OROVILLE DAM CITIZENS ADVISORY COMMISSION

Hosted by the California Natural Resources Agency

ROLL CALL

- Lieutenant Collins
- Supervisor Connelly
- Supervisor Conant
- Secretary Crowfoot
- 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
- Genoa Widener

ITEM 1:
WELCOME AND INTRODUCTIONS

ITEM 2:
ACTION ITEMS & ROADMAPS

Commission Action Items Tracker

No.	Item	Meeting	Status
1	Tour of Joint Operations Center (State-Federal Flood Operations Center in Sacramento)	Mtg 2 11/2019	On hold due to Covid-19. Aiming for Q2 2022.
2	Report out how instrumentation performed and was managed during winter operations	Mtg 2 11/2019	Ongoing.
3	Invite State Water Contractors to future meeting(s)	Mtg 2 11/2019	On track. Invite for Q3 2021 meeting.
4	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 02/2020	On track. Update planned for Q4 2021 meeting.
5	Follow-up on the status of the Federal Energy Regulatory Commission (FERC) relicensing	Mtg 3 02/2020	Ongoing. Anticipate early 2022 update.

Commission Action Items Tracker

No.	Item	Meeting	Status
6	Follow-up on the status of Federal Emergency Management Agency (FEMA) reimbursement for spillway reconstruction	Mtg 3 02/2020	Ongoing.
7	Discussion to help state agencies and local partners address homelessness concern around Feather River.	Mtg 3 02/2020	For future Commission consideration.
8	CalOES follow up with CalTrans on the status of their post-fire mitigation along County highways	Mtg 5 11/2020	Done. Work confirmed complete.
9	DWR updates on debris and storm inflows	Mtg 5 11/2020	DWR monitoring, will notify Commission as needed.
10	DWR follow-up re: Hyatt Power Plant	Mtg 5 11/2020	Done. Update provided at Q2 2021 meeting.

Commission Action Items Tracker

No.	Item	Meeting	Status
11	Offer new members, Kimmelshue, Fuhrer and Vasquez, a Commissioner orientation.	Mtg 6 2/19/21	On track.
12	Post additional contact information on OCAC website.	Mtg 6 2/19/21	Done. Contact e-mail and phone # are available on Commission website.
13	Agendize discussion on lessons learned from 1986 and 1987 water events.	Mtg 6 2/19/21	On track. Update planned for Q4 2021.

2021 Public Meeting Agenda Roadmap

Q3 (August 27, 2021) Infrastructure

Topics

Planned Major Projects at Oroville Facilities

- Asset Management
- Annual Maintenance Plan

Status Updates

Commission Report

Q4 (December 3, 2021) Operations

Topics

Oroville Dam Facility Operations

- Winter Operations Plan
- U.S. Army Corp of Engineers (water control manual update)

Status Updates

Commission Report

Wildfire Season Update

2022 Public Meeting Agenda Roadmap

Q1 (2022) Partnerships

Topics

Dam Facility Partnerships

- FERC Relicensing
- Recreation Partnerships
- Public Safety Partnerships

Status Updates

Commission Report

Q2 (2022) Joint Operations Center – Sacramento

Topics

Joint Operations Center

- Tour of Joint Operations Center
  (Commissioner only portion)
- Overview of Joint Ops and Flood Ops
- 2017 Lessons Learned and Current Procedures

Status Updates

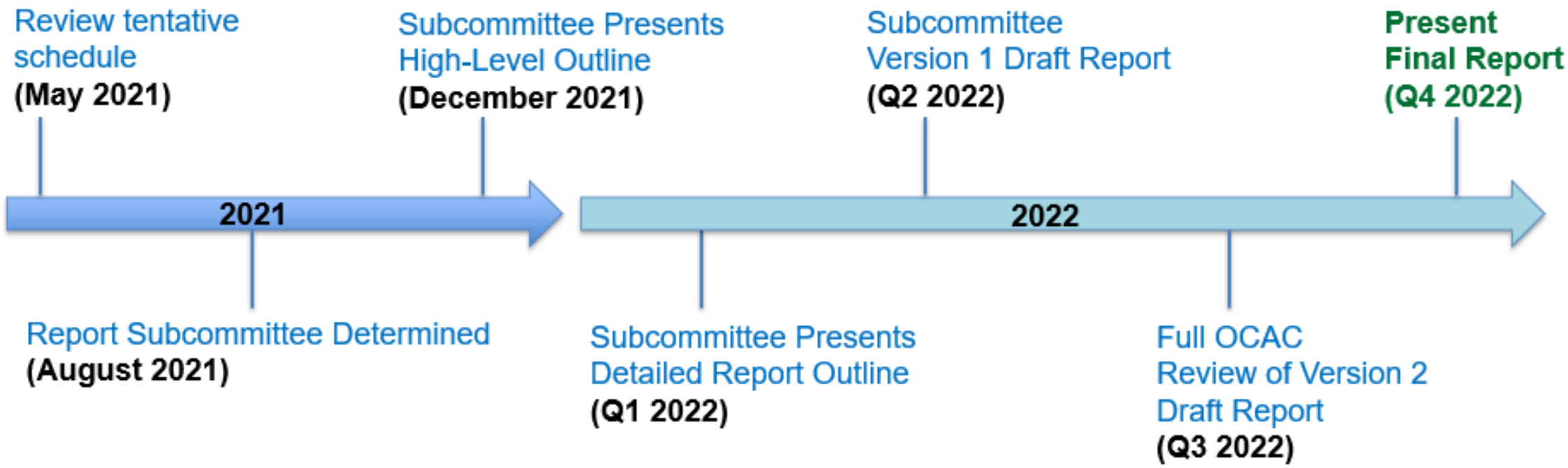
Commission Report

Commission Report
Senate Bill 955 Requirements

SB 955 states the Commission will publish a report at least **once every three years** that provides the following:

- An **overview of ongoing maintenance and improvements** made at the Dam and Dam complex;
- A **register of communications** received from State Agencies and other parties to the Commission;
- **Notice of upcoming plans** made by State Agencies for the Dam and Dam Complex; and
- An **overview of flood management projects on the Feather River** affecting public safety and flood risk reduction.

Commission Report Development Timeline



ITEM 3:
DAM SAFETY PROGRAM:
REGULATORY PERSPECTIVE

California's Dam Safety Program

CALIFORNIA DEPARTMENT OF WATER RESOURCES
DIVISION OF SAFETY OF DAMS

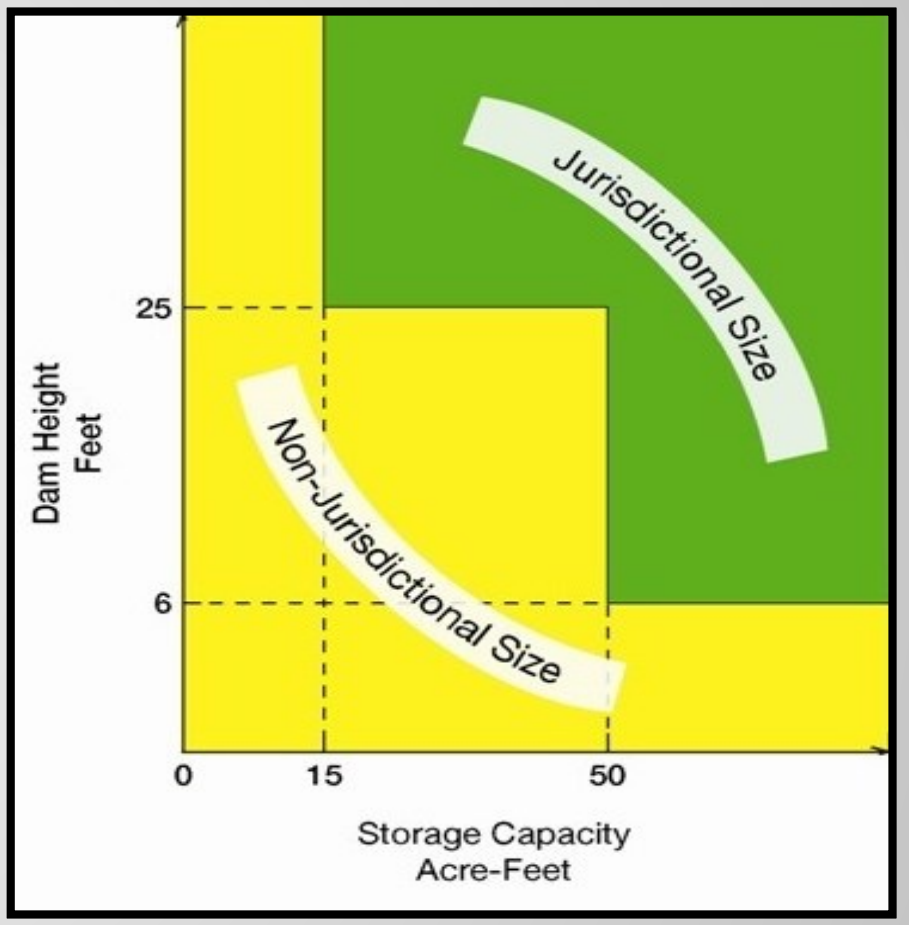
Sharon K. Tapia, P.E., PMP

May 28, 2021

Dam Safety Authorities

California Water Code
Division 3. Dams and Reservoirs
Part 1. Supervision of Dams and Reservoirs

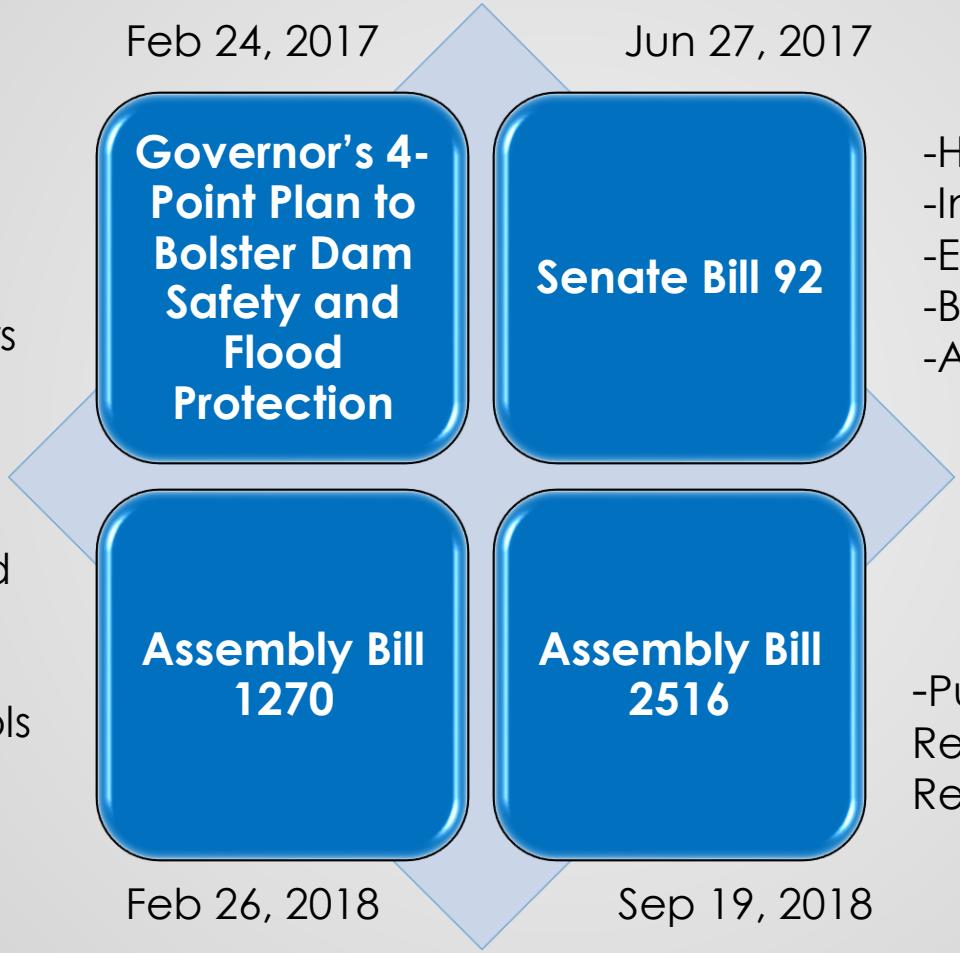
California Code of Regulations
Title 23. Waters
Division 2. Department of Water Resources
Chapter 1. Dams and Reservoirs



Recent Dam Safety Initiatives & Legislation

Dam Safety Initiatives:
-Proposed Legislation for Emergency Action Plans
-Directed Expedited Reviews of Spillways

-Inspection Frequencies and Requirements
-Independent Review of DSOD's Dam Safety Protocols

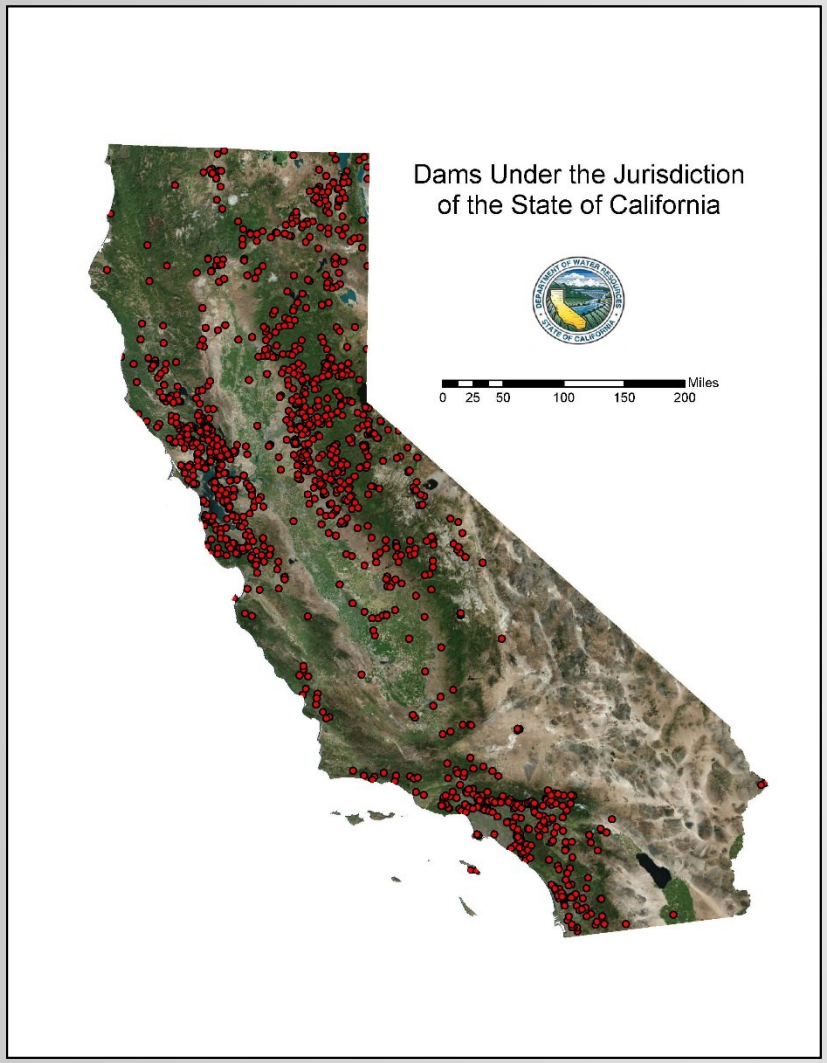


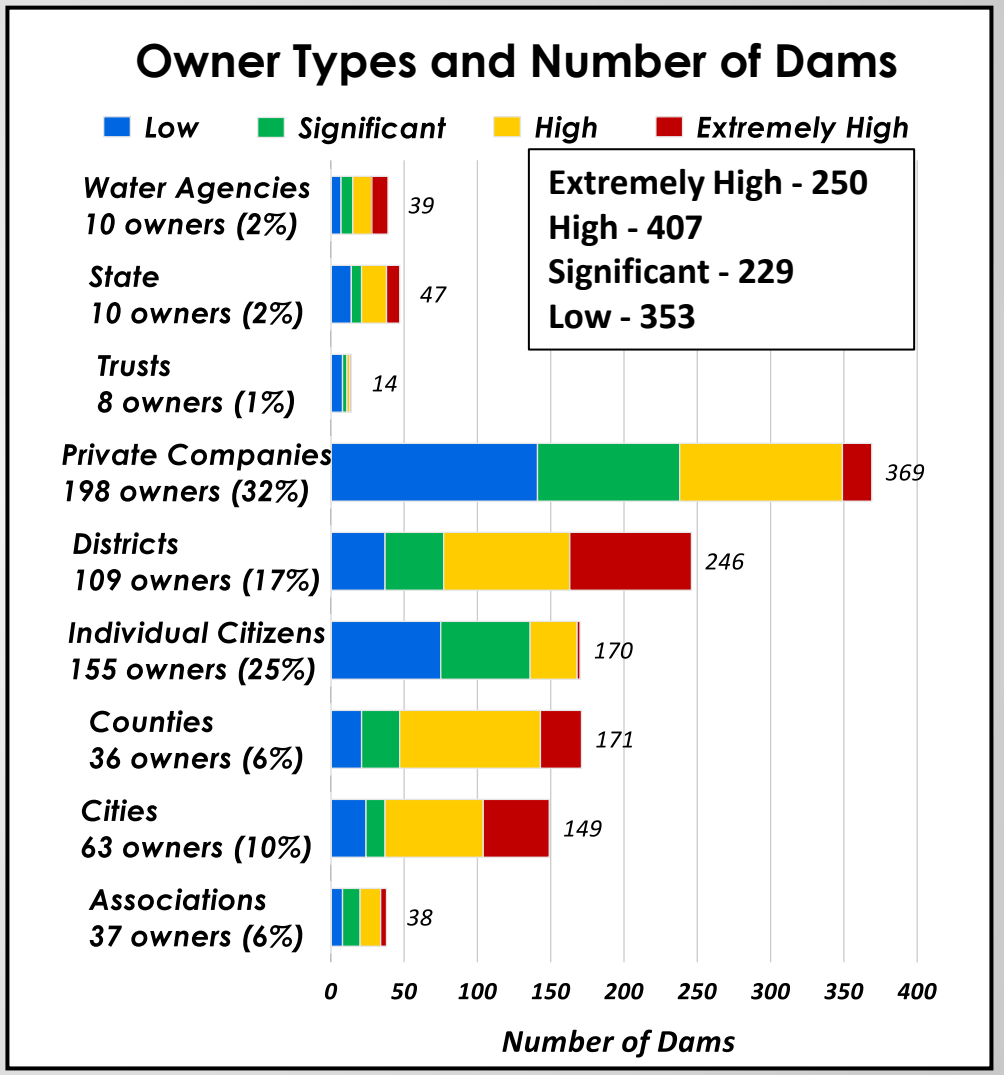
-Hazard Potential Classification Update
-Inundation Maps*
-Emergency Action Plans
-Bolstered Enforcement*
-Amended Annual Dam Fees*

-Public Reporting of Information Related to Dams with Reservoir Restrictions

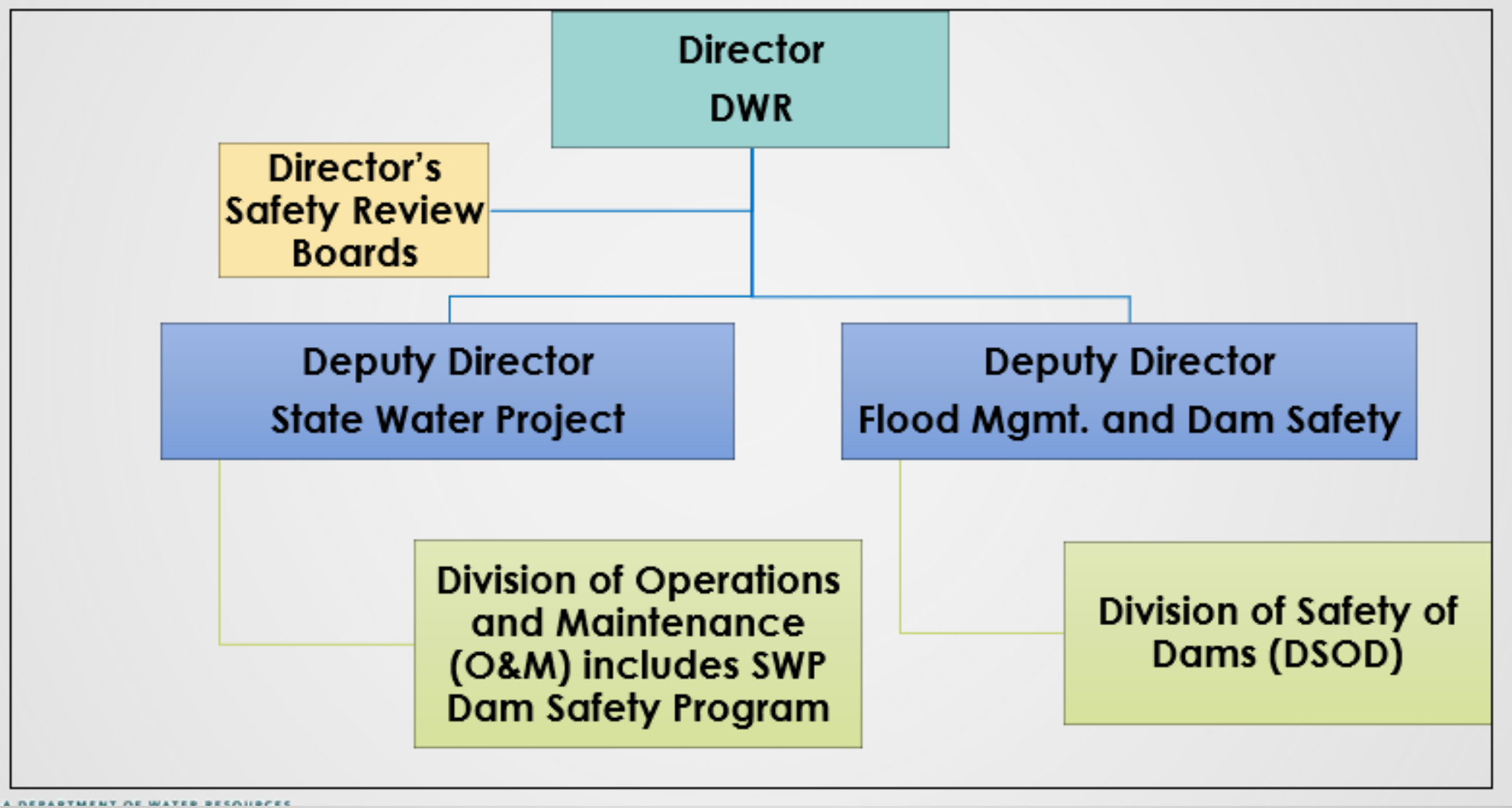
*Requires the promulgation of regulations.

Hazard Classifications and Dam Owners

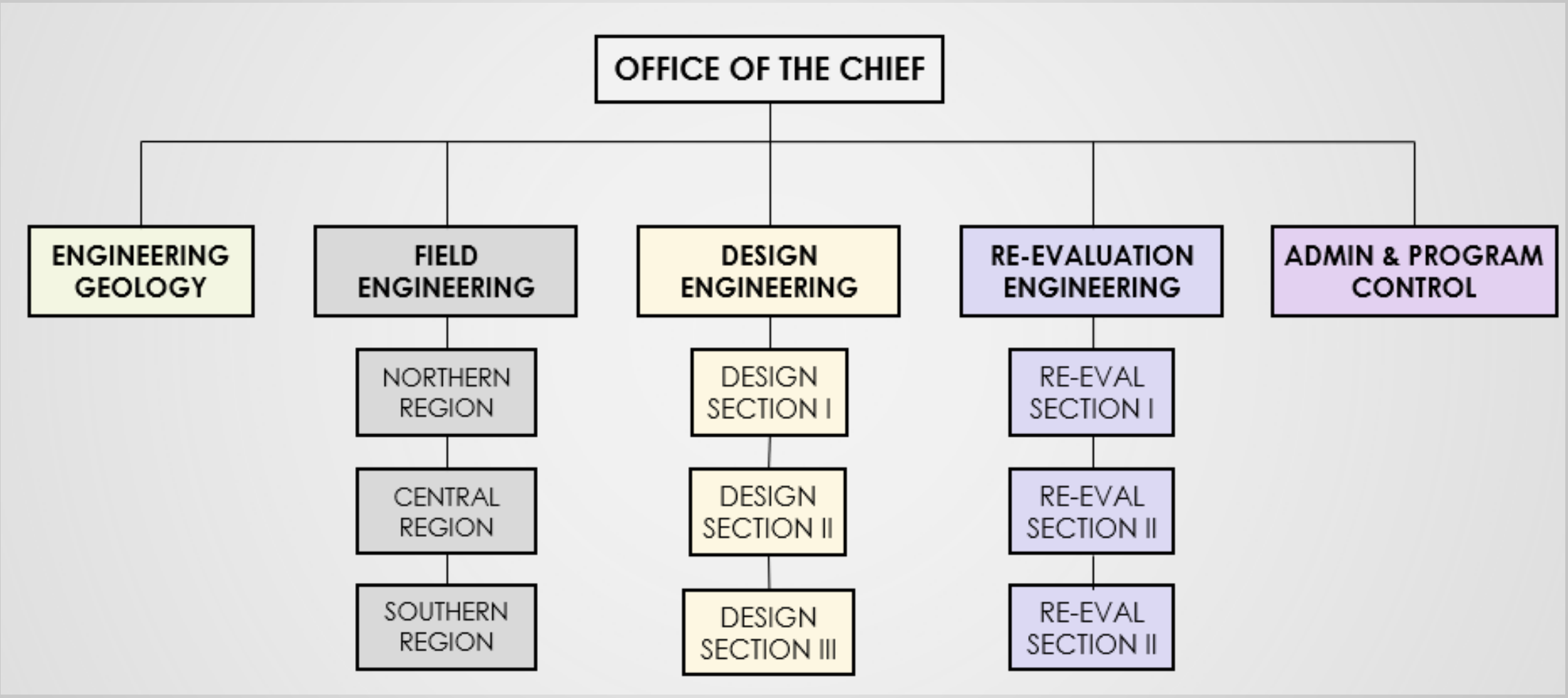




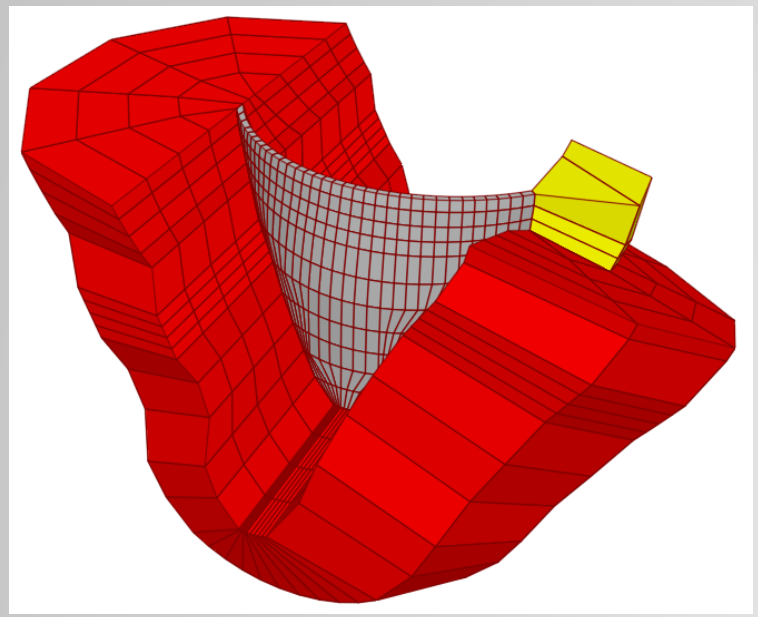
DSOD & O&M within DWR

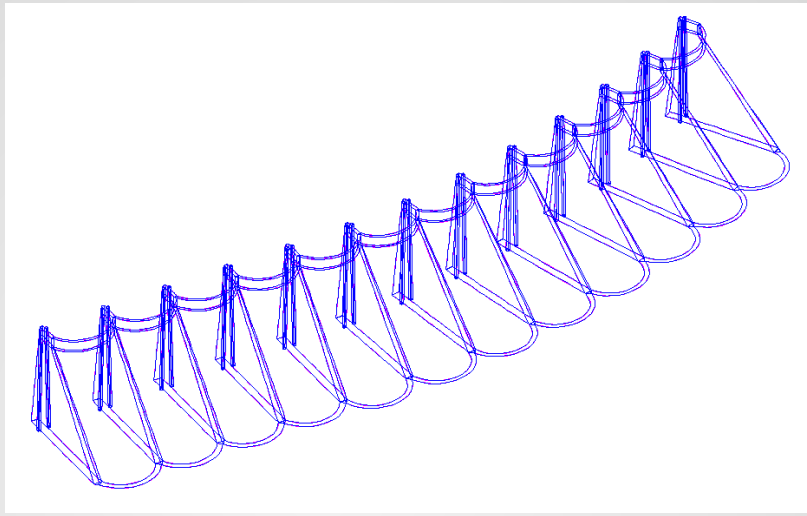


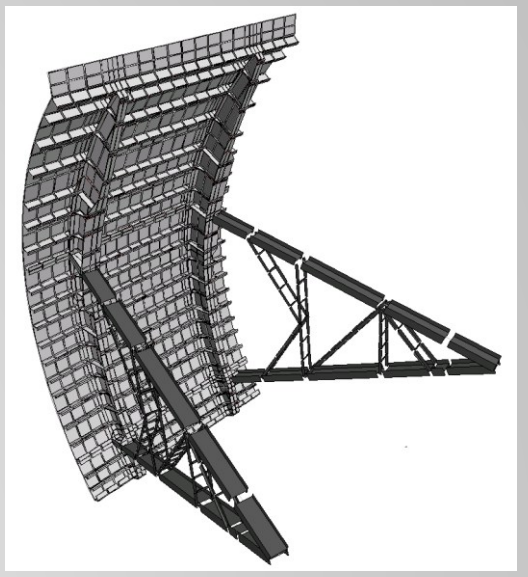
DSOD's Staffing

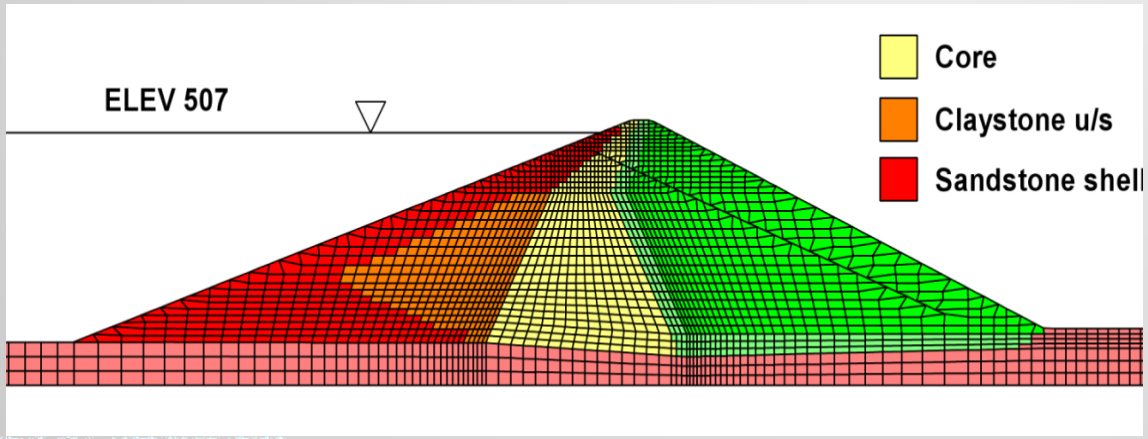


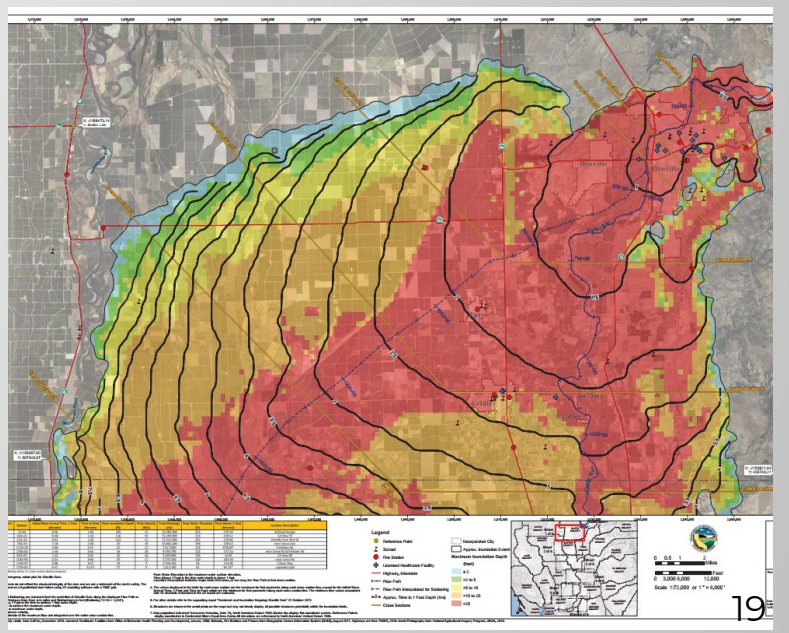
Design Reviews & Re-evaluations





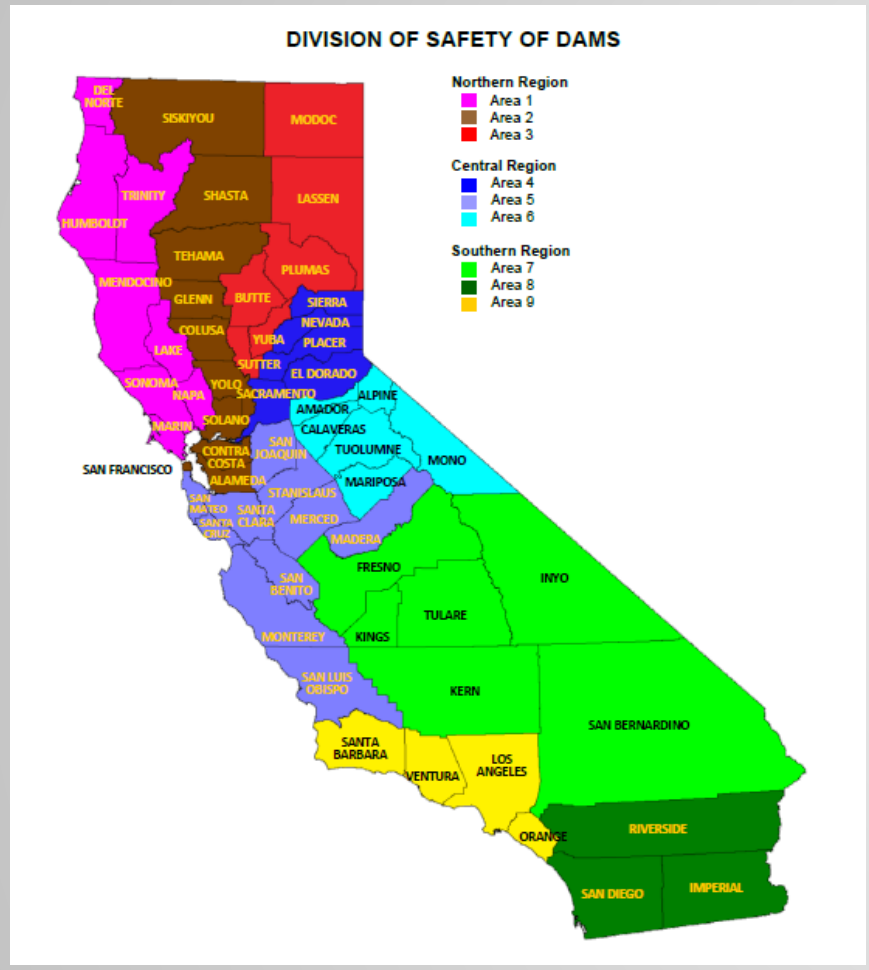




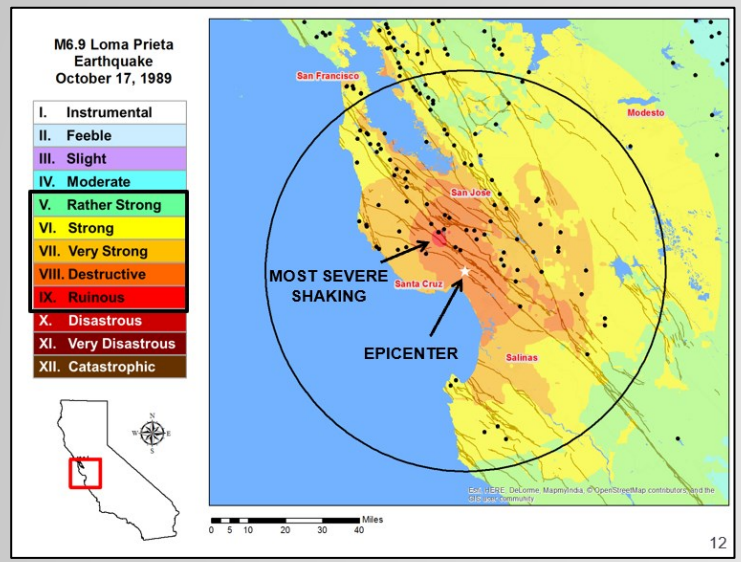


Construction Oversight

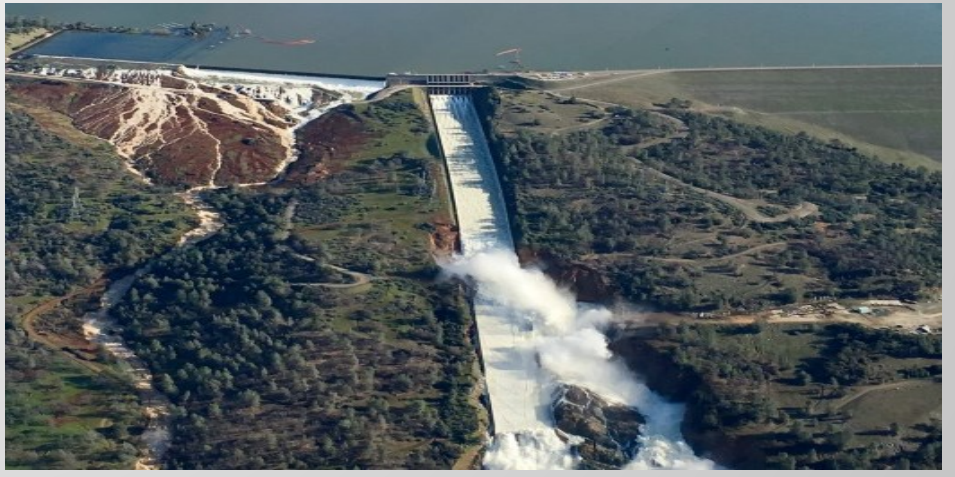
Inspections & Surveillance Monitoring



Emergency Response



Source: CBS Local San Francisco



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ITEM 4:
DAM SAFETY PROGRAM:
PUBLIC SAFETY PERSPECTIVE

CALIFORNIA DEPARTMENT OF WATER RESOURCES

State Water Project Dam Safety Program

Castaic Dam - High Outlet Tower and Access Bridge, Los Angeles County

Oroville Citizens Advisory Commission
May 28, 2021

Presented by:
David Sarkisian, PE, CEG
Chief of Dam Safety Services
SWP Chief Dam Safety Engineer

26 State Water Project Dams

Field Division	Dam
Oroville	Oroville Dam
Oroville	Parish Camp Saddle Dam
Oroville	Bidwell Bar Canyon Saddle Dam
Oroville	Thermalito Diversion Dam
Oroville	Thermalito Forebay Dam
Oroville	Thermalito Afterbay Dam
Oroville	Feather River Fish Barrier Dam
Oroville	Antelope Dam
Oroville	Frenchman Dam
Oroville	Grizzly Valley Dam
Delta	Bethany Dams
Delta	Clifton Court Forebay Dam
Delta	Del Valle Dam
Delta	Patterson Dam
Delta	Dyer Dam
San Luis	O'Neill Forebay Dam
San Luis	Sisk Dam (San Luis Reservoir)
San Luis	Little Panoche Detention Dam
San Luis	Los Banos Dam
Southern	Pyramid Dam
Southern	Quail Dam
Southern	Castaic Dam
Southern	Devils Canyon Second Afterbay
Southern	Cedar Springs Dam
Southern	Crafton Hills Dam
Southern	Perris Dam

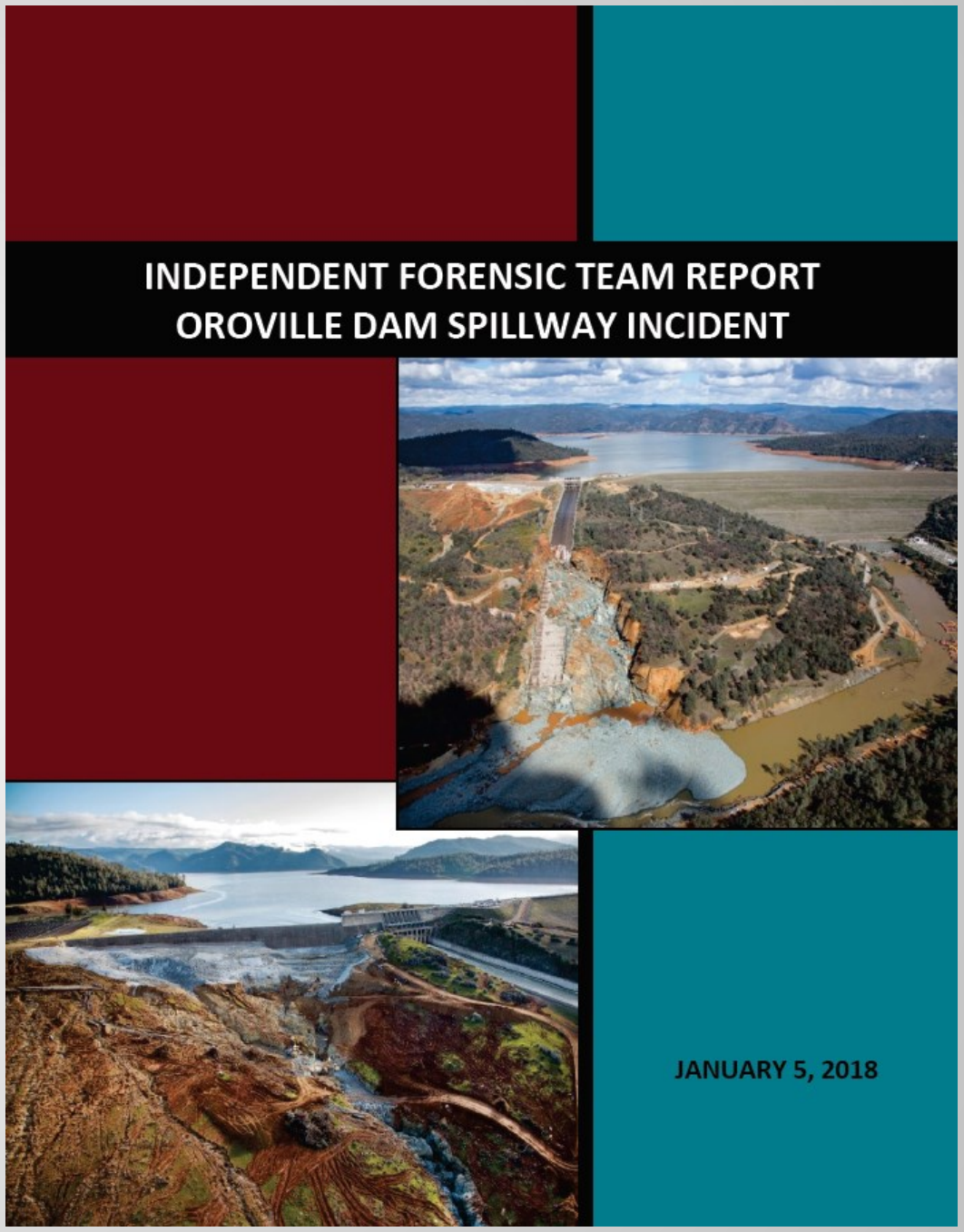
Focus for Typical Industry Dam Safety Program – Pre-2000

- Surveillance & Inspections
- Dam Safety Assessments
- Reservoir Operations
- Maintenance
- Design and Construction
- Emergency Action Plans
- Independent Reviews

B. F. Sisk Dam (San Luis Reservoir) Glory Hole Spillway and Gianelli Pumping-Generating Plant Intake Structure

2017-2018 SWP Dam Safety Program Reviews

- Independent Forensic Team Report
- Owner's Dam Safety Program Audit
- ISO 55000/ASDSO Peer Review
- Management Reviews/Visits with Peers
- Dam Safety Program Maturity Matrices



Common Areas Identified for Improvement

- Update the SWP Dam Safety Policy
- Define the Top-down structure
- Increase training and interaction with dam safety organizations
- Implement Cross-Divisional Dam Safety Teams
- Link the SWP Dam Safety Program to the O&M Asset Management Program
- Improve Culture of Continuous Improvement

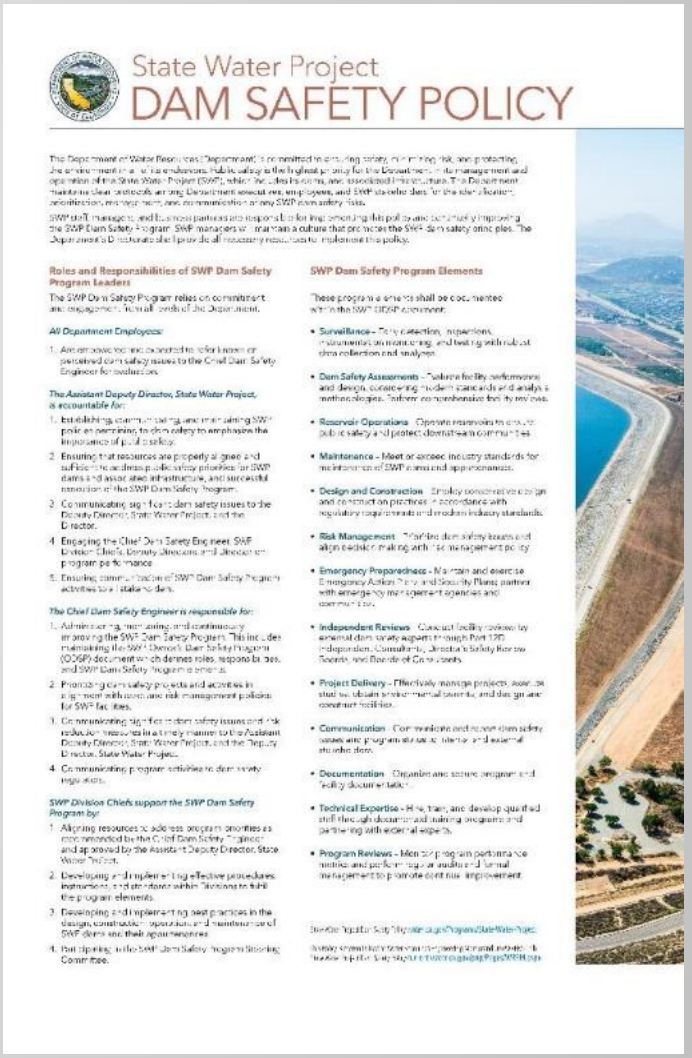
Road-mapping of Multi-year Dam Safety Program Initiatives

- 30 initiatives or “tasks” identified → Consolidated to 16 Initiatives

- Solidify Guiding Documents
- Functional Design Implementation
- Dam-Specific Asset Management Plans
- Risk Management
- Maintenance Management
- Data and Document Management
- Emergency Preparedness
- Core Competencies
- Outsourcing Strategy
- Business Processes
- Resource Requirements
- Training Program
- Industry Outreach
- Communication and Change Management
- Performance Metrics
- Program Reviews

Initiative No. 1 – Solidify Guiding Documents, Including the SWP Dam Safety Program Document

- Updated Policy Signed by Director on November 2, 2018
- Public safety is the highest priority for the Department and the SWP
- Assigns responsibilities and accountability to key positions
- Formally Established Program Elements

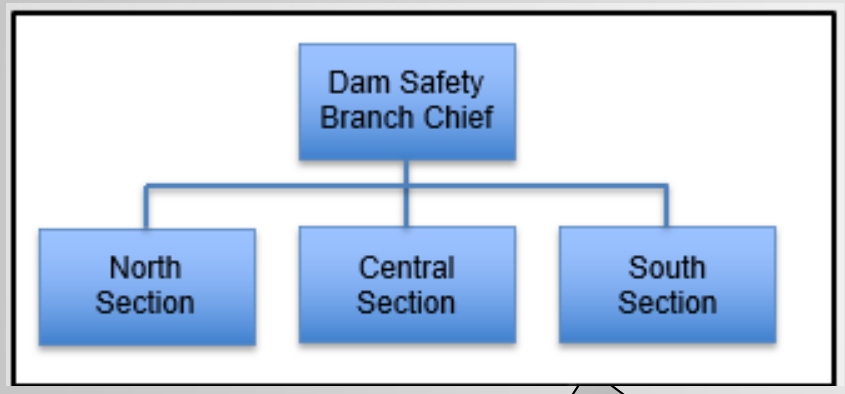

State Water Project
DAM SAFETY POLICY

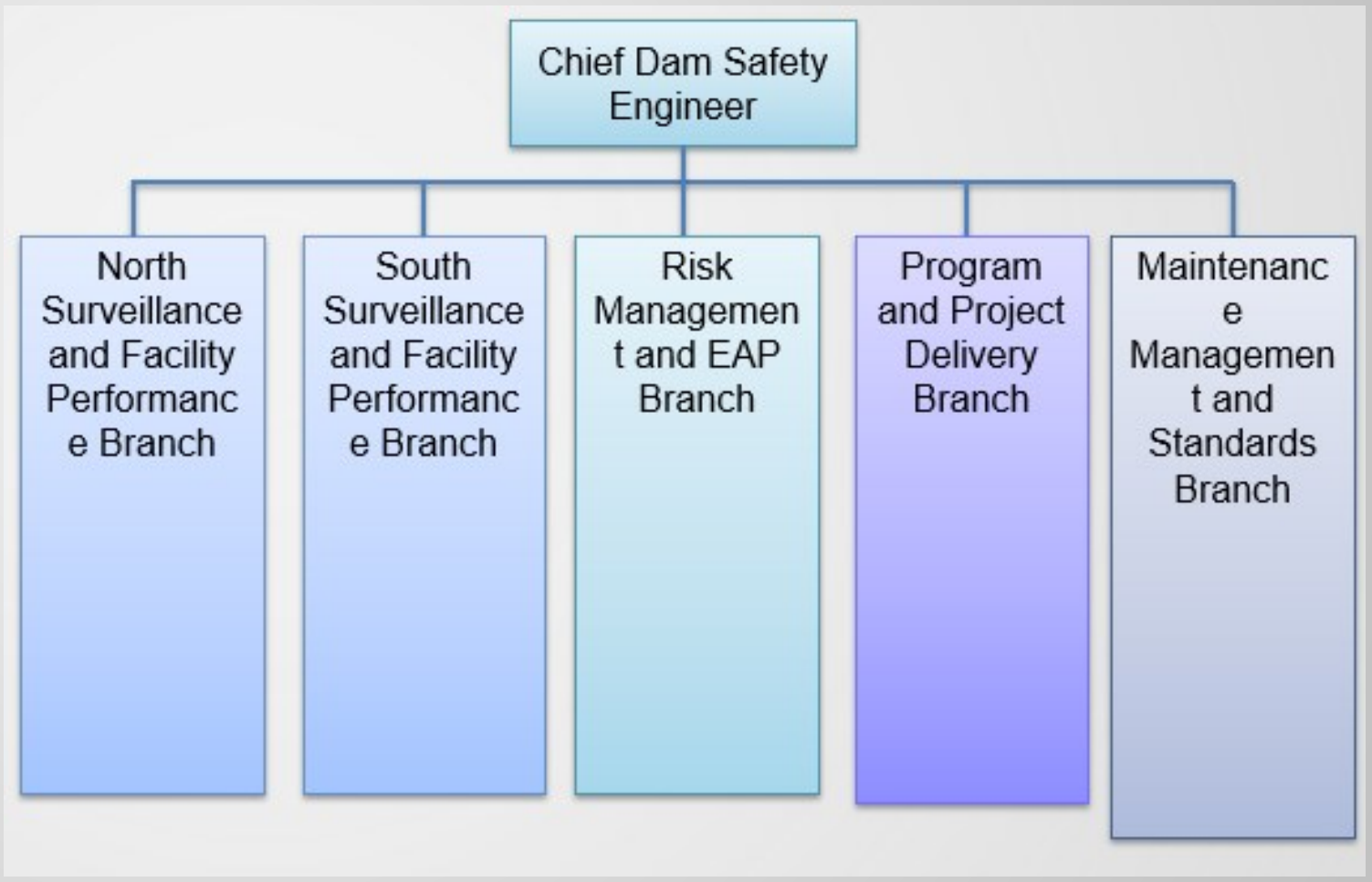
CALIFORNIA DEPARTMENT OF
WATER RESOURCES

SWP Dam Safety Program Elements

- Surveillance
- Dam Safety Assessments
- Reservoir Operations
- Maintenance
- Design and Construction
- Risk Management
- Emergency Preparedness
- Independent Reviews
- Project Delivery
- Communication
- Documentation
- Technical Expertise
- Program Reviews

Initiative No. 2 – Complete SWP Dam Safety Program Functional Design Implementation





CALIFORNIA DEPARTMENT OF WATER RESOURCES

Initiative No. 4 – Enhance DWR's Approach to Dam Safety-related Risk Management

DWR Division of Operations and Maintenance Risk Matrix

Likelihood			DWR Division of Operations & Maintenance Risk Matrix						
Likely to occur 10 times a year	$1x10^{0}$	7	7	14	21	28	35	42	49
Likely to occur within 1 year		6	6	12	18	24	30	36	42
Likely to occur within 3 years	$< 1x10^{0}$ to $3.3x10^{-1}$	5.5	5.5	11	16.5	22	27.5	35	38.5
Likely to occur within 10 years	$< 3.3x10^{-1}$ to $1x10^{-1}$	5	5	10	15	20	25	30	35
Likely to occur within 30 years	$< 1x10^{-1}$ to $3.3x10^{-2}$	4.5	4.5	9	13.5	18	22.5	26	31.5
Likely to occur within 100 years	$< 3.3x10^{-2}$ to $1x10^{-2}$	4	4	8	12	16	20	24	28
Likely to occur within 1000 years	$< 1x10^{-2}$ to $1x10^{-3}$	3	3	6	9	12	15	18	21
Likely to occur within 10,000 years	$< 1x10^{-3}$ to $1x10^{-4}$	2	2	4	6	8	10	12	14
Likely to occur within 100,000 years or greater	$< 1x10^{-4}$	1	1	2	3	4	5	6	7
			Consequence						
Consequence Category			1 Insignificant	2 Minor	3 Moderate	4 High	5 Major	6 Extreme	7 Catastrophic
Public Safety			No injury No damage to public or private property	Near miss Or minor property damage	Minor injuries not requiring medical attention Or moderate property damage	Single injury requiring medical attention Or moderate property damage over large area	Multiple injuries or permanent disability Or major property damage	Fatality Or major property damage over large area	Multiple Fatalities

Oroville Dam Comprehensive Needs Assessment: *Risk Assessment plus Risk Reduction Measures*

DWR O&M Risk Matrix (AM_02_01)

Likelihood			State Water Project Dam Safety Risk Matrix									
Likely to occur 10 times a year	$1x10^{0}$	10	10					60	70	80	90	100
Likely to occur within 1 year		9	9	18	27	36	45	54	63	72	81	90
Likely to occur within 3 years	$< 1x10^{0}$ to $3.3x10^{-1}$	8.5	8.5	17	25.5	34	42.5	51	59.5	68	76.5	85
Likely to occur within 10 years	$< 3.3x10^{-1}$ to $1x10^{-1}$	8	8	16	24	32	40	48	56	64	72	80
Likely to occur within 30 years	$< 1x10^{-1}$ to $3.3x10^{-2}$	7.5	7.5	15	22.5	30	37.5	45	52.5	60	67.5	75
Likely to occur within 100 years	$< 3.3x10^{-2}$ to $1x10^{-2}$	7	7	14	21	28	35	42	49	56	63	70
Likely to occur within 1,000 years	$< 1x10^{-2}$ to $1x10^{-3}$	6	6	12	18	24	30	36	42	48	54	60
Likely to occur within 10,000 years	$< 1x10^{-3}$ to $1x10^{-4}$	5	5	10	15	20	25	30	35	40	45	50
Likely to occur within 100,000 years	$< 1x10^{-4}$ to $1x10^{-5}$	4	4	8	12	16	20	24	28	32	36	40
Likely to occur within 1,000,000 years	$< 1x10^{-5}$ to $1x10^{-6}$	3	3	6	9	12	15	18	21	24	27	30
Likely to occur within 10,000,000 years	$< 1x10^{-6}$ to $1x10^{-7}$	2	2	4	6	8	10	12	14	16	18	20
Likely to occur less often than 10,000,000 years	$< 1x10^{-7}$	1	1	2	3	4	5	6	7	8	9	10
			Consequence									
Consequence Category			1	2	3	4	5	6	7	8	9	10
Public Safety			No injury No damage to public or private property	Near miss Or minor property damage	Minor injuries not requiring medical attention Or moderate property damage	Single injury requiring medical attention Or moderate property damage over large area	Multiple injuries or permanent disability Or major property damage	Fatality 0 - 1 Or major property damage over large area	Multiple Fatalities 1 - 10	Multiple Fatalities 10 - 100	Multiple Fatalities 100 – 1,000	Multiple Fatalities >1,000

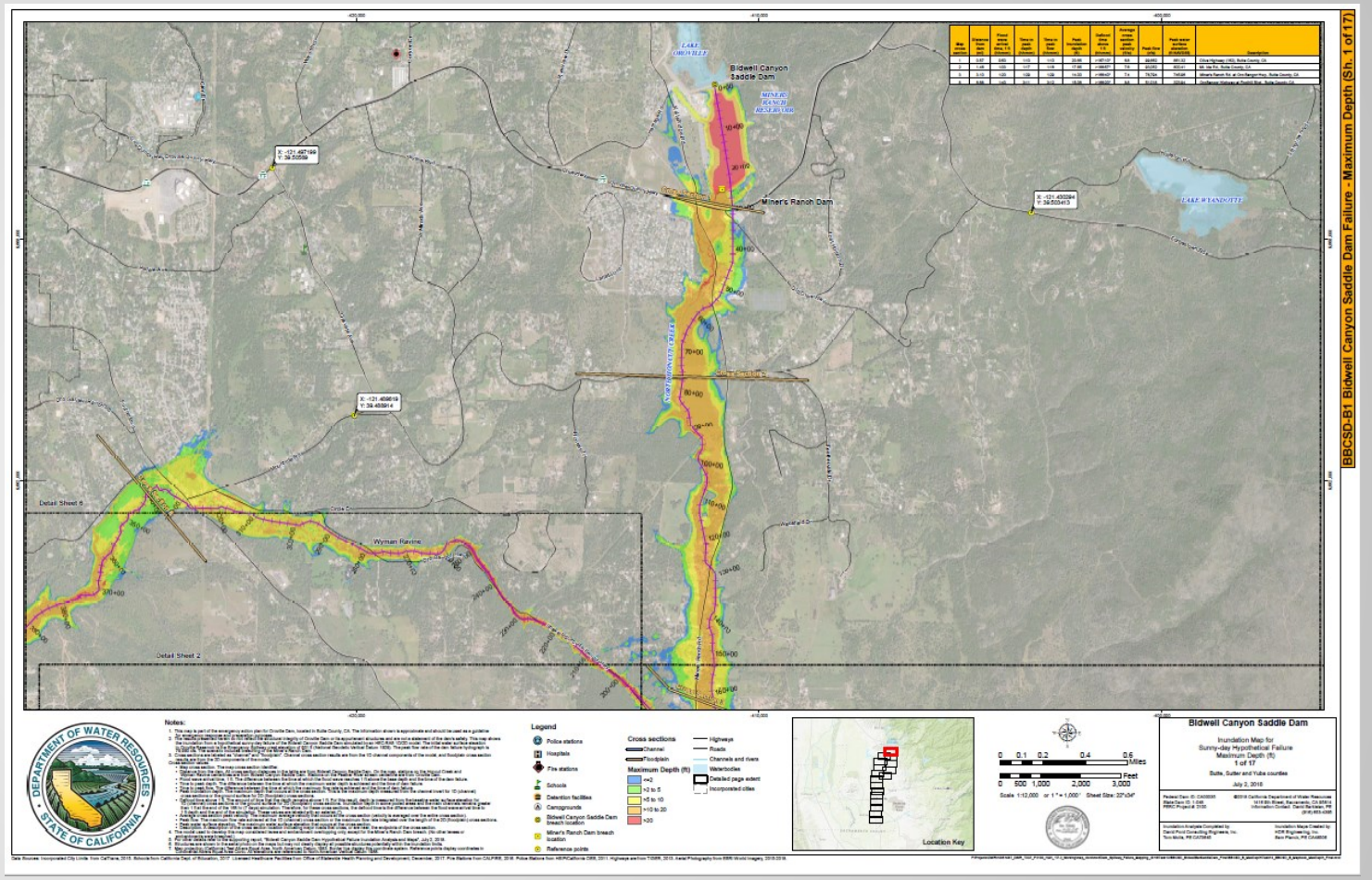
Level 2 Risk Analyses

- ✓ Oroville Dam
- ✓ Pyramid Dam
- ✓ Castaic Dam

CALIFORNIA DEPARTMENT OF WATER RESOURCES

Initiative No. 7 – Enhance Emergency Preparedness

- Dam Breach Inundation Map Web Publisher (ca.gov)
- Emergency Action Plans (EAPs)
- Virtual Annual EAP Seminars
- Tabletop and Functional EAP Exercises
- Internal Rapid Response and Recovery Plans

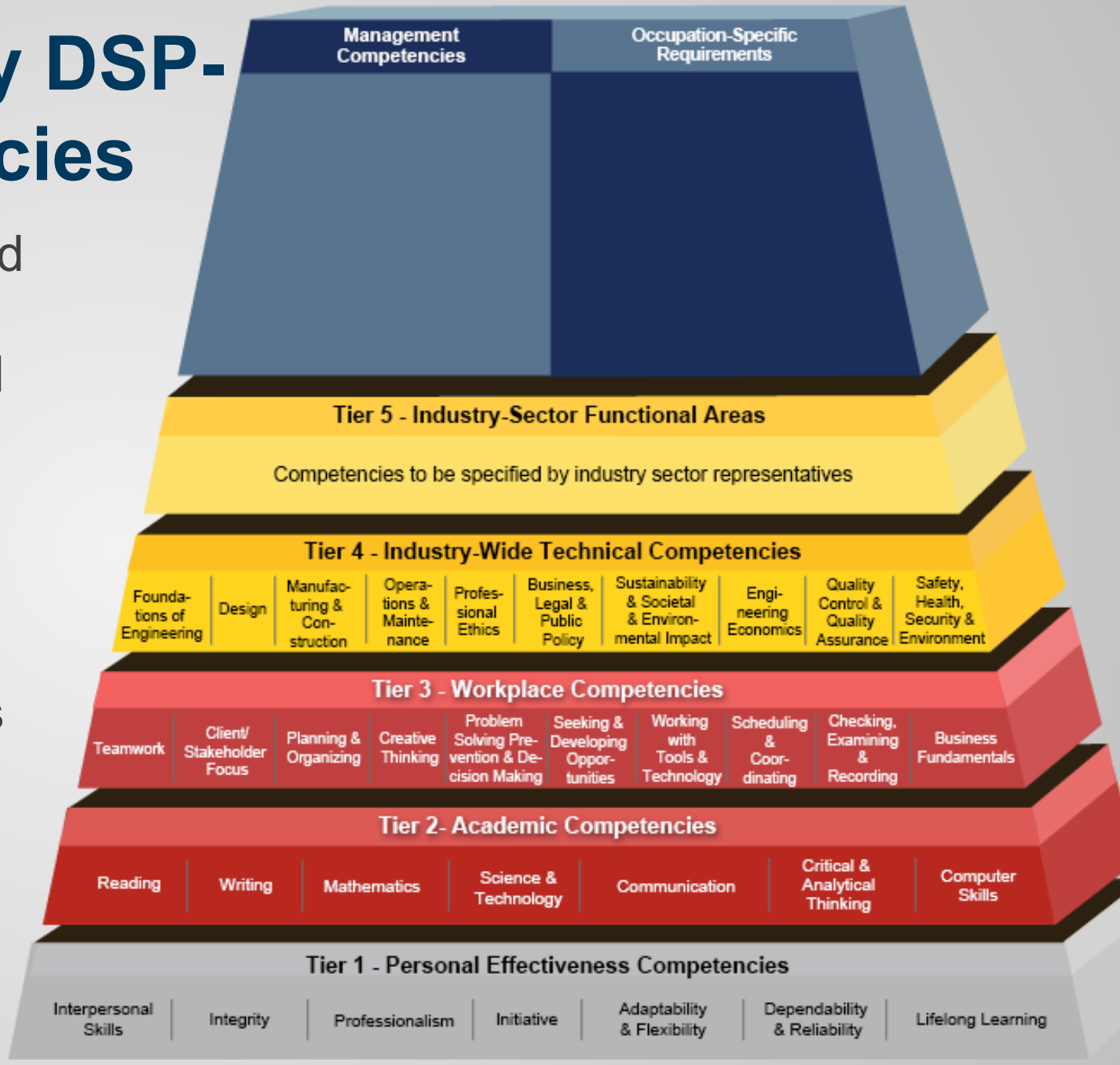


Fair Weather Failure Inundation Map for Bidwell Bar Canyon Saddle Dam, Butte County

CALIFORNIA DEPARTMENT OF WATER RESOURCES

Initiative No. 8 – Identify DSP-related Core Competencies

- Identified the knowledge, skills, and abilities required for successful execution of job duties within O&M Dam Safety Services.
- Utilized the US Dept. of Labor Engineering Competency model
- Multiple Tiers of competencies
- Challenges of Tier 5 competencies

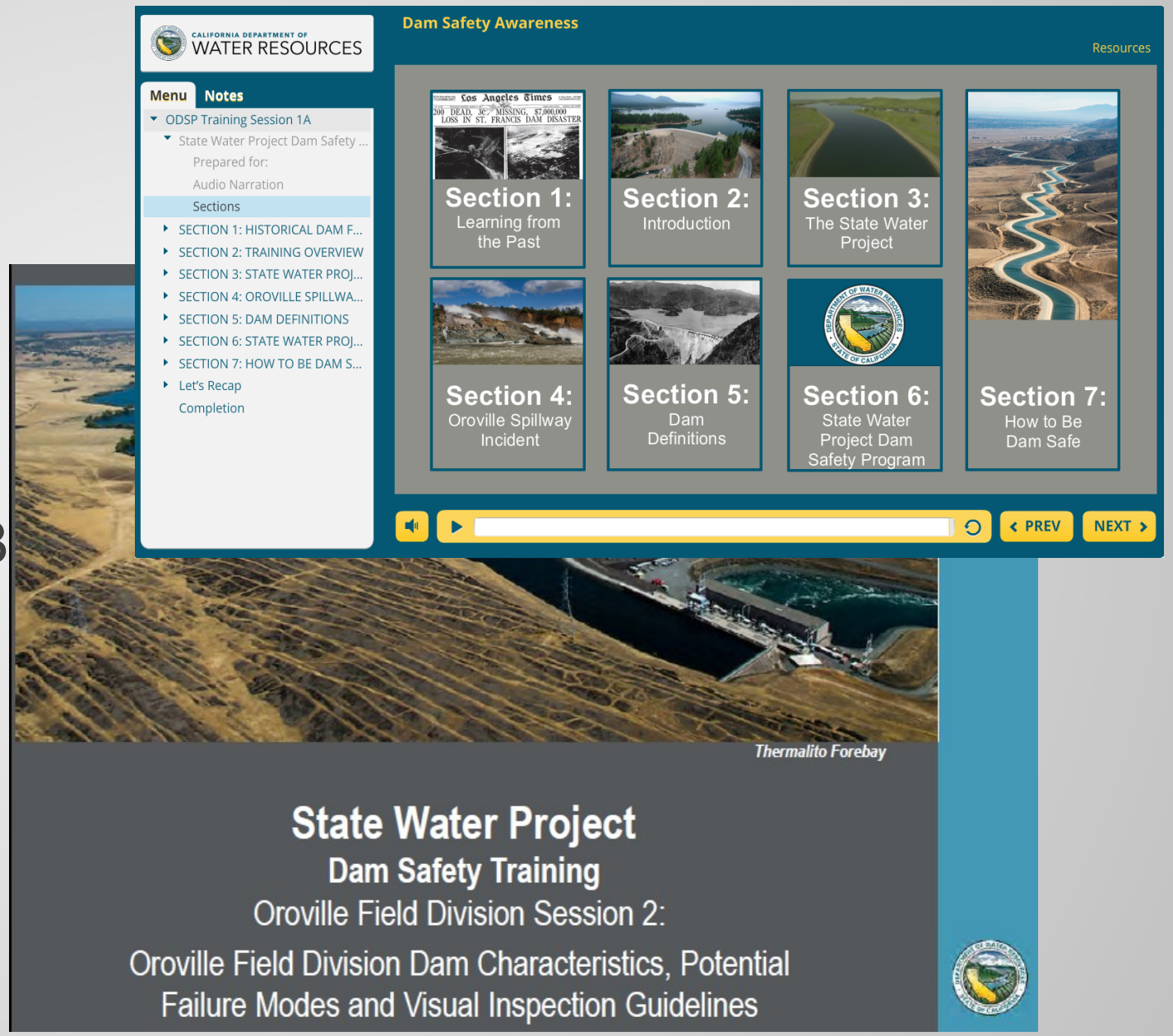


Engineering Competency Model (US Dept. of Labor, ETA)

CALIFORNIA DEPARTMENT OF WATER RESOURCES

Initiative No. 12 – Formalize and Expand Dam Safety Program Training

- ✓ Established Training Plans to require development of **dam safety core competencies**
- ✓ Training Contracts
- ✓ Developed SWP Dam Safety Awareness Modules 1A and 1B
- ✓ Developing Field Division-specific Dam Safety Training Modules



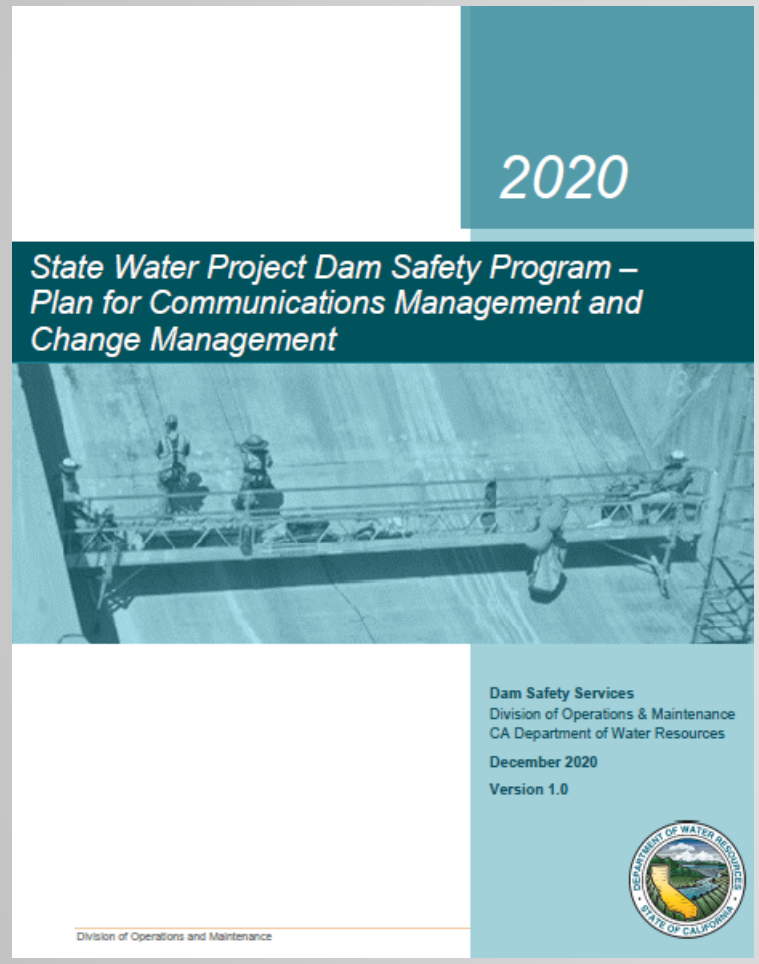
CALIFORNIA DEPARTMENT OF WATER RESOURCES

Initiative No. 13 – Enhance Industry Outreach

- Increased collaboration with the U.S. Army Corps of Engineers and Bureau of Reclamation
- Increased dam safety conference and workshop attendance.
- Participation in CEATI – Dam Safety Interest Group.

CALIFORNIA DEPARTMENT OF
WATER RESOURCES

Initiative No. 14 – Develop DSP Management of Change Program and Communication Plan



- Early Implementation Projects
- Future Dam Safety Projects
- Emergency Action Plan-related Activities
- Inspection & Surveillance Activities (multiple responsible parties)
- Maintenance Activities
- Operational Activities
- Seasonal Forecasting
- Dam Safety Program Enhancements

CALIFORNIA DEPARTMENT OF WATER RESOURCES

Initiative No. 16 – Develop More Formal Dam Safety Program Management Review

- Bi-weekly SWP Dam Safety Program Steering Committee Meetings
- Quarterly meetings with FERC and DSOD
- Independent Verification & Validation
- Annual Program Reporting
- 5-year Program Review/Audit

Thank you

ITEM 5:
RISK ASSESSMENT

Risk Management in Socio-Technical Systems

Comments from Oroville Dam CNA Process

Dr. R. Storesund, PE., GE, Consulting Engineer, Storesund Consulting
American Society of Civil Engineers, Region 9 Governor – San Francisco Section
Executive Director, UC Berkeley's Center for Catastrophic Risk Management
President & CEO, NextGen Mapping, Inc. (Software Development)
President & CEO, Storesund Construction, Inc. (Class A, B, C-57)
President & Director, SafeR^3 (Non-Profit)

May 28, 2021

Berkeley
UNIVERSITY OF CALIFORNIA

About Rune

- Dual Degree Program UC Santa Cruz/UC Berkeley
  - BA Anthropology (UC Santa Cruz)
  - BS Civil Engineering (UC Berkeley)
- Masters in Geotechnical Engineering (UC Berkeley)
- Doctorate in Civil Systems (UC Berkeley)

- Executive Director, UC Berkeley's Center for Catastrophic Risk Management
- Consulting Engineer, Storesund Consulting
- President & CEO, NextGen Mapping, Inc. (Software Development)
- President & CEO, Storesund Construction, Inc. (Class A, B, C-57)
- President & Director, SafeR^3 (Non-Profit)

ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS REGION 9

Storesund Consulting

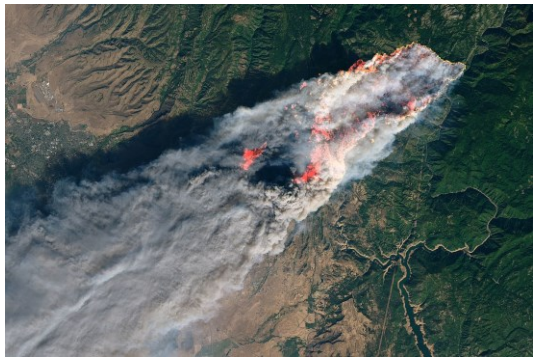
Safety • Risk-Reduction • SafeR^3 • Resilience • Reliability

StoresundConstruction

Berkeley UNIVERSITY OF CALIFORNIA

My Disaster Research

- 1986 NASA Challenger
- 2003 NASA Columbia
- 2005 Hurricane Katrina
- 2010 San Bruno PGE Explosion
- 2010 Deepwater Horizon
- 2014 Oso Landslide (WA State)
- 2015 Aliso Canyon Gas Leak
- 2017 Oroville Dam Spillway Failure
- 2017 US Navy Ship Collisions
- 2018 California Wildfires (Butte County)
- 2019 Brumadinho Landslide
- 2019 Boeing 737 MAX
- 2020 Michigan Dam Failures



Oroville Dam CNA Ad Hoc

- Served at the invitation of Senator Nielsen and Assemblyman Gallagher
- Risk Management Perspective
- Ad Hoc: July 2018 to December 2020
- May 10, 2021 Report with Reflections and Recommendations

http://safer3.world/

Community "Safety" Following Comprehensive Study - Oroville Dam

May 10, 2021

Berkeley
UNIVERSITY OF CALIFORNIA

What I'd like to Talk About Today

- What is risk & crisis
- Socio-Technical Systems (people and organizations too!)
- Understanding utility of "uncertainty" as a management variable
- Setting performance expectations ("Expected" performance)
- Use of "Leading Indicators"
- Tracking skew between "Work as Imagined" and "Work as Done"
- Advanced Inquiry Methods (Dialectic, Multiple Realities, etc.)
- Focus on "Valid" and "Reliable" methods
- Avoiding E3 Errors (solving the wrong problem precisely)
- Triangulation approaches to overcome conflicting/mixed signals
- Safety Culture and Process Improvement Programs

What I Can Talk About in 20 Minutes

- What is risk & crisis
- Socio-Technical Systems (people and organizations too!)
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- Safety Culture and Process Improvement Programs

Safety

- Searching for “safety”
- DWR wants to ensure safety
- Community wants to feel safe

Risk Perception – Insurance

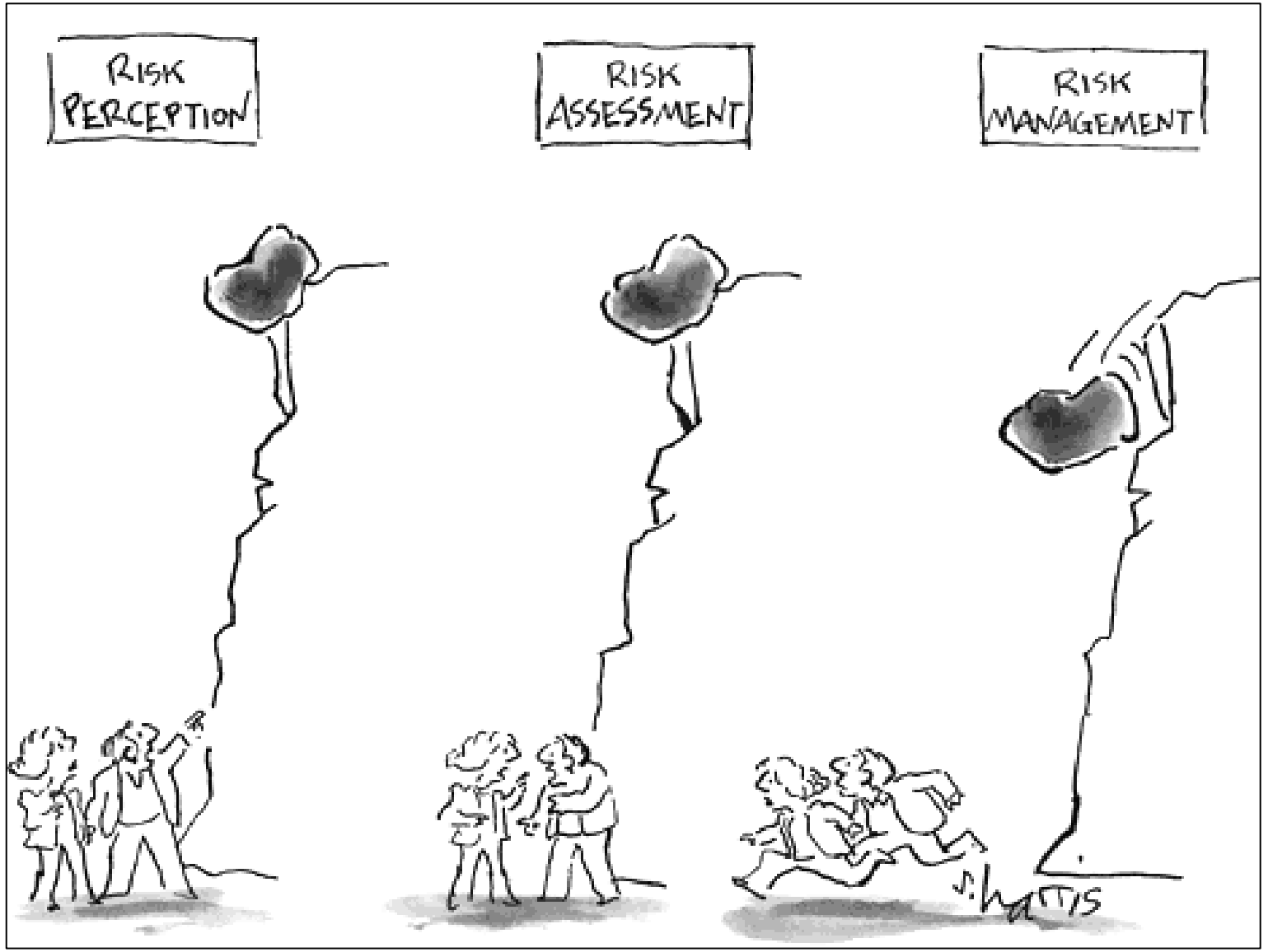
"Regarding dams and private insurance. My understanding, which I confirmed, is that private insurers are not insuring dams (other than surety bonds for construction) and that they don't think its a viable business opportunity because the potential losses are so high (liability insurance) and the costs of repair / reconstruction are so high (property insurance). I think it would be very difficult to get them to insure dams. "

Former California Insurance Commissioner


KCBS
740

Oroville CAC “Opportunities”

- CAC has baton from Ad Hoc
- Take a leadership role in Proactive Risk Reduction
- Dam is not going to ‘fail’ tomorrow….BUT
  - Current techniques are deficient
  - Takes decades to implement substantial improvements
  - Aging infrastructure with unknown service life
  - Climate Change
  - Two (2) evacuations in 50 years, statistics says it will happen again!
- Critical to start laying a resilient foundation today!



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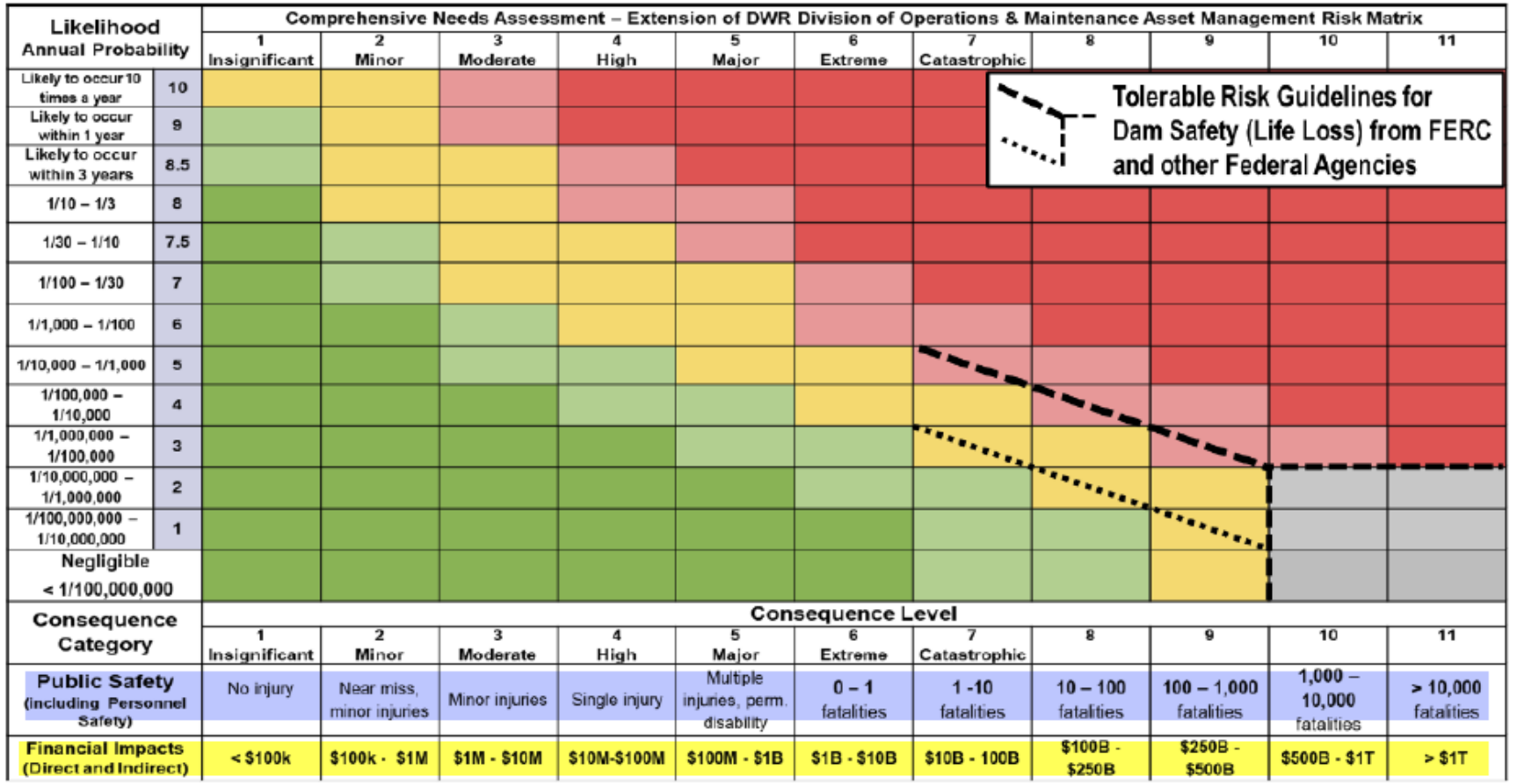
Recommendations (Mini Projects)

- Re-engage the IFT to review progress on 'lessons to be learned'
- Formalize community impacts for discharges 150,000 cfs to 700,00 cfs
- Explicit definition of 'safety' (what does 'safe' mean?)
- Be financially accountable for "Performance" (Compensation Fund)
- Perform detailed assumption audits (all dam infrastructure)
- Scrutinize Asset Management (not just plans but performance)
  - What is it supposed to do?
  - What is it actually doing?
  - Where are the differences?
  - Use on both physical assets as well as methods/procedures
- Require Life-Cycle Management Today!
  - Target service life
    - Components
    - Assemblies
    - System (where are the 'weak' links?)
  - Target maintenance and intervals
  - Life-cycle based budgeting, then track within expectations or not?

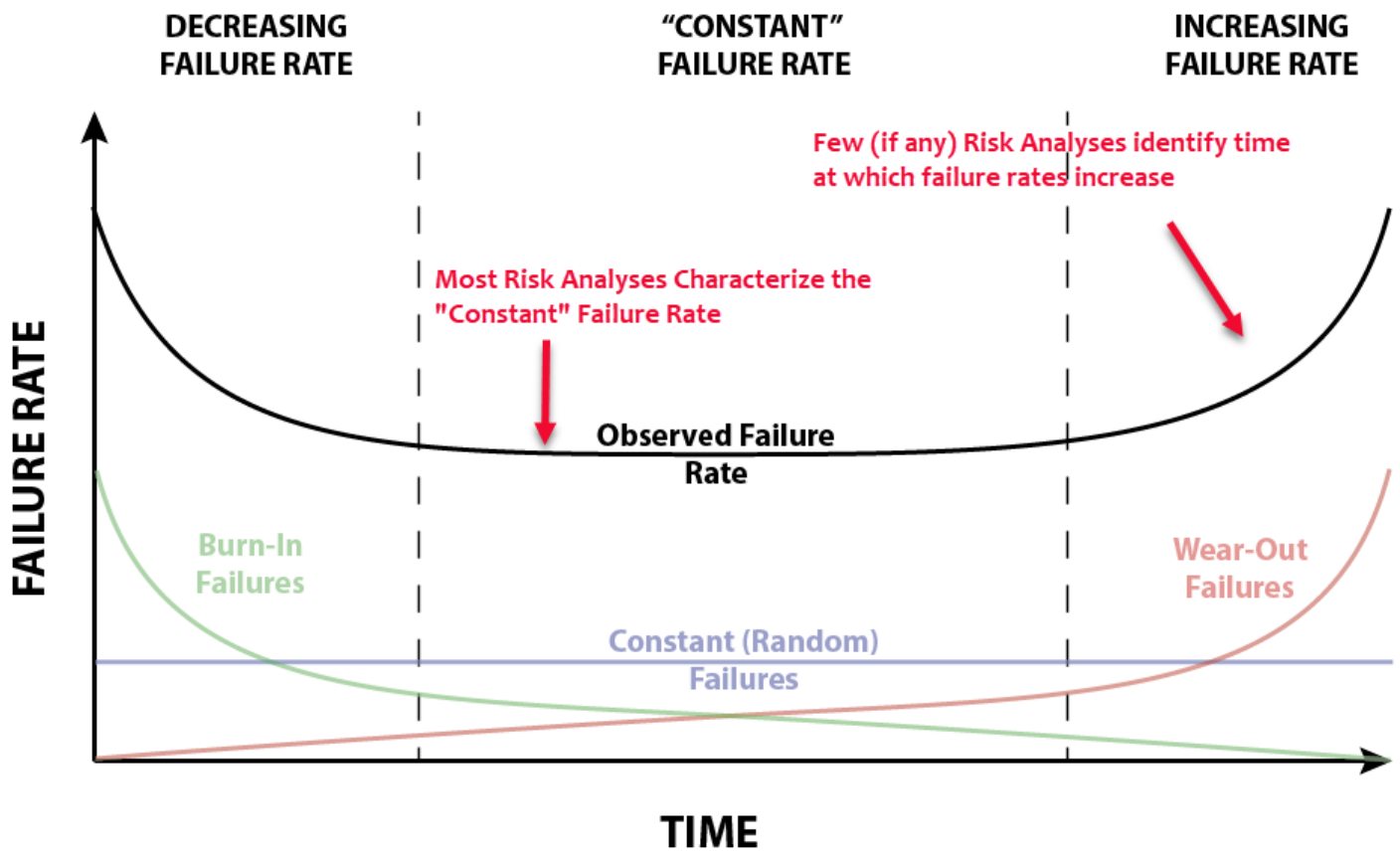
Vagueness of “Failure”

Figure 10. Extended Version of DWR O&M Asset Management Risk Matrix Used in CNA Risk Evaluations

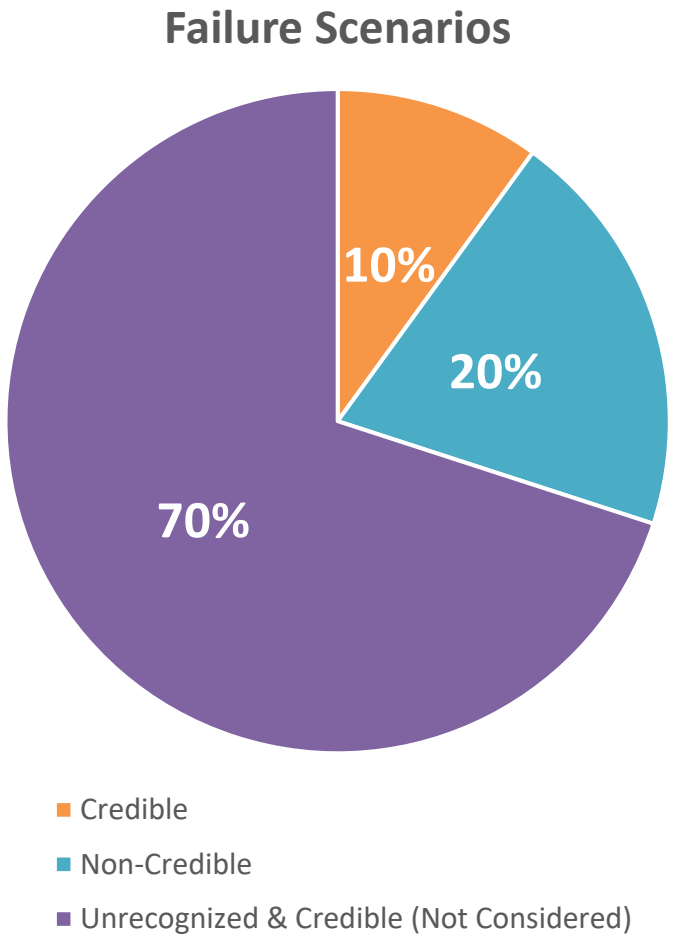


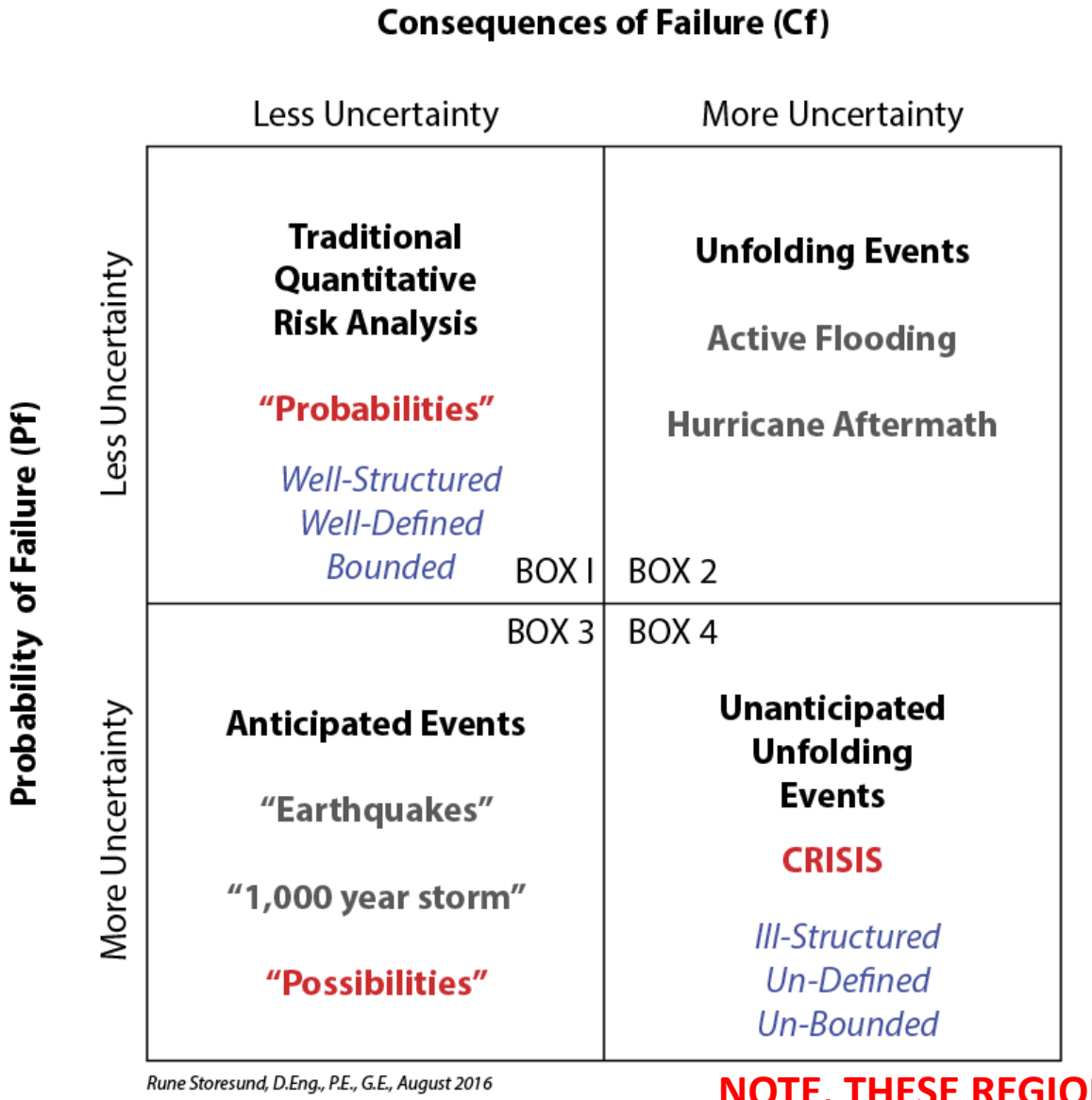
Likelihood Annual Probability		Comprehensive Needs Assessment – Extension of DWR Division of Operations & Maintenance Asset Management Risk Matrix										
		1 Insignificant	2 Minor	3 Moderate	4 High	5 Major	6 Extreme	7 Catastrophic	8	9	10	11
Likely to occur 10 times a year	10											
Likely to occur within 1 year	9											
Likely to occur within 3 years	8.5											
1/10 – 1/3	8											
1/30 – 1/10	7.5											
1/100 – 1/30	7											
1/1,000 – 1/100	6											
1/10,000 – 1/1,000	5											
1/100,000 – 1/10,000	4											
1/1,000,000 – 1/100,000	3											
1/10,000,000 – 1/1,000,000	2											
1/100,000,000 – 1/10,000,000	1											
Negligible < 1/100,000,000												
Consequence Category		**Consequence Level**										
		1 Insignificant	2 Minor	3 Moderate	4 High	5 Major	6 Extreme	7 Catastrophic	8	9	10	11
Public Safety (including Personnel Safety)		No injury	Near miss, minor injuries	Minor injuries	Single injury	Multiple injuries, perm. disability	0 – 1 fatalities	1 -10 fatalities	10 – 100 fatalities	100 – 1,000 fatalities	1,000 – 10,000 fatalities	> 10,000 fatalities
Financial Impacts (Direct and Indirect)		< $100k	$100k - $1M	$1M - $10M	$10M-$100M	$100M - $1B	$1B - $10B	$10B - 100B	$100B - $250B	$250B - $500B	$500B - $1T	> $1T

Failure is Time-Dependent



Limited “Imagination” for Scenarios





NEED DIFFERENT TOOLS/METHODS/ STRATEGIES FOR EACH REGION!

NOTE, THESE REGIONS ARE NOT DISCRETE, BUT VERY FLUID AND TIME-DEPENDENT!!

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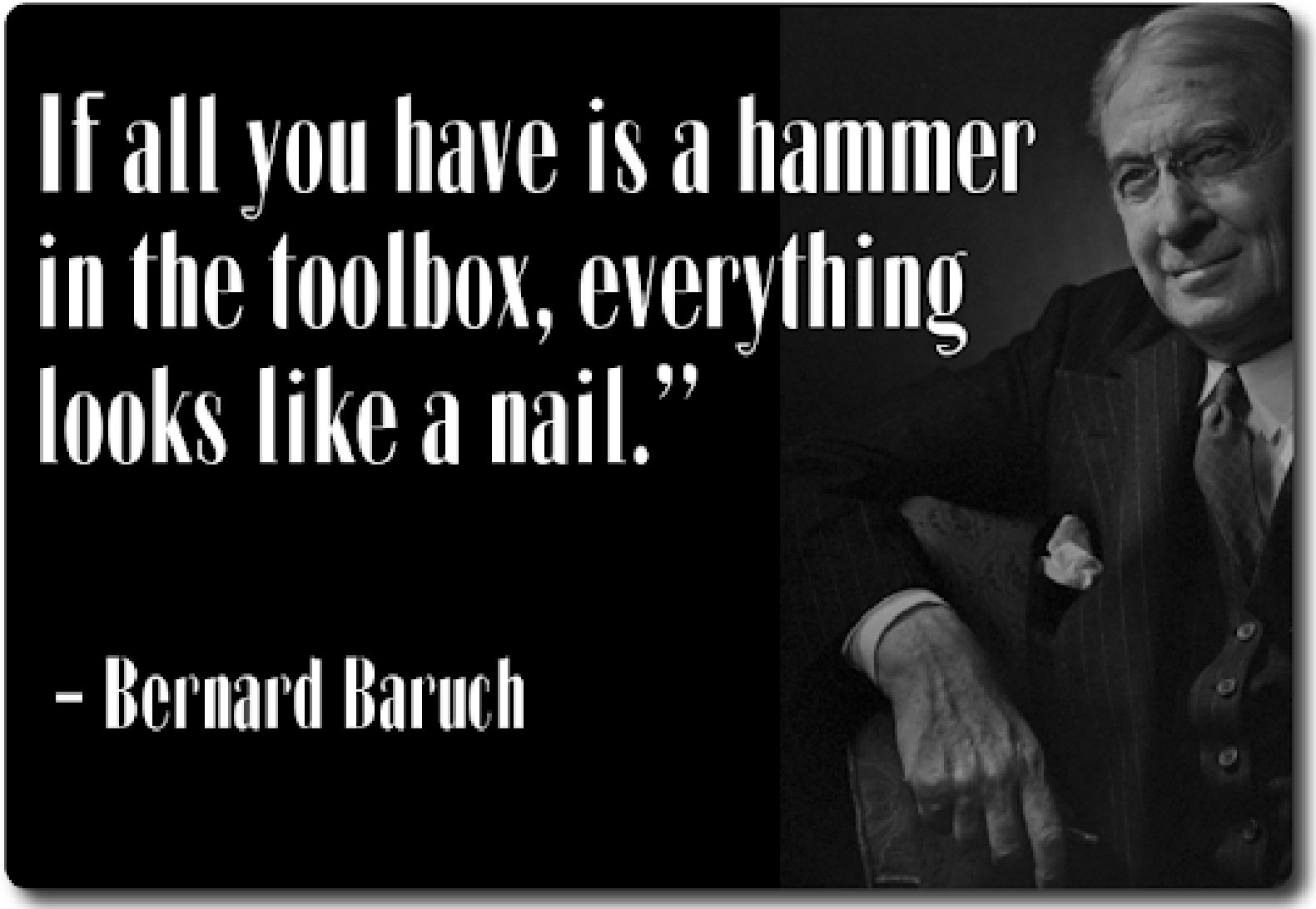
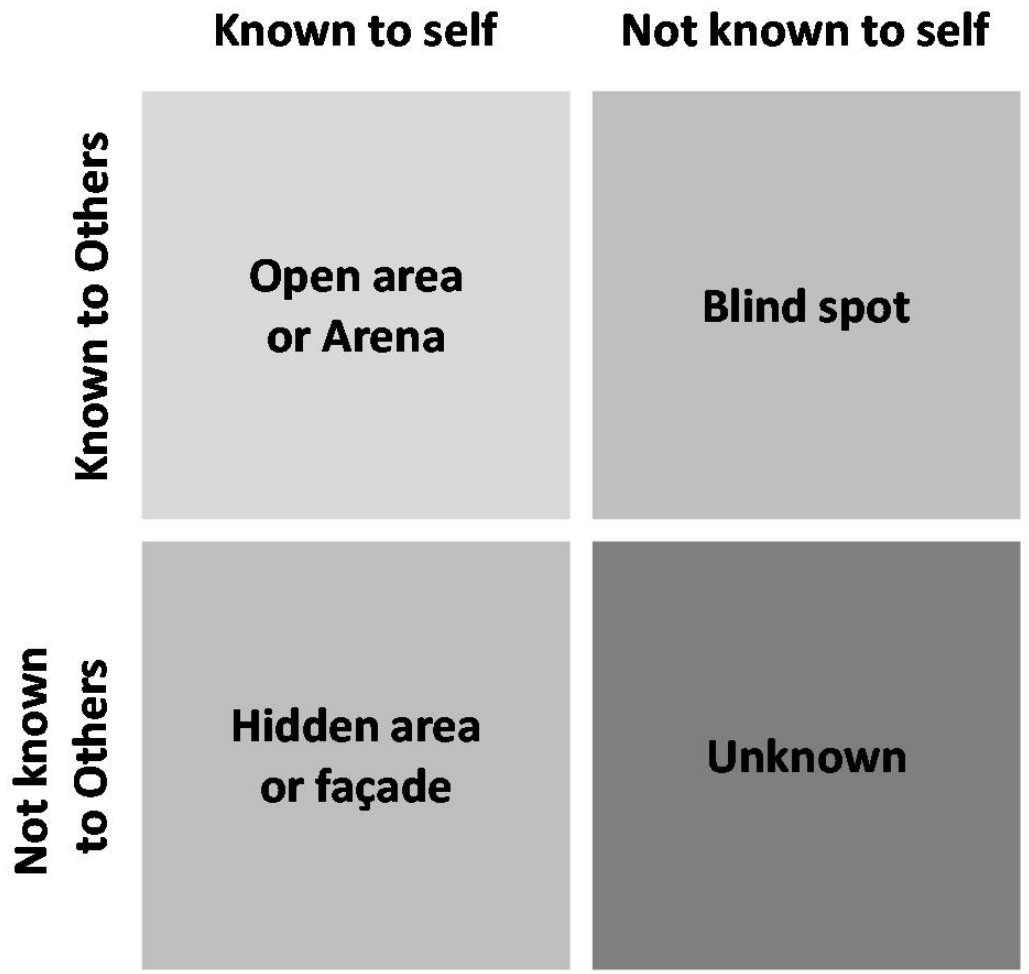

If all you have is a hammer in the toolbox, everything looks like a nail."
– Bernard Baruch



The Johari Window Model

	Known to self (i.e. US Dams)	Not known to self (i.e. US Dams)
Known to others	PFMA/RIDM	PFMA/RIDM Triangulation Leading Indicators Reliability-Centered Maintenance Resilience Engineering High Reliability Organizations Life-Cycle Management Total Quality Management Crisis Management Preparedness
Not known to others	Detailed design calculations Design assumptions Performance characteristics	"Surprises" New Technologies

Risk Management Pledge

I *State Your Name* PROMISE TO APPRECIATE THE VALUE AND IMPORTANCE OF UNCERTAINTIES IN CIVIL SYSTEMS AND HELP DECISION-MAKERS AVOID 'CONFIDENT IGNORANCE' BY ARMING THEM WITH PRAGMATIC INFORMATION AND AVOIDING OVER-SIMPLIFICATION AND E3 ERRORS (SOLVING THE WRONG PROBLEM PRECISELY). I ALSO PROMISE TO TRIANGULATE ANSWERS INSTEAD OF RELYING SOLELY ON ONE TECHNIQUE.

Questions

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THE STATE OF DAM SAFETY PROGRAMS IN THE UNITED STATES

PRESENTATION TO THE OROVILLE CITIZENS ADVISORY COMMISSION MEETING, 28 MAY 2021

ERIC HALPIN, PE

HALPIN CONSULTANTS LLC

- **As a US Army Corps of Engineers Infrastructure Leader (1980-2019):**
  - Owner and Self Regulator of +3,000 Dam and Levee Systems & Safety Programs
  - Vice Chair of the National Levee Safety Program
  - Primary Interface with Accountability to the Administration, Congress, and the Government “Watch-Dogs”
  - US Government Lead for International Partnerships with Spain, Netherlands, Japan, and United Kingdom on Safety Programs
  - Registered Professional Engineer (1988)
- **As Private Consultant:** (2018-present)
  - The Same Thing for Clients in Industry

Pulpit Rock, Norway

(2,000 feet above the fiords of Norway)

MY RISKY BACKGROUND IN SAFETY PROGRAMS

01

WHAT CONSTITUTES A STATE-OF- THE ART DAM SAFETY PROGRAM?

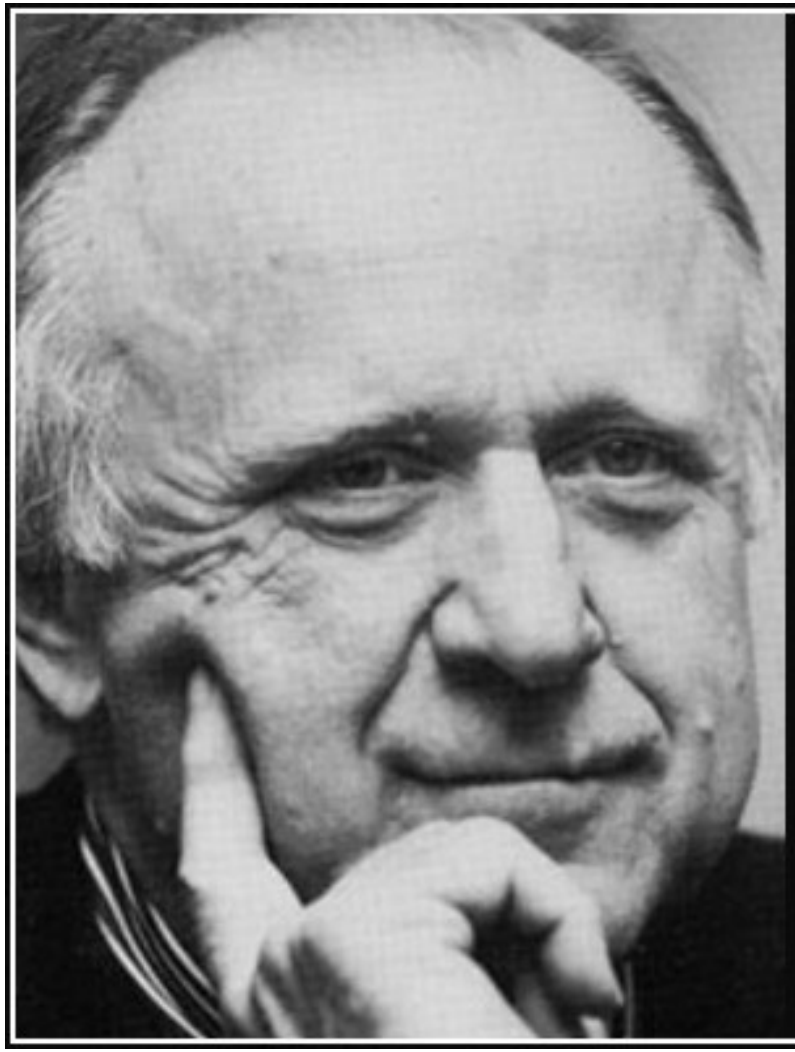
02

HOW DO SUSTAIN THE STATE-OF-THE-ART PRACTICE?

03

WHAT TRENDS SHOULD WE BE AWARE OF?

DISCUSSION TOPICS



Good governance never depends upon laws, but upon the personal qualities of those who govern. The machinery of government is always subordinate to the will of those who administer that machinery. The most important element of government, therefore, is the method of choosing leaders.

— Frank Herbert —

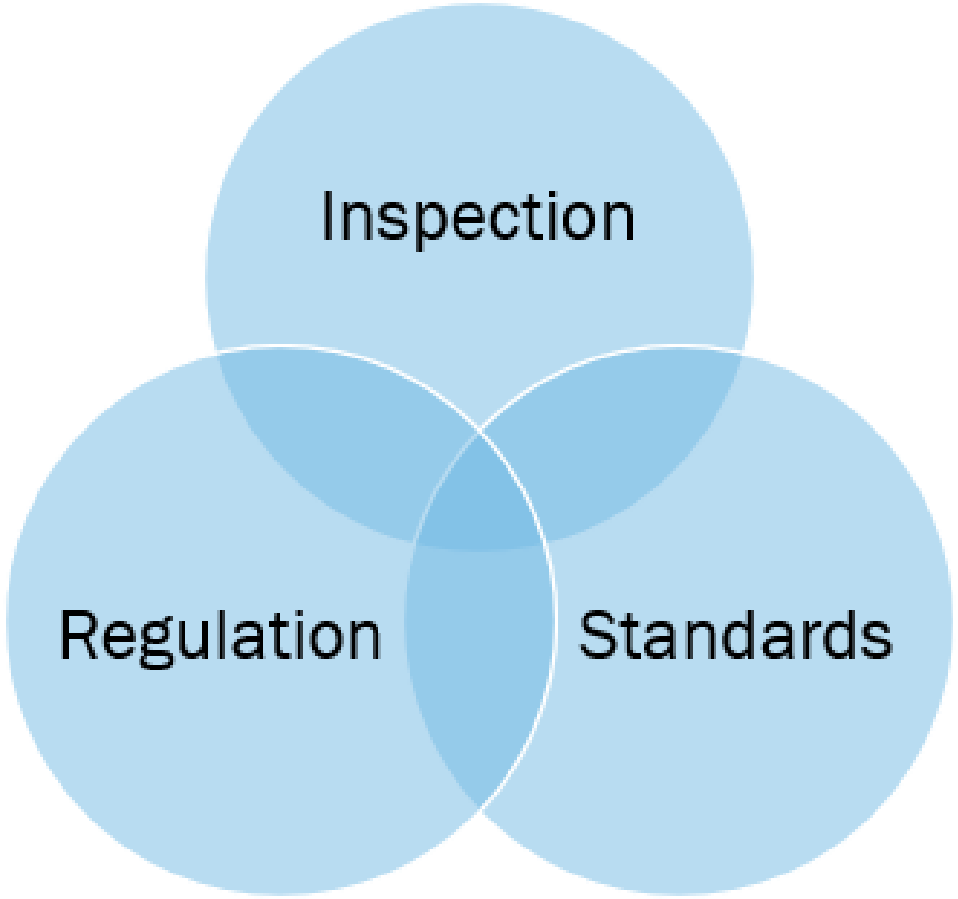
AZ QUOTES

WHAT IS IN A STATE-OF- THE-ART DAM SAFETY PROGRAM?

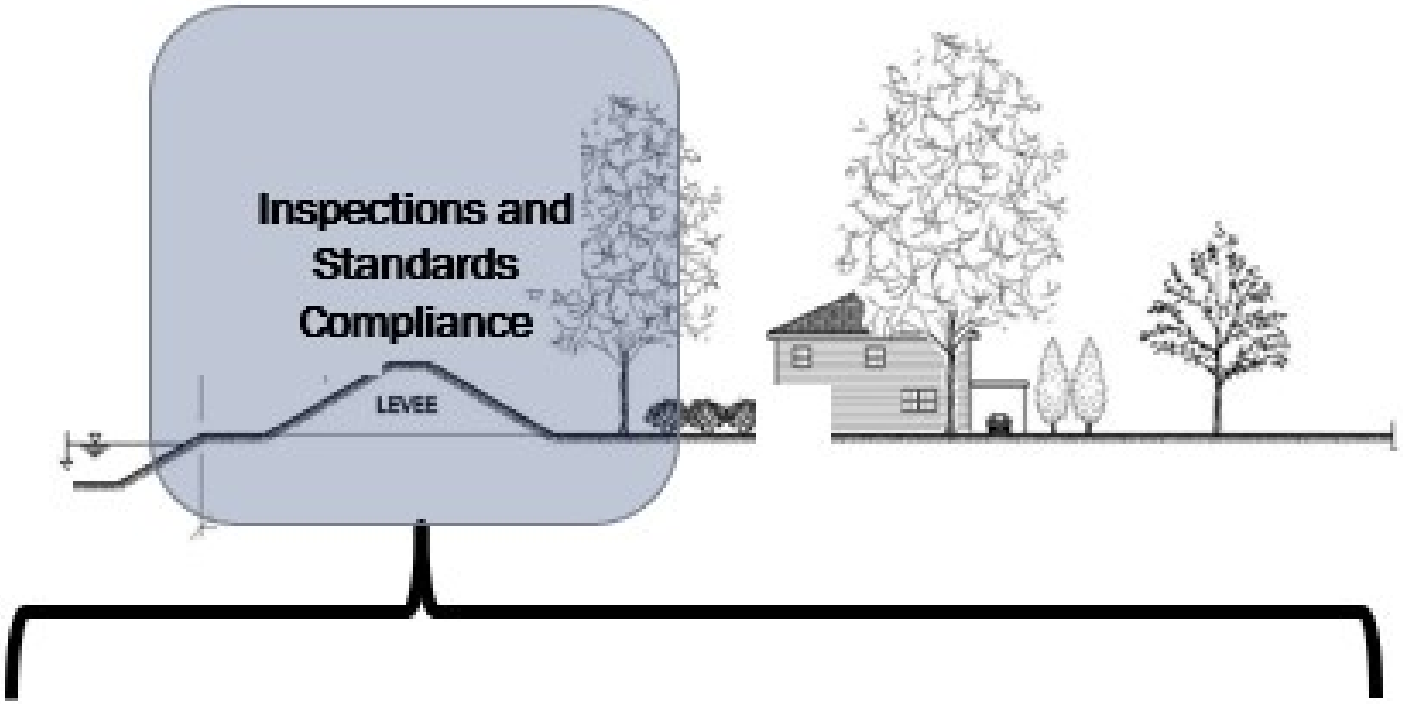
The State of the Dam Safety Industry

TRADITIONAL DAM SAFETY PROGRAM FOCUS (1968-TODAY)

- Compliance with Design Standards as a Measure of Safety
- Inspection and Monitoring for Performance Concerns
- Safety Assured by Regulation?



Traditional View of Infrastructure Safety



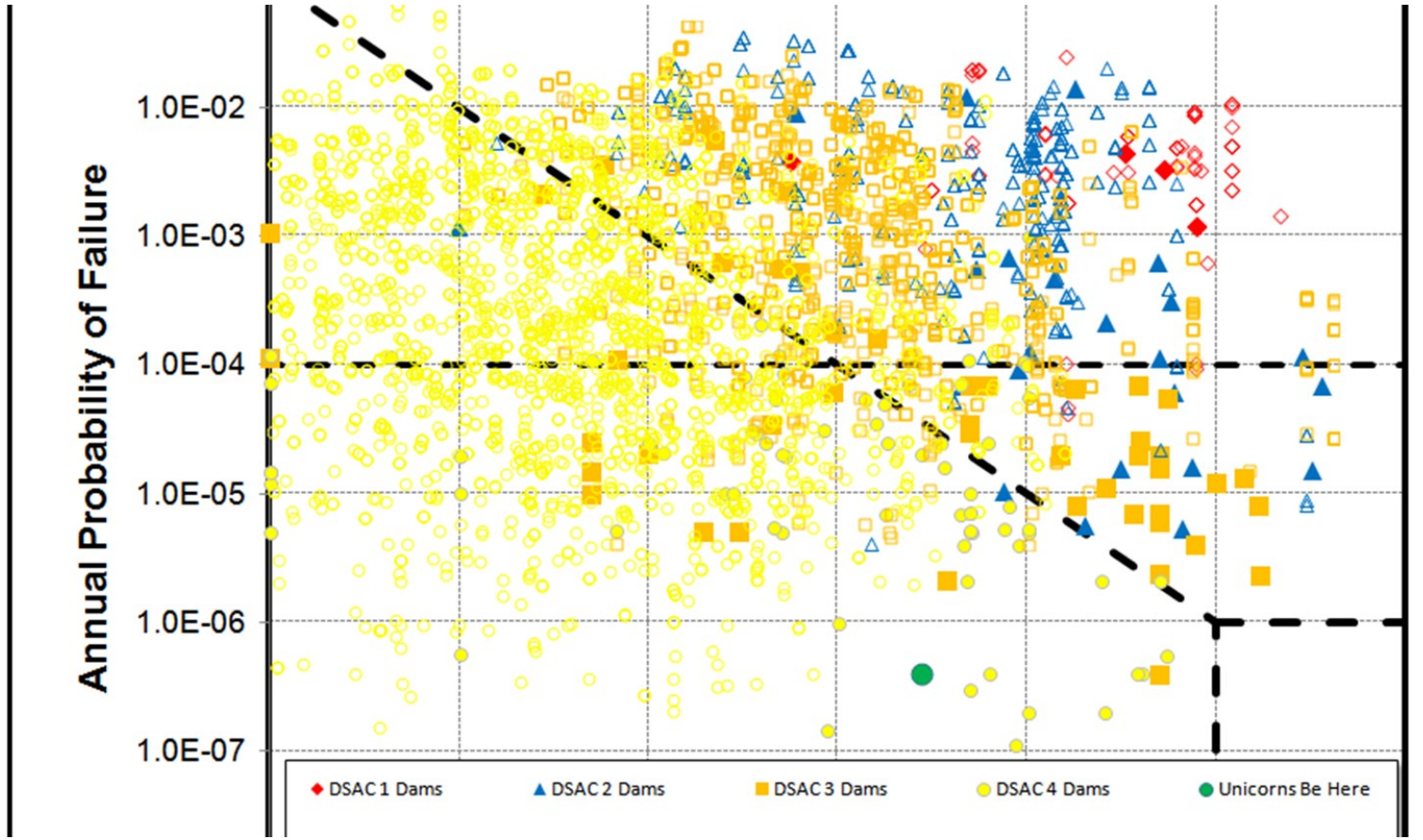
Focused on the Infrastructure (not people, hazard, or consequences)

Focused on How We Built Them, Not How They'll Perform (not integrated systems – think New Orleans)

Focused Compliance with Design Standards as a Measure of Safety, Assured by Regulation

This is what following standards only has resulted in…

- Huge Variation in Risk
- Over and Under Investment in Risk Management
- Wrong Priorities
- Poor Understanding
- Dynamics!



One Size Doesn't Fit All!

Contoso
Suites

MODERN DAM SAFETY PROGRAM FOCUS (SINCE 2000)

- Understand How Things Can Fail and the Risk Associated
- Risk Informed Decisions
- Sharing Responsibilities Via Improved Communication
- Governance: People, Process, & Policy

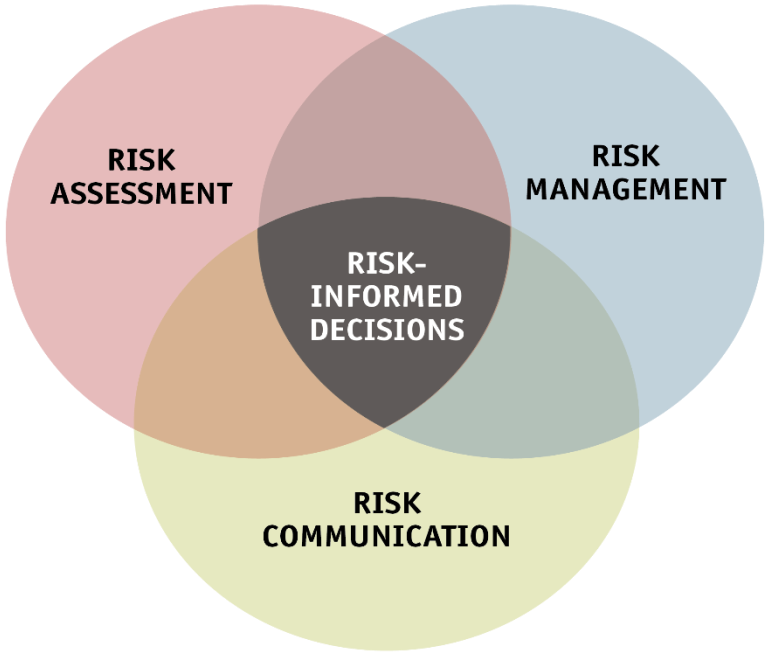
Why is a Strong Risk Framework Necessary?

Integration Via *is* Credibility:

- Dam Systems and the Environments they exist in are Complex and Dynamic
- Problems that You Can Understand are Problems That Can Be Solved
- Clear Relationships Within Governance: Policies, Processes, and People/Organizations

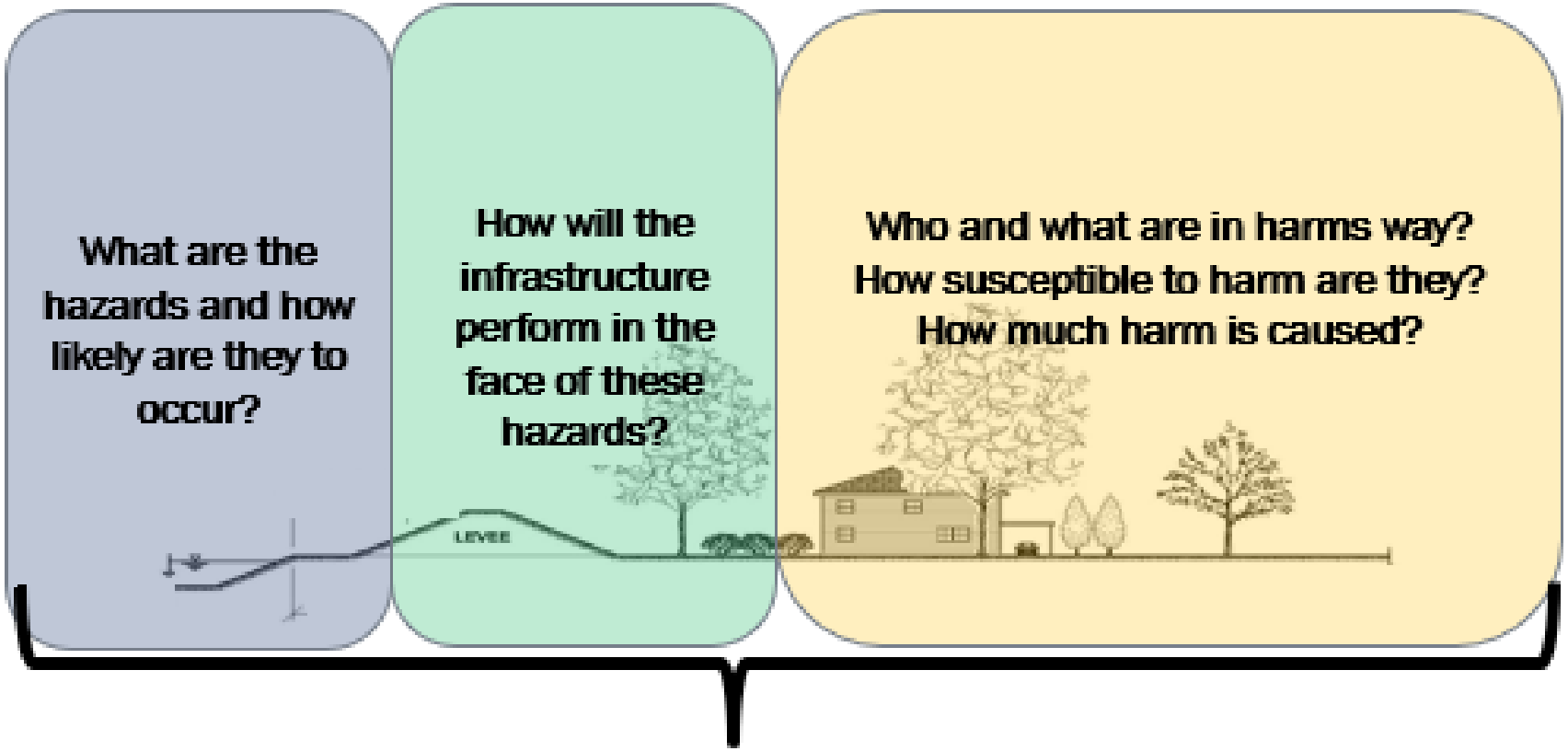
Built for the Long Haul

- Enduring Across Multiple Generations
- Adaptable to Evolving Practice, Science, Data, and Research



Risk Informed View of Infrastructure Safety

Risk = f(Hazard, Performance, Consequences)



Modern Infrastructure Program: Focused on People, Performance, and Risks

How Do We Sustain the State-of- the-Art Practice?

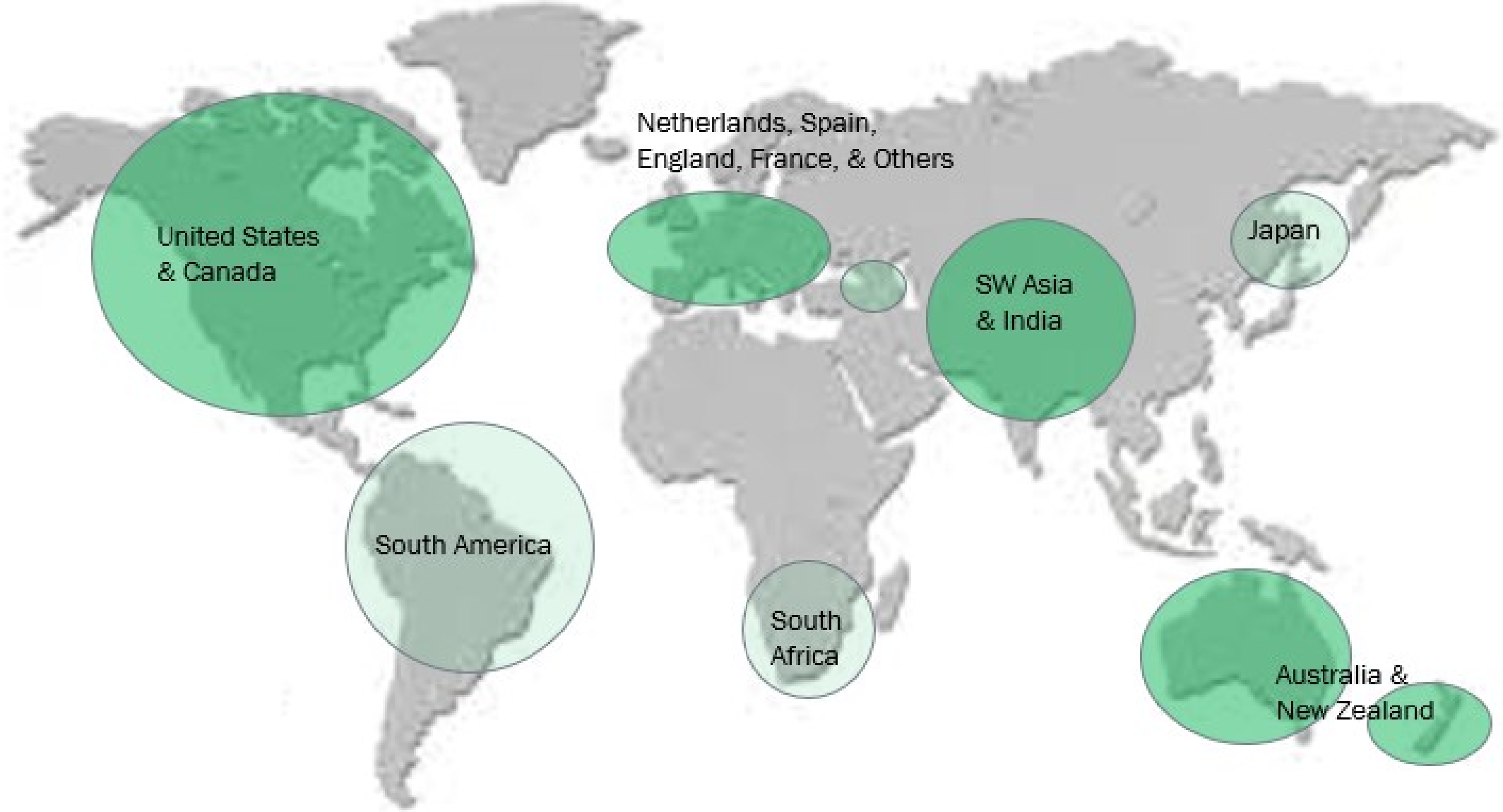
State of the Dam Safety Industry

What Shapes Dam Safety Programs?

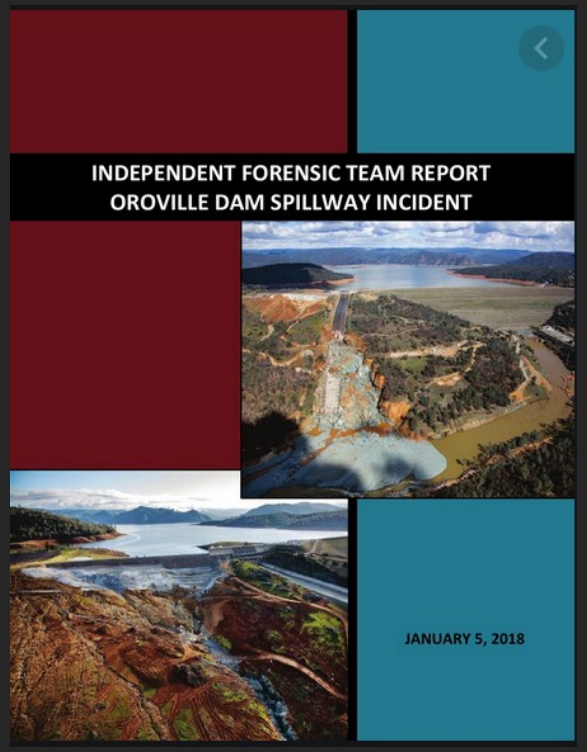
Safety Programs Constraints:

- Legislation and Regulations
- Technical Policies
- Funding
- *State of the Practice*

Places Where Risk Informed Safety Programs are the State of the Practice



What Industry Will Extract from the IFT Report



Change

- The “no fail” branch in some event trees can transition to failure in other failure modes*
- Large Damage States are Impactful and can transfer risk within a system*.

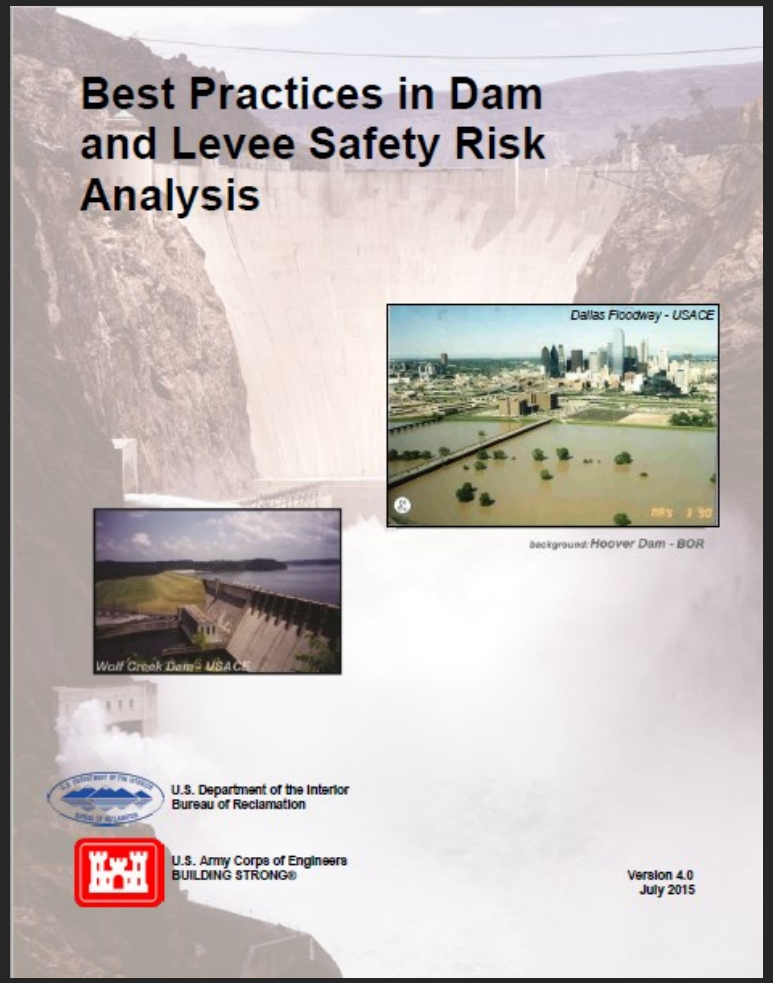
Sustain

- Independent Review and Challenge of Past Assessments is Necessary
  - Debate is Encouraged
  - Failure and Incident Rates are Extremely Low, But Industry Always Learns From Them
- Considerations of Systems and Human Factors Is Consistent with (and already a part of) Risk Informed Practice*

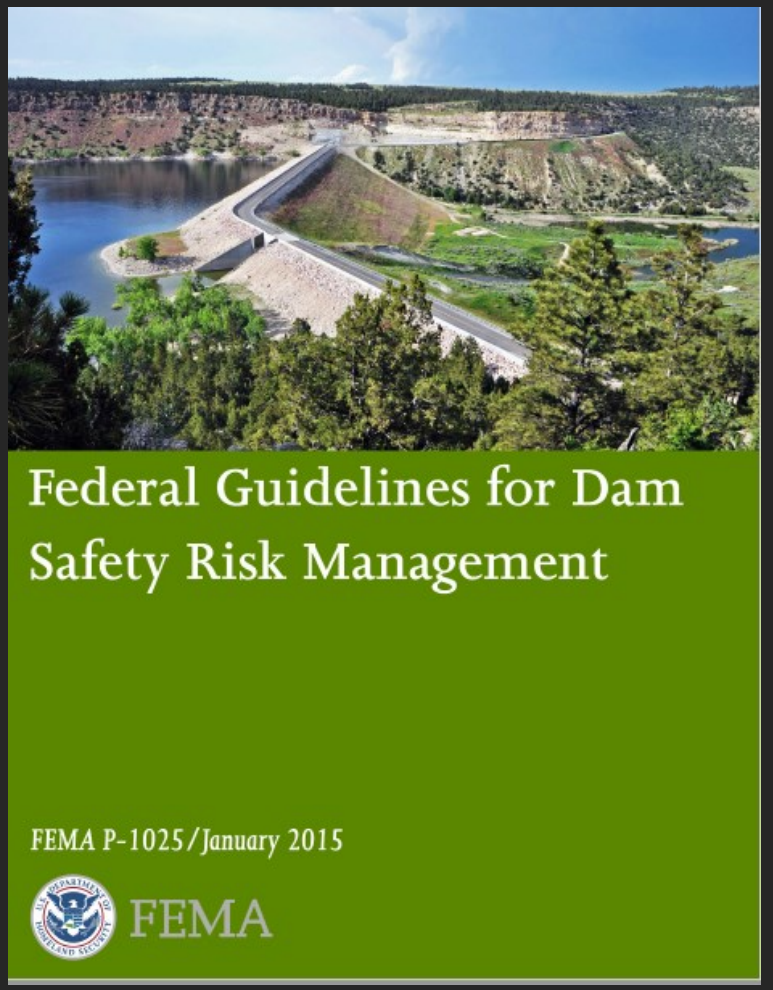
* Part of the Federal Risk Review Effort

Key Technical References for Modern Dam Safety Programs

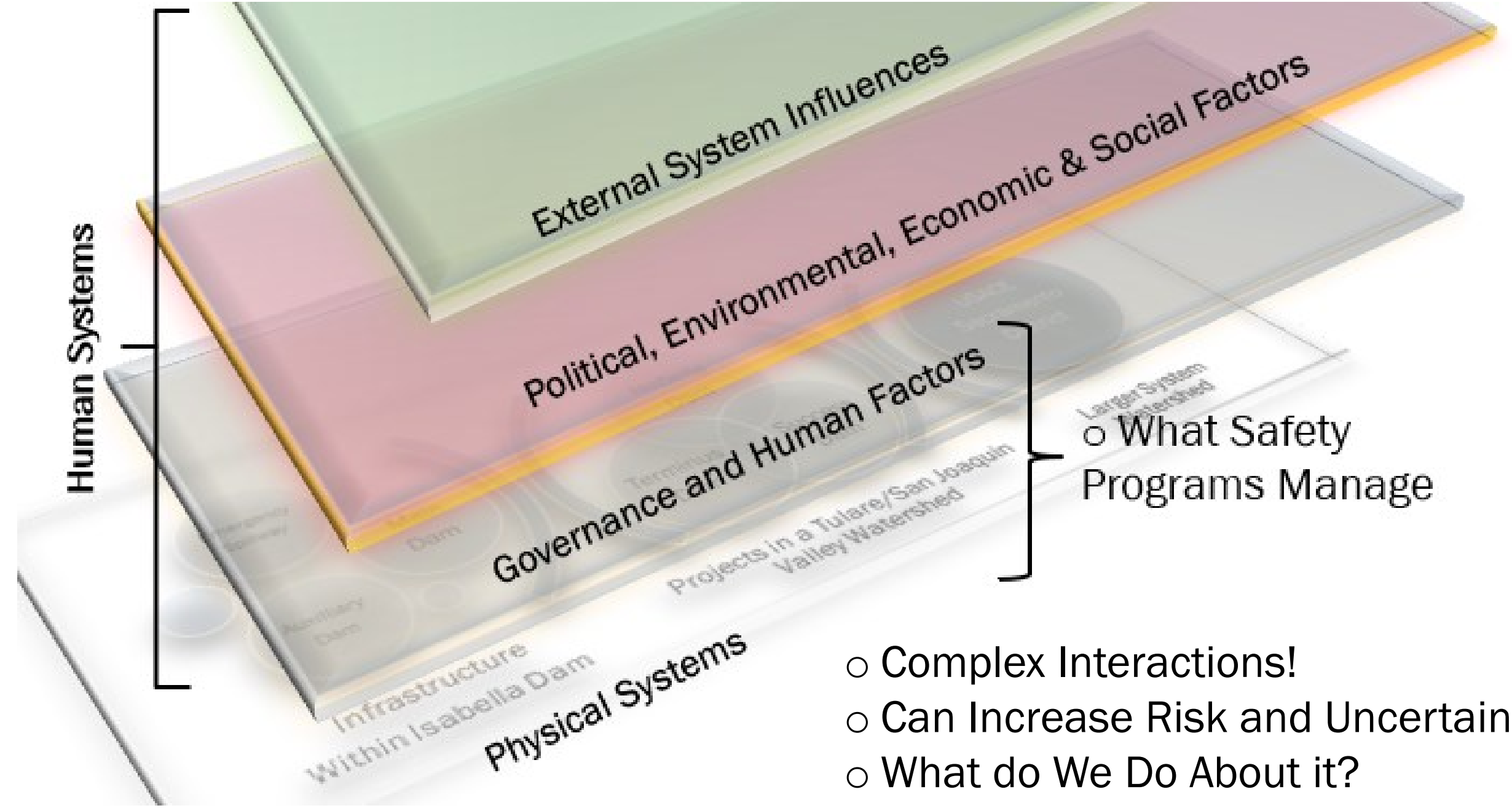
- Guidance documents are the backbone to use of Risk in Dam Safety
- Scalable, but Consistent
- Adaptable, but Equitable
- Employed Broadly in National and International Programs



Assessment



Management & Communication



- Complex Interactions!
- Can Increase Risk and Uncertainty
- What do We Do About it?

How Risk Informed Safety Programs Address Complexities

- Coincident Loadings
- Systems Operations
- Breach & Non-Breach Risks
- Gate Reliability
- Time Dependent Reliability
- Length Effects
- Regional Events

How Risk Informed Safety Programs Address Human Factors

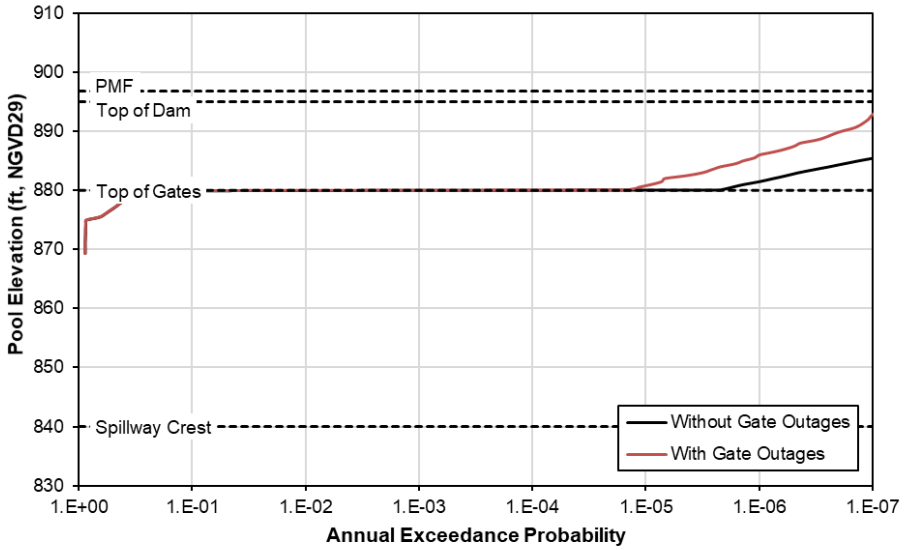
Reliability Analyses in Hydrologic Loading

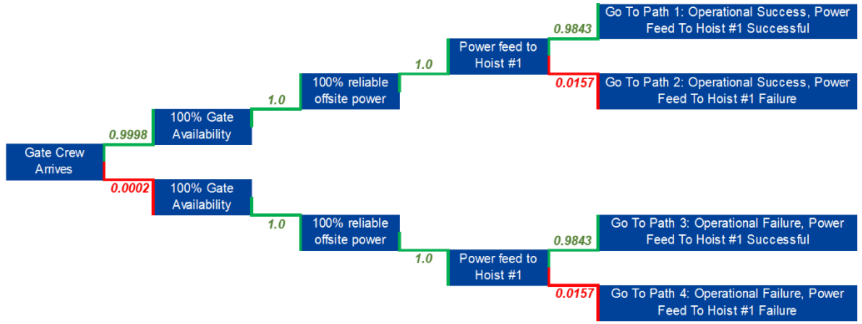
Detection and Intervention Impacts in Fragilities

Remote Operations

Issuance of Warning

Evacuation Effectiveness





Gate Reliability Considerations:

- Remote Operations
- Site Access
- Crew Availability
- Gate Functionality
- Offsite Power Reliability
- Backup Power Reliability

Can Have 1-3 Orders of Magnitude in Effect on AEP of Design Loads (headwater)

Key Mitigating Measures for Human Factors

- Command and Control for Incident Decision Making
- Risk Informed Safety Programs
- Effective Communications and Public Awareness
- Collaboration with Key Stakeholders
- Training and Exercises
- Continuing and Periodic Evaluations
- Qualification Based Roles and Responsibilities

Looking Forward: Trends, Challenges, and Opportunities

The State of the Dam Safety Industry

Risk Directions

Risk Informed Decision Making Continues to Undergo Adaptive Management

Extreme Events

Understanding their Severity and Likelihood

Industry Bench

Building Capabilities to Support the Action

Systems and Human Factors

Recognizing and Considering Complexity

Governance

Modernizing Approach to People, Decision Processes, and Policies

Common Themes from Complex Incidents

Keep Improving

Sustain Independent Thought

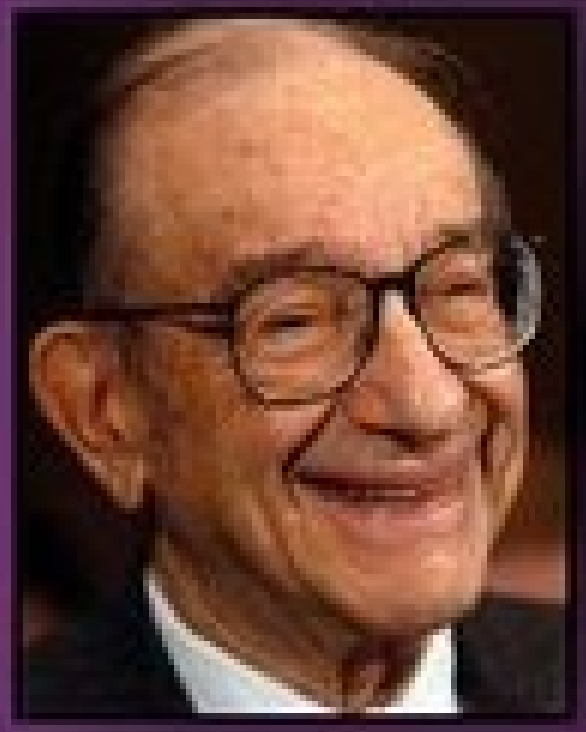
We Need to Be Better Communicators

It’s Rarely About the Numbers

There’s a Reason It’s Called Civil Engineering

Challenges for Our Industry

- Simplifying Assumptions about System Interactions and Human Factors are Necessary and Appropriate
- Don’t Forsake the Governance Lessons that Have Served Us Well: Safety Programs
- Can We *Not* Afford to Implement Risk Concepts in Safety Programs?



"Most of the negatives in housing are probably behind us. The fourth quarter should be reasonably good, certainly better than the third quarter."

Alan Greenspan

Overconfidence Bias

Contoso
Suites

“TRUST IS A RISK THAT MASQUERADES AS A PROMISE.”

Halpin Consultants LLC

Thank You

Eric Halpin

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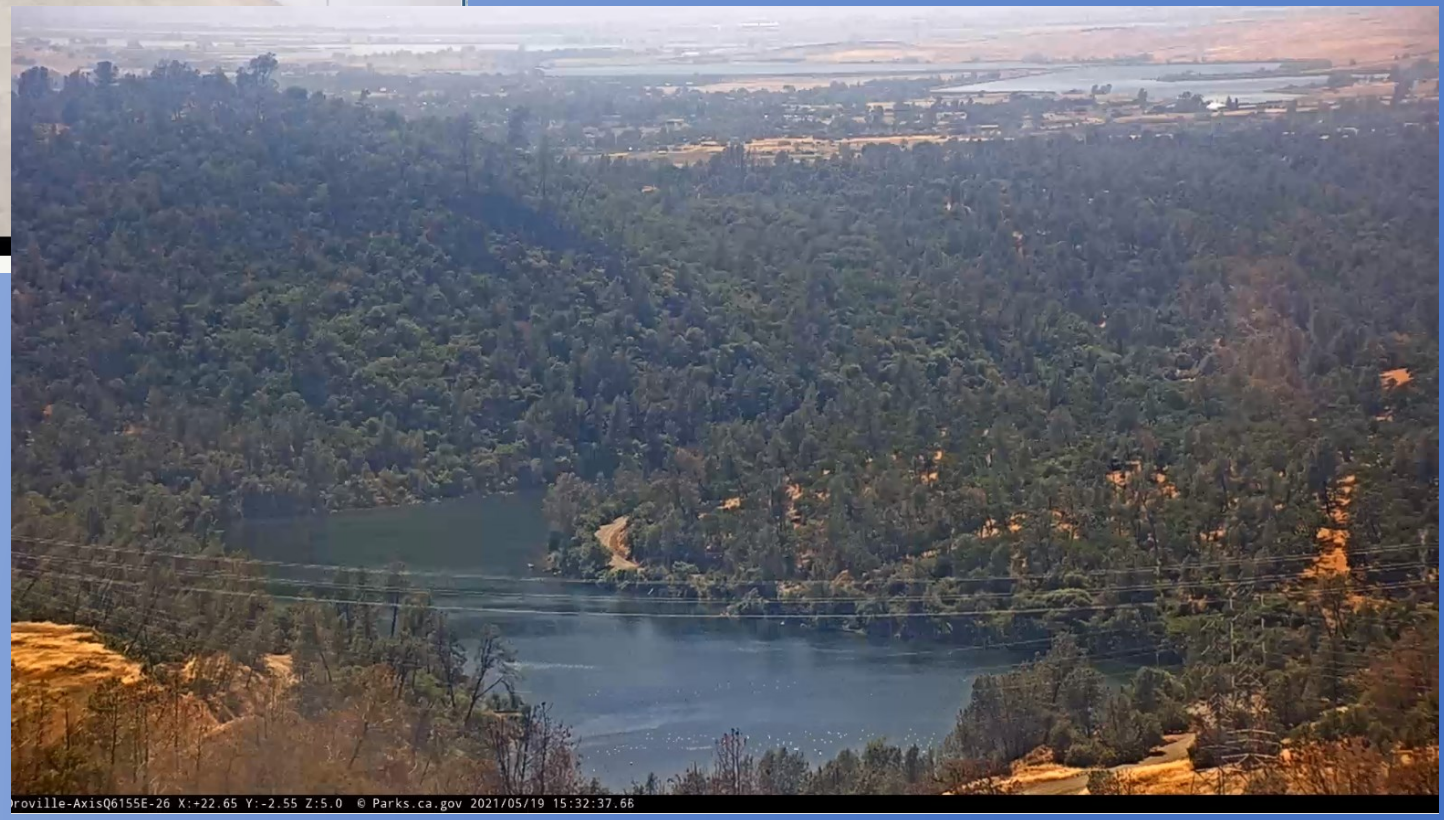
ITEM 6:
SPILLWAY CAMERAS

Oroville Spillway WebCam

Oroville Citizen's
Advisory Commission

May 28, 2021

John Yarbrough



Webcam view of Thermalito Diversion Pool and Forebay (in distance)

Webcam view of
Lake Oroville

Webcam view of Lake Oroville
(looking toward Spillway Boat Ramp Cove)

ITEM 7:
PUBLIC COMMENT

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

We appreciate your input.

ITEM 8: ADJOURN

Thank you all for joining us today, our next Oroville Dam Citizens Advisory Commission meeting will be on August 27, 2021.

CALIFORNIA natural resources AGENCY