

Reservoir Slope Stability, Vegetation Management, and Dam Material Sources

May 7, 2014

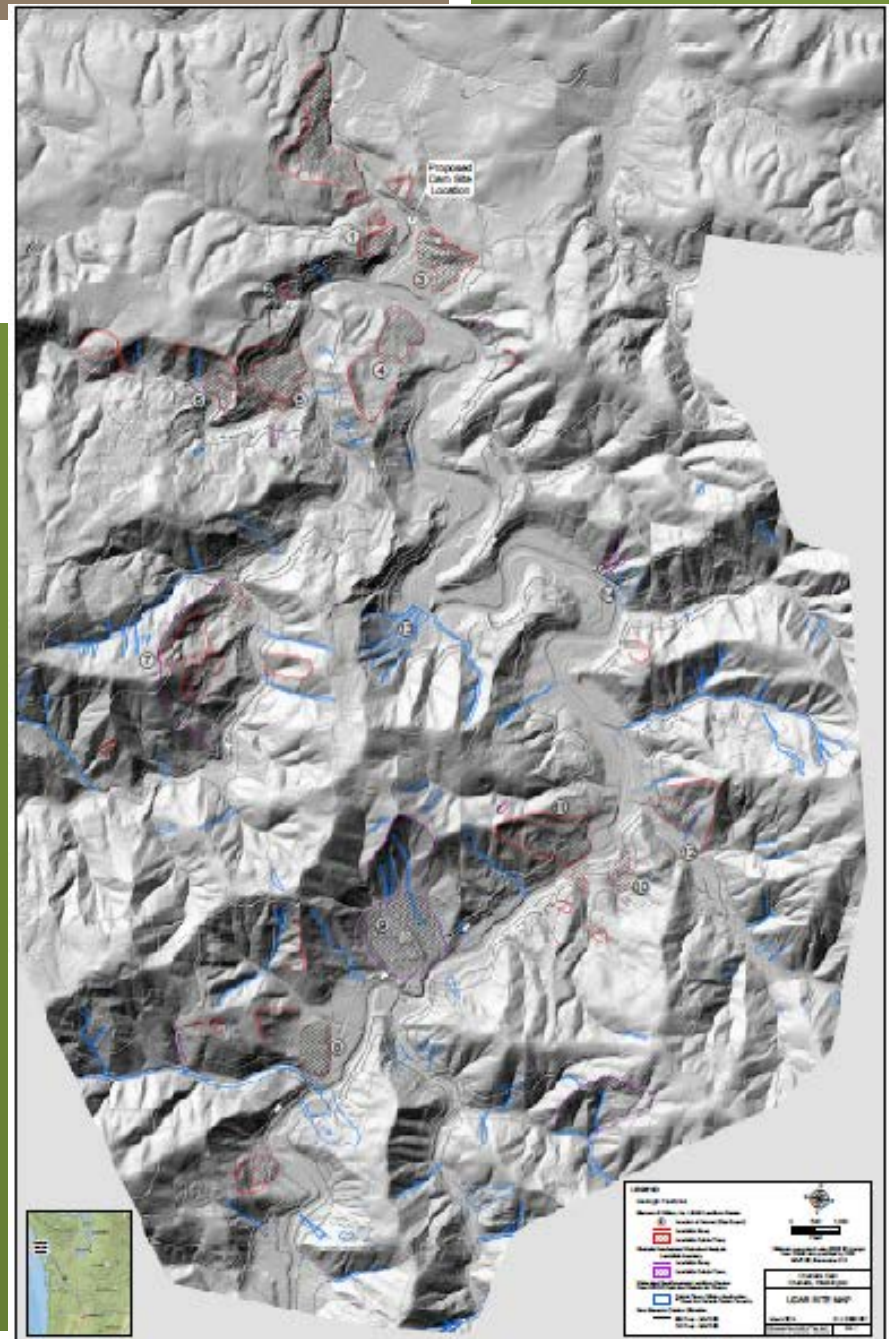


Outline

- Reservoir Slope Stability
- Reservoir Vegetation, Debris, and Sediment Management
- Dam Material Sources

Reservoir Slope Stability

- Watershed GeoDynamics: Geomorphology study, estimates of sediment delivery to river from landslides
- Shannon & Wilson: Characterization of large landslides



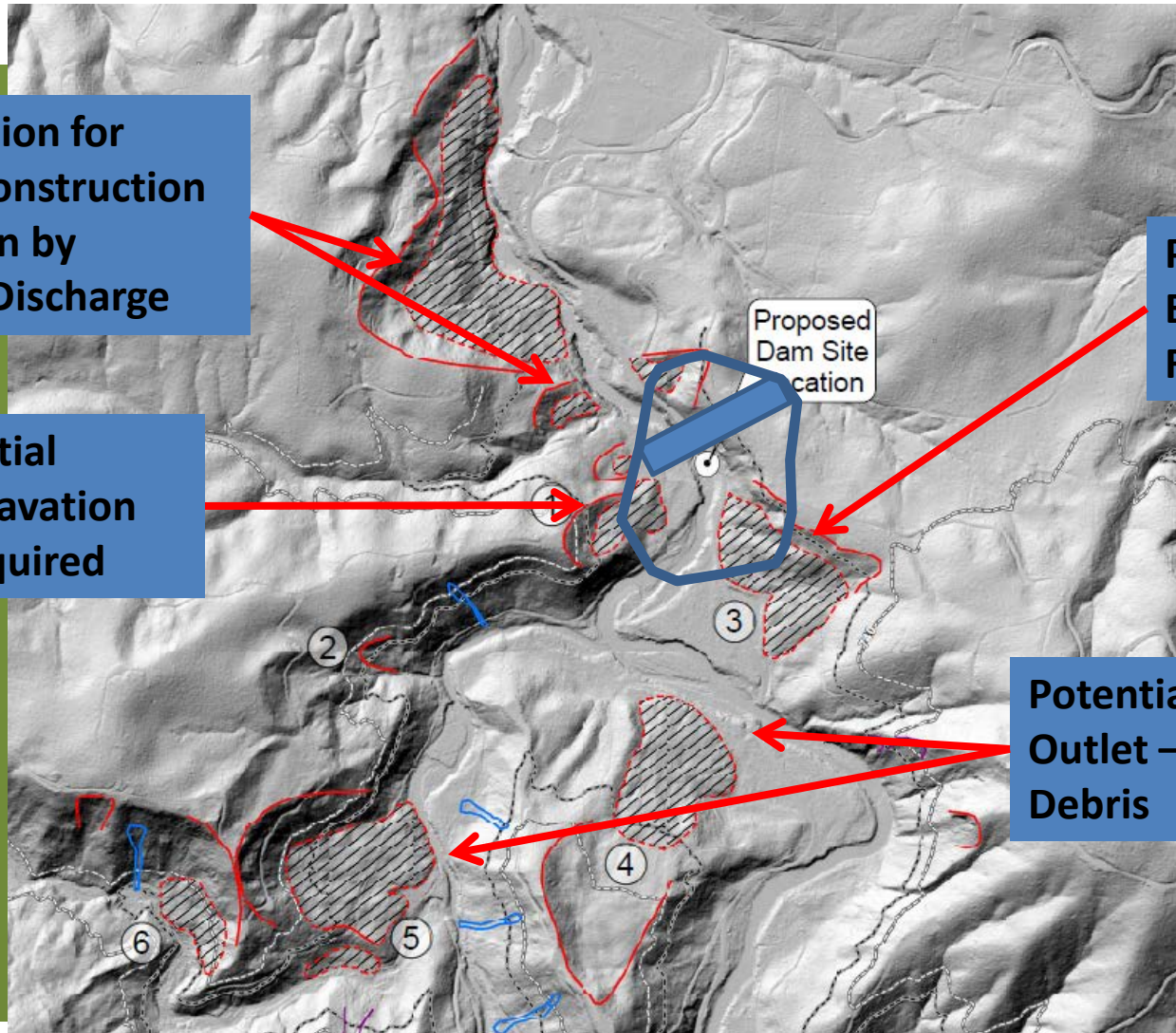
LANDSLIDES – at Dam Site

**Consideration for
Spillway Construction
and Erosion by
Reservoir Discharge**

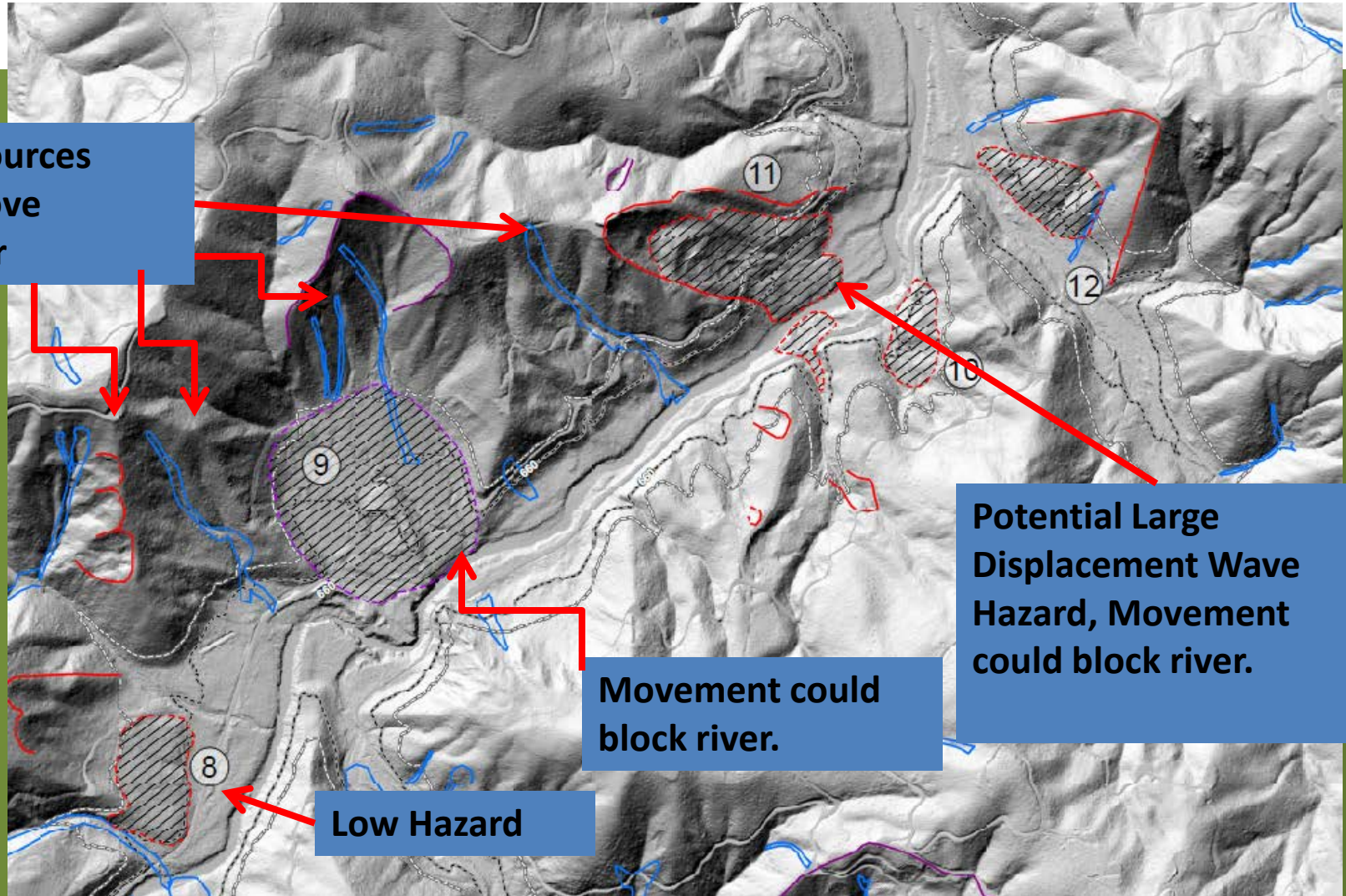
**Partial
Excavation
Required**

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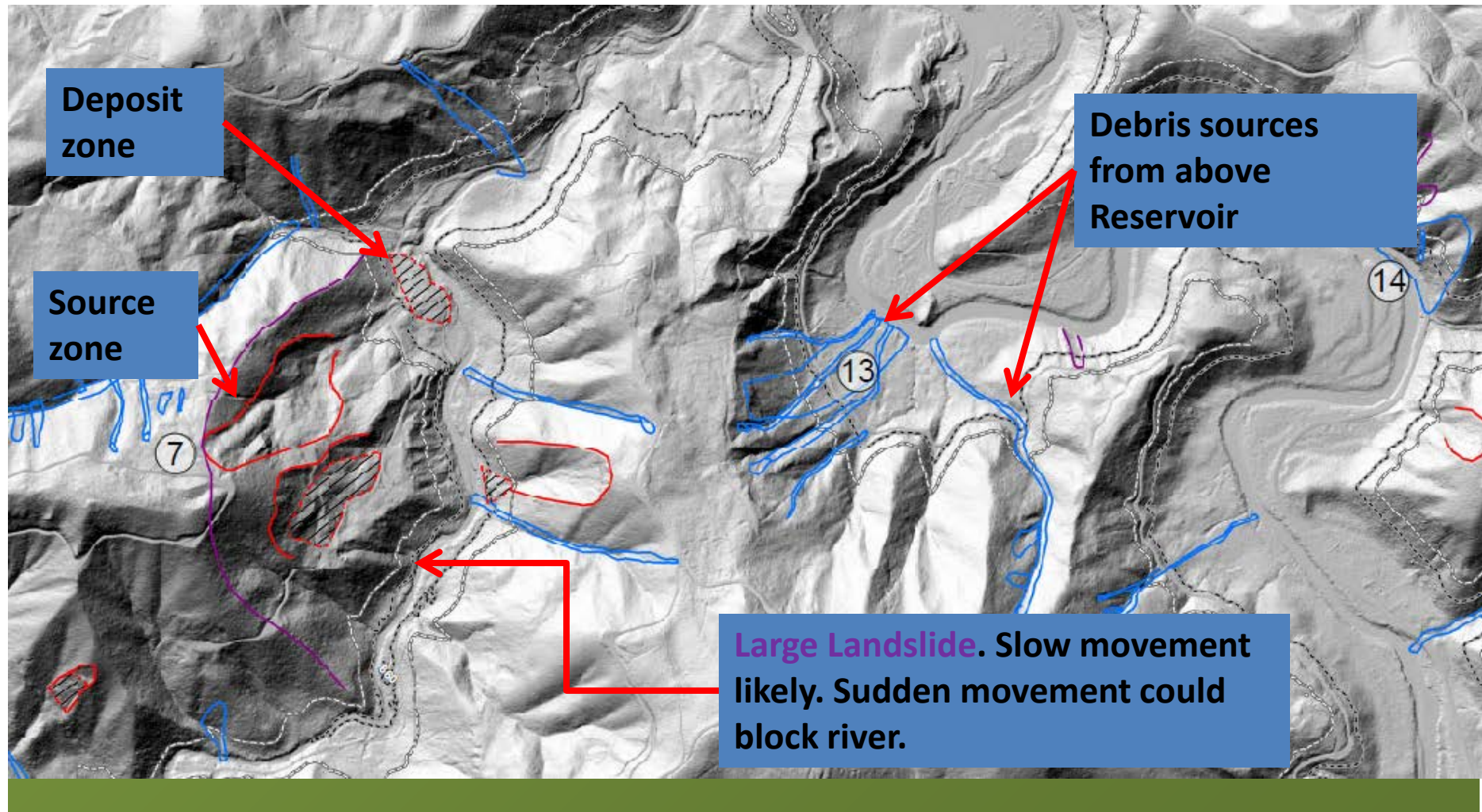
**Potential Hazard to
Outlet – Plugging,
Debris**



LANDSLIDES – in Reservoir



LANDSLIDES – in Reservoir



Reservoir Vegetation, Debris, and Sediment Management

- USACE – Seattle and Portland Districts
- Site Visit – Mud Mountain (MMD) and Howard Hanson (HHD)

Mud Mountain Dam

- MMD is a flood control only
- Pool only during flood events
- Few occurrences of high temporary reservoir pool elevations
- Never overtopped spillway

Mud Mountain Dam - Vegetation

- Most of the reservoir is vegetated
- Willow shrub land on the lower slopes
 - Flooded ~ 3 times / year
- Deciduous species on mid slopes
 - Flooded ~ 1 to 2 times / year
- Conifer forest on the highest slopes

Mud Mountain Dam – Vegetation Mgt



Mud Mountain Dam – Vegetation Mgt

- Initially logged; little vegetation management
- Vegetation and trees not cut or removed
- Log storage areas are cleared
- During flood LWD (from upstream sources) can be backed up for miles
- Floating booms to collect LWD
- Let LWD pass through outlet if possible
- 18 inch opening on bar rack

Mud Mountain Dam – Debris Mgt



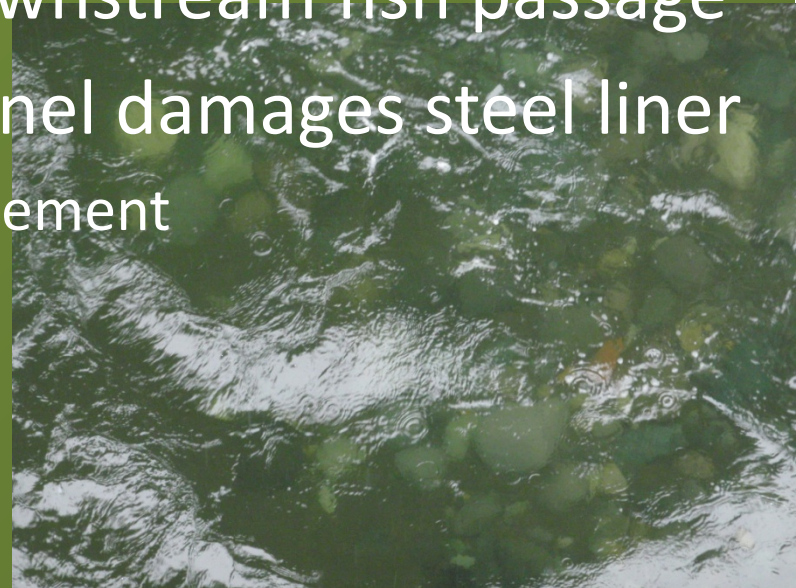
Log boom

Mud Mountain Dam – Debris Mgt

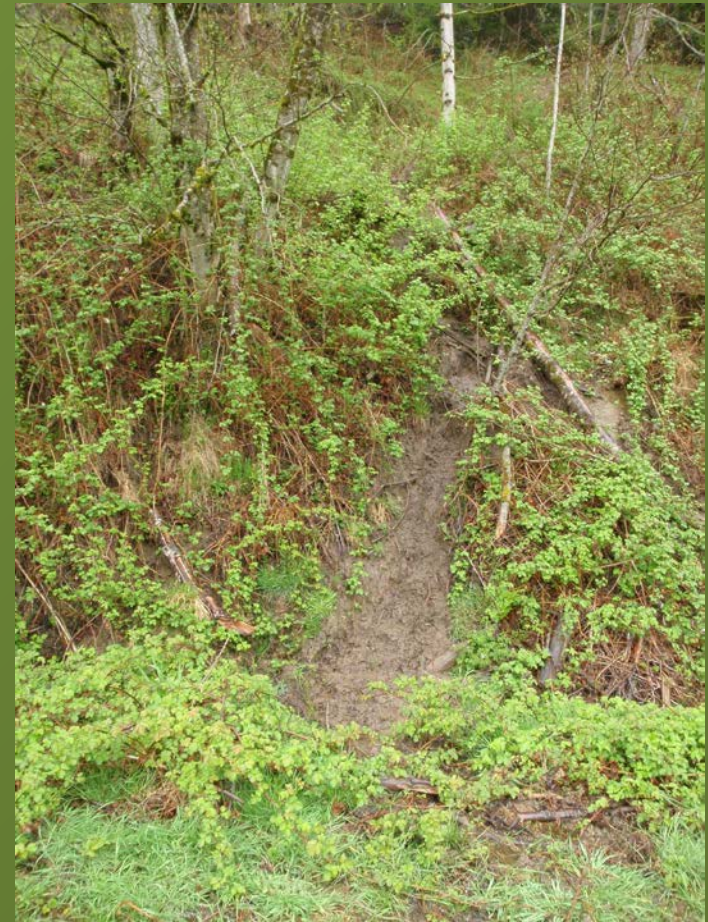
- Lowering pool may be delayed for days or weeks following flood events that deliver large amounts of LWD
- LWD is made available to various stakeholders
- Excess LWD temporarily stored in reservoir
- Use boats to gather and haul LWD to storage areas
- USACE developing management plan to address LWD management, including disposal

Mud Mountain Dam – Sediment Mgt

- Soil, gravel, cobbles, and boulders flushed through low elevation tunnel through dam
- Recently, USACE passing additional flow through higher tunnel to facilitate downstream fish passage
- Material carried through tunnel damages steel liner
 - Liner replaced and due for replacement
 - Used to have rails in invert
 - Full steel liner now
 - Lower strength steel lasts longer



Mud Mountain Dam – Sediment Mgt



Mud Mountain Dam – Reservoir Landslides

- USACE takes no actions to prevent landslides
- Has no procedures limiting drawdown rate for potential reservoir slope instability
- Has slumping in reservoir
- Yearly reconnaissance

Mud Mountain Dam – Drawdown

- As quickly as possible
- As fast as need to get storage for next storm
- Drawdown limited by downstream flow capacity
- ~10 ft/day max rate is typical
- Drawdown may be delayed for LWD removal
- Slower drawdown now because of sediment in channel downstream

Howard Hanson Dam

- HHD is multipurpose
 - Flood
 - Summer stream augmentation
 - Ecosystem restoration
 - Drinking Water (City of Tacoma)
- Pool increase starting Feb., maintained in summer
- Never overtopped spillway

Howard Hanson Dam - Vegetation

- The reservoir has bare slopes
- Reservoir is maintained high for months
- Above maximum pool, slopes are forested
- Reservoir was likely logged during construction

Howard Hanson Dam – Vegetation and Debris Mgt

- Little vegetation management
- Vegetation and trees not cut or removed
- LWD cannot pass through the dam
- More LWD during big floods
- Floating booms to collect LWD
- Booms anchored at multiple elevations
- Use boats to gather and haul LWD to storage areas

Howard Hanson Dam – Debris Mgt

- 50% LWD reintroduced to river downstream
- Other LWD is available to various stakeholders
- Excess LWD stored in reservoir to decompose

Howard Hanson Dam – Debris Mgt



Howard Hanson Dam – Sediment Mgt

- Sediment trapped in reservoir
- Have not yet had to remove sediment to maintain pool
- No plan for dealing with sediment
- Purchase gravel, cobbles, and boulders. Place downstream on bank for river to erode
- Adaptive management approach

Howard Hanson Dam – Reservoir Landslides

- USACE takes no actions to prevent landslides
- Has no procedures limiting drawdown rate for potential reservoir slope instability
- Yearly reconnaissance
- Right abutment is a landslide deposit
 - Has been seepage problem
 - Drainage tunnel recently installed/upgraded



Howard Hanson Dam – Drawdown

- As quickly as possible
- As fast as need to get storage for next storm
- Limited by downstream flow capacity
- ~10 ft/day max rate is typical
- 13 ft/day two events
- Delayed to reduce downstream impacts and for in-reservoir debris management

MMD – HHD – Operating Costs

- \$3.5M / year operating budget
- \$150k / year LDW and gravel placement downstream of HHD
- 8 people at each dam
- Includes boats and land-based equipment

Material Sources Study

- Task is to Determine:
 - Is suitable rock within reasonable distance of dam site?
 - Ascertain rock qualities

Material Sources Study

- DNR permitted and active rock pits in hard rock in the Pe Ell/Chehalis area.
- WSDOT-owned pit information
- Other rock pits in Pe Ell/Chehalis area
- WSDOT's Aggregate Source Approval (ASA) reports
- Not yet synthesized data

Grande Ronde Basalt

- Grande Ronde Basalt is major formation near site
- Suitable rock for RCC dam
- Previously performed test results
 - LA Abrasion
 - Absorption
 - Specific Gravity.
- No test results found for alkali reactivity
 - We will perform alkali reactivity test for a source near dam

Filter Sand / Gravel

- Needed for Rock fill dam
- Sources being identified
- Glacial outwash deposit in the Chehalis/Centralia valley – potential source
- Site visits not yet performed