

Hyrum Dam 2023 Emergency Response

National Dam Safety Program Technical Seminar | February 13, 2024



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RECLAMATION

Hyrum Dam

- Located on Little Bear River near Logan, Utah
- Provides Irrigation Water and Recreation
- Completed 1935
- Transferred Facility – South Cache Water Users Association



Hyrum Dam (1)



Existing Spillway

Key Features:

- Trapezoidal Chute (~1,100 feet)
- (3) 16 x 12.5-foot Radial Gates
- Crest Elevation – 4660 feet
- TOA Elevation – 4672.5 feet
- Discharge Capacity ~9,000 cfs



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Existing Spillway Deficiencies

- Foundation
- Spillway Chute
- Stilling Basin
- Crest Structure



Foundation Deficiencies

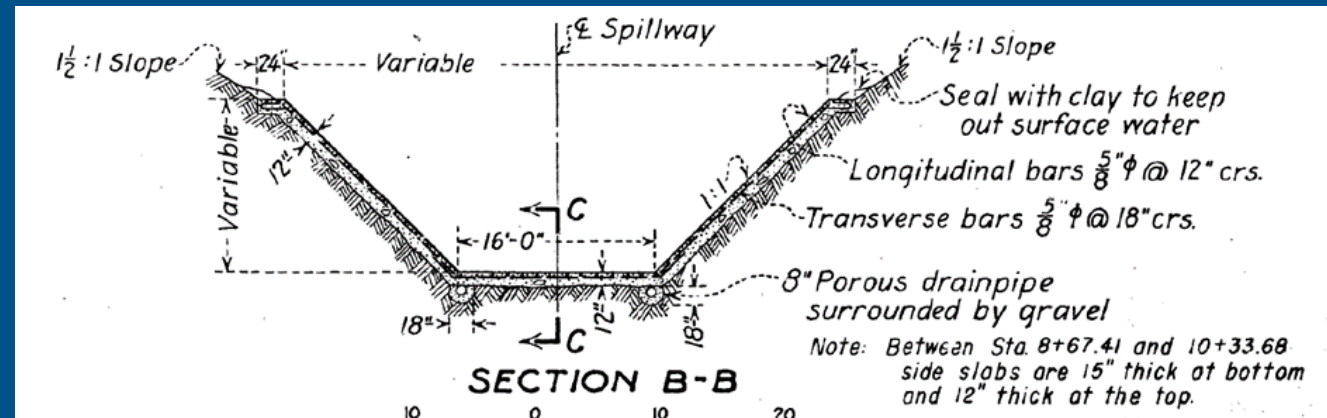
- Material
 - Low Strength
 - Erosive
- Voids Under/Behind Spillway



Spillway Chute Deficiencies



- No Defensive Measures
 - No Waterstops
 - Large Offsets
 - No Drainage Behind Walls
 - Minimal Drainage Under Slab



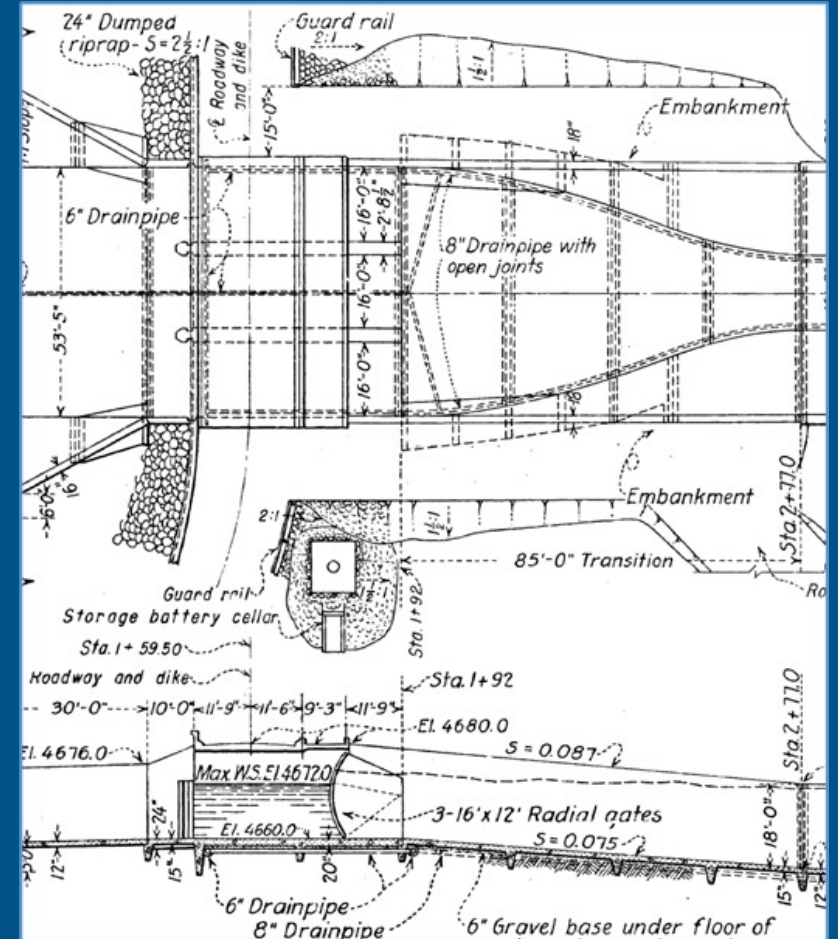
Stilling Basin Deficiencies

- Erosion in Downstream Channel
- High Exit Velocities



Crest Structure Deficiencies

- Lightly Reinforced
- Not Designed for High Seismic Loads



Existing Spillway Potential Failure Modes (PFMs)

Risk Analyses

- SE3 – Seismic failure of spillway crest structure
- H2 – Hydraulic jacking of the lower chute spillway walls
- H3 – Collapse of the upper chute slabs
- H4 – Overtopping of the spillway chute walls
- H6 – Sweepout of the stilling basin

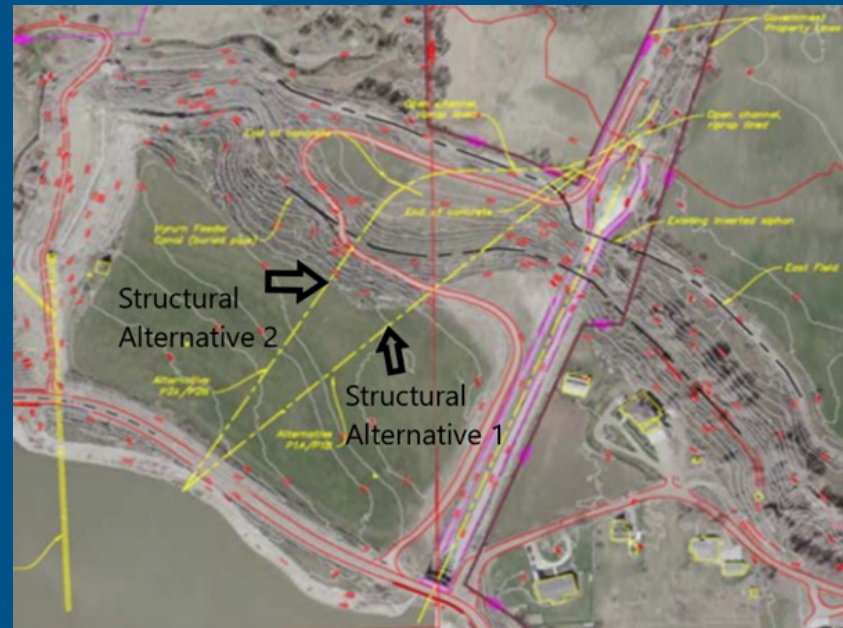
- Total risk exceeds Reclamation guidelines with increasing justification to take corrective action

Corrective Action Study (CAS)

- Dam Safety Modification Process Addressing the Hydrologic and Seismic PFMs
- Preferred Alternative – New spillway to reduce risk of hydrologic and seismic failure
- 90% Design In Progress
- 2024/2025 – Anticipated Submittal of Modification Report
- 2026/2027 – Anticipated Award Construction

Final Design Concept

- New Spillway (New Alignment)
- Foundation Treatment (Aggregate Piers)
- Key Work Restrictions (Provide for Irrigation Deliveries; Maintain Access; Short Construction Window)



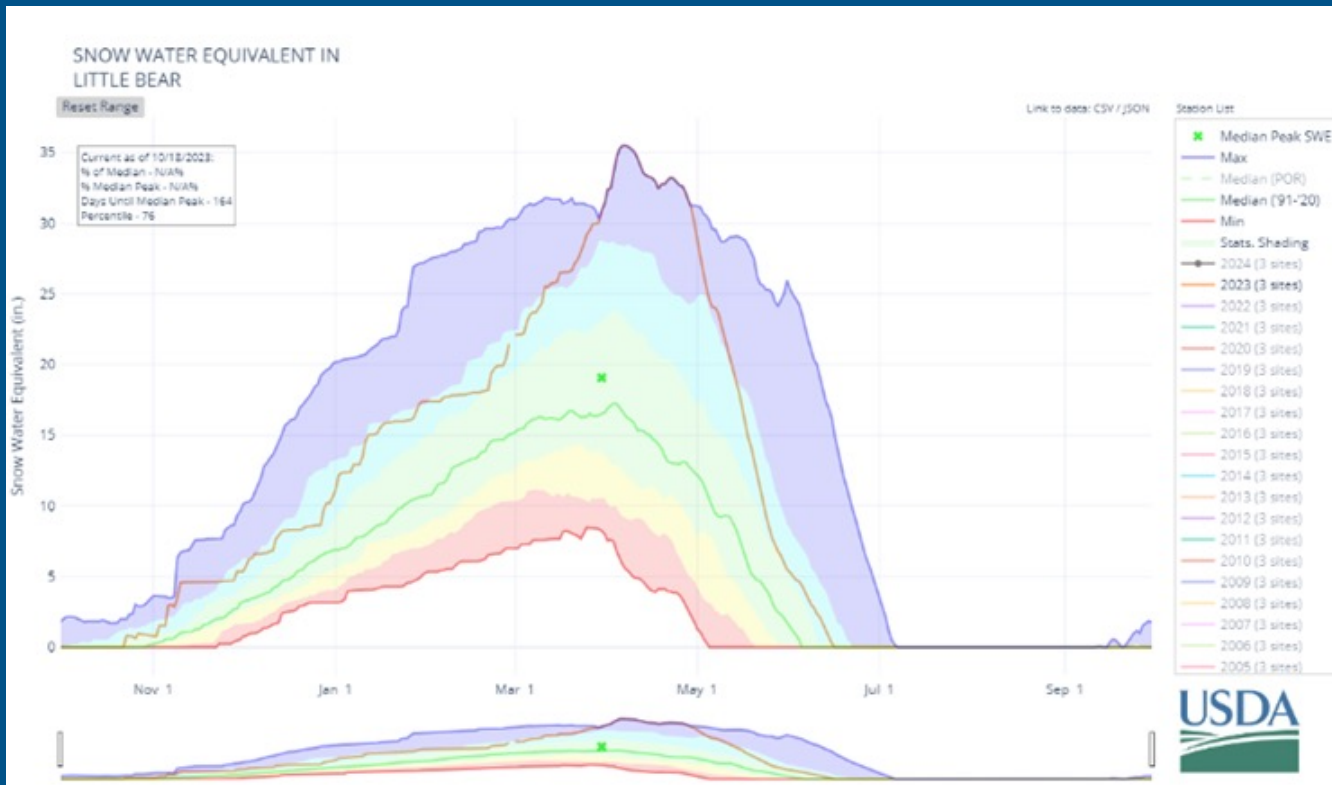
Interim Risk Reduction Measures

- 2021 – (8) IRRMs Identified and Formalized
 - Seal open joints and cracks along chute
 - GPR survey
 - Keep RWS as low as practical
 - Update monitoring schedule (L-23)
 - Add CCTV camera monitoring capabilities
 - Develop emergency response plans
 - Intervention preparedness – identify material sources
 - EAP Tabletop Exercise with focus on spillway-related PFMs



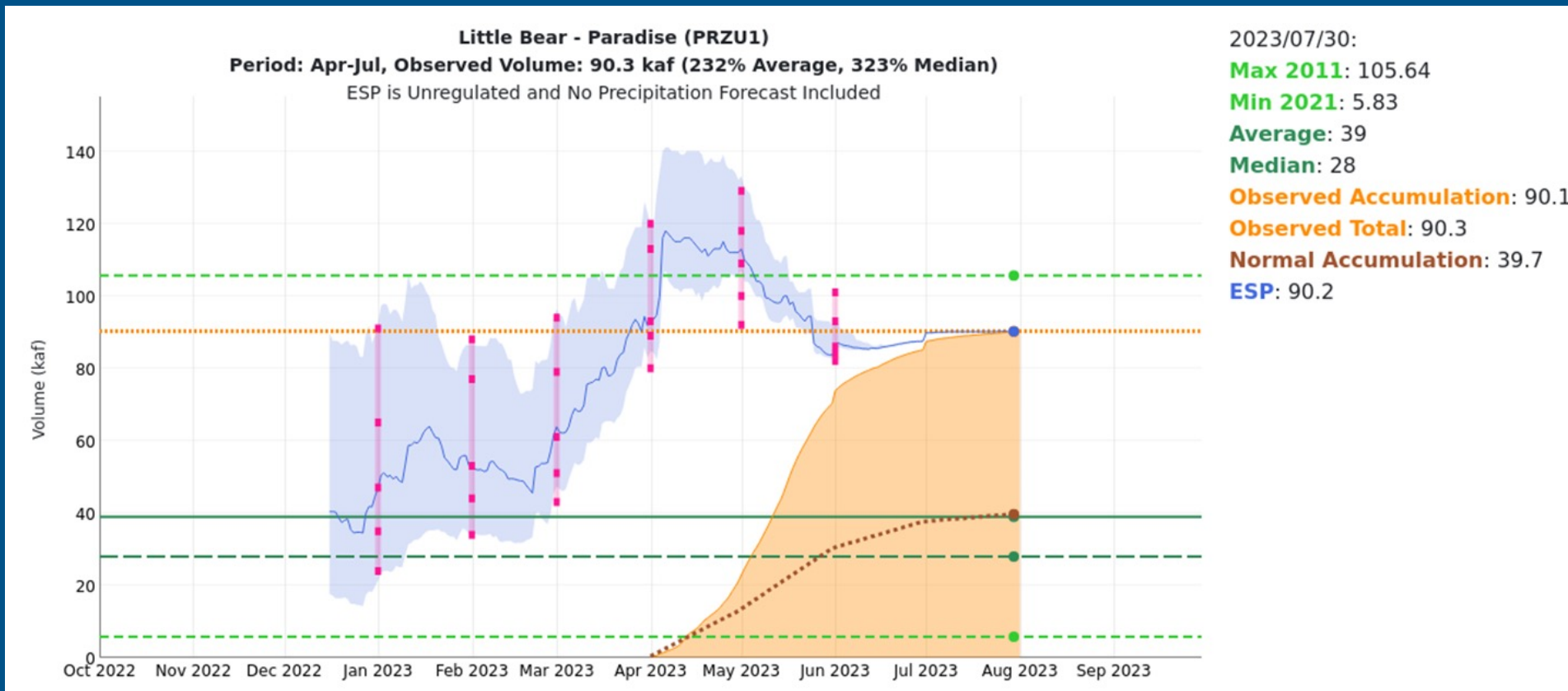
2023 Hydrology

- Record Snowpack
 - 35.5 inches SWE (19.1 inches '91 - '20 median)



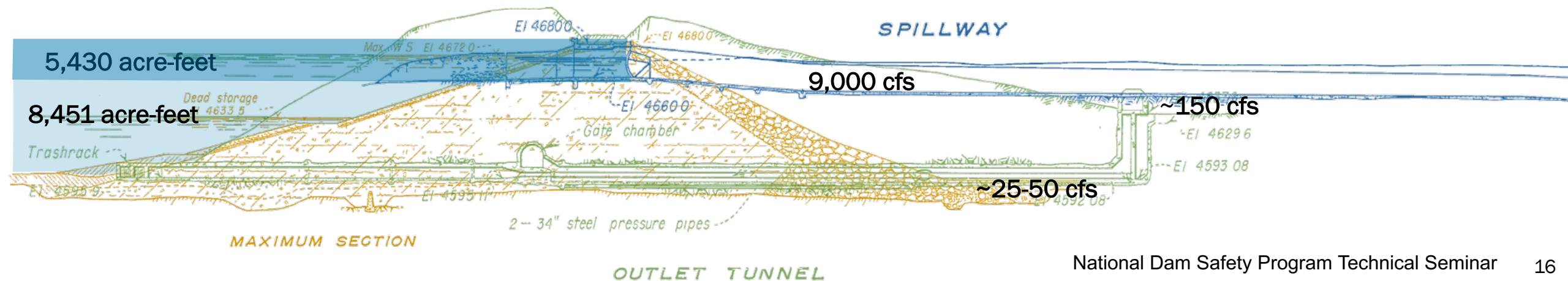
2023 Hydrology (1)

- Record Runoff Forecasted
 - 118 KAF (max forecasted vs 105 KAF – 2011 Record)



Engineering Data

- Reservoir Capacity:
 - Total: 17,746 acre-feet
 - Active: **13,881 acre-feet**
 - Active below spillway crest: **8,451 acre-feet**
- Outlet Works Capacity: 150 cfs (**25-50 cfs**)
 - Operational Reservoir Capacity: **5,430 acre-feet**
 - Limited ability to minimize spillway flows
- Annual Inflow Volume
 - Median: **51,000 acre-feet** (2010-2023)
 - 2023 Inflow Volume: **113,000 acre-feet** (ratio – 8.1)

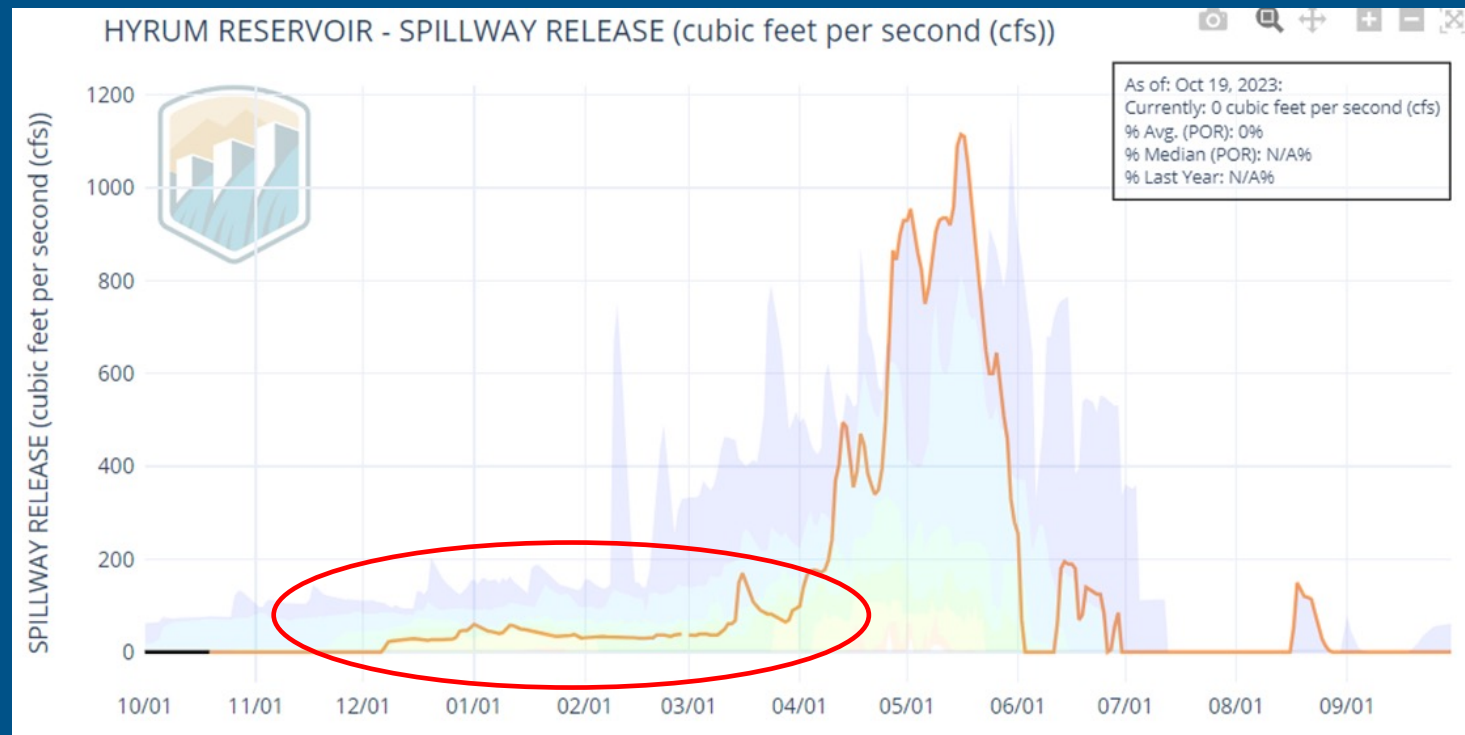


2023 Water Operations

- Observed Inflows:
 - 2023 Inflow Volume: 113,000 acre-feet
 - Peak Inflow: 1,200 cfs (May 15)
- Runoff Operational Objective
 - Kept reservoir as low as possible during runoff for:
 - Attenuating high inflows
 - Potential spillway repairs/intervention
- Spillway Releases:
 - Followed inflows – slightly attenuated
 - Peak daily avg spillway discharge: 1,100 cfs

Hyrum Spillway - Monitoring

- Dec 7, 2022 – Apr 11, 2023: Normal Operations
 - <100 cfs (111 days)
 - 100 cfs – 200 cfs (13 days)
 - 200 cfs – 400 cfs (2 days)



Hyrum Spillway – Monitoring (1)

- April 12, 2023 – Daily Monitoring Began (405 cfs)
- April 12 – April 27 (340 cfs – 550 cfs)



**Photos April 12*

Hyrum Spillway – Monitoring (2)

- April 27: 550 cfs increased to 900 cfs



Hyrum Spillway – Monitoring (3)

- April 27: 550 cfs increased to 900 cfs



4/27/2023 900 cfs

Hyrum Dam EAP Activation

- April 27, 2023
 - Hyrum Dam EAP Internal Alert declared @ 16:07 MDT
- April 28, 2023
 - Two Status Update Meetings (morning and afternoon) (DSO, TSC, PRO, Regional Office, SCWUA)
 - Incident Management Team formally established
 - Dam Safety Emergency Level 1 NON- Failure declared @ 17:04 MDT

Hyrum Spillway – 24-Hour Monitoring

- April 27 – May 30
- April 27: Hyrum Dam EAP Training (Monitoring Team)



Hyrum Spillway – 24-Hour Monitoring (1)

- Portable Camera Trailer



Hyrum Dam EAP Activation (1)

Downstream Impacts

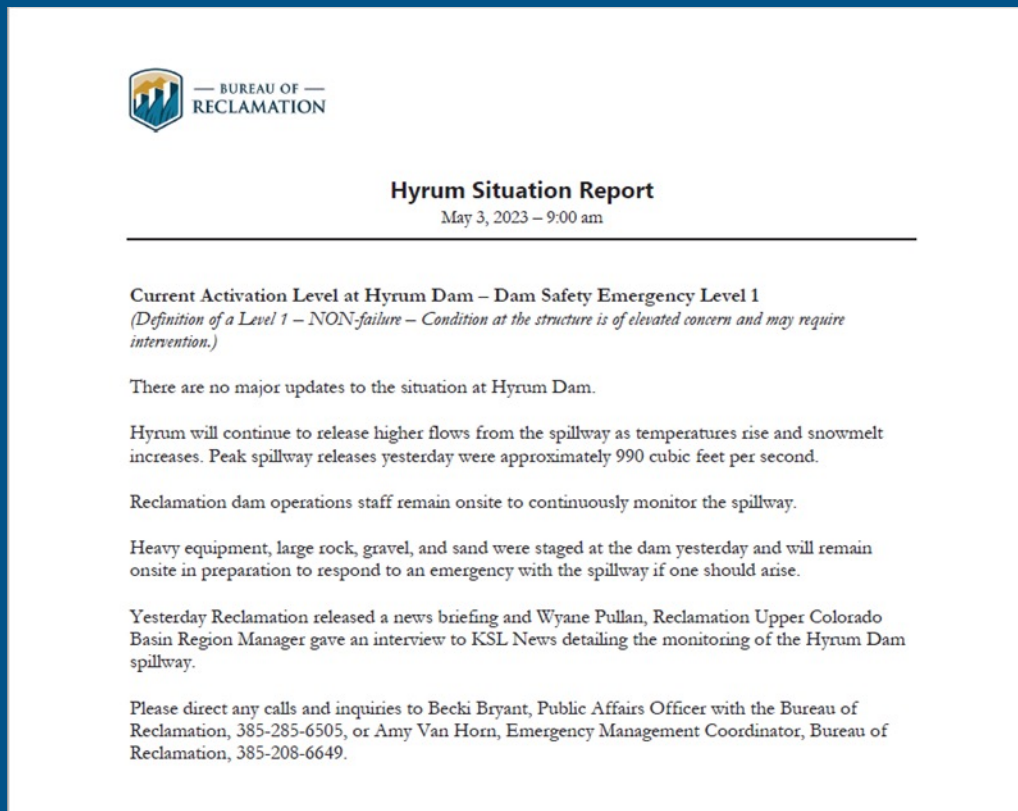
- Safe Channel Capacity – 1,300 cfs



April 28 (~ 900 cfs)

Emergency Management Activities

- Daily IMT Operation Briefings
- Daily Situation Reports



Internal and External Contacts on
Hyrum Dam EAP Notification Chart

Communication with State of Utah
Dam Safety Officials

Dam Safety Office Decisions

- April 28, 2023 – Secure Funds to Support the Emergency Response
 - Intervention – Material; Heavy Equipment
 - Monitoring
- April 30, 2023 – Call for Convening of Technical Response Team (TRT)
 - TSC, DSO, Regional Office, Area Office, SCWUA
 - Review and provide Recommendations on Spillway Performance/Observations; PFMs; Intervention alternatives
 - First TRT Meeting – May 1, 2023

Technical Response Team (TRT) Meetings

- 7 TRT Meetings
- Technical Discussions
 - Hydraulic Pressures behind the Walls
 - Gate closure rates
- Intervention Options
 - Additional Material Purchases
 - Pumping
- Investigation Activities
 - How much flow through the Drains
 - Sediment Transport?
 - Dye Testing



Intervention Preparation

- Fill hole(s) in spillway
 - Riprap: 2- to 6-ft diameter (736 tons)
- Fill voids under spillway
 - Sand: C33 (133 tons)
 - Gravel: ¾" minus (235 tons)
- Grouted/concreted riprap
 - UDOT Rapid Strength Concrete (4000 psi @ 4 hrs)
- Repair concrete spalls
 - Phocrete VO (vertical and overhead)



Intervention Preparation (1)

- Span uneven flow surfaces to minimize erosion
 - Plywood: 5/8" sheets (with anchors)

Heavy Equipment

- Cat D6 Dozer
- Cat 320 Excavator
- Cat 966 Wheel Loader



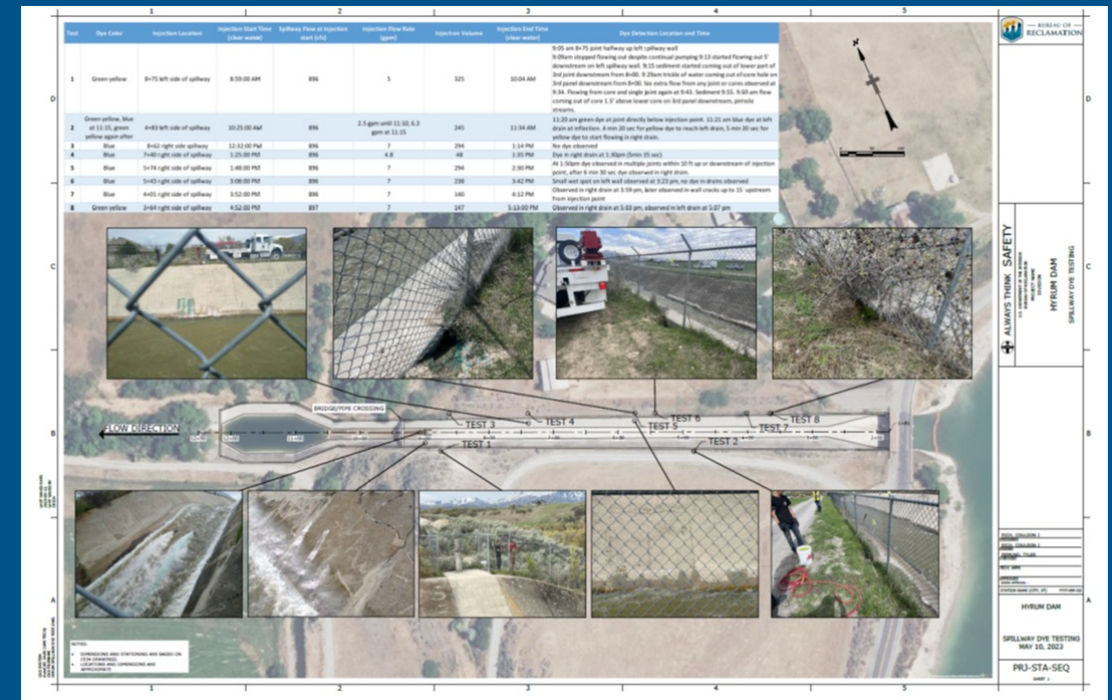
Public Relations

- Public Information Officer (PIO)
- Highly Visible Activities – Media Outreach
- Questions from individual property owners
- Managing Misinformation



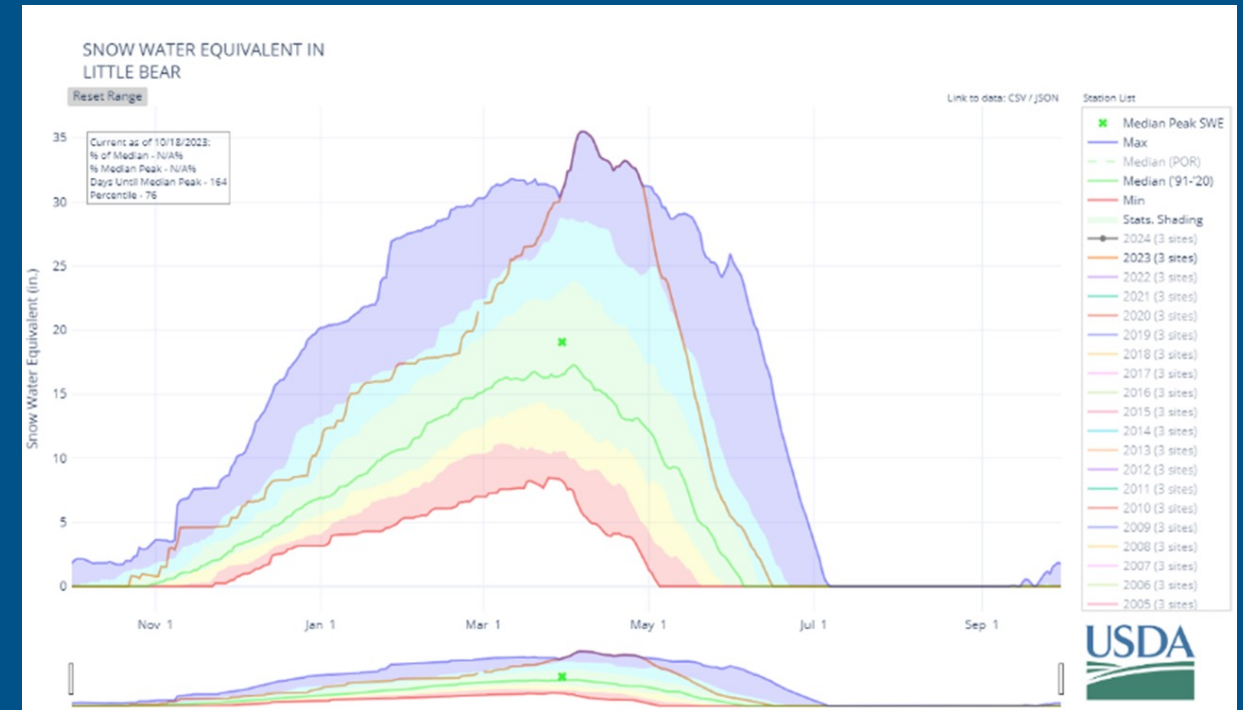
Hyrum Spillway – Onsite Activities

- May 4 – Outlet Works Bypass Opened (~40-50 cfs)
- May 10 – Dye Testing
- May 25 – Brief gate closure, inspection



Late May Hydrology, Operations

- Favorable weather for Hyrum Response
- Snow Nearly Melted Out, Inflows Dropping
- May 25, 2023 – Irrigation Deliveries Begin
- June 3, 2023 – Spillway Gates Closed

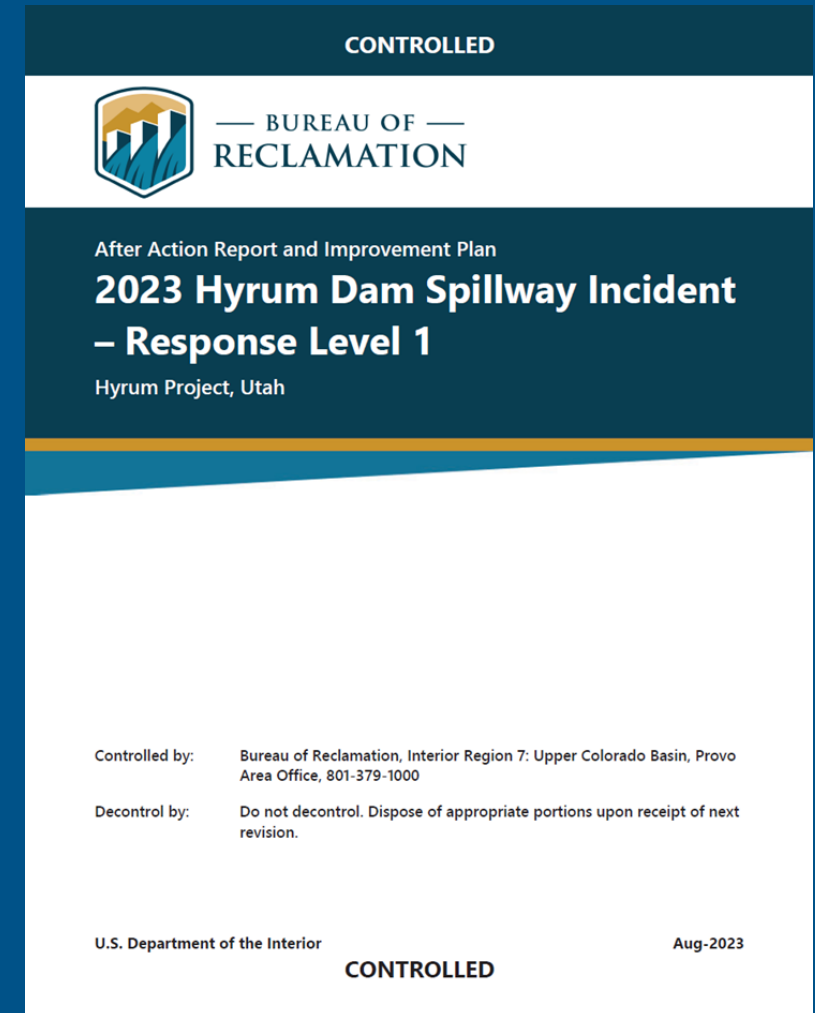


Hyrum Dam EAP Response Termination

- May 26, 2023
 - Downgraded Emergency Level 1 to Emergency Level 0 (Internal Alert)
- June 5, 2023
 - Terminated Emergency Level 0 (Internal Alert)

After Action Report & Improvement Plan

- Hotwash – July 7, 2023
- Per Directives and Standards EMG 02-01
- Report documenting a planned event (e.g., exercise) or incident which explains why and how the EAP was exercised or activated
- Describes the event or incident and actions taken; identifies strengths, deficiencies, and recommended corrective actions



Dam Safety Decisions

- Prepare for next runoff
 - Review current IRRMs and explore any new IRRMs
 - Proposed IRRMs (In Progress – objective to keep as much water as possible out of spillway)
 - Bypass piping in the spillway chute
 - Outlet Works Bypass Modification to increase capacity, improve operational flexibility



Questions?



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