

OROVILLE DAM CITIZENS ADVISORY COMMISSION

Hosted by the California Natural Resources Agency



ROLL CALL

- Lieutenant Collins
- Supervisor Connelly
- Supervisor Conant
- Secretary Crowfoot
- Chief Deputy Director Curry
- Supervisor Flores
- Supervisor Fuhrer
- Assemblyman Gallagher
- Supervisor Kimmelshue
- Deputy Licon
- Captain Million
- Director Nemeth
- Senator Nielsen
- Councilmember Pittman
- Mayor Reynolds
- Lieutenant Stokes
- Superintendent Teague
- Supervisor Vasquez
- Commissioner Widener

ITEM 1
WELCOME AND INTRODUCTIONS

ITEM 2
ACTION ITEMS, ROADMAP, 2022 REPORT

Commission Action Items Tracker

	ITEM	MEETING	STATUS
1	Report out how instrumentation performed and was managed during winter operations.	Mtg 2	Ongoing.
2	Provide regular updates and milestones developments from DWR on Forecast-Informed Reservoir Operations (FIRO) as well as Oroville and New Bullards Bar water control manual processes.	Mtg 3	Ongoing.
3	Follow-up on the status of the Federal Energy Regulatory Commission (FERC) relicensing.	Mtg 3	On track. Anticipated for 2022 meeting.
4	Follow-up on the status of Federal Emergency Management Agency (FEMA) reimbursement for spillway reconstruction.	Mtg 3	Ongoing.
5	Discussion to help state agencies and local partners address homeless encampment concerns around Feather River.	Mtg 3	For future Commission consideration.
6	DWR updates on debris and storm inflows.	Mtg 5	DWR monitoring, will notify Commission as needed.
7	Agendize discussion on lessons learned from 1986 and 1997 water events.	Mtg 6	On track. Will discuss at Stakeholder Technical Workshop.

Commission Action Items Tracker

	ITEM	MEETING	STATUS
8	DWR to respond to Commissioner question regarding what constitutes “failure”.	Mtg 7	Completed. Hold ongoing Commission dialogue on the topic.
9	Develop single tracking log cataloging ongoing or future safety projects.	Mtg 7	Ongoing. Will address during annual dam safety and project updates.
10	Continue to discuss Risk Assessment and hear from outside experts.	Mtg 7	Ongoing.
11	Update on water theft prevention.	Mtg 8	For future Commission consideration.
12	Resources for sediment removal.	Mtg 8	For future Commission consideration.
13	Capital Improvement Projects discussion and expenditure chart for 2010-2017.	Mtg 8	Completed.
14	Recreation expansion project updates, including Bidwell Ramp.	Mtg 8	Update planned for 2022.
15	Update on Proposition 1 and the Sites Reservoir	Mtg 9	Completed. CNRA provided update to Sen. Nielsen's office
16	Update on safety work at the Palermo Tunnel	Mtg 9	On track. Update at Q1 2022 meeting.
17	Update on piezometers	Mtg 9	On track. Update at Q1 2022 meeting.
18	Update on flood control outlets.		On track. Update at July 2022 meeting.

Commission Roadmap

Stakeholder Technical Workshop (April 22, 2022)

Topics

- Flood safety
- Downstream community concerns
- Stakeholder input and questions

Public Meeting (July 29, 2022) Facilities and Safety

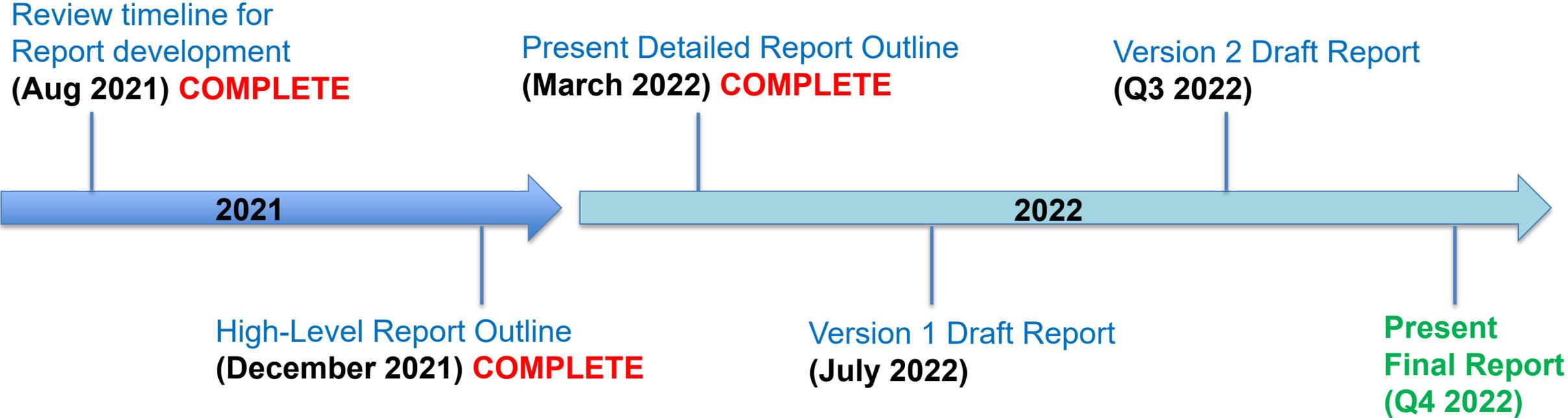
Topics

- Stakeholder Technical Workshop readout
- OCAC Report: First draft review/feedback
- Dam facilities asset management
- Dam facilities annual maintenance plan

Status Updates

Drought updates

Commission Report Development Timeline



ITEM 3
DEPARTMENT OF WATER RESOURCES
UPDATES

CALIFORNIA DEPARTMENT OF WATER RESOURCES

State Water Project Dam Safety Program Progress New Piezometers and Palermo Intake

Oroville Citizens Advisory Commission Meeting
March 25, 2022

David Sarkisian, Manager
Dam Safety Services
Division of Operations and Maintenance



Status of Piezometer Installations

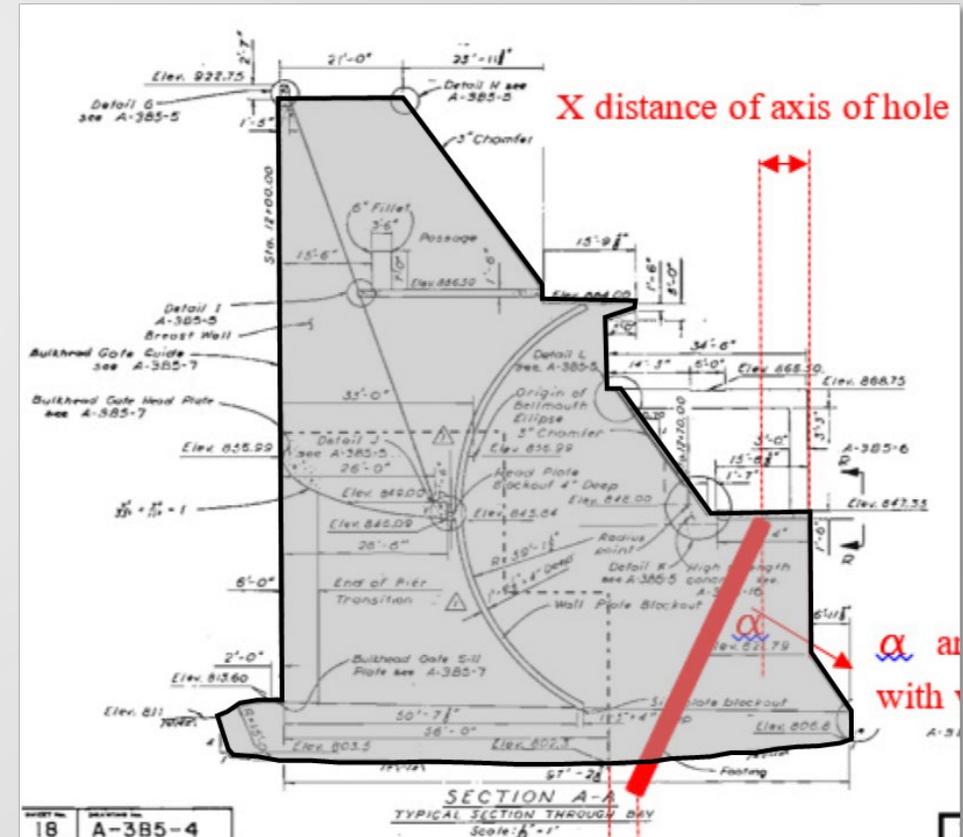
- New piezometers were identified through the Oroville Dam Safety Comprehensive Needs Assessment (CNA) and endorsed by the CNA Independent Review Board and 10th Part 12D Independent Consulting Board as ***Early Implementation Projects***.
 - **Flood Control Outlet piezometers**
 - **Oroville Dam Toe piezometers**
 - **Oroville Dam Coreblock and Grout Gallery piezometers**
- Federal Energy Regulatory Commission (FERC) and Division of Safety of Dams (DSOD) review and approval required prior to installation.



Flood Control Outlet Piezometers

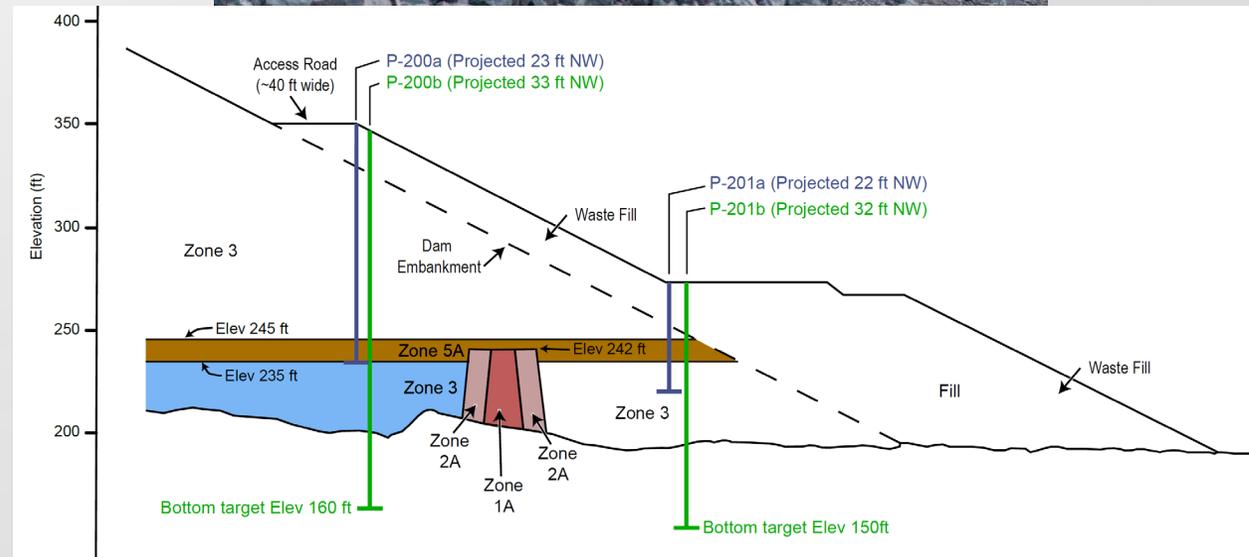
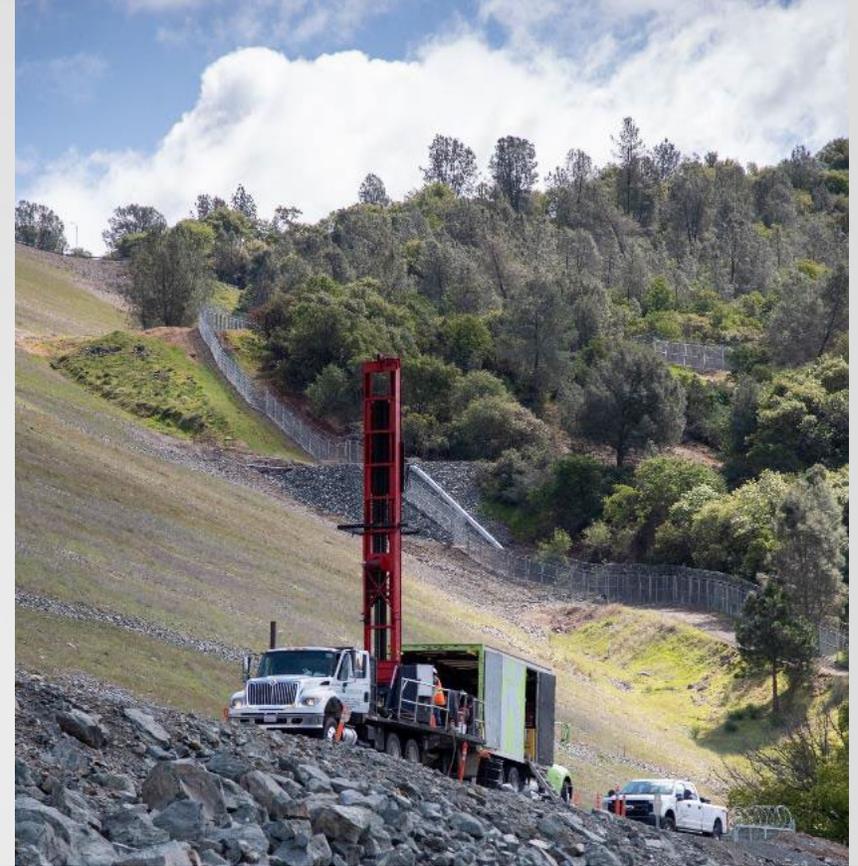
- Four piezometers installed in 2020, each outfitted with two vibrating wire instruments for redundancy.
- Replace original instruments that reached their useful life in mid-2000's.
- Provide information on uplift pressures and effectiveness of grout curtain and drains.
- Since installation, low reservoir levels (less than 800 feet) have persisted.
- One piezometer has shown a modest response to precipitation.

Inclined Piezometers installed through the concrete piers into the foundation rock



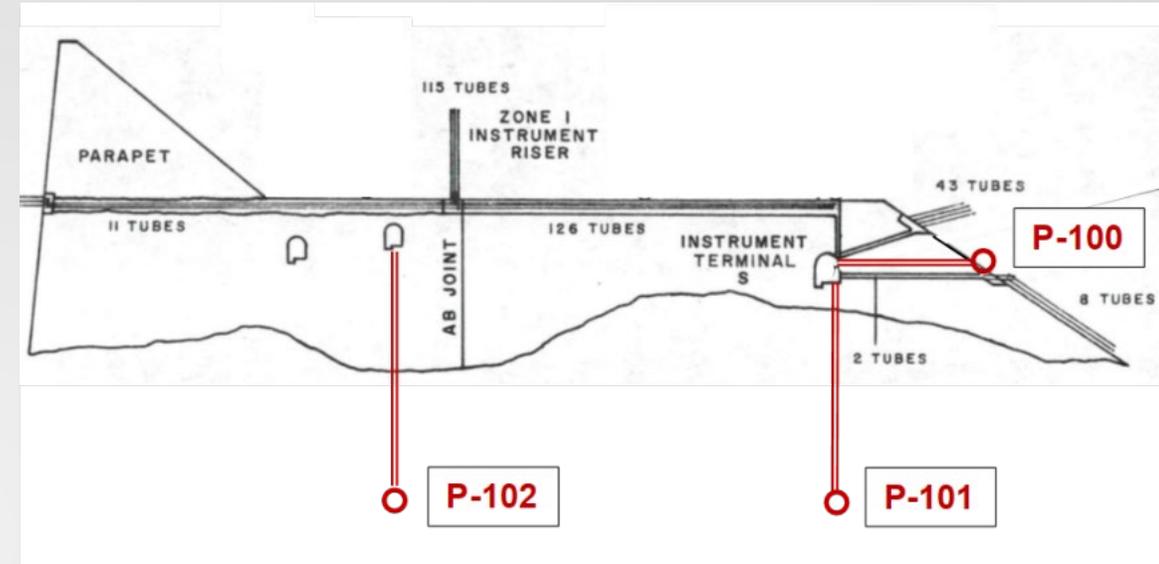
Oroville Dam Toe Piezometers

- Eight piezometers installed in 2020, each outfitted with real-time vibrating wire instruments.
- Enhances surveillance for internal erosion-related potential failure modes and informs seepage analyses and modeling
- Data has further demonstrated the strong influence of precipitation on groundwater levels within the “seepage collection pool” within the dam.

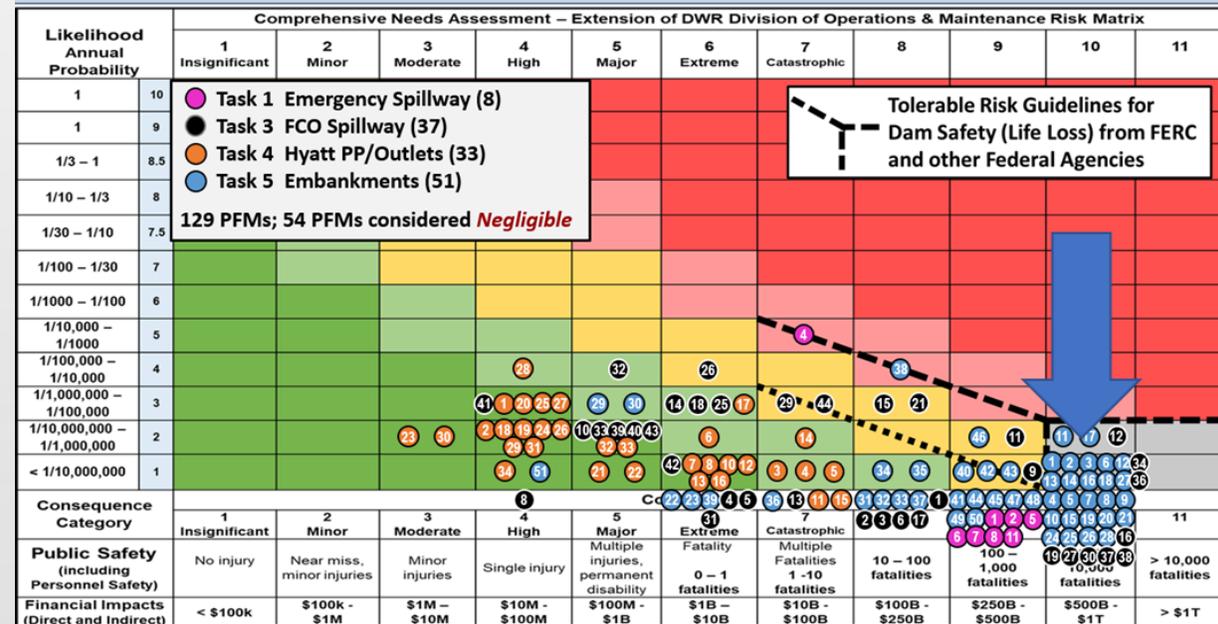


Oroville Dam Coreblock and Grout Gallery Piezometers

- Eight piezometers planned, as well as improvements to seepage weir instrumentation.
- Enhances surveillance for numerous internal erosion-related potential failure modes and informs seepage analyses and modeling.
- Instrument locations prepared for specialized drill rig (Nov 2021 – January 2022).
- Installation planned for Fall 2022.

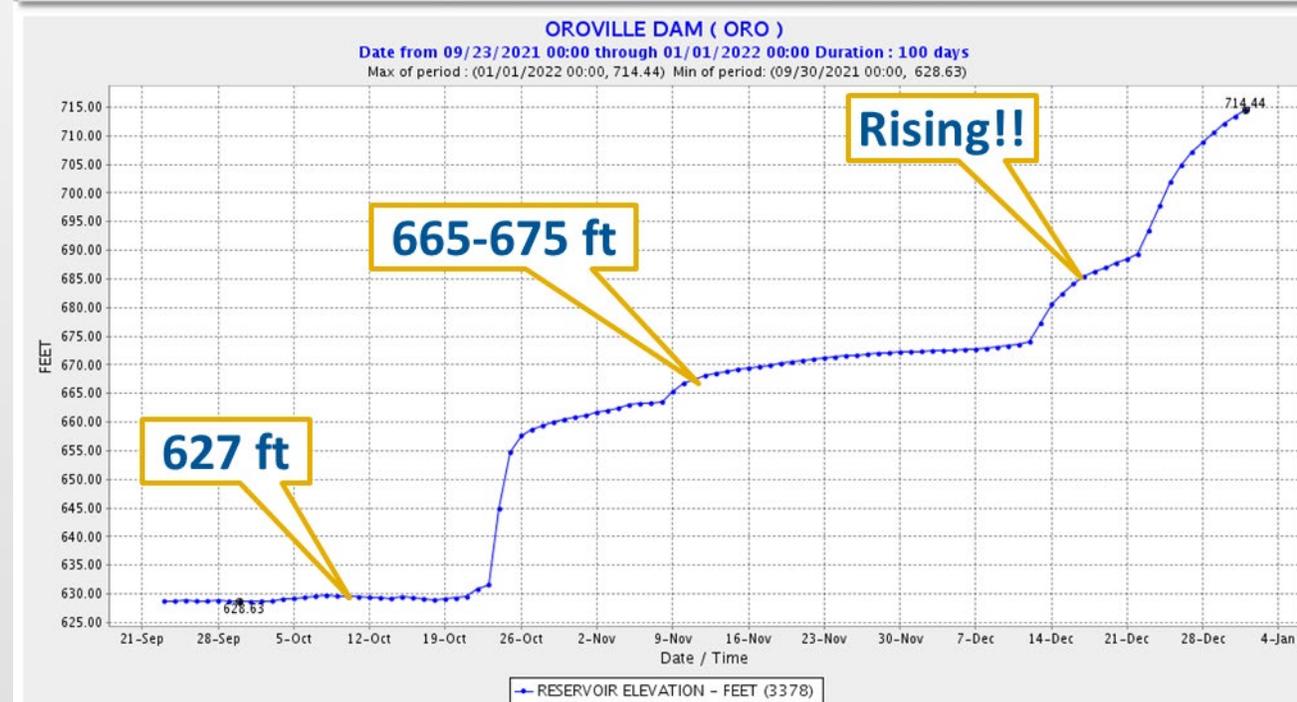


Estimated Risks for CNA Potential Failure Modes – Existing Conditions



Palermo Tunnel Bulkhead Closure Improvements

- 2016: Bulkhead removal and tunnel inspection via remotely operated vehicle – Elev 575 ft.
- 2017-2018 Bulkhead Refurbishment
- Project Mobilization - September 27th-29th, 2021
 - Intake Location and Cleaning
 - Trashrack Removal
 - Bulkhead Template Testing
 - New Pulley System Installation
 - Bulkhead Installation & Commissioning
- De-Mobilization - December 20th-21st, 2021



Palermo Tunnel Bulkhead Closure Improvements



Palermo
Tunnel
Intake

Hyatt Intake

Oroville Dam

Oroville Dam

Oroville Dam Rd

B2

2000 ft

Palermo Tunnel Bulkhead Closure



Mobilization



Staging



Template



Commissioning





Thank you



CALIFORNIA DEPARTMENT OF
WATER RESOURCES

DWR Pixel – July 26,
2021

ITEM 4
RISK SCENARIO PRESENTATION



Cal OES Hazard Mitigation Plan Grant Opportunity

Update to the Local Hazard Mitigation Plan
Characterizing Hazard from Elevated Oroville Dam Releases

Dr. Rune Storesund, P.E., G.E.
Director & Principal Consultant
SafeR³ (non-profit)



Overview

- Hazard: Elevated releases from Oroville Dam
- Risk (consequences) not documented
 - Releases above 150,000 cfs (probable maximum flood release 625,000 cfs)
 - Evacuation areas sequencing & routes
 - Evacuation timing
- Quantifying consequences important for 'benefit/cost' evaluations
 - Installation of Oroville Dam 'low-level outlet' to allow releases well before major storms
 - Bolstering downstream flood conveyance and flood systems
- Submit Cal OES HMPG to update LHMP to include hazard from elevated releases

Update LHMP

Assume this is not a full dam breach, but rather 'safety incidents'....

ADD →
ELEVATED
RELEASES

Table ES-2 Butte County Hazard Identification Assessment

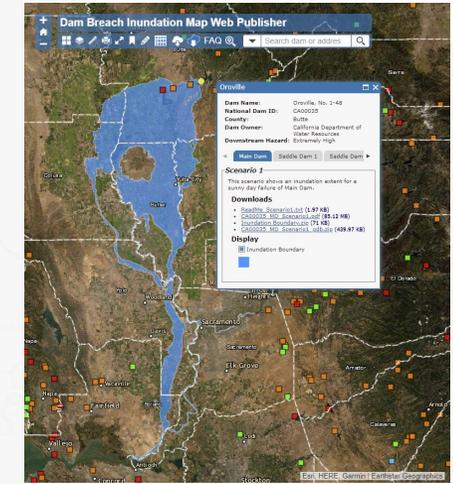
Hazard	Geographic Extent	Likelihood of Future Occurrences	Magnitude/Severity	Significance	Climate Change Influence
Climate Change	Extensive	Likely	Limited	Medium	–
Dam Failure	Extensive	Occasional	Catastrophic	High	Medium
Drought & Water shortage	Extensive	Likely	Critical	Medium	High
Earthquake and Liquefaction	Extensive	Unlikely	Catastrophic	Medium	Low
Floods: 100/200/500 year	Significant	Likely	Critical	High	Medium
Floods: Localized Stormwater	Significant	Highly Likely	Limited	Medium	Medium
Hazardous Materials Transportation	Significant	Likely	Limited	Medium	Low
Invasive Species: Aquatic	Limited	Likely	Limited	Medium	Low
Invasive Species: Pests/Plants	Extensive	Highly Likely	Limited	Medium	Low
Landslide, Mudslide, and Debris Flow	Significant	Likely	Critical	Medium	Medium
Levee Failure	Significant	Occasional	Critical	High	Medium
Severe Weather: Extreme Heat	Extensive	Highly Likely	Limited	Medium	High
Severe Weather: Freeze and Winter Storm	Extensive	Highly Likely	Limited	Medium	Medium
Severe Weather: Heavy Rain and Storms (Hail, Lightning)	Extensive	Highly Likely	Limited	Medium	Medium
Severe Weather: Wind and Tornado	Extensive	Highly Likely/Likely	Critical	Medium	Low
Stream Bank Erosion	Significant	Highly Likely	Limited	Medium	Low
Volcano	Extensive	Unlikely	Negligible	Low	Low
Wildfire	Extensive	Highly Likely	Catastrophic	High	High



HAZARD LIKELIHOOD

1997 Oroville Evacuation
 @ ~165,000 cfs

ELEVATED OROVILLE DAM RELEASES



- Drought/Water Shortage
- Floods (Localized Stormwater)
- Severe Weather
 - Extreme Heat
 - Freeze/Winter Storm
- Wildfires



- Earthquake > Mw 7.0
- Full Dam Failure
- Volcano
- “Ark Storm”

“Design” Releases – Oroville Dam



OROVILLE DAM AND RESERVOIR

Feather River, California

REPORT ON RESERVOIR REGULATION FOR FLOOD CONTROL

AUGUST 1970

DEPARTMENT OF THE ARMY

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

[R]

CHAPTER 9 - PROJECT ACCOMPLISHMENT

45. EXAMPLES OF OPERATION

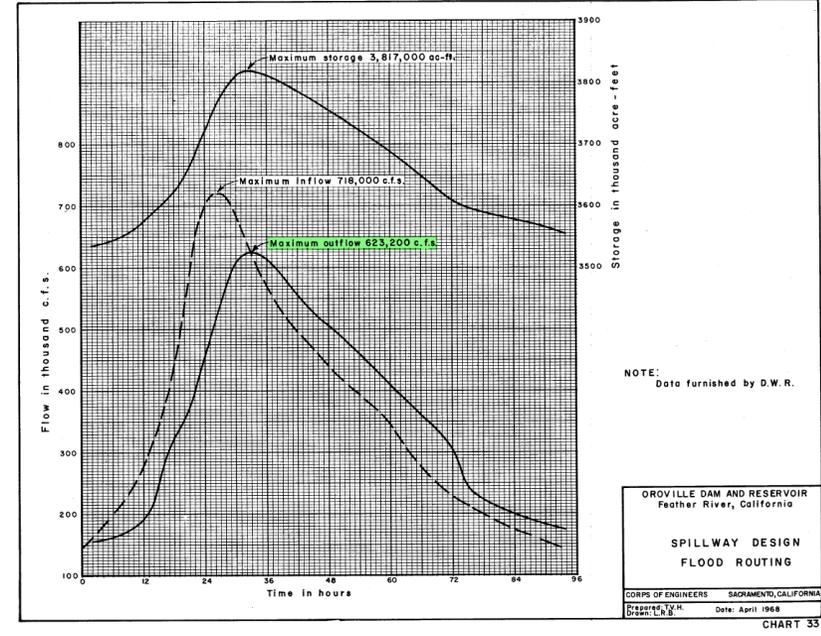
a. Routings of the December 1955 flood, January and December 1964 flood in accordance with the flood (chart A-1) is graphically presented on chart 31.

b. Coordination of reservoir operation for flood between Oroville and Yuba River Reservoirs is shown No. 1 on this chart shows the results of a coordinated operation of Oroville and New Bullards Bar Reservoir, with the primary storm centered on Feather River Basin above Oroville; and Routing No. 3 shows the results of a coordinated operation of Oroville and New Bullards Bar Reservoirs, with primary standard project storm centered on Yuba River Basin below New Bullards Bar Dam; and Routing No. 3 shows a coordinated operation of Oroville, New Bullards Bar Reservoir, Marysville Reservoirs, with primary standard project storm centered on Yuba River below New Bullards Bar and above Marysville Dams.

c. Hypothetical operation of Oroville Reservoir during the spillway design flood is shown in graphical form on chart 33. The routing of this flood by the Department of Water Resources starts at gross pool elevation, and attains a maximum storage of 3,817,000 acre-feet (at 917 ft. elevation) and a maximum outflow of 623,200 c.f.s.

d. Stage-duration curves are presented on chart 34, a stage frequency curve on chart 35, and seasonal variation of reservoir storage frequency on chart 36.

e. Project and preproject rain-flood frequency curves are shown on chart 6 (sheet 2).





Collaboration Overview

1. Submit NOI to Cal OES HMPG (letters of support)

DUE: April 8, 2022 (very soon!)

2. Update LHMP

A) Generate Inundation Maps (work with DWR, use existing models):

200,000 cfs	250,000 cfs	300,000 cfs	350,000 cfs	400,000 cfs
450,000 cfs	500,000 cfs	550,000 cfs	600,000 cfs	650,000 cfs

B) Establish Evacuation Zones, Routes, and Warning Times

C) Identify and list impacted critical infrastructures

D) Estimate life-loss, economic, and environmental damage costs

E) Frame and quantify recommended proactive risk-reduction actions (future HMPG 'projects')



THANK YOU!

Dr. Rune Storesund, P.E., G.E.

SafeR³ (non-profit)

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Kensington, CA 94707

rune@safer3.world

(510) 225-5389

ITEM 5
PUBLIC SAFETY PARTNERSHIPS



Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES

Dam Safety Planning Division

Emergency Action Plans



Water Code Sections 6160 and 6161

- Owners of state-regulated, jurisdictional dams must submit an Emergency Action Plan (EAP) to Cal OES and DWR if classified as EH, H, or S
- EAP must include a DWR-approved inundation map
- Includes deadlines for submissions
- Cal OES review timelines are given
- Owners must update the EAP, including the map, at a minimum every 10 years



Government Code Section 8589.5

- EAP must be developed in consultation with local public safety agencies
- EAP must adhere to FEMA's Guidelines
 - 6 Elements of an EAP

Emergency Notification Flowcharts

Responsibilities

Preparedness Activities

Inundation Maps

Response Process

Additional Info in Appendices

- Dam owner must conduct an EAP notification exercise with local public safety agencies once a year



California Jurisdictional Dams

- Extremely High: 264
- High: 440
- Significant: 171
- Low: 367
 - *No mapping or EAP requirement*
- Total: 1,242 dams



Emergency Action Plans

What is an EAP?

- Identifies potential emergency conditions at a dam
- Specifies actions to be followed to minimize property damage or loss of life
- Based on approved inundation maps, which show critical areas of evacuation in case of a dam emergency



Dam Owner Outreach to Public Safety Agencies

Who

- Those impacted by dam incident
 - Local: law enforcement, fire, OES,
 - State/Fed: NWS, DWR (DSOD, FOC), Cal OES

How

- Meetings, phone calls, etc.

When

- Earlier is better
- Have something to show those groups



Incorporating Outreach into Plan

Methods to Meet Statutory Requirement:

- Signature Page
- Narrative explaining which agencies were consulted during development of the plan and what the contributions were
- Agenda, sign-in roster, and minutes from EAP development meeting(s)
- Include the agencies' roles within the EAP



Notification Flowcharts

Flowcharts

- Identifies who is to be notified of a dam safety incident, by whom, and in what order
- One chart or a set of charts may be needed depending on the complexity on the hazards associated with the dam and affected downstream areas
- Should include emergency level, individuals who will conduct notifications, prioritization of notifications, individuals who will be notified



Questions?

Lori Nezhura
Deputy Director, Planning Preparedness, and Prevention
Cal OES

State Water Project Inundation Mapping for Oroville Dam

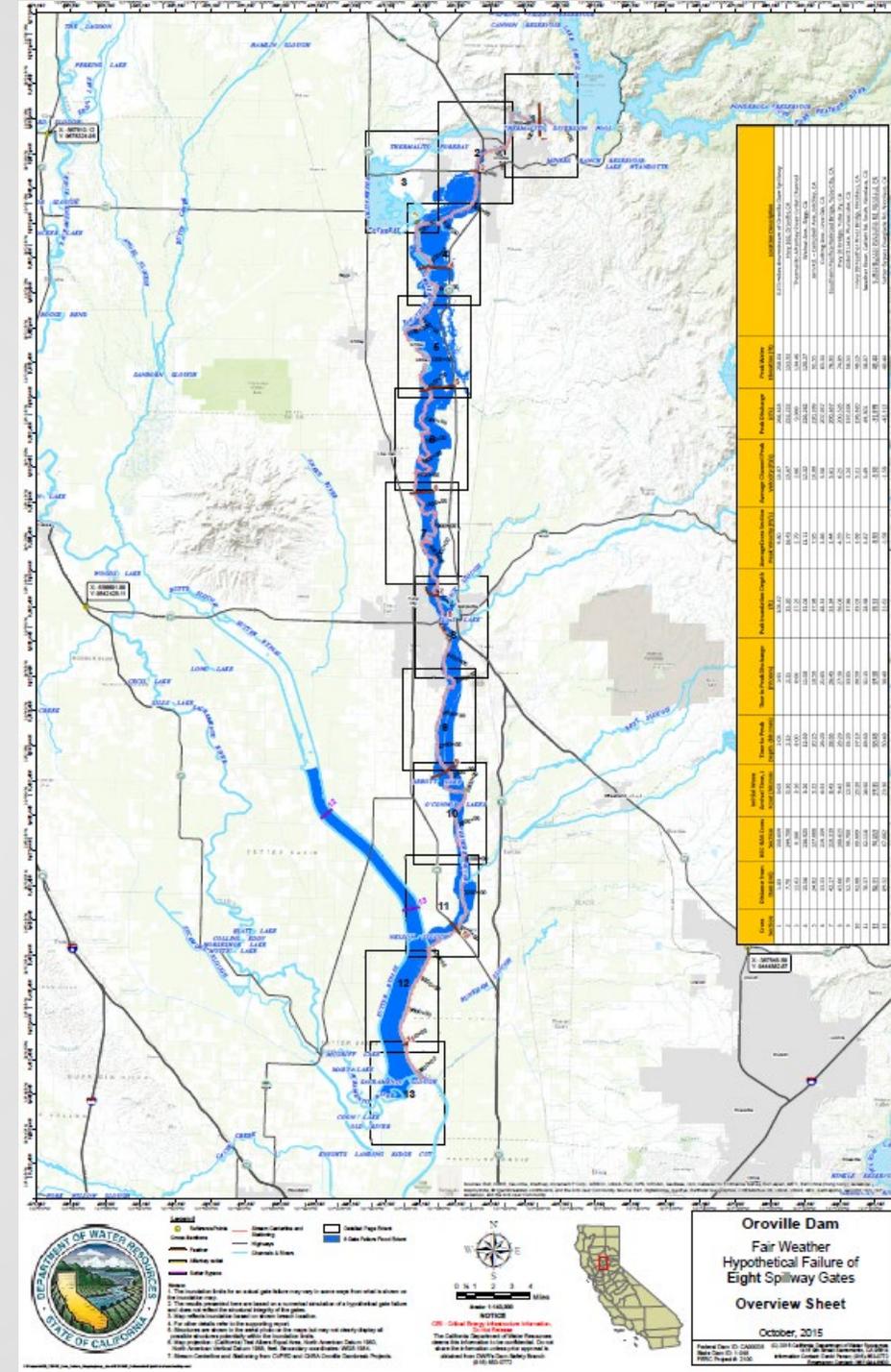
Oroville Citizens Advisory Commission Meeting
March 25, 2022



David Sarkisian, Manager
Dam Safety Services
Division of Operations and Maintenance

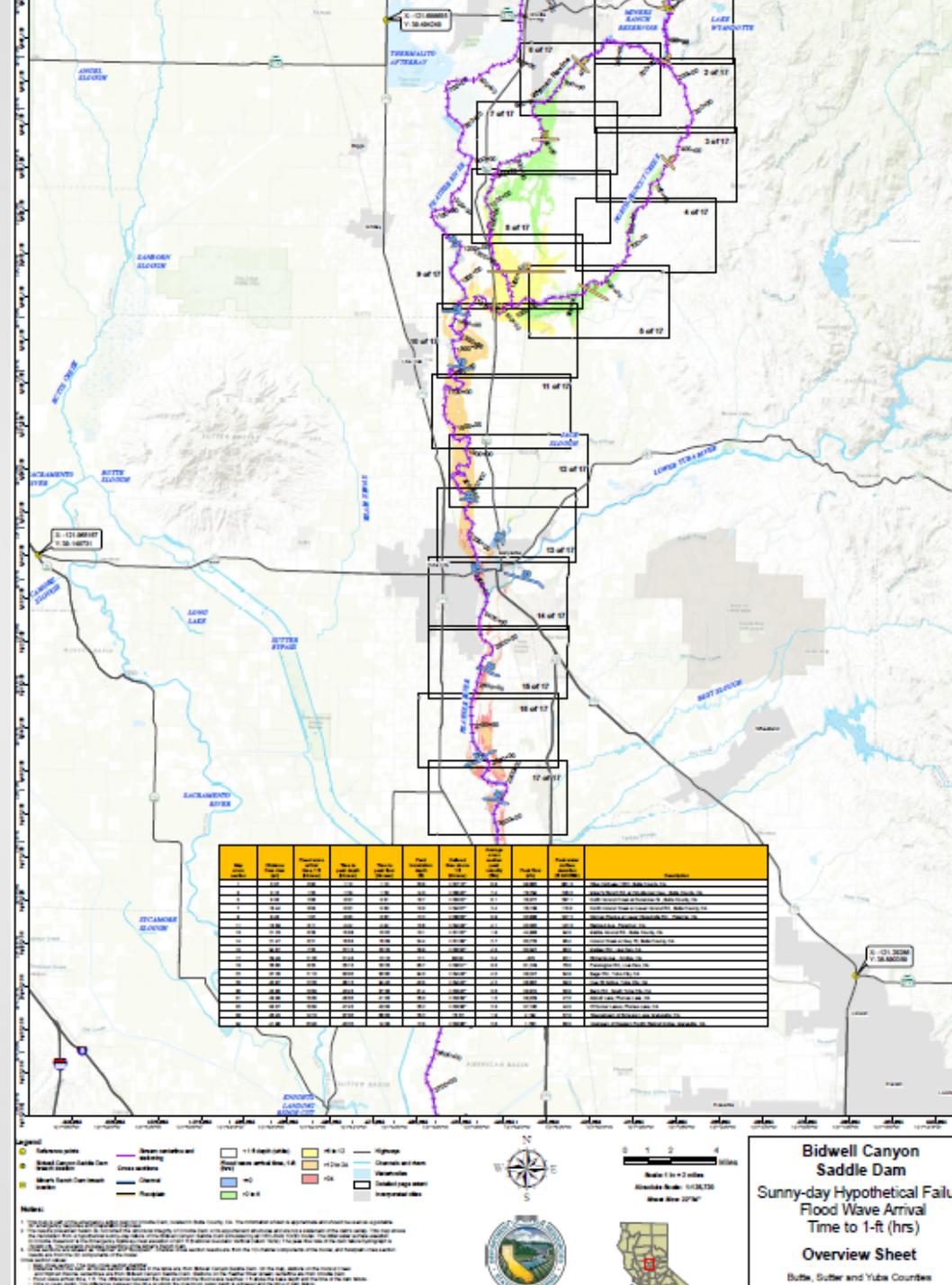
Oroville-Thermalito Complex Inundation Maps

- Illustrate flooding that could result from a hypothetical failure of a dam.
- Included in a dam's Emergency Action Plan to inform the owner and downstream emergency management agencies.
- Prior to 2017, inundation maps were largely driven by FERC requirements.
- Pre-2017 Inundation Mapping Efforts for Oroville Dam
 - 2013 Fair Weather Failure of Oroville Dam – included in EAP
 - 2015 - Hypothetical Gate Failure Inundation Maps for Oroville and Thermalito Diversion Dams



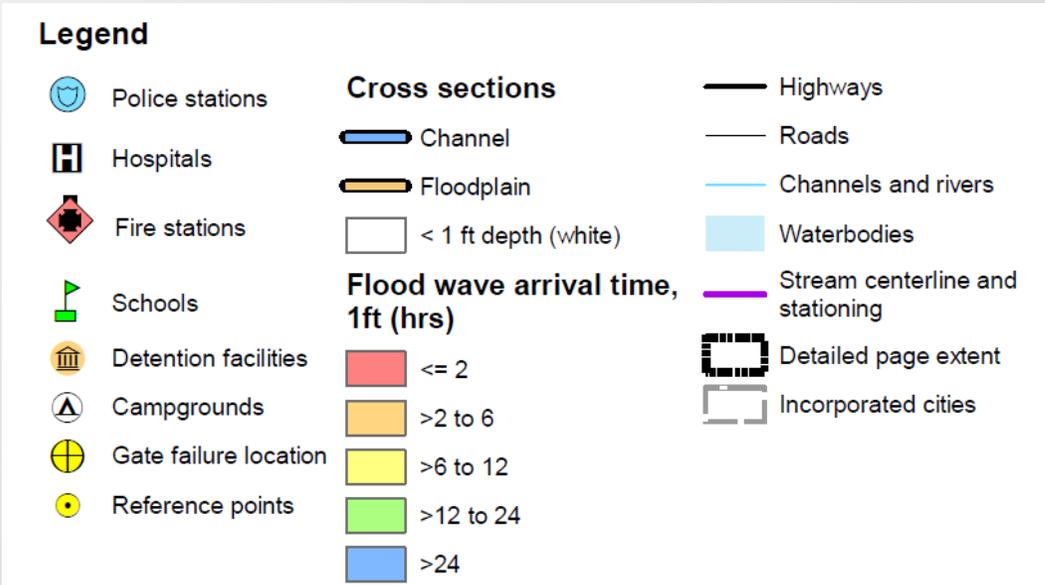
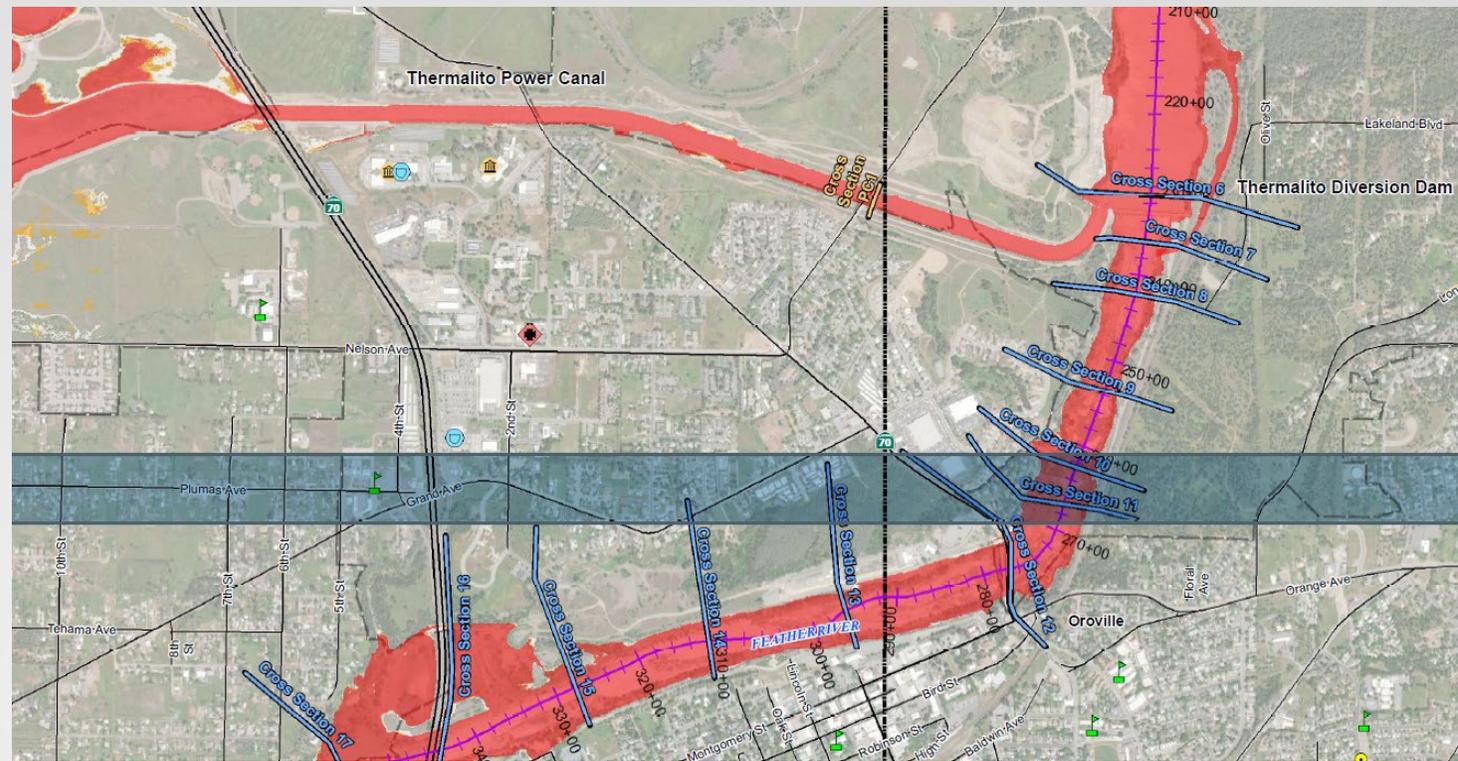
Senate Bill 92

- In 2017, Senate Bill amended California Water Code to require all state jurisdictional dams, except low hazard dams, to have inundation maps and emergency action plans.
 - DSOD approves inundation maps
 - CalOES approves emergency action plans
- Included inundation maps for critical appurtenant structures (CAS).
- 2018 Mapping Efforts for Oroville Dam CAS'
 - Emergency Spillway
 - Flood Control Outlet
 - Parish Camp Saddle Dam
 - Bidwell Bar Canyon Saddle Dam
- Maps available on DSOD's website <https://fmds.water.ca.gov/maps/damim/>



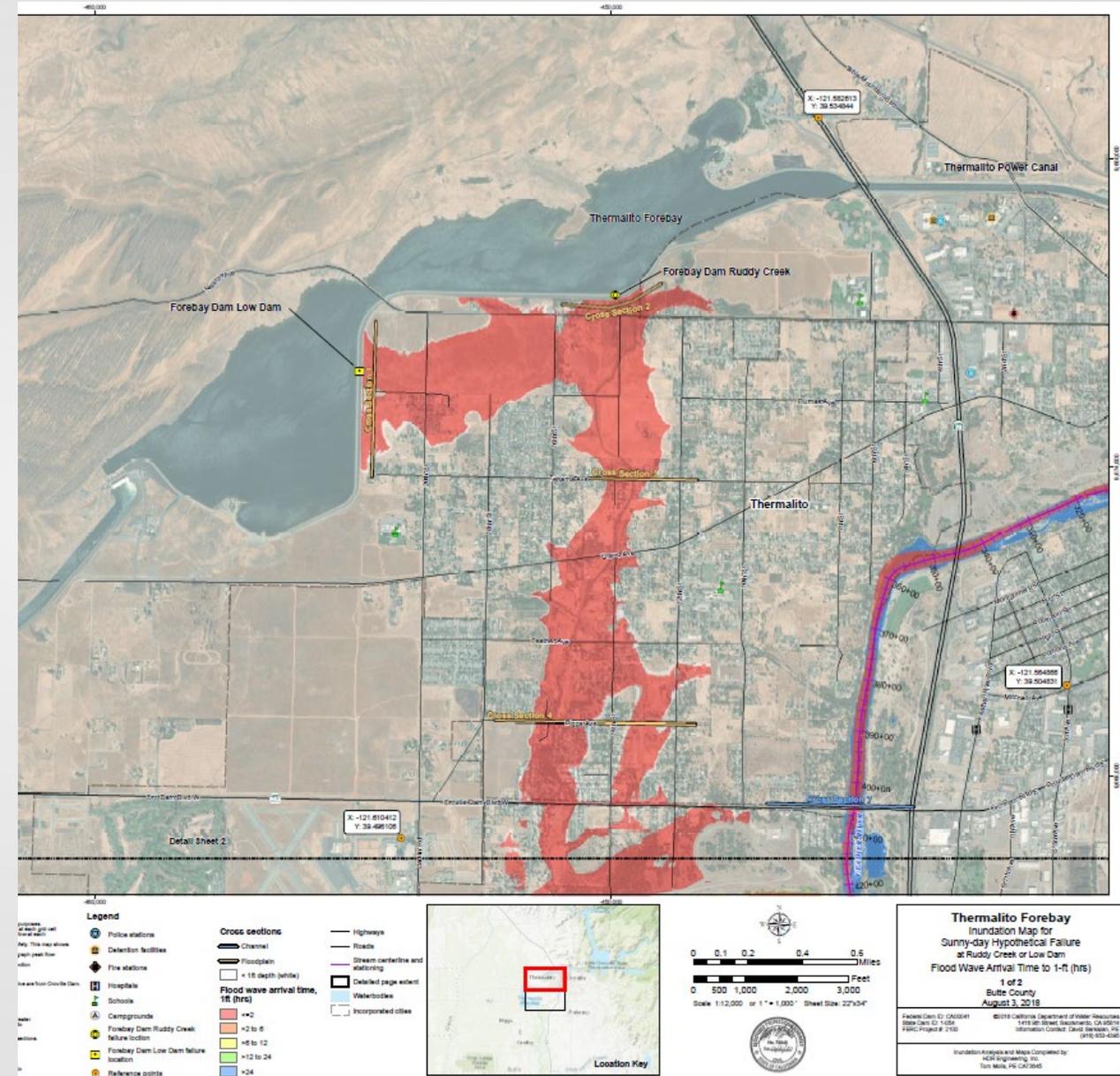
Inundation Map Content

- Regulations require that maps depict Fair Weather scenarios
 - Initial Wave Arrival Time (1-foot)
 - Maximum Depth
 - Maximum Velocity
 - Deflood Time
- Information is intended to inform Public Safety Agencies (PSAs).
- Particularly useful for PSAs and communities for evacuation and recovery planning.



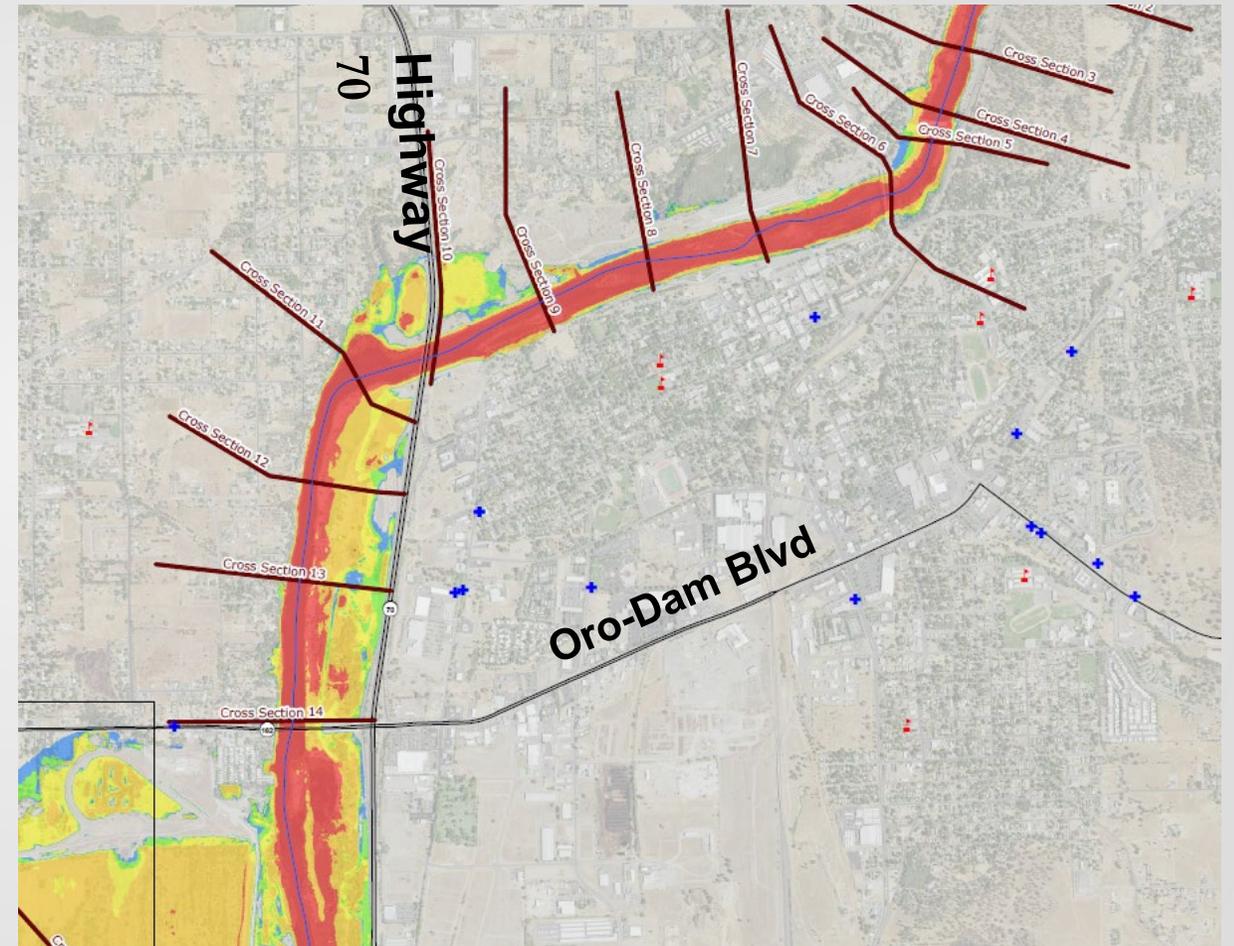
Thermalito Facilities Inundation Mapping

- Thermalito Diversion Dam Fair Weather Failure
- Thermalito Diversion Dam Radial Gate Failures
- Thermalito Forebay Dam and Headworks Fair Weather Failure
- Thermalito Afterbay Dam (multiple breach locations) Fair Weather Failure



Feather River Incremental High Flow Scenarios Inundation Mapping (2017)

- In 2017, DWR developed “incremental flow” inundation maps to better understand the downstream channel capacity.
- Assumption: Levees overtop but do not fail.
- Two hydrograph patterns utilized
 - High Volume & Low Volume Event
 - For each event, maps developed for 100K, 125K, 150K, 175K, 225K, 300K, and 400K



**Inundation Map for 225,000 cfs in Feather River,
City of Oroville**



Summary

- The 2017 legislation and regulations for inundation mapping have enhanced public safety and awareness in regard to dam-related flood hazards.
- There are numerous inputs and parameters to consider in hydraulic modeling – each inundation map is unique and applies to its specific scenario.
- Hydraulic models developed to generate Fair Weather Failure Inundation Maps for EAPs can be leveraged to answer a multitude of questions and hypothetical scenarios.
- GIS shapefiles from inundation maps are being leveraged by Public Safety Agencies for their planning.



Questions?

Thank you.



ITEM 6 PUBLIC COMMENT

**The Oroville Dam Citizens Advisory
Commission will now take public comment.**

We appreciate your input.

ITEM 7 ADJOURN

Thank you all for joining us today, our next Oroville Dam Citizens Advisory Commission meeting will be on July 29, 2022.