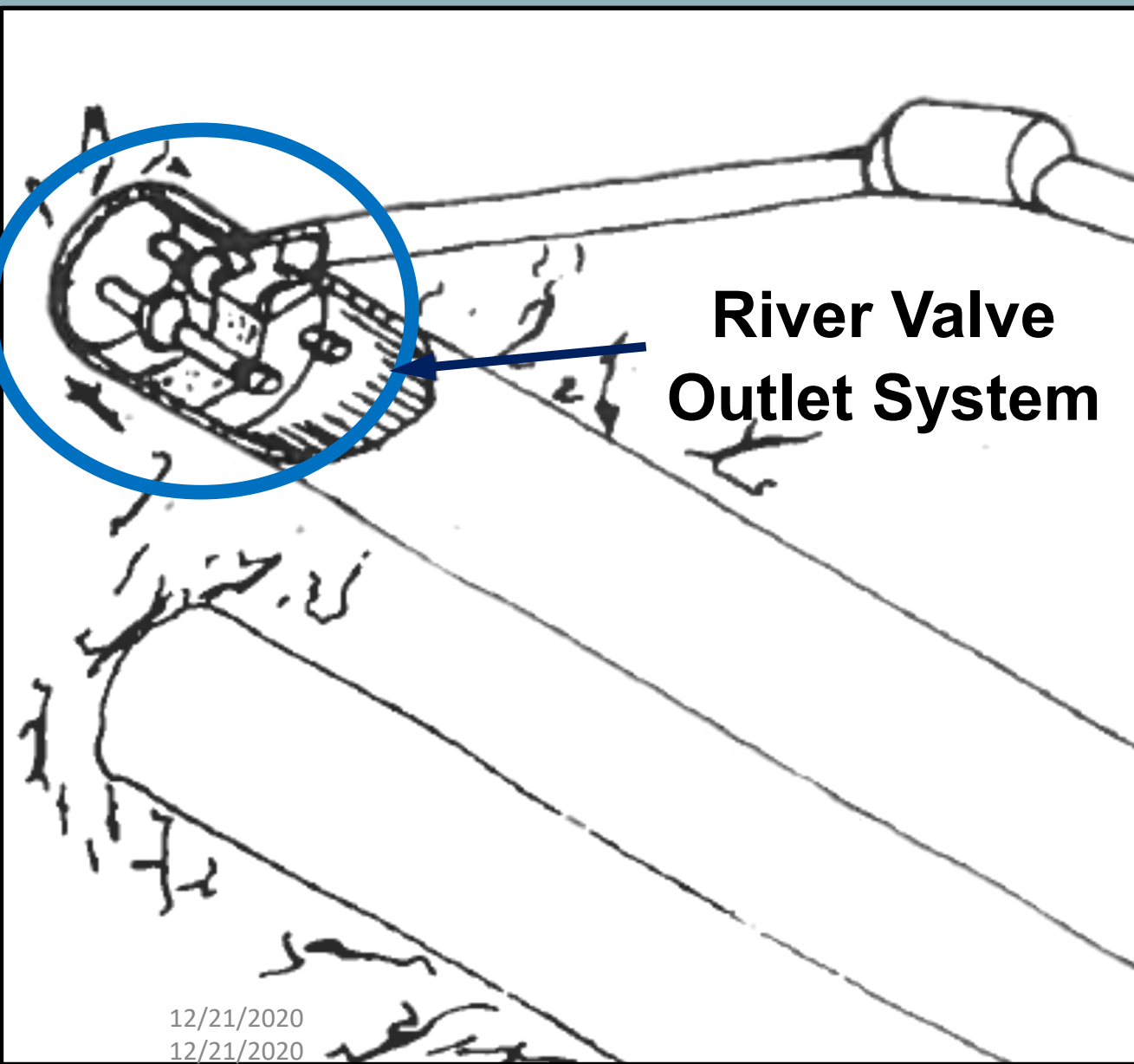
12/21/2020

12/21/2020

Reservoir Release: RVOS (River Valve Outlet System)

River Valve Outlet System (RVOS)

- Two 6-foot diameter pipes/valves through plug in Diversion Tunnel No. 2
- Maximum Capacity ~4,000 cfs
- Valve reliability





Task 4 – Low Level Outlet Need Statement

Task 4 Need Statement

Are additional outlet facilities needed to provide **redundancy** or **additional** reservoir drawdown capacity at Oroville Dam?

Objective T4-1 – Determine whether new outlet facilities should be added to enhance **redundancy** to the **FCO Gates** for Emergency Reservoir Drawdown of the Upper Reservoir

Objective T4-2 – Determine whether new outlet facilities should be added to enhance **redundancy** to the **Hyatt PP** for Emergency Reservoir Drawdown of the Lower Reservoir

Objective T4-3 – Determine whether new outlet facilities should be added to provide **additional** capacity for Emergency Reservoir Drawdown of the Lower Reservoir.

Objective T4-4 – Determine whether new outlet facilities should be added to provide **additional** capacity for **routine reservoir operations** of the Reservoir (likely focused on the Lower Reservoir releases).

Constraints

- Physical limits of Existing Facilities
- Reliability of Existing Facilities
- Tolerable risk
- Regulatory requirements
- Additional physical constraints (e.g. channel capacity, geology, operations)



Example Evaluation #1:

Objective T4-3 – Additional Capacity for Emergency Reservoir Drawdown Capabilities for Lower Reservoir

A yellow circular icon containing a black question mark, positioned to the left of the "Not Known" text.

Not Known: What risks we are trying to mitigate in providing **additional** Emergency Reservoir Drawdown capacity, to what elevation might this be important, and whether DSOD Criterion #2 is the appropriate amount and rate of drawdown with respect to Tolerable Risk.



Evaluation: Interview Task Leaders/Teams for Task 3 and 5 to determine risks and potential reservoir drawdown mitigation, identify possible risk reduction benefits. Participate in upcoming PFMA and Level 2 Risk Analysis



Example Evaluation #2:

Objective T4-1 - Redundant Capacity for Emergency Reservoir Drawdown for Upper Reservoir



Not Known: What are the requirements by FERC and DSOD for redundancy in providing Emergency Reservoir Drawdown Criteria for the Upper Reservoir



Evaluation: Meet with FERC and DSOD staff to discuss their potential requirements with respect to redundancy in drawing down the upper portion of the reservoir. Discuss the specific issues, risks, and potential risk reductions with respect to Oroville Dam and the draw down capabilities for the Upper Reservoir



Example Evaluation #3:

Common for Objectives T4-1 to T4-4 – Consider the potential use of existing Diversion Tunnels



Not Known: Whether we can use one of the existing Diversion Tunnels as a new LLO.



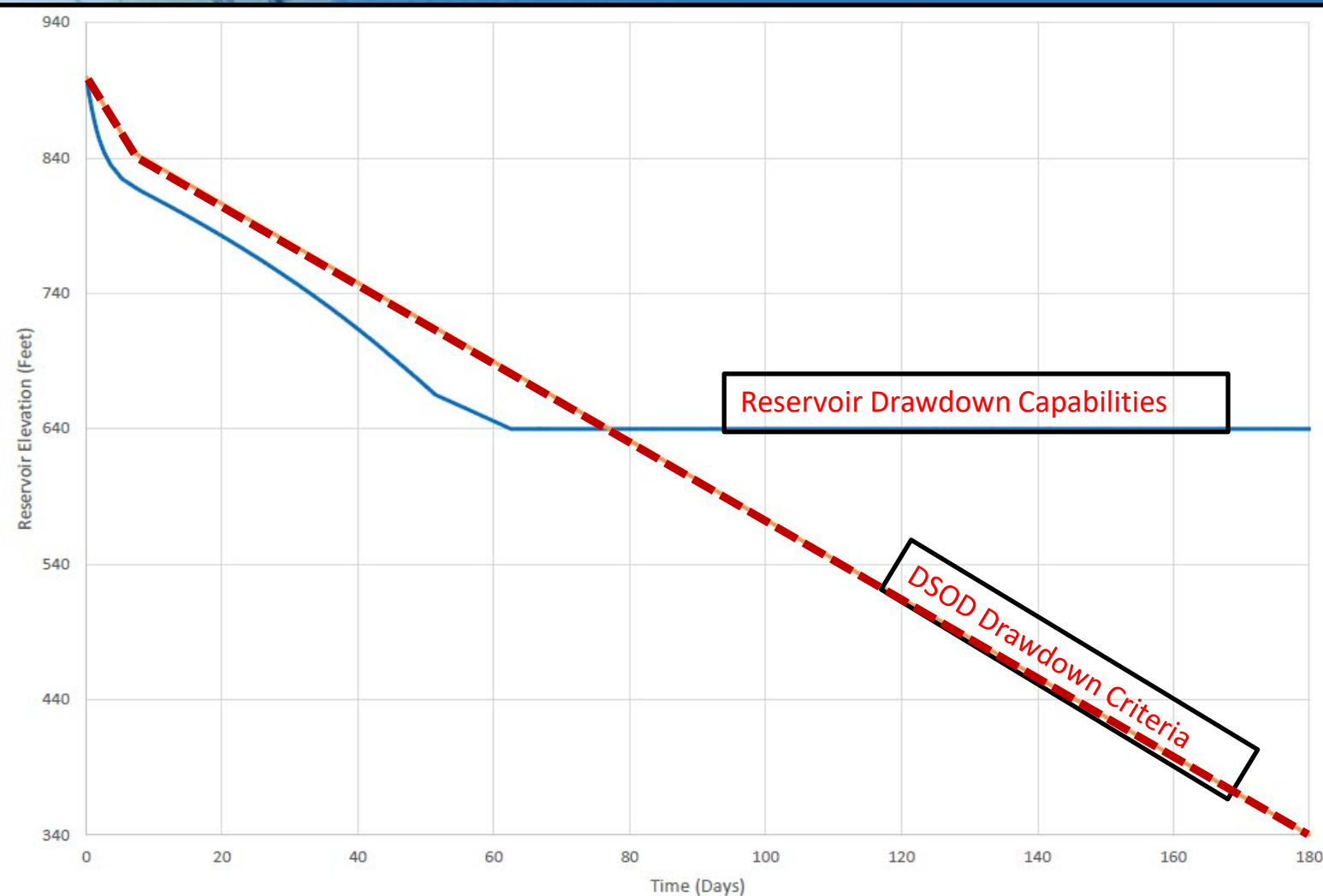
Evaluation: Develop cursory level measures that use one of the existing diversion tunnels, identify requirements for hot tap of the reservoir, new valve chambers, facilities to isolate the diversion tunnels from the Hyatt PP during releases, and ability to maintain facilities. Evaluate whether this approach contains any fatal flaws.



CNA Task 4 Work Progress Briefing

Additional Task 4 Updates

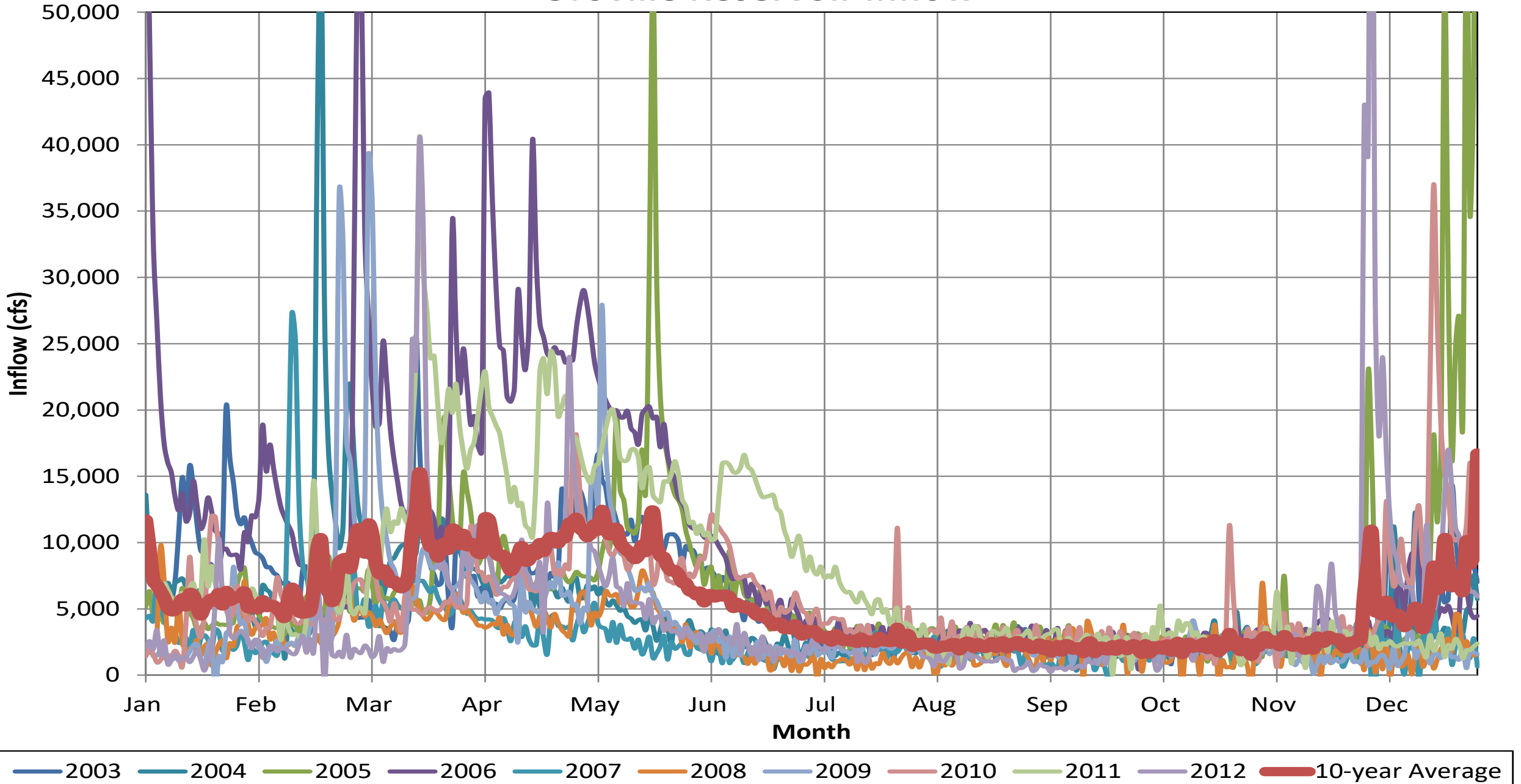
Maximum Possible Reservoir Drawdown Calculations



Max. Drawdown under Existing Conditions:

- Assumes all 8 FCO Gates fully open
- All 6 units online in Hyatt
- RVOS at full capacity
- Inflow assumption is a constant 5,000 cfs.

Oroville Reservoir Inflow



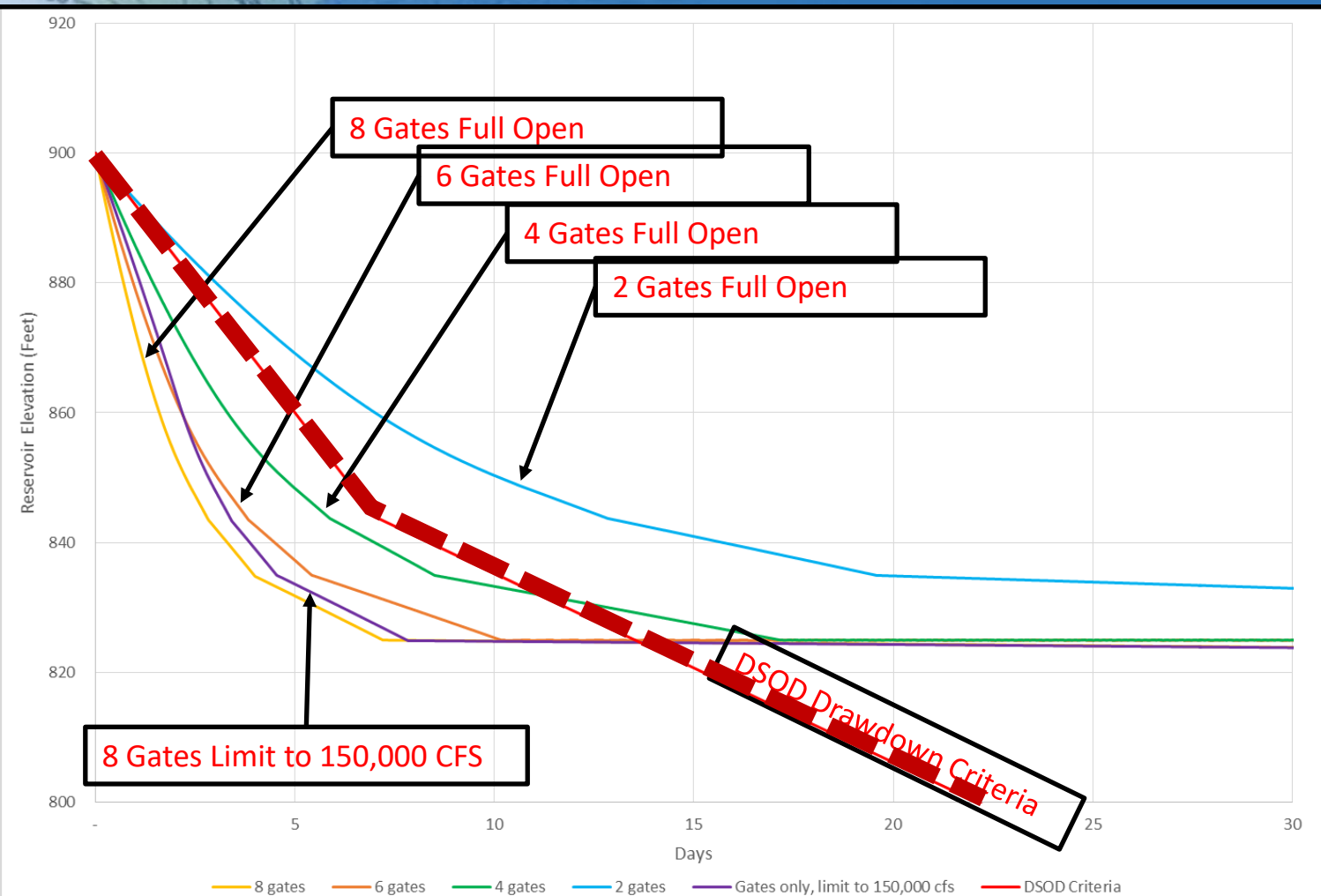
Source: Oroville drawdown calc3.xlsm (CDEC Daily Inflow Jan 1, 2003 - Jan 1, 2013)



CNA Task 4 Work Progress Briefing

Additional Task 4 Updates

Upper Reservoir Drawdown Calculations



Drawdown under Existing Conditions:

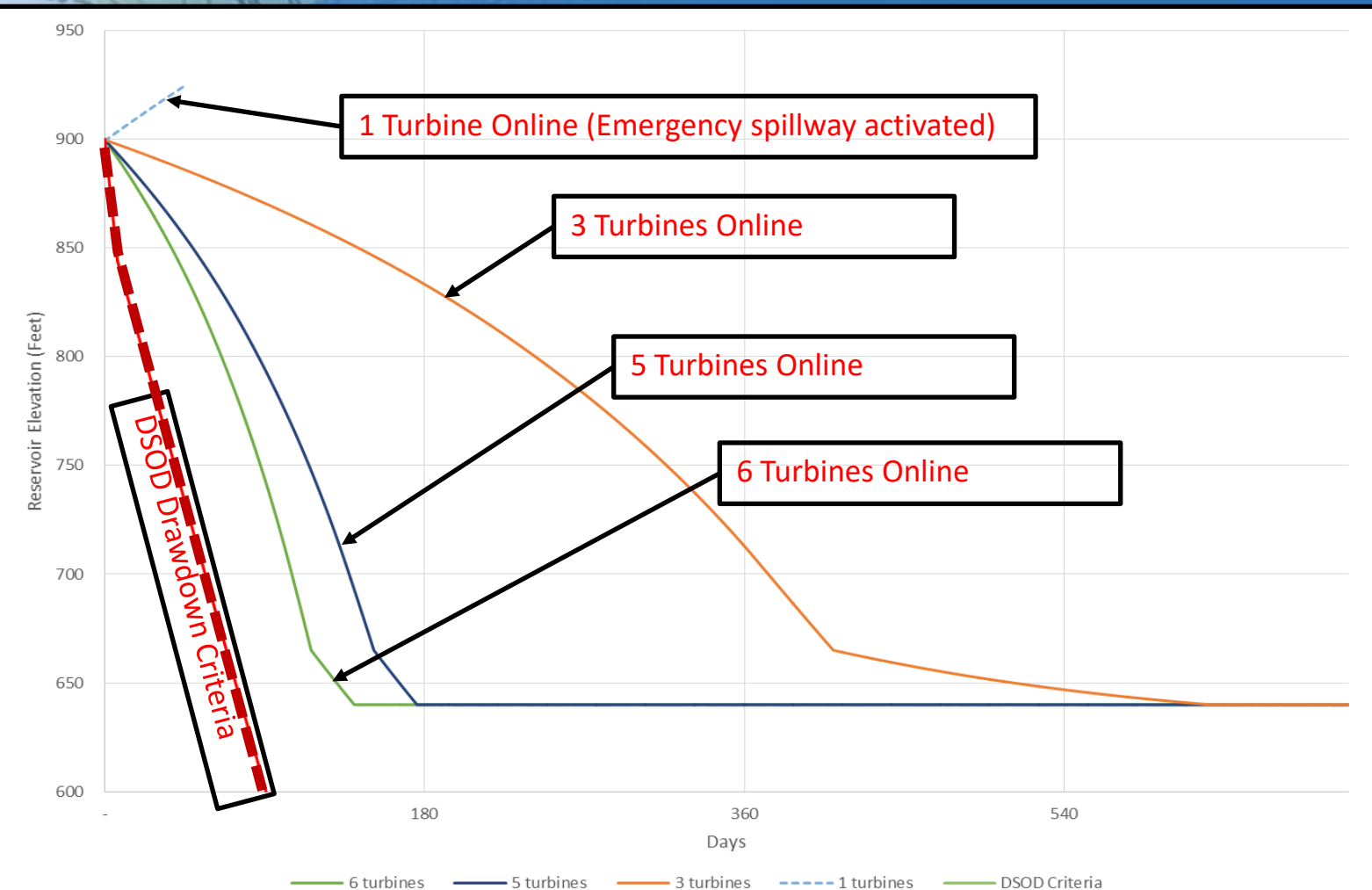
- Assumes only discharge from FCO gates
- No discharge from Hyatt or RVOS
- Constant inflow is 5,000 CFS



CNA Task 4 Work Progress Briefing

Additional Task 4 Updates

Reservoir Drawdown Calculations – Hyatt PP Only



Drawdown under Existing Conditions:

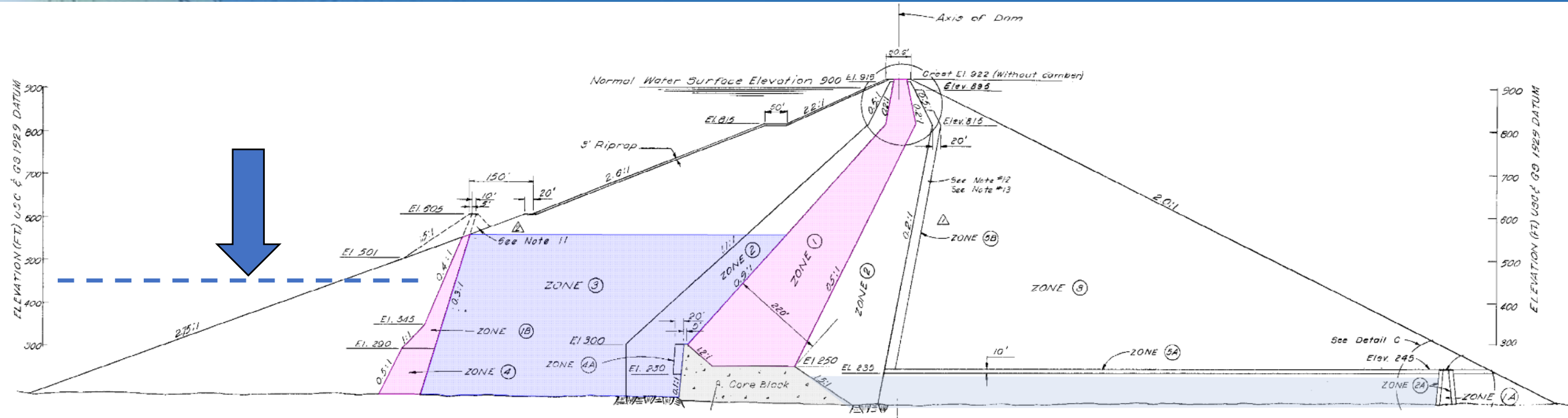
- Assumes only discharge from Hyatt
- No discharge from FCO or RVOS
- Constant inflow is 5,000 CFS



CNA Task 4 Work Progress Briefing

Additional Task 4 Updates

Potential Reservoir Drawdown Limitations/Benefits



Outlet Portals

Switchyard

Central Control



CNA Task 4 Work Progress Briefing

Additional Task 4 Updates

Potential Reservoir Drawdown Limitations/Benefits

Probability of lake elevation falling below the LLO in any given year.

Month	LLO - 340 feet	LLO - 550 feet	LLO - 680 feet	LLO - 700 feet
January	n/a	n/a	10%	20%
February	n/a	n/a	5%	10%
March	n/a	n/a	<5%	<5%
April	n/a	n/a	<5%	<5%
May	n/a	n/a	<5%	<5%
June	n/a	n/a	<5%	8%
July	n/a	n/a	8%	10%
August	n/a	n/a	8%	20%
September	n/a	n/a	10%	20%
October	n/a	<5%	15%	25%
November	n/a	<5%	20%	30%
December	n/a	<5%	15%	25%

Operations modeled over 81 years of historical hydrology.

Lake Oroville Water Operations Benefit of a Low-Level Outlet

- In the event of a series of extreme dry year(s) a LLO would provide access to water supply at elevations lower than the Hyatt intakes and at a greater capacity than that provided by the RVOS...at lower elevations. The table shows the CALSIM results of the probability of lake elevation for each month falling below the LLO.
- Elevation 550 feet was chosen because it represents the same elevation as the Palermo Canal intake, which is being assessed for a cold-water project.



CNA Task 4 Work Progress Briefing Additional Task 4 Updates

Seismic Shaking Estimates for Hyatt PP



EARTH SCIENCE CONSULTANTS

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Walnut Creek, CA 94596
(925) 482-0360; fax (925) 482-0361

MEMORANDUM

Date: November 2, 2018

To: Mr. Don Hoirup, GEG
Senior Engineering Geologist
California Department of Water Resources
Division of Engineering
Project Geology Section
3500 Industrial Blvd.
West Sacramento, CA 95691

From: Stephen Thompson, PhD, PG
Andrew Seifried, PhD, PE
Nora Lewandowski, PG
Patricia Thomas, PhD

SUBJECT: Results of Site Response Analysis for the Underground Hyatt Power Plant

Dear Mr. Hoirup,

This draft memorandum presents preliminary results of a 1-D site response analysis and ground motion evaluation of the underground Hyatt Power Plant (HPP) beneath the Oroville Dam left abutment, Butte County, California. This work was performed by Lettis Consultants International, Inc. (LCI) to support the California Department of Water Resources (DWR) and its consultants with its evaluation of the seismic safety of the Oroville Dam complex. We note that the preliminary analysis has undergone some – but not a complete – internal review, and we anticipate submitting a revised draft memorandum in the near future. We are providing this preliminary memorandum now as we understand that the results are time sensitive.

1.0 INTRODUCTION

The objective of the study is to provide preliminary estimates of ground motions for the HPP that may be useful for a qualitative or semi-quantitative assessment of the seismic safety of that facility as part of an alternatives analysis being performed by DWR. As the HPP is located under the left abutment of Oroville Dam, in amphibolite bedrock, LCI recommended that an initial 1-D site response analysis be performed to understand the amplification (or deamplification) of ground

Preliminary Draft Report by LCI,
November 2, 2018

Objective: Provide preliminary estimates of ground motions for use in risk assessments of underground Hyatt Power Plant

Approach: Performed simplified 1D dynamic response analyses

Results: Recommended following Site Amplification Factors:

- ✓ For low frequency motions (1 Hz or less) assume an SAF = 1
- ✓ For high frequency motions (>20 Hz), assume an SAF = 0.67
- ✓ For frequencies in between 1 and 20 Hz, use linear interpolation (e.g. for 5 Hz, or Period = 0.2 sec), use SAF = 0.82.

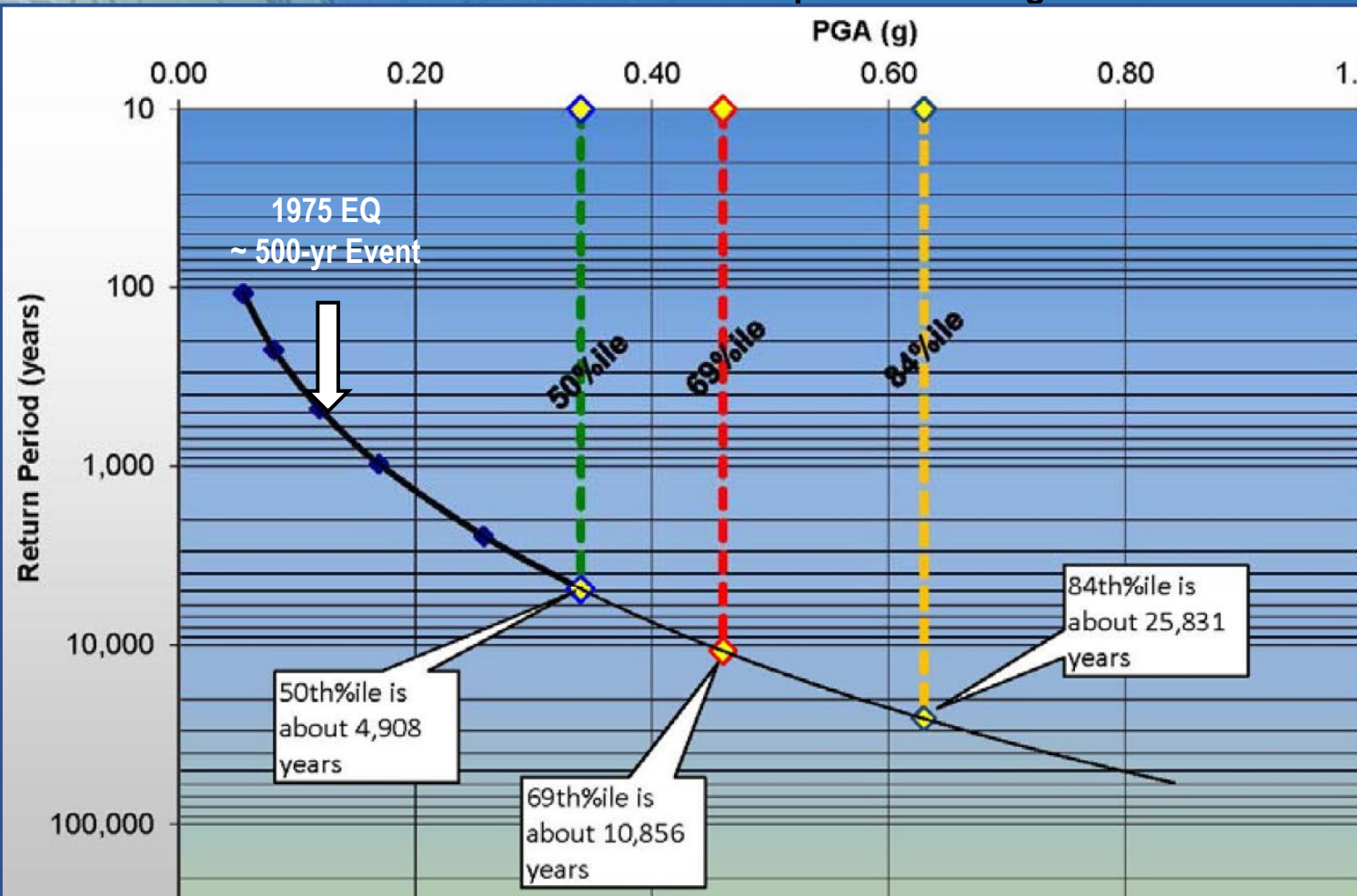


CNA Task 4 Work Progress Briefing

Additional Task 4 Updates

Seismic Shaking Estimates for Hyatt PP

Left Abutment PGA Estimates from 2018 DWR Updated Faulting



Potential Impacts on PGA (100 Hz)

INPUT SPECTRA	OUTCROP GROUND MOTIONS (g)*	SAF	IN-LAYER GROUND MOTIONS (g)*
Median M = 6.6	0.35	0.67	0.23
69 th Percentile M = 6.6	0.48	0.67	0.32
84 th Percentile M = 6.6	0.64	0.67	0.43
1975 Oroville Earthquake M ~ 6	0.14	0.67	0.09



Next Steps

- ✓ Finalize Identification of Needs, Objectives, and Constraints Table
- ✓ Finalize Identification of Assignments to Complete Evaluations
- ✓ Begin Identifying Potential Measures to Address Objectives
- ✓ Participate in Upcoming PFMA and Level 2 Risk Analysis



Questions?