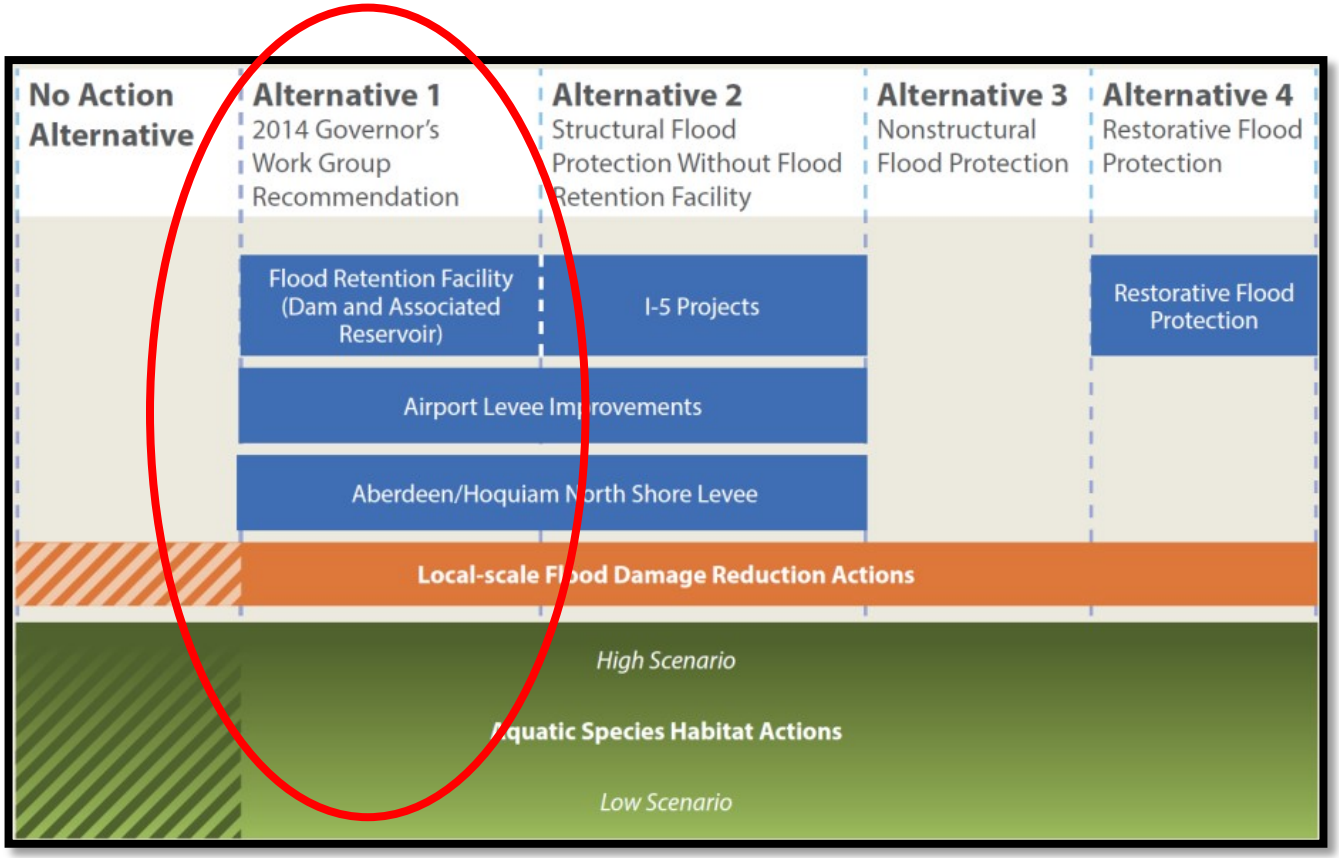
Chehalis Basin Strategy Flood Retention Dam and Airport Levee

August 3, 2017

Programmatic EIS



Airport Levee Improvements

- Will raise the existing levee around the Chehalis-Centralia Airport by 4-7 ft
- Will also raise 1,700 ft of Airport Road to meet levee elevation on south end of airport
- Will provide 100-year flood protection plus freeboard of 3 ft
- When combined with dam, will have greatest reduction in flood depth and extent in Chehalis River floodplain during major flood.

Airport Levee Improvements

Pathway for selecting Dam Site

- U.S. Army Corps of Engineers Twin Cities Project and Alternatives Study reviewed these alternatives:
  - Twin Cities Levee
  - Modifying Skookumchuck Reservoir
  - Small headwater dams at 12 locations
  - Dams upstream of Centralia-Chehalis at 5 locations
  - Other alternatives such as dredging, capacity improvements, floodplain storage areas
- Lewis County PUD and Flood Authority studies followed:
  - Reviewed sites for dams on the Newaukum River, upper Chehalis River, and South Fork Chehalis River.
  - Further review was performed for site upstream of Pe Ell on the upper Chehalis River and a site on the South Fork Chehalis River. The South Fork site was dropped because of cost and impacts to fisheries.
- Since 2013, investigations have been focused on the one site above Pe Ell on the mainstem Chehalis River.

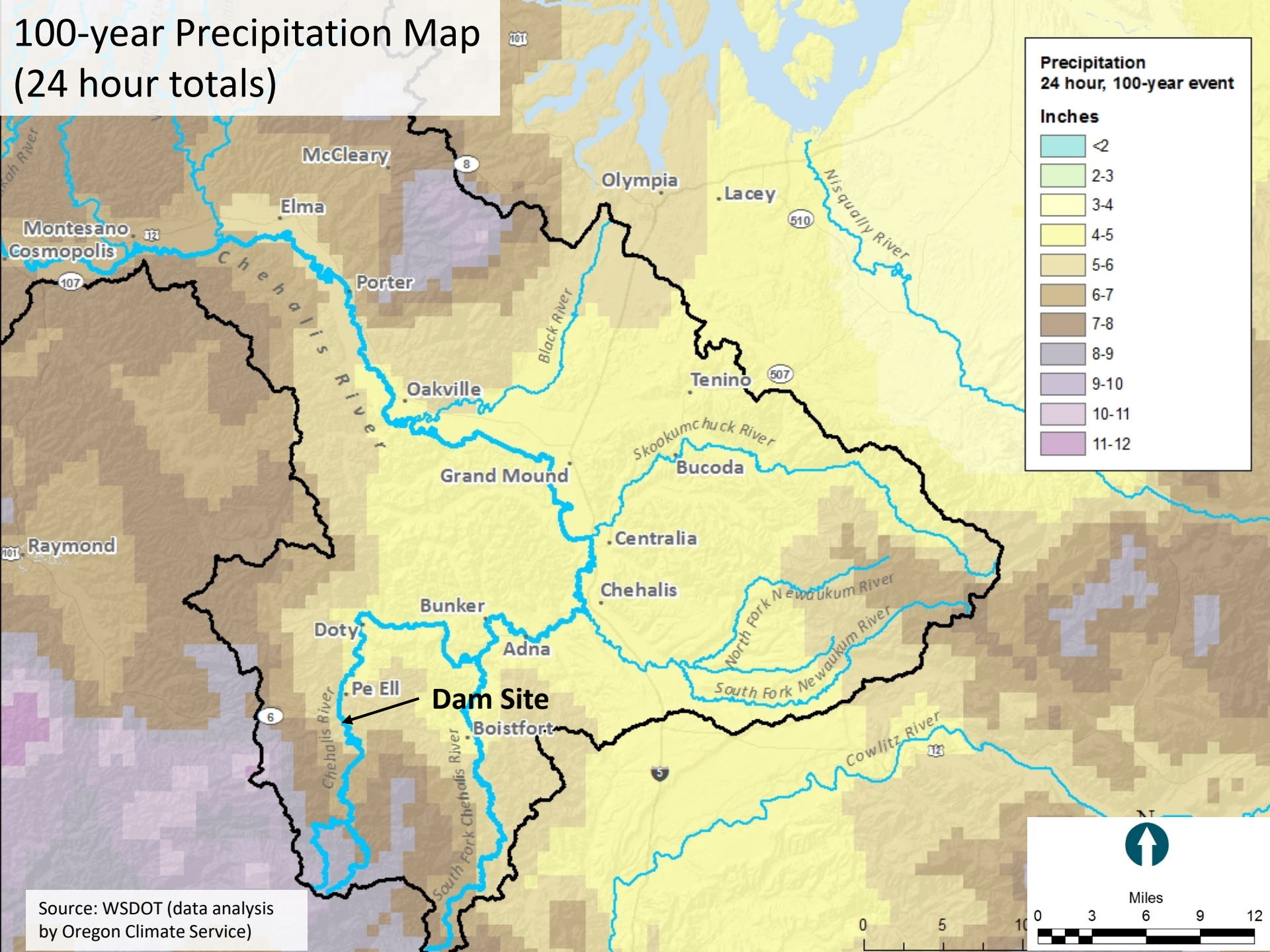
Upper Chehalis Basin Contribution to Flooding

- Atmospheric Rivers are almost always the cause of major flood events (Nieman et al. 2011)
- Heavy precipitation results when moisture source (atmospheric river) interacts with topography, greatest rainfall occurs above dam site because of Willapa Hills.
- Relative Contributions from Upper Chehalis and Cascade Tributaries for Top 10 Historical Floods (measured at Grand Mound)
  - Upper Chehalis Contribution

    Average: 66%, Range: 58% to 85%
  - Cascade Tributaries Contribution

    Average: 34%, Range: 15% to 42%

100-year Precipitation Map (24 hour totals)



Source: WSDOT (data analysis by Oregon Climate Service)

Flood Retention Dam Options

- Flood Retention Only (FRO)
  - Normally dry with 65,000 acre-feet of flood storage
- Flood Retention/Flow Augmentation (FRFA)
  - Will have a permanent reservoir pool of 65,000 acre-feet and 65,000 acre-feet of flood storage pool for total potential storage of 130,000 acre-feet
- Hybrid Dam (FRX)
  - Built to FRO size with capability to expand to FRFA size in the future
- All options will have same flood reduction benefit for current climate conditions

Peak Flow Reduction During Floods

Reservoir in use during major flood (greater than 38,700 cfs at Grand Mound) which is a 7-year flood (about 15% chance of occurrence in any year).

Chehalis River at Grand Mound Peak Flow Reduction

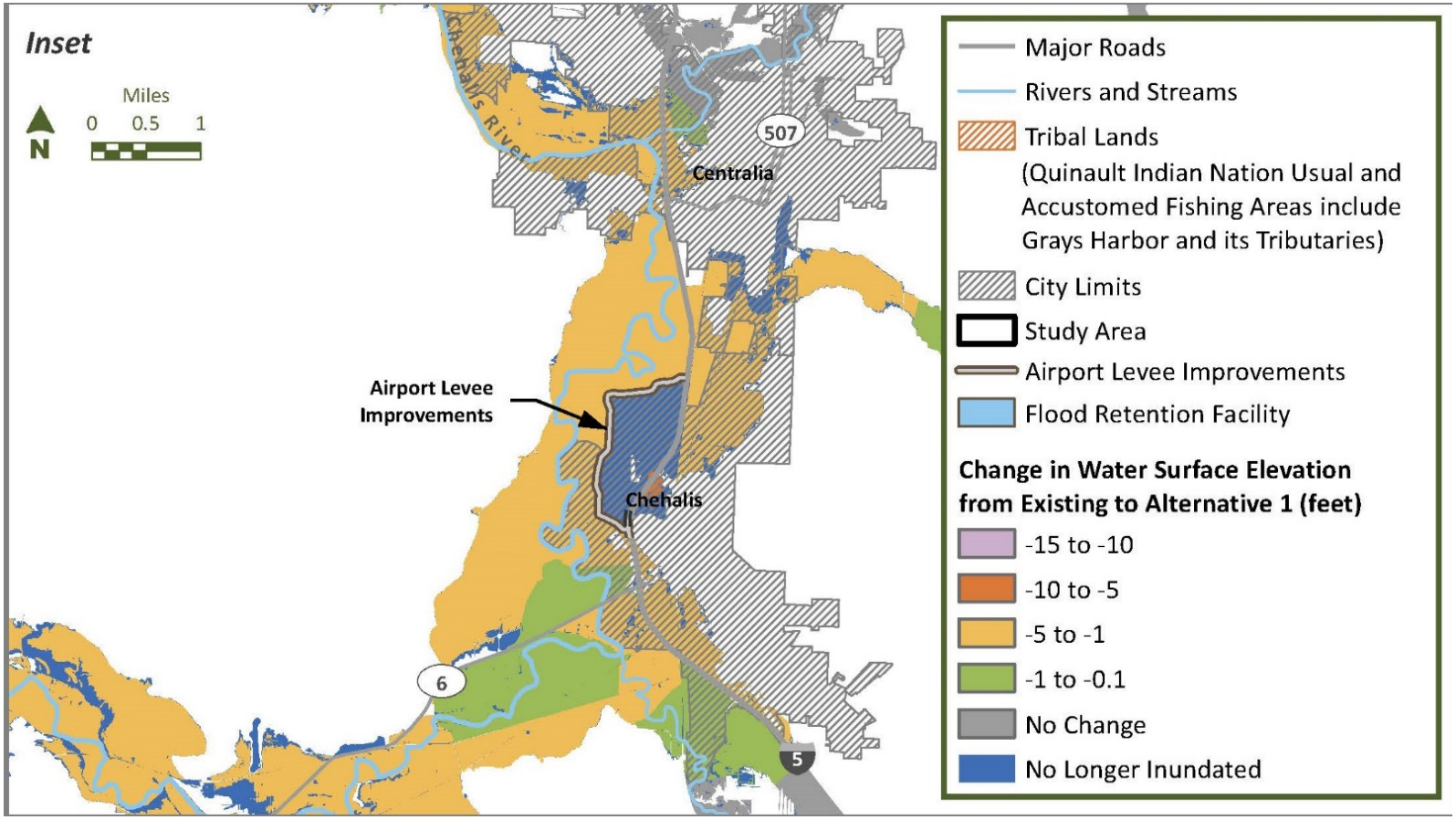
FLOOD	EXISTING PEAK FLOW (CFS)	PEAK FLOW WITH FLOOD RETENTION (CFS)	DIFFERENCE IN PEAK FLOW (%)
100-year	70,600	58,400	-17.3%
10-year	43,800	37,500	-14.4%
1996	72,100	61,200	-8.5%
2007	71,100	52,100	-26.7%
2009	57,300	48,600	-15.2%

Peak Elevation Reduction

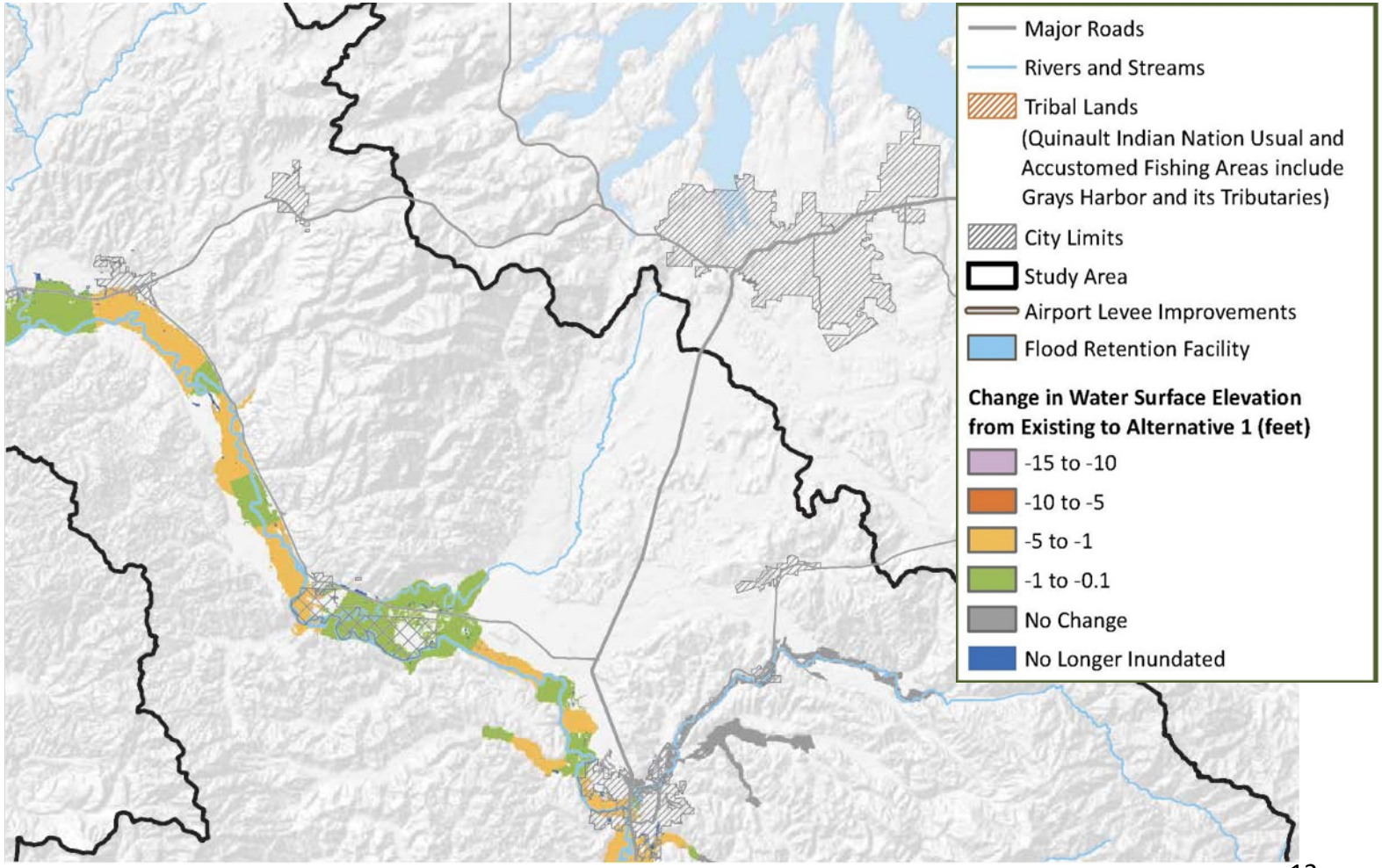
Water Surface Elevation Reduction in the Chehalis River and behind Airport Levee (100-year flood)

LOCATION	EXISTING PEAK ELEVATION (FT)	PEAK ELEVATION WITH FLOOD RETENTION (FT)	DIFFERENCE IN PEAK ELEVATION (FT)
Near Doty	319.2	308.1	-11.1
Downstream of South Fork	222.2	217.1	-5.1
Along Airport Levee	180.5	179.0	-1.5
Behind Airport Levee	180.3	173.3	-7.0
Mellen Street	177.7	176.0	-1.7
Galvin Road	168.2	166.5	-1.7
Grand Mound	147.5	146.6	-0.9
Near Rochester	124.4	123.4	-1.0
Montesano	18.6	17.9	-0.7

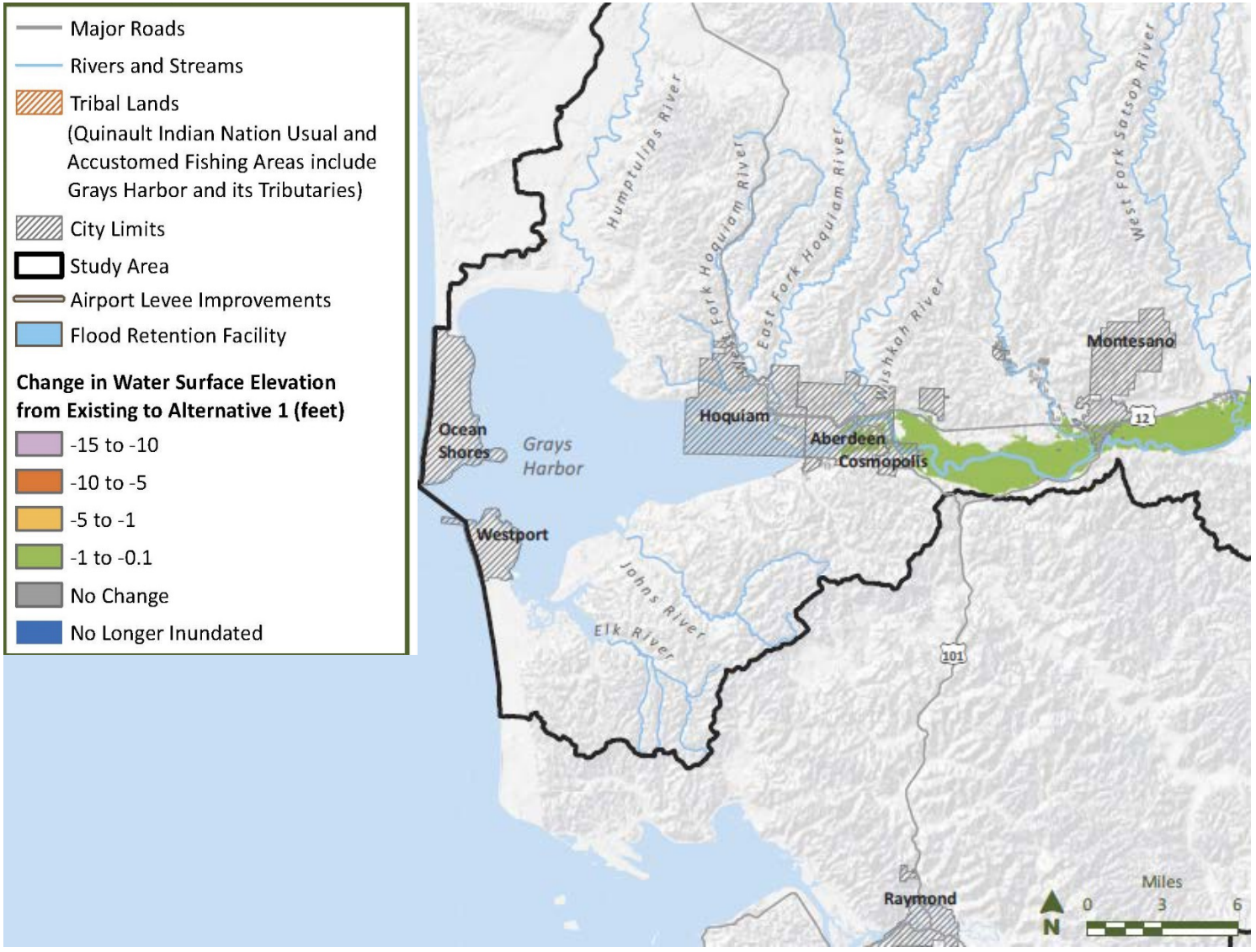
Flood Reduction – Upper Chehalis Basin (100-year Flood)



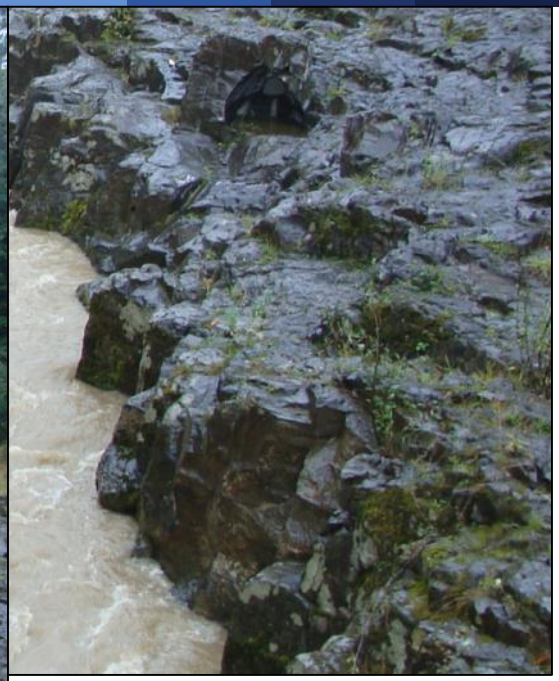
Flood Reduction – Middle Chehalis Basin (100-year flood)



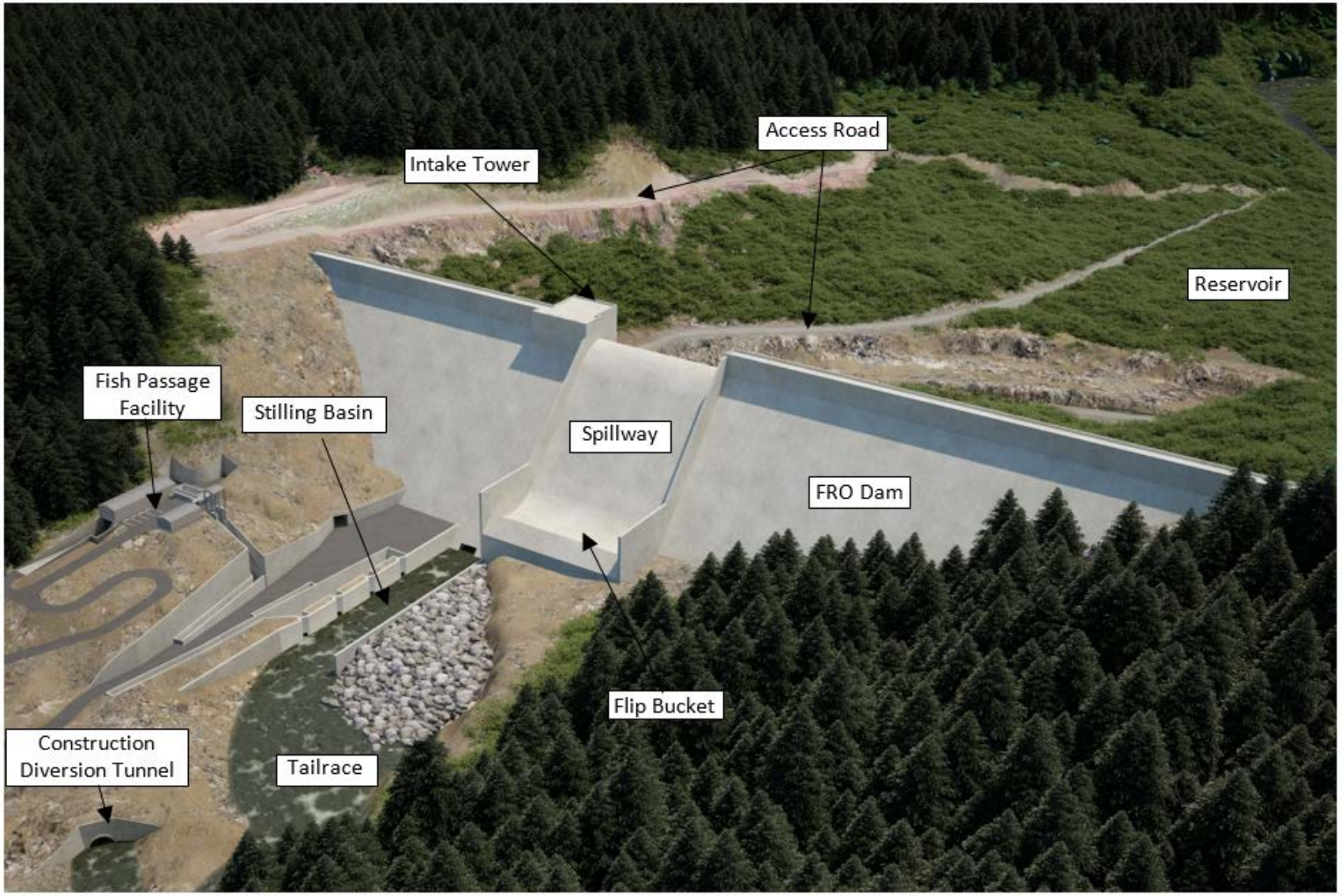
Flood Reduction – Lower Chehalis Basin (100-year Flood)



Dam Options



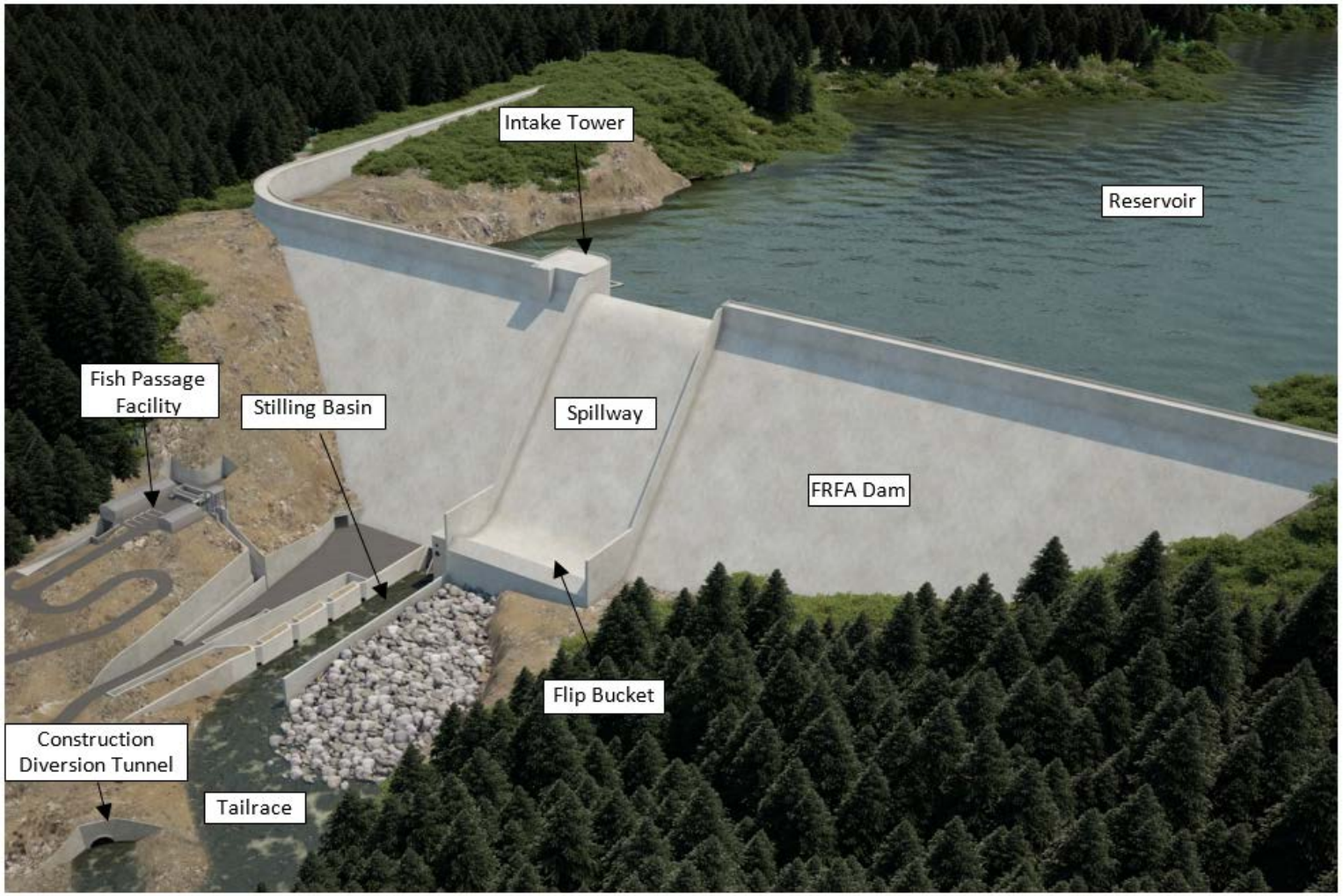
Flood Retention Only (FRO)



FRO Design

- Reservoir normally dry, temporary inundation during major floods (up to 32 days)
- Flood storage = 65,000 acre-feet
- Max storage depth in reservoir (at dam) = 227 feet
- Inundation area at max storage = 863 acres
- Length of reservoir at full pool = 6.8 miles
- Fish passage through 5 large tunnels in dam except when reservoir is in use then a CHTR (trap and haul facility) will be used

Flood Retention Flow Augmentation (FRFA)



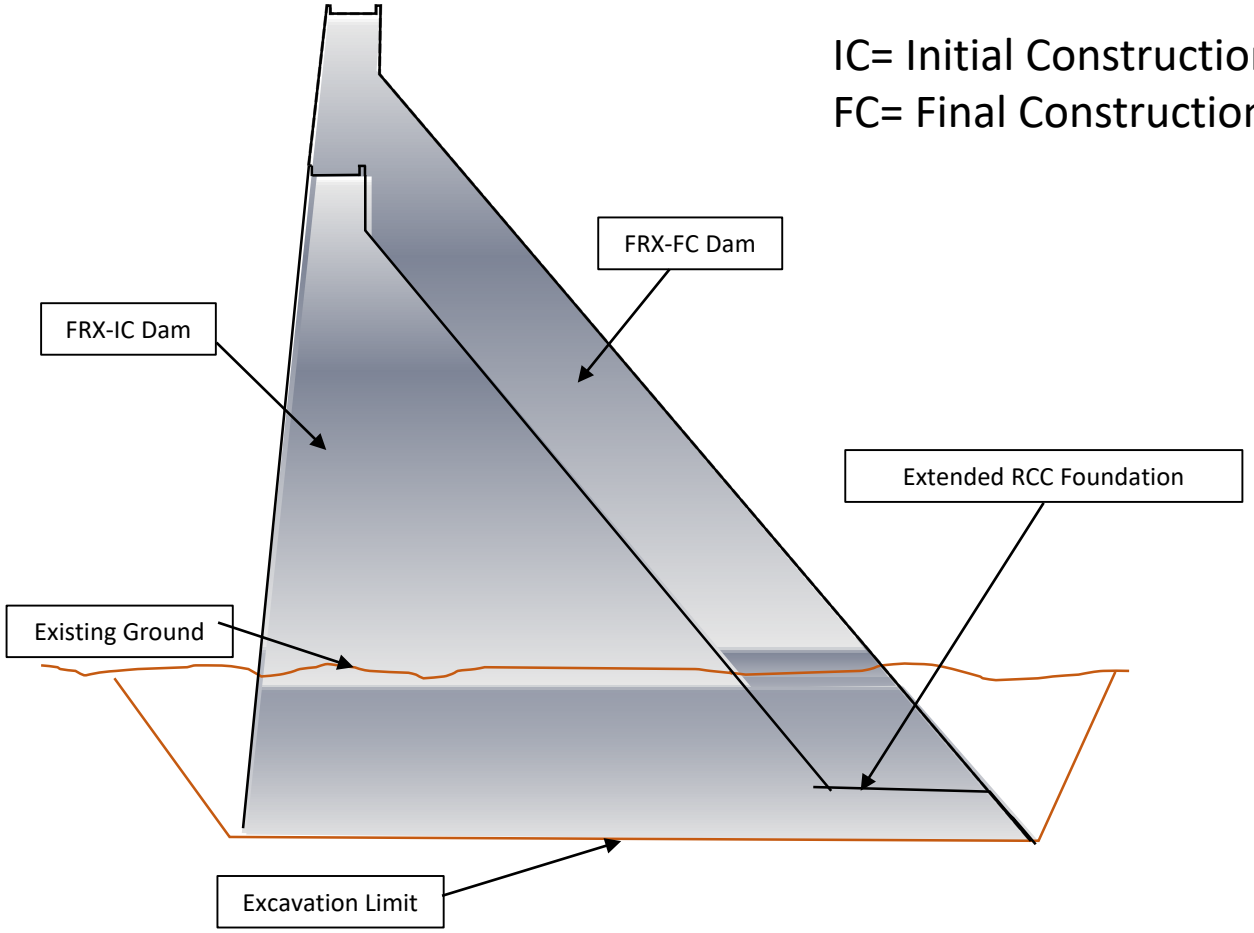
FRFA Design

- Max storage = 130,000 acre-feet (65,000 acre-foot conservation pool, 65,000 acre-foot flood pool)
- Max storage depth in reservoir (at dam) = 287 feet
- Inundation area at max storage = 1,344 acres
- Inundation area at full conservation pool = 863 acres
- Length of reservoir at full pool = 7.5 miles
- Upstream fish passage through CHTR facility (full time operation) and downstream fish passage through either floating surface collector or multi-port system

Hybrid Dam Option (FRX)

- FRX option would allow for future expansion of FRO dam
- Initially built for FRO volume (65,000 acre-feet) but with a larger foundation to allow the dam to be raised to store 130,000 acre-feet.
- Gates and outlets would also be designed to work under greater pressure if dam raised in the future
- Additional storage volume could be used to hold larger floods expected under climate change or to provide instream flow and reduce temperatures in the Chehalis River in the future.

FRX Stages


IC= Initial Construction
FC= Final Construction
FRX-FC Dam
FRX-IC Dam
Extended RCC Foundation
Existing Ground
Excavation Limit

Summary of Long-term Beneficial Effects

- Substantial flood damage reduction in downstream Chehalis River floodplain areas
  - An estimated 559 high-value structures not flooded
  - I-5 closure reduced by 3 days
  - Local roadway closures (such as SR 6, U.S. 101, U.S 12) reduced by 1-3 days
  - 100 year net present value of flood damage reduction is $929 million
  - Corresponding beneficial effects to land use, recreation, transportation, public services and utilities, and environmental health and safety
- FRFA option would increase flows and reduce temperature in Chehalis River in low-flow periods between Pe Ell and Skookumchuck River with some benefit to fish

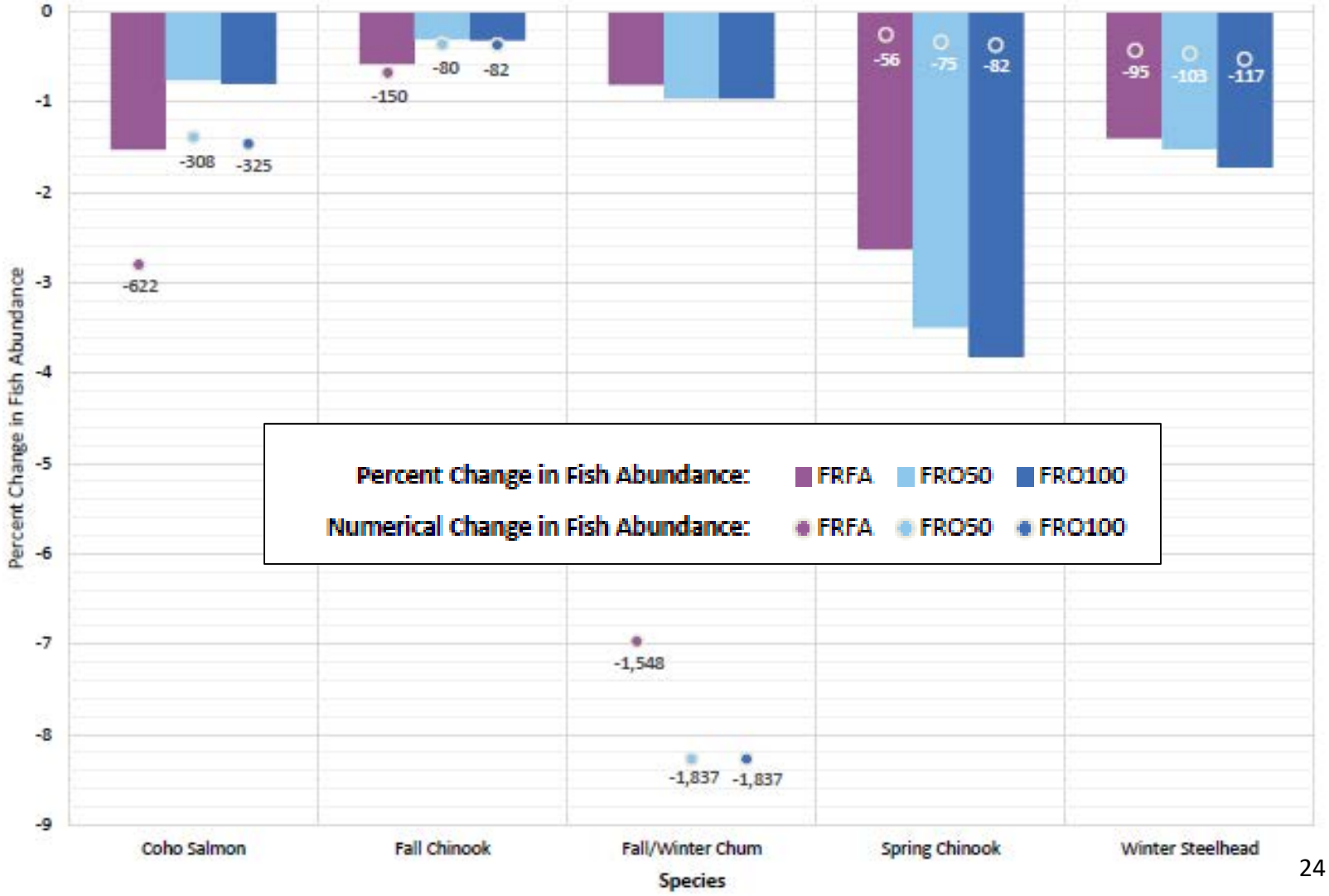
Summary and Comparison of Major Impacts

- FRFA reservoir would inundate and cause loss of salmon spawning habitat, some habitat would remain under the FRO
- Permanent loss of approximately 68 acres (FRO facility) and 98 acres (FRFA facility) of wetlands
- Permanent loss of vegetation: 6 acres for the FRO facility (in the dam footprint) and 720 acres for the FRFA facility (9 acres in the dam footprint, 711 acres in the reservoir area)
- FRO would allow fish passage for all species of adults and juveniles except during floods. FRFA would have less efficient passage

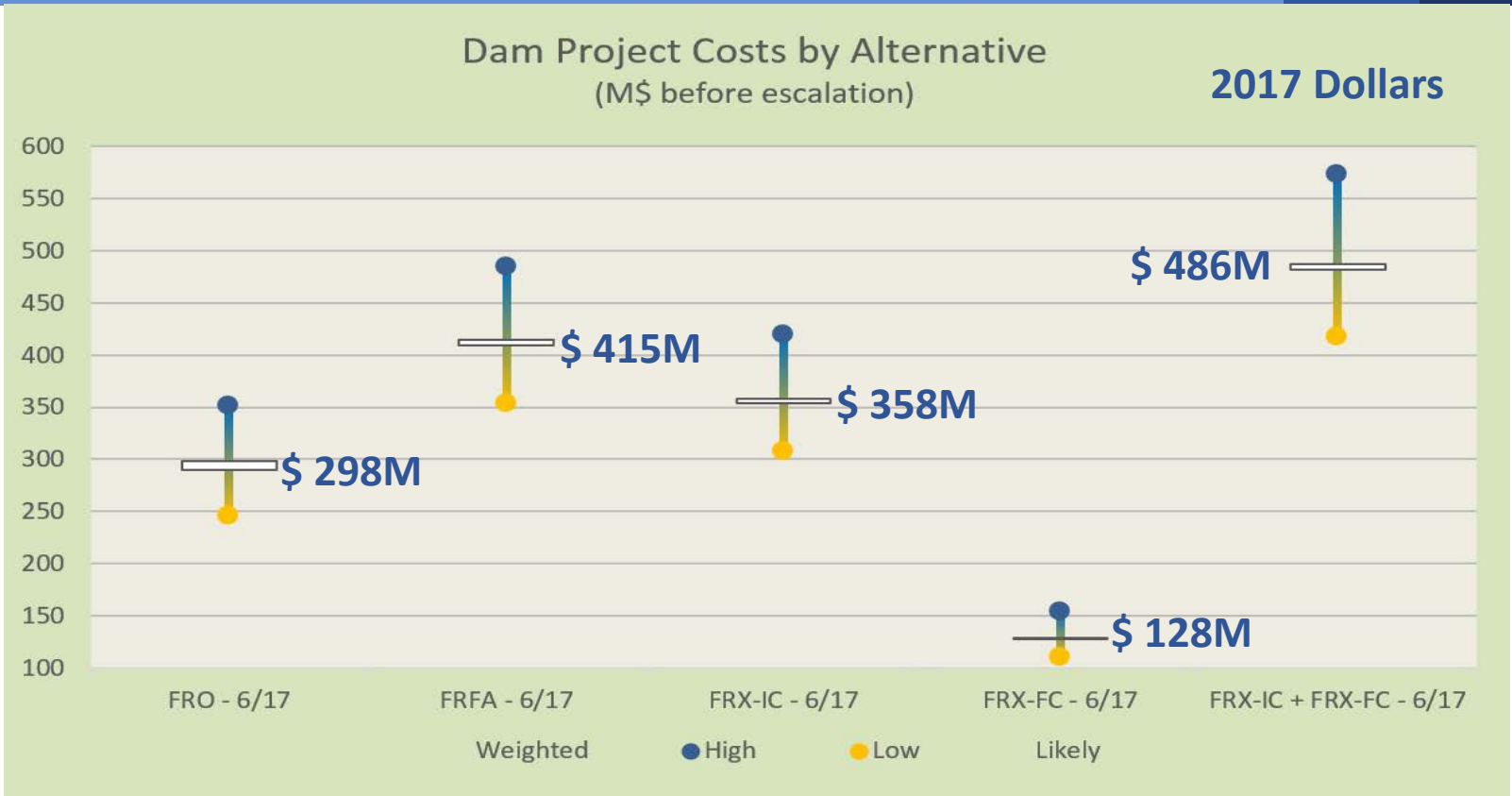
Summary and Comparison of Major Impacts

- FRFA reservoir would retain all coarse sediment and most fine sediment while FRO will pass most sediment through sluices. Changes to fish habitat-forming processes will be greater downstream for FRFA
- Change in visual quality of the area due to clearing of vegetation for both options
- FRO would increase temperatures downstream of dam to about Doty while FRFA will reduce temperatures to about the Skookumchuck River
- Exposure of juvenile salmonids that use the FRFA reservoir for rearing to predators that may thrive in the reservoir

Effect of Dams on Chehalis Basin Salmonids



Cost Comparisons



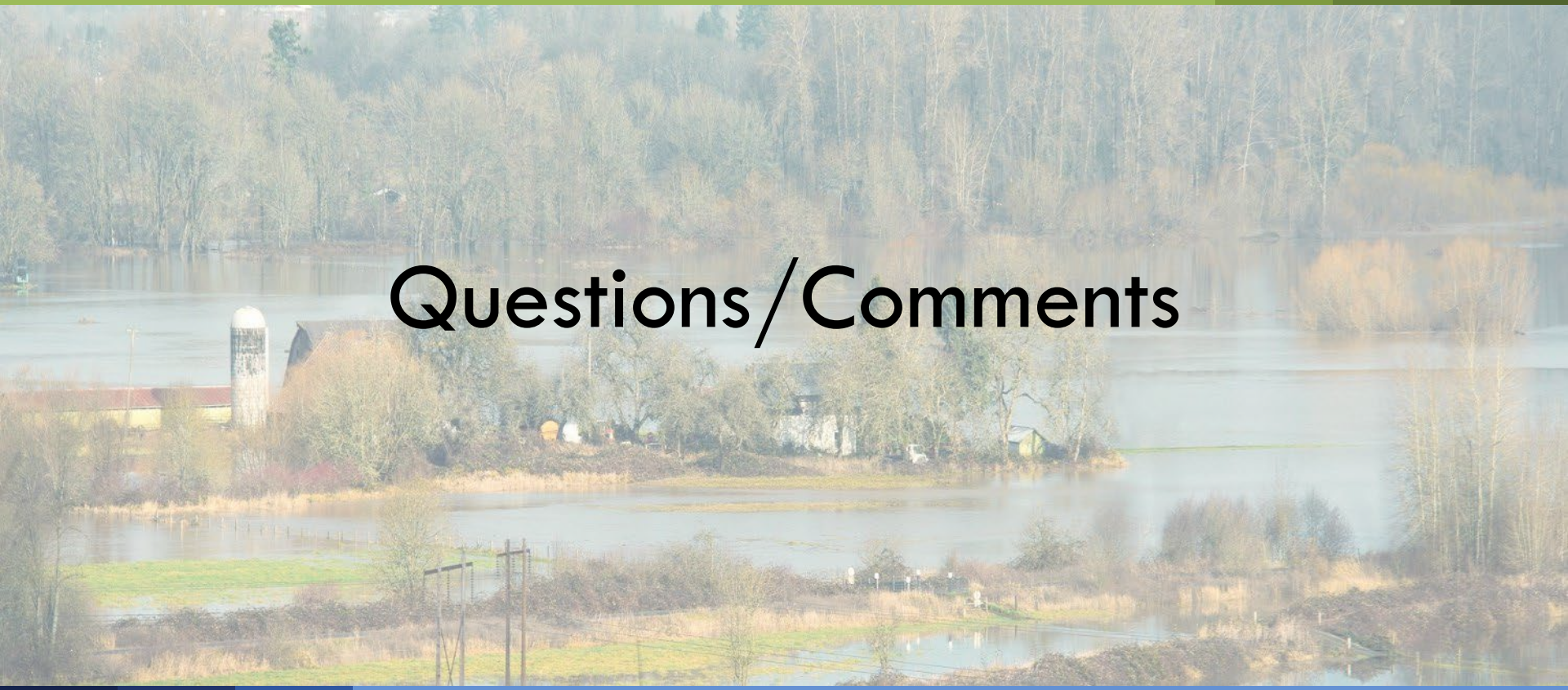
- Notes – does not include CHTR and/or floating fish collection facilities costs, costs include 22.5% contingency and 25% design, permitting and CM allowance

Fish Passage Costs (Conceptual Design Report)

FISH PASSAGE OPTION	LOWER BOUND COST ($ MILLION)	MIDDLE COST ($ MILLION)	UPPER BOUND COST ($ MILLION)
FRO – Fish Passage Conduits	Integral to dam construction.		
FRO and FRFA – Upstream Fish Passage: CHTR Facility	**$10.9**	**$13.6**	**$17.7**
FRFA – Upstream Fish Passage: Conventional Fishway	$47.8	$59.8	$77.7
FRFA – Downstream Fish Passage: Fixed Multi-Port Collector	$83.6	$104.5	$135.9
FRFA – Downstream Fish Passage: Floating Surface Collector	$69.0	$86.2	$112.1

Comparison of Dam Options

- FRO is least expensive and have least environmental impacts because no reservoir will exist
- FRFA would have greater environmental impact because of reservoir that inundates spawning grounds. More costly than FRO because of larger dam and greater cost of fish passage facilities. Would have instream flow and temperature benefit however there is uncertainty about the benefits to spring chinook, the most critical salmon specie in the Upper Chehalis Basin
- FRX option would cost more than FRO but provide flexibility for future operations



Questions/Comments