Chehalis Basin Strategy
Comparison of Combined Alternatives
• Overview of Alternatives
• Comparison of Combined Alternatives
  o Reduce Flood Damage
  o Restore Aquatic Species Habitat
• Results of Economic Analysis
Overview of Alternatives
EIS Alternatives

- No Action Alternative
- Alternative 1: 2014 Governor’s Work Group Recommendation
  - Dam and Associated Reservoir
  - Airport Levee Improvements
  - Aberdeen/Hoquiam North Shore Levee

- Alternative 2: Structural Flood Protection Without Flood Retention Facility
  - I-5 Projects

- Alternative 3: Nonstructural Flood Protection

- Alternative 4: Restorative Flood Protection

Local-scale Flood Damage Reduction Actions

High Scenario
Aquatic Species Habitat Actions

Low Scenario
Comparison of Combined Alternatives
No Action Alternative

• Maintain status quo
  o Ongoing flood damage reduction actions and habitat improvements at historic funding levels (excluding recent legislative funding)
  o Actions to reduce flood damage and improve habitat conditions continue to a lesser extent than with an integrated Strategy, and in a piecemeal fashion

• Limited localized benefits outweighed by ongoing risk of major floods and continued degradation of aquatic species habitat
Common Beneficial Effects Among the Action Alternatives

• Aquatic Species Habitat actions would result in significant increases in salmonid abundance, and maintain or improve conditions for other species (such as amphibians)

• Floodproofing and Local Projects would reduce flood damage to structures and content, infrastructure and roads, and agricultural uses

• Land Use Management changes could improve protection for new developments within the 100-year floodplain

• Flood Warning Systems Improvements would result in increased accuracy with regard to forecasting flood timing and extents, and increased public safety
Reduce Flood Damage
Objectives

Reduce the following conditions caused by a major flood:

1. Threats to human health and safety, including access to critical medical facilities
2. Flood damage to commercial and residential properties
3. Flood damage to agricultural properties, livestock and crops
4. Disruption in transportation systems, including closures of Interstate 5 and local and regional transportation systems
5. Disruption to industry, commercial businesses, and public services
Change in Water Surface Elevation – 100-year Flood

[Bar chart showing changes in water surface elevation for different locations and alternatives.]
Alternative 1 – Upper Chehalis Basin (100-year Flood)

Inset

Major Roads
Rivers and Streams
Tribal Lands
(Quinault Indian Nation Usual and Accustomed Fishing Areas include Grays Harbor and its Tributaries)

City Limits
Study Area
Airport Levee Improvements
Flood Retention Facility

Change in Water Surface Elevation from Existing to Alternative 1 (feet)
-15 to -10
-10 to -5
-5 to -1
-1 to -0.1
No Change
No Longer Inundated
Alternative 2 – Upper Chehalis Basin (100-year Flood)
Alternative 4 – Upper/Middle Chehalis Basin (100-year Flood)
## Reduction in Flood Damage to High Value Structures

<table>
<thead>
<tr>
<th>Action</th>
<th>Change from Baseline 100-Year Flood</th>
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<tbody>
<tr>
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<td>No Action Alternative</td>
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<tr>
<td>Structures that would no longer be flooded</td>
<td>0</td>
</tr>
<tr>
<td>Structures relocated</td>
<td>0</td>
</tr>
<tr>
<td>Structures floodproofed</td>
<td>0</td>
</tr>
<tr>
<td>Damage Reduced/Total</td>
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<tr>
<td>Remaining structures flooded</td>
<td>1,379</td>
</tr>
</tbody>
</table>

Does not include the Aberdeen/Hoquiam Northshore Levee (for Alternatives 1 and 2), which would reduce coastal flooding to approximately 2,715 structures.
Agricultural/Forestry Impacts – Alternative 1

• Reduction in flooding to 1,956 acres of agricultural/forestry land use zones

• FRO Reservoir
  • Conversion of up to 405 acres of mixed coniferous/deciduous forested riparian areas to deciduous riparian shrubland resulting from selective harvesting
  • Conversion of up to 306 acres of coniferous forest to mixed deciduous/coniferous forest resulting from periodic inundation
Agricultural/Forestry Impacts – Alternative 1

• FRFA Reservoir
  o Permanent loss of 711 acres of managed forest
  o Conversion of up to 178 acres of mixed coniferous/deciduous forested riparian areas to deciduous riparian shrubland from selective harvesting
  o Conversion of up to 262 acres of coniferous forest to mixed deciduous/coniferous forest from periodic inundation
Agricultural/Forestry Impacts – Alternative 4

• Alternative 4 would result in new or increased flooding to an area potentially reaching 21,000 acres
  o Includes 12,100 acres of active farmland

• Alternative 4 would relocate land use out of the created 10-year floodplain to upland areas
  o Convert up to 16,000 acres of managed forest to agricultural, residential, public services and commercial land
  o Includes 8,500 acres of farmland relocation

• Requires landowner compensation, relocation or adaptation assistance for landowners willing to participate
Transportation — Reductions during 100-year Flood

• I-5 Closures (Closed ~4 days during a 100-year flood)
  o Alternative 1: Reduced by 3 days
  o Alternative 2: Reduced up to 3 days
  o No Action Alternative, Alternatives 3 and 4: No reduction

• Local Roadways (such as SR 6, U.S. 101, U.S 12)
  o No Action Alternative and Alternative 3: No reduction
  o Alternative 1: Reduced by 1 to 3 days
  o Alternative 2: Reduced behind levee, increased flooding on west side of I-5 (SR 6 and local roadways)
  o Alternative 4:
    • Reduced in Chehalis-Centralia area by up to 1 day
    • Increased on SR 6 (4 days), SR 506 (1-2 days), and SR 508 (2 days)
Restore Aquatic Species Habitat
Objectives

Protect and restore aquatic species habitat function to:

1. Improve resiliency of natural floodplain processes and ecosystems from the effects of climate change, including warming stream temperatures, low flows, and other effects

2. Increase abundance of native aquatic species, including increased populations of healthy and harvestable salmon and steelhead

3. Reduce the potential for future Endangered Species Act listings

4. Enhance tribal and non-tribal fisheries
Aquatic Species Habitat – Current Conditions
Aquatic Species Habitat – Future Conditions

Percent Change in Fish Abundance: With Climate Change Only, 20% Riparian (Low), 20% Riparian (High), 60% Riparian (Low), 60% Riparian (High)

Numerical Change in Fish Abundance: With Climate Change Only, 20% Riparian (Low), 20% Riparian (High), 60% Riparian (Low), 60% Riparian (High)

Species:
- Coho Salmon
- Fall Chinook
- Fall/Winter Chum
- Spring Chinook
- Winter Steelhead
Comparison of Alternatives

• For all action alternatives, the low and high restoration scenarios would increase salmon abundance
• Alternative 1 would result in the least increase in salmon abundance
• Alternative 4 would result in the greatest increase in salmon abundance
• Across all alternatives, climate change would reduce salmon abundance; the low restoration scenario would generally maintain the status quo
Potential Response in Salmon Abundance to Habitat Change in the Chehalis Basin to the Dam (By Subpopulation)
Chinook Salmon

Percent Change in Fish Abundance:

Numerical Change in Fish Abundance:

Spring Chinook Salmon

Subpopulation

Fall Chinook Salmon

Subpopulation
Chum and Coho Salmon
Steelhead

Winter Steelhead

Percent Change in Fish Abundance

Subpopulation

- Satsum to Skookumchuck
- Black River
- Skookumchuck River
- Skookumchuck to South Fork
- Newaukum River
- South Fork Chehalis
- South Fork to Elk
- Elk Creek
- Elk to Crim
- Above Crim

-100 -80 -60 -40 -20 0 20

Graph showing the percent change in fish abundance for various subpopulations.
Potential Response in Salmon Abundance to Habitat Change in the Chehalis Basin Alternative 1
Alternative 1 – Climate Change Conditions (FRFA)
Alternative 1 – Climate Change Conditions (FRO50)
Alternative 1 – FRO 100
Alternative 1 – Climate Change Conditions (FRO100)
Potential Response in Salmon Abundance to Habitat Change in the Chehalis Basin Alternative 4
Alternative 4 – Climate Change Conditions (RFPA)
Potential Response in Salmon Abundance to Habitat Change in the Chehalis Basin
Spring Chinook Salmon
## Change in Abundance – Spring Chinook Salmon

<table>
<thead>
<tr>
<th>Action</th>
<th>Change in Abundance (Number; Percent)</th>
<th>Change in Abundance (Number; Percent)</th>
<th>Change in Abundance (Number; Percent)</th>
<th>Change in Abundance (Number; Percent)</th>
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<tbody>
<tr>
<td></td>
<td>Low Restoration 20% Reaches</td>
<td>Low Restoration 60% Reaches</td>
<td>High Restoration 20% Reaches</td>
<td>High Restoration 60% Reaches</td>
</tr>
<tr>
<td>Aquatic Species Habitat Action</td>
<td>2,051 96%</td>
<td>5,583 260%</td>
<td>4,590 214%</td>
<td>15,357 715%</td>
</tr>
<tr>
<td>Alternative 1 (FRFA)</td>
<td>1,007 47%</td>
<td>2,614 122%</td>
<td>1,665 78%</td>
<td>4,904 228%</td>
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<tr>
<td>Alternative 1 (FRO50)</td>
<td>2,013 94%</td>
<td>5,506 257%</td>
<td>4,555 212%</td>
<td>15,265 711%</td>
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<tr>
<td>Alternative 1 (FRO100)</td>
<td>1,990 93%</td>
<td>5,448 254%</td>
<td>4,520 211%</td>
<td>15,175 707%</td>
</tr>
<tr>
<td>Alternative 4 (RFPA)</td>
<td>13,233 616%</td>
<td>17,679 824%</td>
<td>16,966 790%</td>
<td>28,781 1,341%</td>
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</table>
Change in Riparian Area
Change in Riparian Area

• Aquatic Species Habitat action, riparian area would be increased between 1,150 to 9,750 acres

• Alternative 1 (reservoir area)
  o Periodic inundation and tree removal would degrade between 174 (FRO) and 178 acres (FRFA) of riparian area
  o Loss of 241 acres of riparian area (FRFA only)
  o Alternative 1 would therefore result in a gain of approximately **909 acres to 9,509 acres of riparian habitat**

• Alternative 4 would result in a gain of 562 to 6,552 acres through adding large wood in treatment areas, for a total of 1,712 to 16,302 acres of increased riparian habitat
Results of Economic Analysis
### Action Alternative Costs

#### Low Restoration

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<tr>
<th>Alternative</th>
<th>Costs (in Millions)</th>
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<tr>
<td>FRO CHTR</td>
<td>$0</td>
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<tr>
<td>FRFA Conventional Fishway &amp; Forebay Collector</td>
<td>$200</td>
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<tr>
<td>FRFA CHTR &amp; Forebay Collector</td>
<td>$400</td>
</tr>
<tr>
<td>FRFA Conventional Fishway &amp; Multi-Port Outlet</td>
<td>$600</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>$800</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>$1,000</td>
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<tr>
<td>Alternative 4</td>
<td>$1,200+</td>
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**Legend:**
- Blue: Aquatic Species Habitat Actions
- Orange: Flood Retention Facility
- Yellow: Airport Levee Improvements
- Gray: I-5 Project
- Blue: Restorative Flood Protection
- Green: Floodproofing

*Note: The costs for Alternative 4 exceed $1,200 million.*
Action Alternative Costs
High Restoration

<table>
<thead>
<tr>
<th>Alternative</th>
<th>FRO CHTR</th>
<th>FRFA Conventional Fishway &amp; Forebay Collector</th>
<th>FRFA CHTR &amp; Forebay Collector</th>
<th>FRFA Conventional Fishway &amp; Multi-Port Outlet</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
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<tr>
<td>Millions</td>
<td></td>
<td>$0</td>
<td>$200</td>
<td>$400</td>
<td>$800</td>
<td>$1,000</td>
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Legend:
- Aquatic Species Habitat Actions
- Flood Retention Facility
- I-5 Project
- Airport Levee Improvements
- Restorative Flood Protection
- Floodproofing
100-Year NPV at 1.5% Discount Rate, $2016

- Alternative 1
- Alternative 2
- Alternative 3
- Alternative 4

Vehicle Damage
Crop Damage
I-5 Delay
Clean-up Costs
Emergency Aid
Inventory
Content
Structure
# Results Summary

## State Perspective

<table>
<thead>
<tr>
<th>Alternative 1</th>
<th>Low Restoration</th>
<th>High Restoration</th>
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<tbody>
<tr>
<td>FRO RCC with CHTR Fish Passage</td>
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<tr>
<td>FRFA RCC with Conventional Fishway &amp; Forebay Collector</td>
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<tr>
<td>FRFA RCC with CHTR &amp; Forebay Collector</td>
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<tr>
<td>FRFA RCC with Conventional Fishway &amp; Fixed Multi-Port Outlet</td>
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<td>$929</td>
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<table>
<thead>
<tr>
<th>Alternative 2</th>
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<td>$109</td>
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<td>$72</td>
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<tr>
<td>$1,390</td>
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**Expected, Depreciated Values 100-Year NPV 1.5% Discount Rate, Millions ($2016)**

<table>
<thead>
<tr>
<th>Impacts</th>
<th>Flood Damage Reduction</th>
<th>Fishery Use Value (Salmon)</th>
<th>Project Implementation Costs</th>
<th>Net Benefit</th>
<th>Benefit/Cost</th>
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<tbody>
<tr>
<td>Alternative 1</td>
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<td>FRFA RCC with CHTR &amp; Forebay Collector</td>
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<td>FRO RCC with CHTR Fish Passage</td>
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Questions/Comments