

**To:** Quinault Indian Nation

**From:** Natural Systems Design, Inc. and Northwest Hydraulic Consultants

**Date:** April 27, 2020

**Re:** Critical Review of Proposed Chehalis River Basin Flood Damage Reduction Project Draft SEPA EIS

**Local Actions Alternative Technical Analyses Review**

## EXECUTIVE SUMMARY

The elements of the Local Action Alternative (LAA) presented in the Draft Environmental Impact Statement (DEIS) have been reviewed by a qualified technical team consisting of Tim Abbe, PhD, PEG, PHG, Danielle Devier, PLA, MS, and Cynthia Carlstad, LHG. The DEIS has been prepared to support the Washington State Department of Ecology's review of a proposed Flood Retention Expandable (FRE) facility under the State Environmental Policy Act (SEPA).

The review team concluded that:

- ▶ The DEIS fails to provide an adequate or comprehensive evaluation of flood risk for the proposed target area; nothing in the DEIS acknowledges the flood risks posed by local creeks, and thus the DEIS cannot definitively conclude that the specific areas noted would be removed from flood risk.
- ▶ The flood damage reduction analysis presented in the DEIS contradicts sound standards of flood risk management practices to comprehensively assess all flood risks to an area, and then develop solution options to address those risks.
  - Tens of millions of dollars of state money have been spent evaluating flooding from a single source within the Chehalis Basin – the upper basin above the Town of Pe Ell (upper basin) – when it is well known that damaging floods originate from numerous sources within the Chehalis Basin, including the South Fork Chehalis, Newaukum, Skookumchuck, Satsop watersheds.
- ▶ The DEIS fails to present adequate specificity in the elements of the LAA, fails to present any meaningful analysis of the LAA, and thus fails to present a valid comparison of the LAA and the FRE facility and each alternative's potential to meet the objectives stated in the DEIS. This lack of specificity also deprives the public of evaluating the benefits and impacts to its local community and personal property.
- ▶ The development of the LAA by the FCZD fails to meaningfully develop elements such as buyouts, relocation and local flood protection measures, fails to describe how and when these elements would be accomplished, and fails to objectively analyze how such elements could achieve the goals and purpose stated in the DEIS, even though data is available to do so.
- ▶ The DEIS fails to demonstrate how the Office of the Chehalis Basin (OCB) would manage and lead a basin-wide LAA. This omission demonstrates that the DEIS has not given the LAA any serious consideration.
- ▶ The elements presented in the DEIS as the LAA are proven mechanisms to accomplish flood damage reduction. Development of a viable Local Actions Program offers the only viable means to deliver flood

damage reduction, aquatic species habitat restoration, and community benefits, yet the State has invested almost nothing into defining and evaluating the LAA in the DEIS.

- ▶ A viable Local Actions Program would provide benefits throughout the Chehalis Basin and can be targeted to provide the greatest benefits for the cost, focusing on structural solutions (e.g., levees, floodwalls) in densely populated areas and non-structural solutions (e.g., floodproofing, buyouts, relocation) in rural areas.
- ▶ A viable Local Actions Program offers sustainable long-term solutions, with no risk of pervasive ecosystem impacts or catastrophic flooding caused by a dam failure.
- ▶ Key elements of flood damage reduction, particularly buyouts and relocation, are the only permanent solutions forever removing the risk of flood damages and requiring no ongoing operation, maintenance, or replacement costs. Acquisitions and relocations permanently remove flood damage liabilities while providing valuable environmental benefits.
- ▶ A Local Actions Program would build resiliency into the community by protecting designated necessary or critical land uses in the floodplain against all flooding (not just major flooding) and encouraging other growth to shift to upland areas.
- ▶ A Local Actions Program would be completely compatible with the Aquatic Species Restoration Plan (ASRP), opening up large areas of floodplain for restoration and sustaining the natural processes such as flooding and channel migration that support ecosystems services and resilient fish and wildlife populations.
- ▶ A Local Actions Program would directly address economic development to ensure the Cities and Ports of Chehalis and Centralia can pursue development and job creation in upland areas that do not conflict with environmental goals and Treaty rights.

It is our conclusion that the shortcomings in the DEIS analyses and conclusions result in an underestimation of potential viability of the LAA and related actions that could be taken to accomplish flood damage reduction at a lower environmental, social, and economic cost to the Chehalis Basin. We believe that the Local Actions Alternative could be developed into a viable Local Actions Program with enough specificity to enable comparison of benefits and impacts against the proposed project, and to enable the State to evaluate implementation feasibility and community support.

## INTRODUCTION

An expandable flood retention (FRE) facility has been proposed as an alternative to accomplish flood damage reduction on the Chehalis River, Washington. The stated purpose of the facility is to store water in the upper watershed to alleviate flood damage to developed areas of the lower floodplain near the towns of Centralia and Chehalis. It is designed for a 100-year hydrologic event, such as the 1996 flood, but is not designed to retain larger floods such as the 2007 flood.

According to a 2019 letter from Ecology the “SEPA EIS includes a Local Actions Alternative which looks at local-scale and nonstructural efforts to improve floodplain function and reduce flood damage.” (White, 12/19/19).

Development and analysis of a robust Local Actions Alternative (LAA) is important to determine how the State will best achieve the dual goals of the Chehalis Basin Strategy to reduce flood damages and improve aquatic species habitat over the long-term. This memo analyzes the approach of the DEIS to presenting and considering the LAA. We consider specifically how the DEIS fails in its identification of crucial issues, evaluation of flood risk, configuration of the Local Actions Alternative, and evaluation of benefits and impacts, and we provide recommendations for what should have been included. We also present our analysis of the components and benefits of formulating a viable Local Actions program, focusing on the following components:

- ▶ Buy-Outs
- ▶ Floodproofing
- ▶ Land Use Management
- ▶ Increase Floodplain Storage
- ▶ Stay-in-Place Farm Assistance
- ▶ Localized Levees, Dikes, Floodwalls, and Floodgates
- ▶ Channel Migration Protection
- ▶ Early Flood Warning and Response System
- ▶ Developing a Comprehensive Strategic Plan for Prioritizing Actions
- ▶ Examples of Area-Specific Chehalis Basin Strategies Under a Local Actions Program

## ANALYSIS OF DEIS

### DEIS fails to provide adequate comprehensive flood risk evaluation for proposed project target area.

Flood damage reduction and flood risk mitigation standards of practice dictate that flood risks to the target area be comprehensively evaluated to provide reasonable assurance that the best techniques are applied to the right areas. As stated in FEMA Guidance for Flood Risk Analysis (2019),

*“data and information obtained during the Discovery process should demonstrate a holistic picture of flooding issues, flood risk, and flood mitigation needs and capabilities within a watershed. The data and information gathered should also provide an understanding of the geography, demographics, and willingness to address risks, infrastructure presence, underlying building codes, and other critical elements that will provide a full understanding of the watershed. The data and information collected*

*must be both sufficient and firmly understood by the Project Team before possible elements of a Flood Risk Project - including flood hazard mapping, community engagement and outreach, mitigation planning technical assistance, and flood risk assessments - are suggested.” (FEMA 2019)*

The Proposed Project purpose is “to reduce flood damage in the Chehalis-Centralia area by constructing a flood retention facility and temporary reservoir near Pe Ell and making changes to the Chehalis-Centralia Airport levee.” This statement implies that lowering peak flows in the Chehalis River will reduce flooding in the Chehalis-Centralia area. But this area also experiences regular damaging flooding from several local creeks that flow through the two cities, most notably China Creek, Salzer Creek, Coal Creek and Dillenbaugh Creek. The DEIS includes a vague statement that “storms centered over the Black Hills and Cascade Range foothills can cause flooding in the Skookumchuck, Newaukum, and Chehalis Rivers in the Centralia/Chehalis area” (DEIS App. N, p. N-15), but nothing in the DEIS acknowledges the flood risks posed by local creeks. Unlike the proposed project, the LAA offers a means of reducing local flood damages originating from streams and rivers other than the Upper Chehalis. The approach of the DEIS contradicts sound standards of flood risk management practices to comprehensively assess flood risks to an area, and then develop solution options to address those risks. A much more detailed LAA is best suited to provide a comprehensive plan needed to address specific flood problems.

The flood risks posed to the target area in and around the cities of Centralia and Chehalis should have been evaluated comprehensively to understand the geographic sources of flooding by a range of storm events that include the following:

- ▶ Storm event centered over the Cascade Range where the bulk of flood water originates from the Skookumchuck and Newaukum Rivers. This storm event should include variations where Skookumchuck Reservoir has storage capacity to dampen the flood event, and where it does not have flood storage capacity. Storm events centering over this area have the added risk of being rain-on-snow events which significantly contributes to the magnitude of flooding.
- ▶ Storm event centered in the Willapa Hills, but with the majority of flow coming from the South Fork Chehalis River versus the Upper Chehalis River.
- ▶ Storm event centered in the Willapa Hills similar to the 2007 flood event. We understand that for the late-century catastrophic flood scenario for the DEIS, rainfall and runoff projections were modeled statistically throughout the Basin, with peak flows distributed in all areas in the basin, and not focused on a particular area as occurred in the 2007 flood when rainfall was concentrated in the Willapa Hills.
- ▶ Cloudburst rain event with intense rainfall centered over Centralia and Chehalis sub-basins, including China, Salzer, Coal and Dillenbaugh Creeks.

Flood analysis and mapping produced from these scenarios, combined with the mapping already produced from the hydraulic modeling associated with the proposed project, would provide a broader suite of conditions upon which to identify and evaluate solution options that would truly benefit the communities. They would also help the communities evaluate the interplay between flood waters coming from the east with the Chehalis River, and identify flow paths that could potentially be blocked with discrete levee segments or accommodated with storage. This work would be essential for identifying actions such as floodplain restoration (some of which has been done in China Creek), local levees or floodwalls, floodgates, raising structures, and acquisition and relocations.

It should be noted that predictive tools for flood impact analysis for Skookumchuck River and the creeks need significant updating. The FEMA Flood Information Rate Maps (FIRM) and Flood Information Study (FIS) for the Skookumchuck River date from 1982. China Creek has likely better modeling developed for Centralia’s China Creek restoration projects, but the latest hydraulic modeling that included Salzer Creek could not be calibrated

for the January 2009 event (WSE, 2019), with model results underpredicting flood elevations in Salzer Creek by four feet.

Accounts of historical floods provide insights into the variations in how where the storm is centered can drive a different inundation area within Centralia and Chehalis. Backwater from the flooding Chehalis exacerbates inundation from the Skookumchuck River and smaller creeks. Integrating sub-basin inflows and calibrating model results is needed for all target areas. Armed with this suite of scenarios, it would be possible to more comprehensively assess flood risk within and surrounding Centralia and Chehalis and develop a Local Actions Alternative that is optimized to reduce flood damage for a broad range of flood scenarios, rather than focused on only one catastrophic scenario, leaving the community vulnerable to catastrophic flood damage from a scenario not evaluated.

The failure to assess the scenarios described above for different geographic sources of flooding and a range of storm events is particularly acute for the residential and business district of Centralia. This area is shown in the DEIS flood inundation maps as “no longer flooded” during the catastrophic flood. Because the DEIS does not comprehensively evaluate potential sources of flooding for this area (which could include the Skookumchuck River and/or China Creek and Salzer Creek), it cannot definitively conclude that these areas would actually be removed from flood risk, rather than just removed from flood risk for the specific Chehalis River event evaluated in the DEIS. A Local Actions Alternative comprised of discrete levee/floodwall protection, floodproofing and buyouts for this area could provide a flood damage reduction alternative that would protect this community for all flood conditions.

### Examples for Addressing Urban Flooding from Other Areas

Urban flooding is a known complex, multi-dimensional, problem nationwide; FEMA does not currently have an established method for analyzing urban flooding (NASEM 2019). A recent National Academies of Sciences, Engineering, and Medicine (NASEM) paper (2019) found that the managers for each of four case study cities were working to address urban flooding in their own way. In all four cities, Baltimore, Houston, Chicago, and Phoenix, the impacts of flooding were particularly felt by disenfranchised populations and citizens generally wish to know more about and understand their flood risk. Most actions to address urban flooding include land acquisition to establish and restore new flood corridors. Additional examples include:

**The City of Portland, Oregon** – The City of Portland, Oregon, began purchasing parcels and structures within the floodplain at Johnson Creek. The City has successfully restored large portions of Johnson Creek’s floodplain to slow and store water during peak flows with a 2-year recurrence interval and larger (Stonewall and Beal 2017) <https://www.portlandoregon.gov/bes/32201>.

**The Napa River Basin, California** – With a population of 80,000 and at a cost of \$900 million, the City of Napa and Napa County, California, have implemented a suite of nonstructural flood protection measures including, property buy-outs, setback levees, establishing flood bypasses, flood water detention areas, flood friendly culverts and bridges, restoring floodplains, open space preservation, and designing waterfront parks (<http://nrcsolutions.org/>). Flood protective benefits were seen early in project construction, when a large storm swept through the Napa County area in 2005. Many flood-experienced Napa citizens agreed that damages from this flood were less than anticipated. Further ecological and economic benefits were realized, with new bird habitat in created wetlands, more recreational areas and parks with 6 miles of trails, and beautifying the river adding value to restaurant owners and hotel developers. These benefits were realized despite the project being only 70 percent complete as of February 2016.

**Washington D.C.** – The District of Columbia’s Department of Energy and Environment (DOEE) funds a RiverSmart program which offers significant financial incentives, such as a savings of up to 55% off of

stormwater fees and assistance with green infrastructure project construction, all of which help commercial, residential and non-profit property owners retain and clean stormwater on-site, preventing urban pollution from entering Chesapeake Bay (<https://doee.dc.gov/riversmart>). Another RiverSmart program in New England is working to address the need for broad communication of flood risk and flood resilience strategies, and highlights the work of local governments in New England to emphasize sustainable flood resilience (<https://extension.umass.edu/riversmart/about-riversmart-communities>).

## INSUFFICIENT LOCAL ACTIONS ALTERNATIVE DEFINITION AND ANALYSIS

### DEIS fails to analyze the Local Actions Alternative with sufficient specificity.

The DEIS does not adequately define or evaluate the Local Actions Alternative with sufficient specificity to provide a meaningful comparison to the FRE alternative. The DEIS lists the following ways that the elements listed in Table 1 below could achieve the stated objective to reduce flooding from storms in the Willapa Hills through:

- ▶ Improving floodplain function
- ▶ Land use management actions
- ▶ Buying out or relocating at risk properties or structures
- ▶ Improving flood emergency response actions, and
- ▶ Increasing water storage from Pe Ell to Centralia

None of these elements are developed to a level of specificity for the DEIS to evaluate the flood damage reduction benefit that could be achieved. We find this to be a major failure to provide a valid comparison to the proposed FRE facility alternative. This lack of specificity also deprives the public of evaluating the benefits and impacts to its local community and personal property. Without such specificity, it is impossible to judge the merits of the Local Actions Alternative.

The DEIS also states that “Ecology considered actions that could be implemented by the Applicant either alone or with other agencies, private entities, or jurisdictions in the Chehalis Basin” and “The Applicant could support local efforts for flood damage reduction through local regulatory powers, funding, or technical assistance.” Either approach to implementing a Local Actions Alternative could be the basis for comparison, yet the DEIS fails to provide any such meaningful comparison (see Table 1).

**Table 1. Local Action Alternative Elements and Description (DEIS, Chapter 2.5)**

LOCAL ACTIONS ALTERNATIVE ELEMENT FROM DEIS	DESCRIPTION IN DEIS	WHAT'S MISSING? DETAILS AND ANALYSIS
Land Use Management	<p>Minimize floodplain development.</p> <p>Provide technical support and assistance to local jurisdictions and landowners for local land use management efforts that reduce flood damage</p>	<p>Specific mechanisms for minimizing floodplain development are not defined. How much is needed?</p> <p>Land management cannot be solely left to local municipalities, it must be led by regional entity in order to achieve continuity across jurisdictional boundaries.</p> <p>No description of how buyouts and relocations could reduce flood damages.</p> <p>No description of how a reduction in regulatory floodplain resulting from the FRE will affect new development and difference to LAA.</p> <p>No description of LAA relocation options such as purchasing suitable uplands and making jurisdictional adjustments in order for Ports and other large landowners to reduce damages and pursue new development.</p> <p>No analysis of how local flood protection (levees, floodwalls, floodgates, pump stations) could reduce flood damages, nor how they would be part of LAA.</p>
Floodproofing	<p>Raising structures, building berms or floodwalls around structures, installing flood vents in homes previously elevated</p>	<p>No description of flood proofing options nor integrating of local flood protection elements (levees, floodwalls, pump stations).</p> <p>How many structures, berms, floodwalls would need to be built when combined with buyouts and relocations?</p> <p>What would that cost and where would they be?</p> <p>What's required for maintenance?</p> <p>No description or analysis of effectiveness of flood-proofing versus other elements of LAA (is it more cost effective to buy-out these homes instead?)</p>
Buy-Out or Relocation of At-Risk Properties or Structures	<p>Following buy-outs, property could be cleared and reused for public purposes</p> <p>Assist local governments to identify funding</p> <p>Providing technical assistance to identify at-risk structures that cannot be floodproofed or identify other beneficial uses for the property</p>	<p>No assessment of how many flood prone properties are currently and voluntarily for sale. Our review of floodplain and riverside property for sale from Pe Ell to just downstream of Chehalis/Centralia revealed at least 59 properties for sale at an average listing price of \$287,000 per property.</p>

LOCAL ACTIONS ALTERNATIVE ELEMENT FROM DEIS	DESCRIPTION IN DEIS	WHAT'S MISSING? DETAILS AND ANALYSIS
		<p>What kind of public purposes? What does the community want and need?</p> <p>Why was information in the Restorative Flood Protection (RFP) assessments not incorporated?</p> <p>Why were suitable upland areas for relocation not described as they were in the RFP alternatives?</p> <p>No descriptions provided of any of the numerous successful programs in the U.S. doing buyouts and relocations to reduce flood damages.</p> <p>Why is same source of funding assumed for the FRE not being used for LAA elements? Why is this not being led by FCZD and OCB?</p> <p>What types of funding are already available? What types of funding resources need to be developed? What have other communities done?</p> <p>What does the technical assistance look like? Who's in charge? And who decides what can be floodproofed versus not?</p> <p>How are beneficial uses determined and measured?</p>
Floodplain Storage Improvement	<p>Reconnect floodplain storage areas</p> <p>Encourage new floodplain storage through in-channel wood installations and floodplain reforestation</p>	<p>How are effective floodplain storage areas identified? And at what scale are they effective? Are they prioritized for buy-out or floodproofing actions? Is there a particular land use that is desirable for these areas when they're not flooded?</p>
Channel Migration Protection	<p>Mapping high risk areas</p> <p>Large wood placements</p> <p>Regulatory and incentive-based approaches to reducing flood damage to properties in channel migration areas</p>	<p>Where are the high-risk areas? How does the local actions alternative prioritize who to help first? What are the incentives? Are incentives needed? Or just a fair and transparent process? What types of regulations exist elsewhere that have been effective at reducing flood damages to properties in channel migration areas?</p>
Early Flood Warning Systems	<p>More robust and interactive flood prediction and flood warning system that would allow vehicles, machinery, and livestock to be moved before flooding.</p> <p>Identify and fund the most critical stream gages that provide data for the warning system.</p>	<p>Doesn't the Chehalis basin have an early flood warning system already? Is this truly a part of local actions? If it needs improvement, there are likely some specific needs that are already known that should have been included in this alternative.</p>

## A VIABLE LOCAL ACTIONS PROGRAM

We believe that a Local Actions Alternative could be developed into a viable Local Actions Program with enough specificity to enable comparison of benefits and impacts against the proposed project, and with enough specificity to enable evaluation of implementation feasibility and community support. In this section we describe the elements of such a Local Actions Program and provide the rationale for why it is essential to consider such a program.

A viable Local Actions Program would include the elements listed below:

- ▶ Develop more accurate flood models for entire Chehalis Basin with focus on sub-basins
- ▶ Develop a comprehensive strategic plan for prioritizing local actions
- ▶ Delineate erosion hazards through a comprehensive channel migration zone delineation of Chehalis and its tributaries. Develop recommendations of areas where bank protection is acceptable and guidelines on how it should be done.
- ▶ Improve floodplain function with regards to temporarily storing flood waters
- ▶ Land use management actions
  - Encourage development outside flood and erosion hazard areas
  - Legislative actions to allow Cities and the Ports of Chehalis and Centralia to expand land holdings outside flood prone areas and restore flood prone lands
- ▶ Local flood protection actions
  - Levee improvements
  - New floodwalls
  - Flood gates
  - Pumping stations
  - Raising structures
  - Relocation of infrastructure such as roads, water treatment facilities.
- ▶ Floodplain agriculture 'stay-in-place' assistance tailored to address site-specific flood and erosion risks
- ▶ Acquisition of flood-prone land
  - Establish & fund a land acquisition division within Office of Chehalis Basin
    - monitor floodplain properties for sale
    - quickly acquire land
    - establish protocols for land ownership (e.g., land trust, state, county) and coordination with Aquatic Species Restoration Plan (ASRP)
- ▶ Relocating people out of harm's way
  - Establish and fund a hazard relocation division within Office of Chehalis Basin
    - Identify homes and businesses with flood and erosion hazard areas
    - Identify regional areas outside flood and erosion hazards well suited for relocation
      - Agricultural areas (e.g. high terraces and prairie communities south of South Fork Newaukum, State Route 512 area, and Southern Lewis County have existing agriculture, area with potential to expand agriculture, and good transportation infrastructure).
      - Residential areas (e.g., high ground with established infrastructure)

- Industrial areas (e.g., high terraces south of Newaukum River along I-5)
    - Public outreach program to landowners
    - Legislature actions to streamline land development associated with relocations out of flood and erosion risk areas.
- ▶ Improving flood emergency response actions
- ▶ Increase floodplain water storage along South Fork Chehalis River, Newaukum River, mainstem Chehalis River from Pe Ell to Centralia and other upper watershed sub-basins.
  - This should be done in manner consistent with meeting goals of the ASRP.
  - Increasing floodplain engagement in areas outside of the upper basins of the Chehalis watershed could benefit additional communities and should be considered.

This memo presents compelling reasons and evidence for why a viable Local Actions Program deserves equal consideration and should be led by the state working with local municipalities as a large-scale flood protection action. A local actions alternative offers the only viable means to deliver flood damage reduction, aquatic species habitat restoration, and community benefits, yet the State has invested almost nothing into defining and evaluating the LAA in the DEIS.

In the below sections, we focus on several aspects of such a Local Actions Program and present examples and rationale for its flood damage reduction benefits to the Chehalis Basin.

## EXAMPLE ELEMENTS OF A LOCAL ACTIONS PROGRAM

### Flood Damage Avoidance

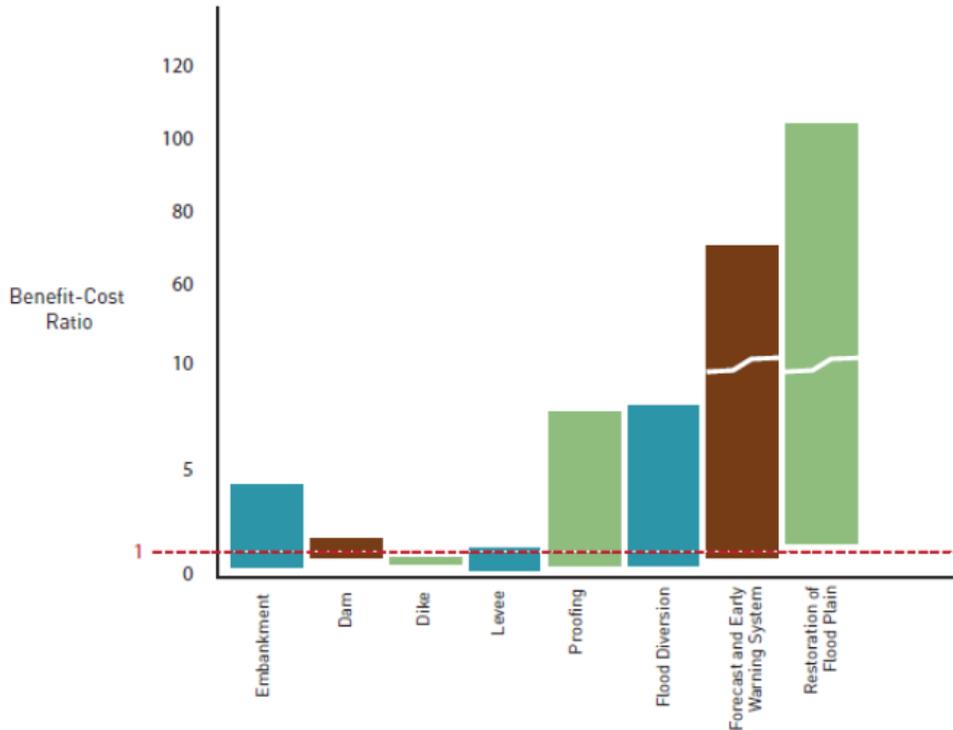
The best possible flood protection is to not build in areas prone to flood or erosion damages. Unlike some lowland regions of the United States, the Chehalis Basin has abundant upland locations outside flood or erosion hazard areas. While large portions of the Basin are susceptible to mass wasting hazards (e.g. landslides), there are also large areas to safely develop that have gently sloping or level ground with no mass wasting, flood or erosion hazards. Focusing development in areas not subject to natural hazards eliminates the high costs of flood damages and protective measures. The first European homesteaders recognized the extensive flood hazards within the Chehalis-Centralia lowlands and other valleys and focused development in upland areas (Smith, H. 1941):

*“To be out of reach of the flood waters, the early homesteaders built on the hillslopes.”*

The costs of flood damage to lives and property, along with environment and economic benefits of restoring floodplains, has led local, state and federal government agencies to implement major land acquisition and relocation programs across the country (e.g., Conrad et al. 1998, FEMA 2009, Polefka 2013, Mechler et al 2014, Schiff et al. 2015, Frendenberg et al. 2016, ELI 2017, Patterson 2018, Kinder Institute 2018, Salvesen et al. 2018, Siders 2019, Johnson et al. 2020). Pierce County has implemented very successful buy-out programs in floodplains of the Puyallup and Carbon Rivers. These programs have significantly reduced flood damages as well as allowing for levee removal or setback projects that have increased flood storage (FEMA 2011). Following construction of the Soldier Levee setback project, flood stage dropped downstream in Orting. After decades of chronic flood damages along Johnson Creek, the City of Portland, Oregon implemented a large-scale plan to establish a flood corridor founded on land acquisitions, relocations and floodplain restoration.

Helping people get out of harm’s way not only protects them, but can save taxpayers millions of dollars not only in flood relief, but in the costs of building and maintaining flood defenses. Acquisitions and relocations

permanently remove flood damage liabilities while providing valuable environmental benefits. This is in stark contrast to structural solutions such as dams that ultimately will need major repairs or replacement, at costs far exceeding their initial cost. For every dollar spent on acquisition of flood prone properties there is a \$2 to \$7 return (Figure 1; Hawley et al. 2012).



**Figure 1. Benefit-cost ratios for flood protection strategies (Hawley et al. 2012; Mechler et al. 2014). Note that floodplain restoration has highest ratio of benefits to costs, followed by forecast and early warning systems.**

Flood damage reduction benefits of the proposed FRE are focused on a relatively small area of the Chehalis River valley from Centralia to Pe Ell. Most of the area that would no longer flood as a result of the FRE facility is rural agricultural land but would be accomplished with significant environmental impact. Flood hazards will remain even if the FRE facility is built and continuous flood protection will be dependent on decades of operations and maintenance costs for the FRE facility. Local communities will have to live with the introduced risk of catastrophic consequences to life and property of a potential dam failure.

A Local Actions Program would provide benefits throughout the Chehalis Basin and can be targeted to provide the greatest benefits for the cost, focusing on structural solutions (e.g., levees, floodwalls) in densely populated areas and non-structural solutions (e.g., floodproofing, buyouts, relocation) in rural areas. Such a program offers sustainable long-term solutions with no risk of catastrophic flooding caused by a dam failure. Key elements of flood damage reduction in the LAA, buyouts and relocation, are the only permanent solutions forever removing the risk of flood damages and requiring no ongoing operation, maintenance, or replacement costs.

## Floodplain Storage and Flood Attenuation Opportunities

The Restorative Flood Protection Alternative (RFPA) assessed in the PEIS (Abbe et al. 2016, Abbe et al. 2020) described how floodplain restoration can increase floodplain storage and reduce the celerity (speed) of flood waves. These studies showed the potential to more than triple water storage and reduce downstream flood peaks by as much as 21%. While large scale floodplain restoration may not be possible in the short-term, acquisition of key floodplain properties can not only remove flood damage liabilities, but cumulatively contribute to floodplain storage and downstream flood stage reductions. Acquisition and relocation projects would also directly support the ASRP, and thus the dual goals of the Chehalis Basin Strategy, given its greatest challenge will be securing floodplain land for restoration.

## Channel Migration Protection

The DEIS fails to address erosion risks in any way even though they account for a significant percentage of flood damages. The FRE facility would result in increases in erosion and sediment inputs to the river within its reservoir and may increase the risks of bank erosion downstream due to the sustained duration of high flows during reservoir drawdown (see Cascade of Ecosystem Effects technical memo). A Local Actions Program would identify erosion risks and provide resources for relocation or buyouts in rural areas, and environmentally sensitive bank protection in developed areas (including for farmland on terraces).

No comprehensive mapping of erosion hazards or channel migration zones has been completed in the Chehalis Basin, other than for the Newaukum Restorative Flood Protection Assessment (Abbe et al., 2020). Establishing fluvial corridors is directly linked to mapping flood inundation and erosion hazards, along with consideration of aquatic and riparian habitats. These corridors create greenways that can directly benefit local communities and increase adjacent property values. The DEIS does not describe any of this and fails to not how such mapping, as part of the LAA, would provide a valuable contribution to prioritizing properties at risk, informing residents of hazards, and limiting future flood damage liabilities. Mapping of erosion hazards and channel migration zones is both essential to flood damage reduction and is a valuable element for the community.

## Floodplain Buy-out Evaluation and Resources

In 2017, Natural Systems Design, Inc. conducted an analysis of how much space 21 miles of the South Fork Newaukum River may need during a 100-year flood event to accommodate flooding and then estimated the cost of improving roads and bridges, buying-out or relocating those with the highest risk of flood and erosion, and providing floodplain easements for property owners who would be least impacted by flooding. This analysis was recently published as Appendix 2 of “Advanced Feasibility Evaluation of The Chehalis Basin Restorative Flood Protection Approach” (Abbe et al., 2020). This study analyzed a total of 444 parcels, half of which were mostly flooded (i.e. where floodwaters reached the center of the parcel or more), and the other half of which were mostly outside of the inundation extents, with floodwaters at the property edges. The cost assessment included four elements:

1. Potential changes to roads (4.5 miles) and bridges (9)
2. The fair market purchase price of willingly-sold residential properties (96 parcels, 560 ac.)
3. The fair market cost of the willing-relocation of agricultural properties (45 parcels, 525 ac.)
4. Easements (303 parcels, 815 ac.)

In 2017 dollars, creating space for the South Fork Newaukum River at a 100-year flood stage would cost between \$58 million and \$120 million. This type of investment would have lasting beneficial effects on both local flood conditions and downstream flooding. More information about national programs for floodplain property acquisition are provided below as examples to illustrate the feasibility of this approach.

## Federal Resources for Community Commitments to Pursue Buy-Outs

- ▶ The federal government shares responsibility for flood recovery and there is increasing interest in assisting state and local governments with reducing community flood risk. A comprehensive list of federal flood resilience and risk reduction assistance programs is provided in a recent 2019 Congressional Research Service report, <https://crsreports.congress.gov>, report number R45017.
- ▶ Repetitive Loss Program: Using FEMA’s Cost-Benefit Calculator, “beneficial” actions for repetitive loss properties (more than 1 FEMA insurance claim) can be identified. This opens up funding opportunities and reduces community insurance premium costs (including for floodplain residents).
- ▶ Hazard Mitigation Grant Program: This program funds buyouts for homes and businesses that meet the cost-benefit ratio. <https://www.fema.gov/hazard-mitigation-grant-program>
- ▶ The federal government is increasingly pushing for communities to commit to buy-out programs in chronic flood-prone areas (Mach et. al 2019). In a recent federal policy change, funding partially administered by the U.S. Army Corps of Engineers for flood protection and climate adaptation can be contingent on local governments agreeing to use eminent domain to purchase properties whose owners are unwilling to voluntarily sell: <https://www.nytimes.com/2020/03/11/climate/government-land- eviction-floods.html?action=click&module=Top%20Stories&pgtype=Homepage>.
  - This decision by the federal government supports past observations that many individuals residing in highly hazard prone areas are unwilling to invest to reduce future losses (Mileti 1999).

## Example Actions for Purchase of Flood Prone Properties

- ▶ Establish funding for immediate acquisition of flood prone properties that come up for sale.
- ▶ Develop preliminary criteria for prioritizing acquisitions. In many locations, the current cost of floodplain land acquisition is 3 to 5 times less than future flood damages (Johnson et al, 2020).
- ▶ Moving residents, businesses and infrastructure to safe ground:
  - Establish outreach program to assist landowners who want to stay in community but move out of flood prone areas.
  - For agricultural operations that would entail finding high ground with attributes needed for their operations, such as appropriate soils, topography, water supply and transportation access. This may entail site improvements associated with converting a previous land use.
  - Ensure adequate services and access to I-5 and state highways in plans for relocation of businesses such as manufacturing, distribution (warehouses) and retail.
  - The concerns of key stakeholders, such as cities and Ports of Chehalis and Centralia that have experienced past flood damages and have constraints on new development due to flooding, could be addressed through necessary legislative actions and land acquisitions needed to allow them to achieve economic development outside flood prone areas.

## Examples Plans and Analyses for Purchase of Flood Prone Properties

- ▶ Managed retreat from increasingly hazardous areas, such as the purchase of flood prone property, will become an unavoidable situation as climate change effects intensify (see Jay et al, 2018 in <https://nca2018.globalchange.gov/>) and locally-driven buyout planning and implementation may inadvertently become focused on socially vulnerable populations rather than focusing on larger contiguous properties or other, more systematic, land acquisition approaches (Mach et al. 2020).

- For example, in Charlotte-Mecklenburg, NC, Stormwater Services is limiting construction in flood hazard areas and buying out properties that become greenways and parks that benefit local communities and increase home values which offset losses to tax base from purchased properties (Mazur 2019).
- ▶ Cost-Benefit analyses have demonstrated that establishing fluvial flood corridors provide a net gain, as illustrated by the “Room for the River” project implemented in the Netherlands by the Dutch government (Brouwer and van Ek 2004, Mechler et al. 2014).
- ▶ Local government action guides exist which provide detailed guidance and resources for developing a floodplain acquisition program which maximizes ecological benefits and minimizes risk as projects are planned and completed (ELI 2017.)

## Floodproofing and Agroforestry

Flood proofing involves local structural actions such as raising structures above flood elevations or equipping the structure to withstand flooding (wet floodproofing). In situations where a structure cannot be moved or an owner is unwilling to relocate, this can provide the best means of reducing the costs of flood damages (e.g., Czajkowski et al. 2012).

The OCB has an ongoing program for floodproofing that appears to be successful, including wet floodproofing for many structures within the urban areas and construction of critter pads for farms in flood-prone areas. Building on these successful programs would be an important part of a local actions program.

Because of the substantial flood impacts to farmland, floodproofing elements should extend to technical and financial assistance to enable agricultural landowners to adapt operations to function within a flood-prone setting. There are many local, national and international examples of agriculture systems that function well in flood-prone areas. These systems tend to:

- ▶ incorporate perennial crops (i.e. tree fruits and nuts, berries),
- ▶ emphasize a vertical structural component absent from most annual cropping systems,
- ▶ incorporate more than one crop type and sometimes numerous crops, growing in conjunction

“Agroforestry” is a term often used to describe robust, vertical, and diverse farms. The benefits of agroforestry practices are more typically focused around economic and ecological diversity, rather than flood resilience. However, in the Western Washington region, specialized work has been done by conservation districts and counties to show that agroforestry principals, specifically structural and layout principles, can have a positive impact where flooding is an issue – namely as buffering and protective structures that also produce cash crops (Dittbrenner et al., 2015). A detailed synopsis of flood-friendly farming practices in Western Washington can be found in Appendix 4 of Abbe et al. 2020.

## Land Use Management and Local Community Resiliency

As acknowledged in the DEIS, if built, the FRE would likely stimulate new development in floodplain areas (DEIS Section 5.7.3 and Appendix G, page G-49), which undermines building resiliency in the Chehalis Basin. A Local Actions Program would build resiliency into the community by protecting designated necessary or critical land uses in the floodplain against all flooding (not just major flooding) and encouraging other growth to shift to upland areas. New development in upland areas will create safer communities, resilient against the chronic flood damage that has plagued the area all of its developed history. Improved infrastructure would also provide jobs and more security.

The core of a Local Actions Program would be effective regional land use management planning consistent with the goals of the Chehalis Basin Strategy to reduce flood damages and improve aquatic habitat. Land use management must consider a variety of factors, not just flood hazards and aquatic habitat, but also economic and community effects.

Another key component of a Local Actions Program would be strategies that allow for and explicitly support local economic development. For example, the core mission of the Ports of Chehalis and Centralia is economic development which can include expansion of its hinterland to new areas (e.g., Rodrigue et al. 2013). Flood hazards directly impact large portions of their land holdings and thus motivate finding solutions to reduce their exposure to flooding.

A viable Local Actions Program can directly address the need for local economic development, either with local structural solutions such as levees, floodwalls and pumping stations, or by expanding the Ports' land holdings to areas with no flood hazards as has been done elsewhere in the state. For example, the Port of Tacoma acquired a 200-hectare property about 20 km south of existing port terminals where they developed a major industrial park which has numerous manufacturing facilities such as Boeing, Toray Composites, Medallion Foods and Ikea ([http://www.worldportsource.com/ports/review/USA\\_WA\\_Port\\_of\\_Tacoma\\_190.php](http://www.worldportsource.com/ports/review/USA_WA_Port_of_Tacoma_190.php)). Similarly, the Port of Skagit expanded its real estate with a 123-acre industrial park located near I-5 in a non-municipal Urban Growth Area (<http://www.portofskagit.com/media-center/news/port-of-skagit-expands-industrial-land-holdings-on-bayview-ridge/>). With support from the OCB and state legislature, challenges to expanding Port holdings to new upland areas accessible to the I-5 corridor could be met, which would allow goals for economic development to be met while removing flood hazard liabilities and minimizing environmental impacts, even producing net benefits where floodplain properties can be restored.

Land use planning approaches to flood damage reduction are supported by federal programs for climate resilience, hazard mitigation assistance, and others. There are numerous executive orders and policies which support climate resilient communities and infrastructure including:

- ▶ The President's 2015 Opportunity, Growth, and Security Initiative (OGSI);
- ▶ Executive Order 13653 Preparing the United States for the Impacts of Climate Change;
- ▶ the President's 2013 Climate Action Plan;
- ▶ FEMA's Climate Change Adaptation Policy;
- ▶ and the 2014-2018 FEMA Strategic Plan.

These policies and initiatives promote a process to identify the risks and impacts on community resilience to natural hazards associated with climate change, and direct Federal agencies to support climate resilient infrastructure, including a Hazard Mitigation Assistance (HMA) program by FEMA, which provides funding for flood mitigation strategies rooted in restoring ecological process and function. *Source:*

[https://www.fema.gov/media-library-data/1487161136815-ecad1c0312eda2111ffa28735a4d06ad/FSR\\_Fact\\_Sheet\\_Feb2017\\_COMPLIANT.pdf](https://www.fema.gov/media-library-data/1487161136815-ecad1c0312eda2111ffa28735a4d06ad/FSR_Fact_Sheet_Feb2017_COMPLIANT.pdf)

## Environmental Restoration

The proposed FRE has significant and unmitigable environmental impacts and directly conflicts with the goal of the Chehalis Basin Strategic to improve aquatic habitat (see Cascade of Ecosystems Effects Technical Memo).

A Local Actions Program would be completely compatible with the Aquatic Species Restoration Plan (ASRP). Buyouts and relocations would open up large areas of floodplain for restoration and sustaining the natural processes such as flooding and channel migration that support ecosystems services and resilient fish and wildlife populations. These outcomes also support vibrant urban communities, as numerous recent studies have shown

the economic payback for cities embracing natural elements within the urban setting (Elmqvist et al., 2015). Local structural actions supported by a Local Actions Program could have environmental impacts (as repeatedly noted in the DEIS), but they would be highly localized and mitigated in both scale and consequence by the overarching environmental benefits of buyouts and relocations on the river, its floodplain, and habitats.

## Economic Development Considerations

The proposed FRE is very expensive and will economically benefit only a small number of local residents over a short period (i.e. during the anticipated ~5-year construction period). Much of the work is specialized and would likely be done by large contractors from outside the area. The FRE will be expensive to maintain and someday need to be replaced or removed at a much higher cost than its initial construction.

A Local Actions Program will also be expensive but will have dramatically different economic effect to the benefit of local communities. Buyouts would send money directly to local residents. Relocations would improve living conditions for those involved and stimulate new development in upland areas that would benefit local businesses and economies. A Local Actions Program would directly address economic development to ensure the Cities and Ports of Chehalis and Centralia can pursue development and job creation in upland areas that do not conflict with environmental goals and Treaty rights. Restoration of floodplain buyout and relocation areas will provide local contractors jobs, as has been demonstrated in restoration projects throughout the Pacific Northwest (Neilsen-Pincus and Moseley, 2010). Local structural solutions and flood proofing will also provide economic stimulus to local communities since local contractors will be more competitive than the large infrastructure contractors likely to build the FRE.

## Comprehensive Strategic Plan Development for Prioritizing Actions

The DEIS presented the LAA as an ad hoc attempt to aid over 1,300 valuable structures with flood damage reduction. Successful implementation of the LAA would require a comprehensive strategic plan for prioritizing actions and coordinated oversight/administration for delivering the appropriate flood damage measures at a site scale over a large area. The DEIS fails to demonstrate how the Office of the Chehalis Basin (OCB) would manage and lead a basin-wide LAA. This omission demonstrates that the DEIS, OCB have not given the LAA any serious consideration. The DEIS also fails to acknowledge the fact that OCB has begun development of this program through its CFAR program. To be most effective, such a strategic plan would need to include the following elements:

- 1) Complete comprehensive flood and erosion hazard mapping throughout Chehalis Basin, building upon existing work. Rank areas based on probability of flood and erosion damages along with potential for habitat restoration.
- 2) Develop a specific plan for implementing LAA elements/actions, including metrics for reducing flood damages and short-and long-term funding estimates:
  - a. Buyouts
  - b. Relocations (including new development in suitable locations)
  - c. Local flood protection projects
  - d. Flood proofing
  - e. Floodplain water storage
- 3) Develop a prioritization plan for local action elements above.
- 4) Prepare plans in cooperation with FEMA and Federal Government for taking actions consistent with the Local Actions Alternative in response to future catastrophic floods that result in federal emergency declaration (e.g. acquisition, relocation, local flood defenses or flood proofing).

## EXAMPLES OF AREA-SPECIFIC CHEHALIS BASIN STRATEGIES UNDER A LOCAL ACTIONS PROGRAM

In the following sections, we describe the limited flood damage reduction benefits of the proposed FRE and offer examples of area-specific strategies for applying these Local Actions Program elements in the Chehalis Basin. We use the late-century DEIS-defined catastrophic flood, which represents the most extreme scenario evaluated in the DEIS (but see Hydrology 2 technical memo regarding issues with DEIS integration of climate change projections). In the figures below, the entire floodplain area shaded in color illustrates the area inundated during late-century catastrophic flood of 75,100 cfs according to the hydraulic modeling done for the DEIS. Yellow shading indicates areas projected in the DEIS to experience reduced depths of flooding with the Proposed Project; blue shading indicates areas which would still be flooded with the Proposed Project. We used the 2016 Lewis County 'structures' dataset, which represents most of the buildings in the FEMA 500-year floodplain, to determine the number and type of valuable structures which are projected to experience reduced depths of flooding with the Proposed Project, and then describe how a viable Local Actions Program could accomplish flood damage reduction for these same areas.

### Proposed FRE Site Downstream to South Fork Chehalis River Confluence

According to the hydraulic modeling done for the DEIS, the areas which are projected to experience reduced flooding with the Proposed Project are primarily farmland and rural homes, with pockets of protection also provided to the community of Dryad (see Figure 2). Modeled flood depths in this reach are more than 10 feet in many locations in the channel and floodplain flow velocities may be high in areas, making conditions especially unsafe and damaging to humans and human infrastructure. The Proposed Project would result in reduced flooding for 137 rural homes. Local Actions Alternative measures in this reach would need to accomplish protection or purchase of these buildings. Specific actions could also include the following:

- ▶ A fire station is identified near the Meskill area; this would likely need to be relocated to safe ground.
- ▶ Church and other commercial structures in Dryad area could be elevated or relocated.
- ▶ The 137 rural homes within the 'no longer flooded' area could be accommodated on a case-by-case basis; Local Actions Program would consider flood proofing such as farm pads, home elevation and vegetated riparian corridors to inhibit fast-flowing water, sand and debris from damaging farm fields. Farm adaptations to flood tolerant crops could be considered by landowners staying in place. Buy-outs and relocation would also be evaluated.
- ▶ State Route (SR) 6 is inundated for sections along this reach even with the Proposed Project; alternate flood routing is needed along with emergency evacuation plans during flood periods.

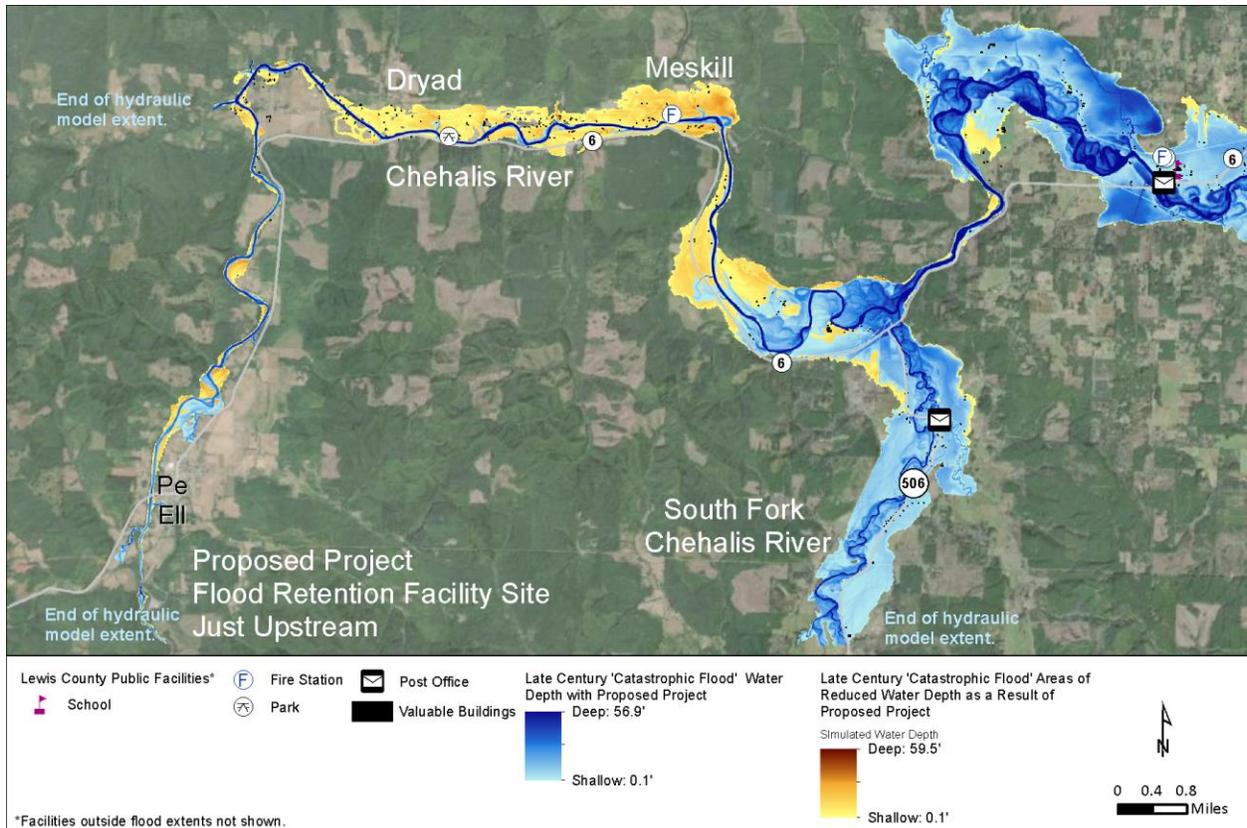


Figure 2. DEIS hydraulic model results showing depth of flooding for late-century DEIS-defined ‘catastrophic flood’ of 75,100 cfs, from proposed FRE facility site, downstream to confluence of Chehalis River with South Fork Chehalis River. The model simulates flooding in all shaded areas. Yellow shading indicates areas which would experience reduced flood water depths as a result of the Proposed Project.

## Confluence with the South Fork Chehalis River Downstream to the Newaukum River Confluence

According to the hydraulic modeling done for the DEIS, flood flow from the South Fork Chehalis River significantly reduces the effectiveness of the Proposed Project at eliminating flooding (see Figure 3). The small areas experiencing reduced flooding under the late-century catastrophic flood are farmland and include reduced flooding of approximately 76 rural homes. Overall, the modeled late-century catastrophic flood extents included 380 valuable buildings still flooded with the Proposed Project. SR6 remains flooded for most of its length through this reach with the Proposed Project. Similar to the reach above, a Local Actions Program would consider farm adaptation, flood proofing along with buyouts and relocations. Upland land acquisition for relocations would consider the area between the Newaukum River and Stearns Creek, along with the Napavine area south of the Newaukum along I-5.

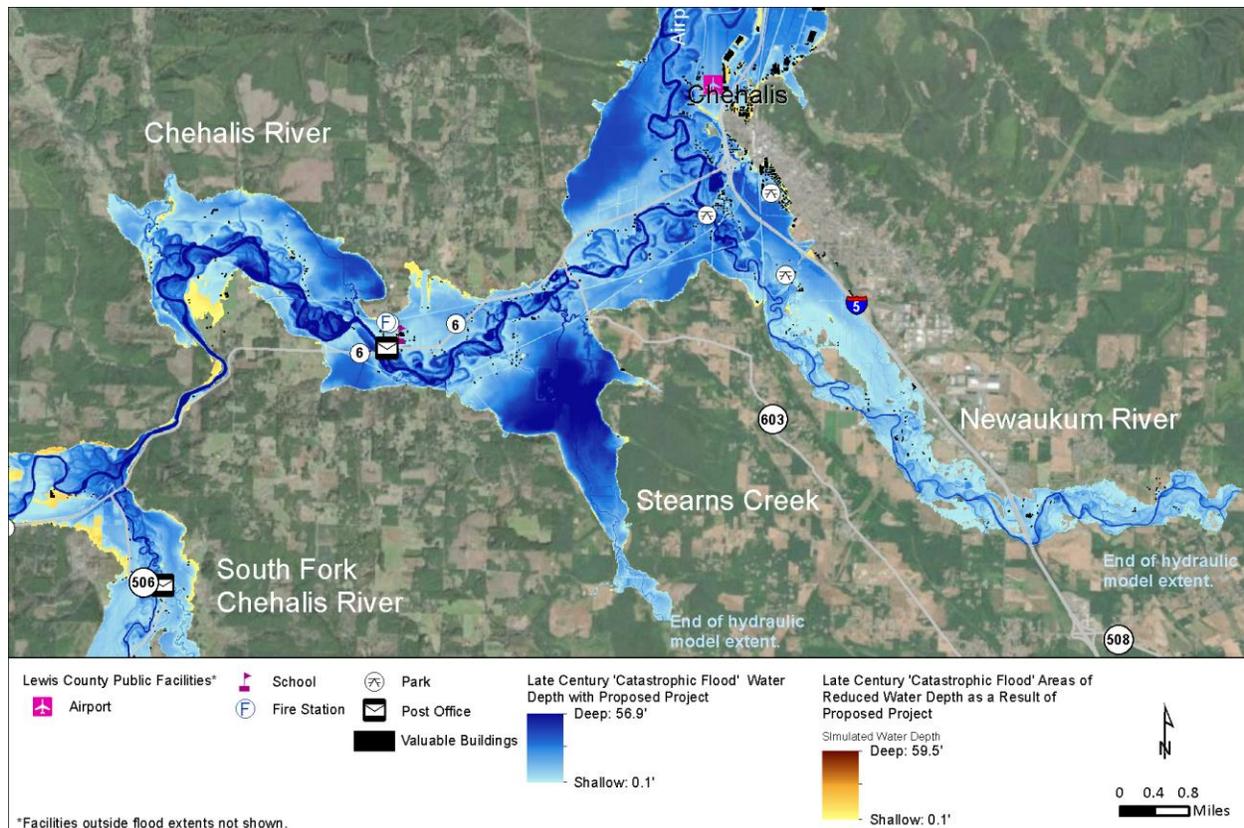


Figure 3. DEIS hydraulic model results showing depth of flooding for late-century DEIS-defined 'catastrophic flood' of 75,100 cfs, from confluence of Chehalis River with South Fork Chehalis River, downstream to confluence of the Chehalis River with Newaukum River. The model simulates flooding in all shaded areas. Yellow shading indicates areas which would experience reduced flood water depths as a result of the Proposed Project.

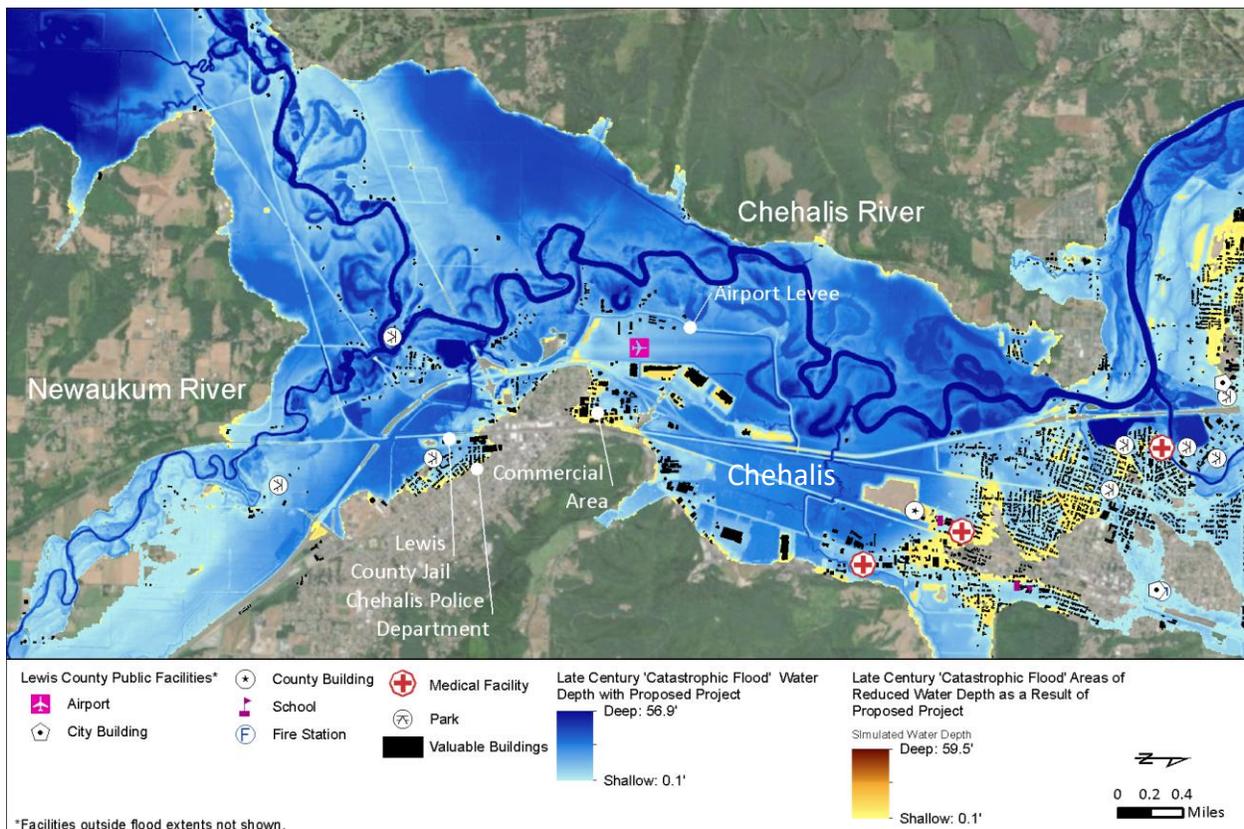
## City of Chehalis, and Vicinity, including Airport Levee

According to the hydraulic modeling done for the DEIS, the City of Chehalis receives very little benefit from the Proposed Project (see Figure 4). A narrow band near the Lewis County offices is projected to experience reducing flood depths, however the Lewis County Jail appears to still flood with water depths approximately 2+ feet. Overall, the Proposed Project would result in reduced flooding for approximately 72 rural homes.

Further north within the City, a commercial area including Plaza Jalisco, Once Upon A Thyme, Tractor Supply Co., NC Machinery, Chehalis Centralia Vet Hospital, State Avenue Auto & Muffler, Sorenson Transport, H&H Classic, H&H Classic Cars, and Moerke Drilling is projected to experience reduced flooding with the Proposed Project. However adjacent areas to the northwest remain flooded. The DEIS fails to explain where this flooding originates from, and if it is backwater from the Chehalis River, whether alternate structural measures such as raising existing levees, and/or constructing new floodwalls and pump stations could protect this entire area of Chehalis from all levels of flooding. This should be evaluated as part of the LAA along with elevation/relocation/floodproofing structures in this area.

In the Airport Levee area, several retail businesses are projected to experience reduced flooding with the Proposed Project, including Walmart, Grocery Outlet, Home Depot, I-5 Toyota, and Les Schwab. The Chehalis Regional Water Reclamation Facility is not projected to experience flooding with or without the Proposed Project.

The DEIS dismisses the Airport Levee as being a viable component of the LAA because it would increase flood levels in surrounding areas unless coupled with the proposed FRE facility. The DEIS fails to explain the extent of that flood level increase (where and how much), and also does not explain that there is a standard FEMA process for authorizing flood level increases from such structures. Essentially, the impacted landowner needs to accept the consequent rise in flood levels; this can be negotiated through easements, land purchase, or construction of compensatory flood storage. If the Airport Levee were constructed in the absence of the FRE facility, it is likely that most of the flood rise would affect rural land. Under a LAA, the local government could pursue a process whereby any consequent flood level increase in these rural lands would be negotiated with land owners and ultimately authorized. A Local Actions Program would also consider strategic buyouts and relocations, particularly with respect to considering options for new development in safe areas of the I-5 corridor south of Chehalis to facilitate relocations, including options for the City and Port of Chehalis.



**Figure 4. DEIS hydraulic model results showing depth of flooding for late-century DEIS-defined 'catastrophic flood' of 75,100 cfs, from confluence of Chehalis River with Newaukum River, downstream to City of Chehalis, including the Airport Levee. The model simulates flooding in all shaded areas. Yellow shading indicates areas which would experience reduced flood water depths as a result of the Proposed Project.**

### River Reach: City of Centralia and Vicinity, East of Interstate 5

According to the hydraulic modeling done for the DEIS, the residential and commercial areas within the City of Centralia would see the greatest reduction in flooded areas (see Figure 5). However, the DEIS did not evaluate the flood risk to this area comprehensively (i.e. it did not evaluate flooding related to Salzer and/or China Creeks). The failure to do a comprehensive flood risk analysis renders the public and decision makers unable to evaluate whether the identified areas will actually receive the depicted benefit or would be left vulnerable to flooding from a different source.

Areas projected to experience reduced flooding with the Proposed Project include commercial and residential areas along Kresky Ave, Grand Ave, and S. Gold St. between Fair Street and E. Union and then extending further north and west of the railroad tracks to E Summa Street. There is also a pocket of protection south of China Creek, east of I-5 and north of Alder Street and another pocket of protection north of China Creek. Significant public facilities in this area include Jefferson Lincoln Elementary School, the Centralia School District Transportation Facility and a few churches. It is unclear whether Centralia College would receive a flood-reduction benefit. There is also a pocket projected to experience reduced flooding with the Proposed Project at the mouth of Salzer Creek (north side). Much of this area is likely also subject to flooding from Salzer Creek, China Creek, and potentially the Skookumchuck River, however as discussed earlier, since the DEIS failed to evaluate risk from tributary sources, this vulnerability to flooding from the creeks is not evaluated.

Because of its chronic historical flood vulnerability, this area has been the subject of numerous flood studies and benefit evaluations, including the 2013 Loss Avoidance Study (State of Washington Military Department, 2013) which evaluated the benefits from 24 home elevations mostly in this area of Centralia. The DEIS failed to reference this study or use it to help inform the LAA. Some of the key conclusions and recommendations from that study were:

- ▶ In Centralia, updated flood estimates may greatly raise the level of flood risk, with significant increases in the elevations of the 100-year and other flood events.
- ▶ Updated flood risk estimates typically result in higher flood estimates because of increasing development, sedimentation in the channel and channel migration, and other common trends.
- ▶ “Floods greater than the 100-year flood, such as the December 2007 flood of record, can and do occur.” Elevated homes may still be damaged during these events but, to a much lesser extent than if they were not elevated. For example, \$4.8 million dollars in losses were avoided during the 2007 flood event for the 24 homes in the study. The pre-elevation flood losses to these homes added up to \$5.8 million, whereas post-elevation flood losses were reduced to \$1.0 million
- ▶ This study recommended elevating homes more than 2 feet above the 100-year flood elevation, or elevating to the > 1 foot above the flood of record, whichever is greater.
- ▶ Even if elevated, homes in flooded areas will experience some unavoidable residual flood risks, such as silt and mold.

Floodwalls, levees, flood gates, and pump stations could be particularly effective in reducing flood damage in Centralia. A Local Actions Program would also consider strategic buyouts and relocations, particularly with respect to considering options for new development in safe areas of the I-5 corridor north of Centralia to facilitate relocations, including options for City and Port of Centralia. A Local Actions Program would build upon work the City of Centralia has already begun on China Creek to increase flood storage and reduce flooding in the city.

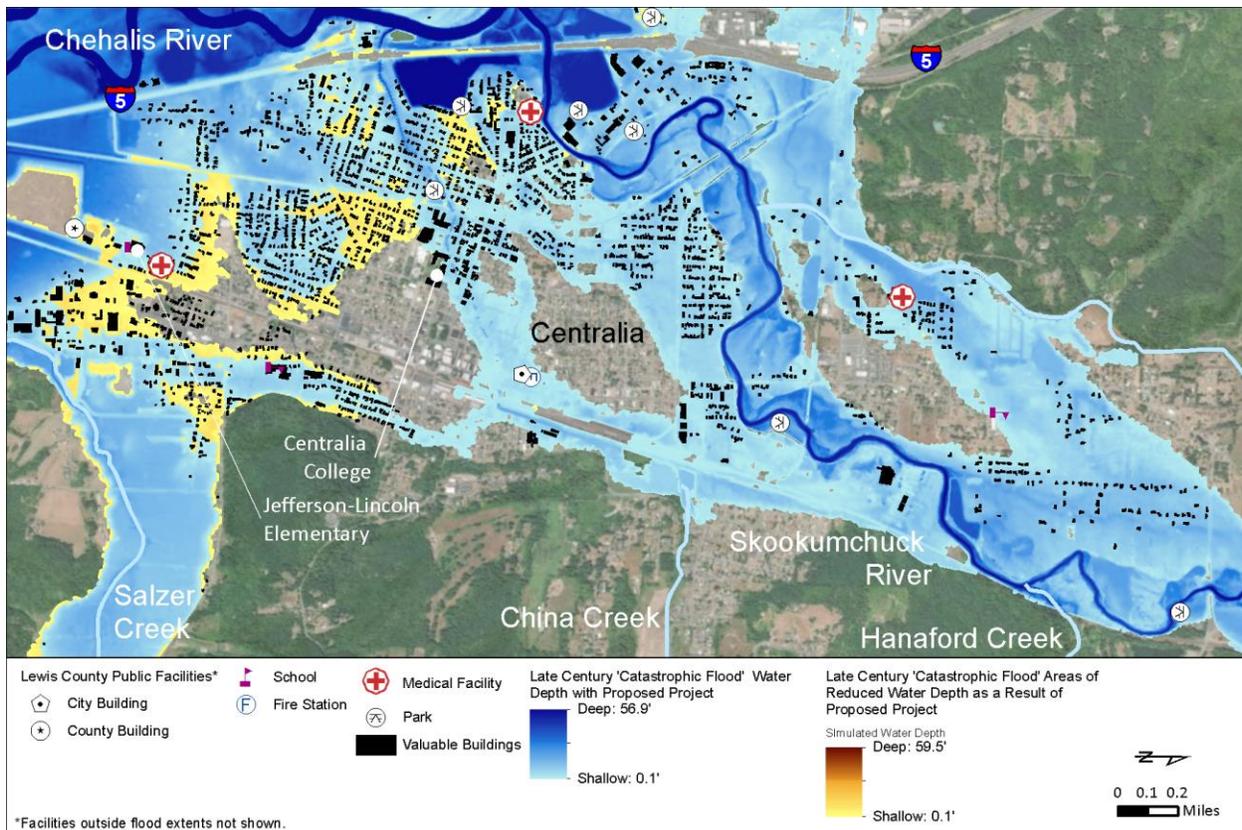
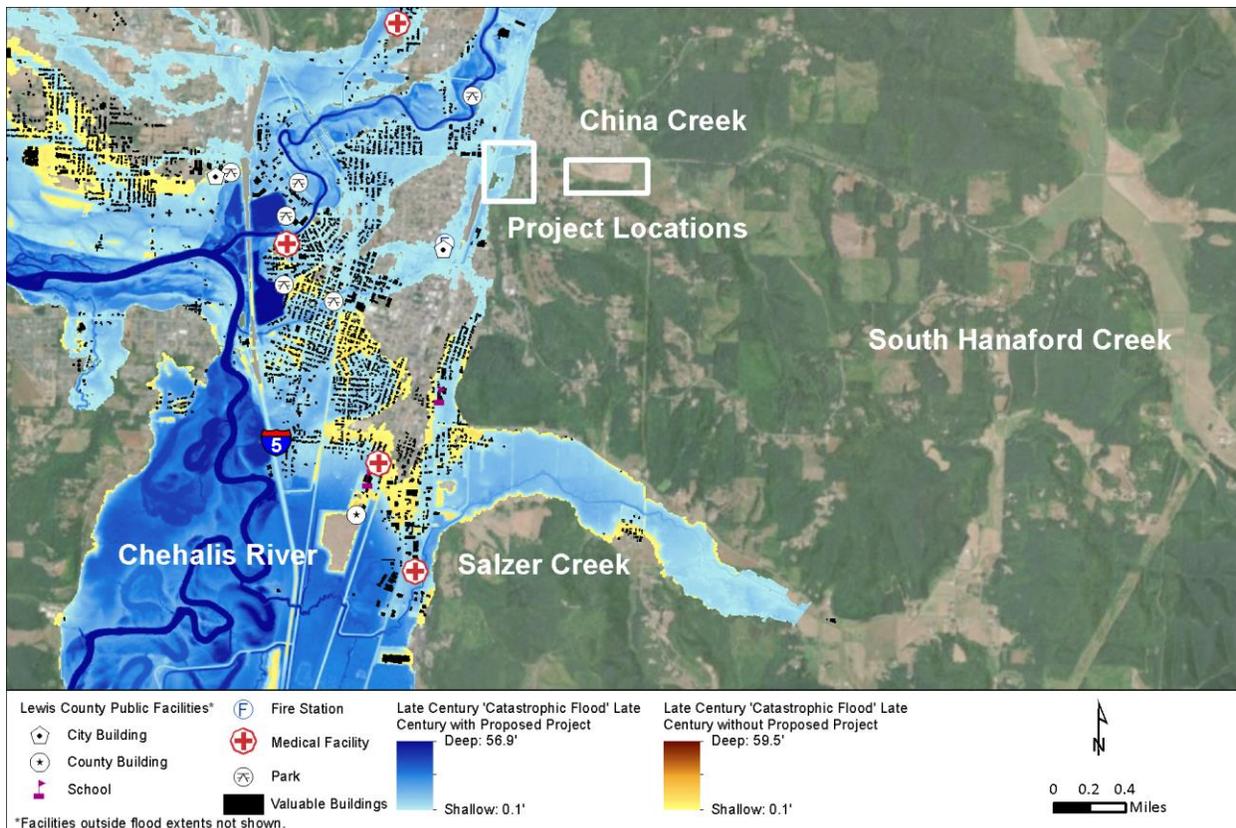


Figure 5. DEIS hydraulic model results showing depth of flooding for late-century DEIS-defined ‘catastrophic flood’ of 75,100 cfs, for City of Centralia, east of interstate 5 (I-5). The model simulates flooding in all shaded areas. Yellow shading indicates areas which would experience reduced flood water depths as a result of the Proposed Project.

The DEIS also failed to describe benefits from increasing floodplain storage within the creek basins contributing to this area, even though this work is already actively occurring. The City of Centralia is implementing multi-benefit flood risk reduction and habitat improvement projects in the China Creek watershed that create connected floodplain storage upstream from the urbanized portions of the City. Phase 1 was constructed in 2019, and Phase 2 is planned for construction in 2020.

Because of the wide flat valleys that both China Creek and Salzer Creek flow through upstream from the downtown Centralia area, there is good opportunity for floodplain storage projects to dampen the flood impacts from these creeks (see Figure 6). In its funding application to the Chehalis River Basin Flood Authority for the China Creek project, the City stated that *“Delaying the peak flow runoff from the upper basin (approximately 70% of the watershed, generating 40% of the runoff flow) will allow China Creek to transport runoff from the urbanized middle basin (approximately 15% of the watershed, generating 50% of runoff flow), reducing the frequency and/or intensity of flooding in downtown Centralia. The benefits of the project include reduced/eliminated flooding of downtown businesses, preserving access along main travel corridors for emergency vehicles and the public, improved emergency response time during flood events and new/improved fish habitat.”* (City of Centralia, 2016).



**Figure 6. DEIS hydraulic model results showing depth of flooding for late-century DEIS-defined ‘catastrophic flood’ of 75,100 cfs, showing China Creek and Salzer Creek. The model simulates flooding in all shaded areas. Yellow shading indicates areas which would experience reduced flood water depths as a result of the Proposed Project. White boxes depict general location of flood storage restoration projects along China Creek intended to reduce flood damages in the city.**

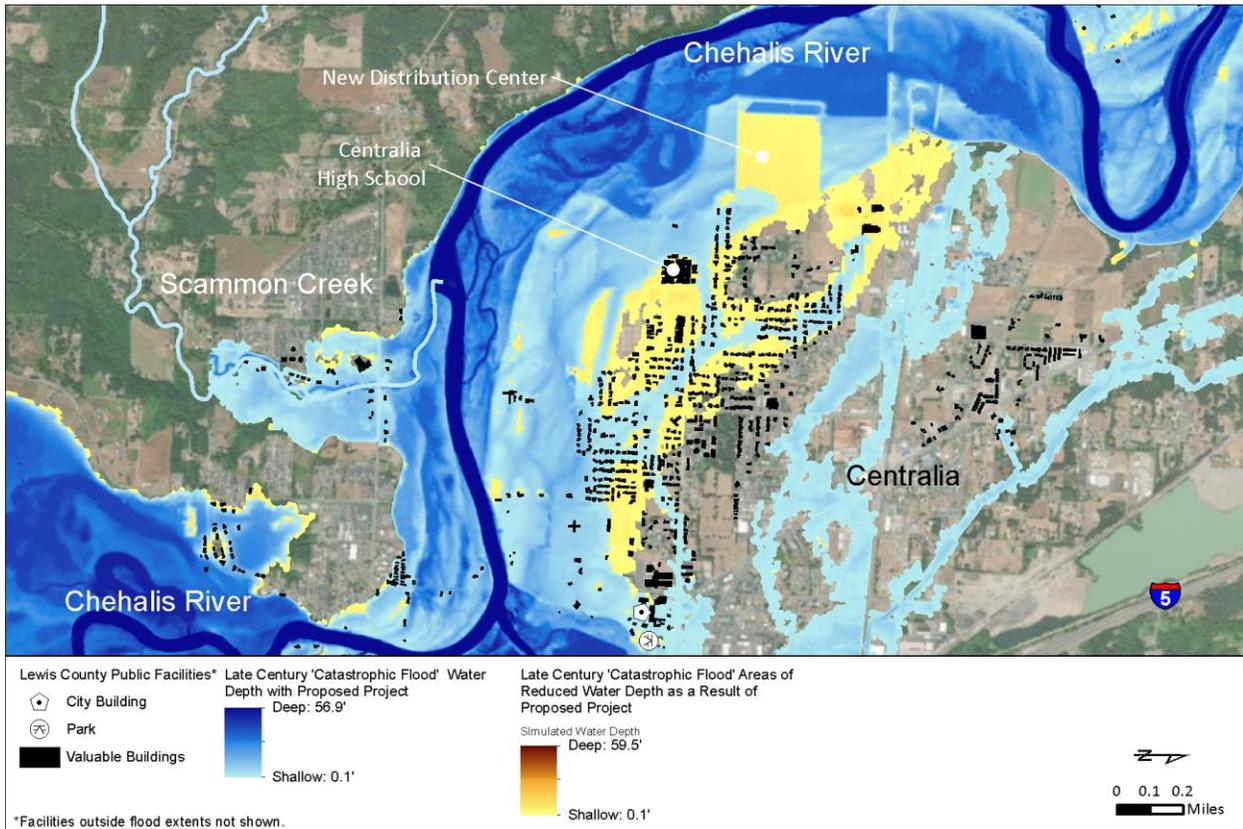
In the recent 2020 Restorative Flood Protection Study of the Chehalis watershed, the rivers and floodplains with low gradients, less than 0.003 ft/ft, represent locations with the greatest opportunity to attenuate large flood peaks (Abbe et al., 2020). The Chehalis River valley in the Cities of Centralia and Chehalis has a gradient of 0.00014 ft/ft, indicating that this area once helped to reduce downstream flood peaks, which is consistent with historical accounts by early homesteaders. Restorative flood protection benefits of these broad shallow river valleys have not been studied, perhaps due to current development patterns. Prioritizing buy-outs based off of natural flood protection benefits of key areas has also not been conducted to date. A Local Actions Program could further investigate such low-gradient areas for flood peak attenuation and prioritized buy-outs.

### City of Centralia and Vicinity, West of Interstate 5

According to the hydraulic modeling done for the DEIS, the areas projected to experience reduced flooding with the Proposed Project west of I-5 in Centralia and unincorporated Lewis County include some commercial areas (although not the outlet mall commercial area, potentially Centralia High School, Centralia Community Church of God, and some open space and farm land south of Galvin Road (see Figure 7). Overall, the Proposed Project model results indicated flood reductions for approximately 209 valuable buildings for the late-century DEIS-defined ‘catastrophic flood’ of 75,100 cfs.

A Local Actions Program would consider including flood defensive measures such as levees or floodwalls to protect more highly developed areas and the high school along with other floodproofing options. Buyouts and

relocation would be considered for some areas, along with promoting new development in areas outside flood inundation areas.



**Figure 7. DEIS hydraulic model results showing depth of flooding for late-century DEIS-defined ‘catastrophic flood’ of 75,100 cfs, for City of Centralia, west of interstate 5 (I-5). The model simulates flooding in all shaded areas. Yellow shading indicates areas which would experience reduced flood water depths as a result of the Proposed Project.**

## Areas Downstream from Centralia

According to the hydraulic modeling done for the DEIS, the areas projected to experience reduced flooding with the Proposed Project include pockets of rural home and farmland near Rochester and straddling Hwy 12 west of Rochester, a few large farms such as Black River Blues blueberry farm, significant portions of downtown Oakville, and small areas in and around Elma and Montesano, mostly undeveloped land (see Figure 8).

Overall, the Proposed Project DEIS hydraulic model results indicated flood reductions for approximately 243 valuable buildings for the late-century DEIS-defined ‘catastrophic flood’ of 75,100 cfs. A Local Actions Program in this area would focus on farm adaptation, floodproofing (raising structures, critter pads, and riparian buffers to limit flood debris damages), buy-outs, relocation and flood plain restoration to provide flood storage and restore aquatic habitat.

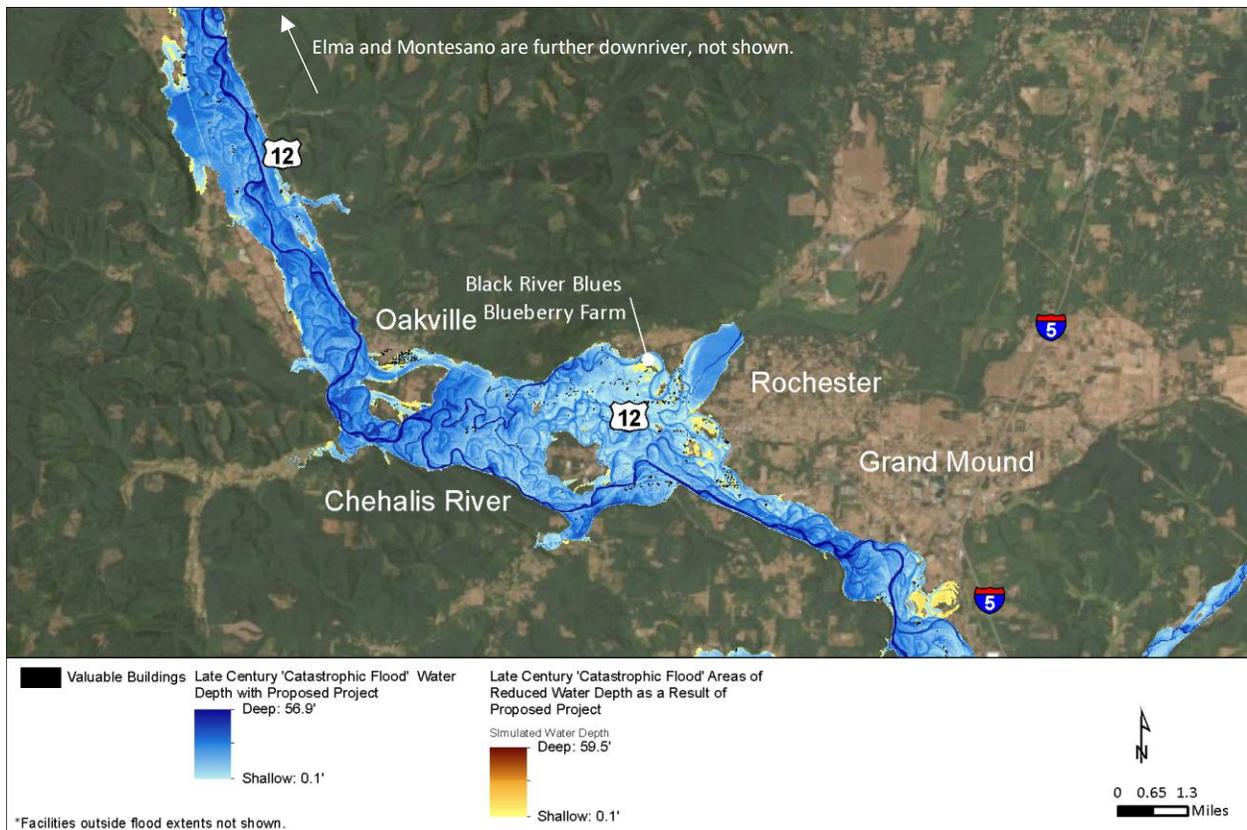


Figure 8. DEIS hydraulic model results showing depth of flooding for late-century DEIS-defined ‘catastrophic flood’ of 75,100 cfs, for areas just downstream from City of Centralia. The model simulates flooding in all shaded areas. Yellow shading indicates areas which would experience reduced flood water depths as a result of the Proposed Project.

## CONCLUSIONS

A viable Local Actions Program offers the best way to achieve the stated objectives of the DEIS. Such a program would also holistically support the dual goals of the Chehalis Basin Strategy to reduce flood damage and restore aquatic species habitat. Based upon the enormous unmitigable impacts concluded by the DEIS for the Proposed Project, it is clear that a large-scale flood damage reduction strategy comprised of the proposed FRE facility, combined with mitigating actions will not deliver secure and significant flood damage reduction for basin residents. The OCB must therefore put its energy and resources toward developing a Local Actions Program that truly addresses flood and erosion damage for all basin residents without irreparably harming the basin's aquatic species and endangering tribal treaty rights.

The Local Actions Alternative as presented and evaluated in the DEIS is inadequate. It does not:

- ▶ consider the need to address flood and erosion risks from sources other than severe storms focused in the Willapa Hills
- ▶ identify and describe specific options for addressing flood risk in different settings throughout the basin such as rural and urban areas, or from different flooding sources that exist particularly in Centralia.
- ▶ describe the magnitude of specific Local Actions that would likely be needed and compare that to existing programs where such efforts have already been undertaken to assess feasibility
- ▶ describe the need for a large-scale program, similar in scale of investment to the Proposed Project, through which local actions could be administered, or the many federal programs that are available to assist with such programs.

The lack of detail developed for the LAA deprives the public, agencies, and stakeholders of the information they need to evaluate the relative benefits and impacts between the Proposed Project and the LAA, and also deprives them of the ability to judge whether the LAA approach would be an acceptable alternative from the perspective of cost and community support. The DEIS indicates that 1,300 structures will no longer be flooded, most of these in the residential area of Centralia. However, this protection would only be provided from major/catastrophic floods (as defined by the DEIS). Assuming a cost of \$500,000 per structure for buy-out/relocation, all of these structures could permanently be removed from flooding for all flood conditions originating from all flood sources, including China Creek, and the Skookumchuck River for \$650 million, which is a similar scale to the reported cost of the Proposed Project.

In this memo, we have provided additional detail that should have been included in the DEIS to give a better basis for comparison of alternatives, including areas where levee, floodwall, flood gate/pump station flood defense options should be considered as part of an LAA, locations for floodplain storage opportunities, and various floodproofing options and buy-out programs, including the magnitude of available properties for potential buy-out right now. We have identified upland areas suitable for development where urban, suburban and rural residents and business could relocate, and provided examples of port expansions in other areas of the state that could be advanced in the Chehalis to support additional growth and development opportunities for the Port of Chehalis and Port of Centralia.

We have also provided reach-by-reach descriptions of the characteristics of structures and land uses the DEIS states would be receive flood relief from the Proposed Project, and the most likely options available to alternatively provide flood damage reduction for structures and lands within each reach under a Local Actions Program. Additional hydraulic modeling could better define a range of flood risks to which these site-specific flood defenses could be designed. The type of flood damage reduction actions that could be included in an LAA have the additional benefit of being synergistic between the dual goals of the Chehalis Basin Strategy, while the Proposed Project would result in profound, cumulative, and amplifying impacts on entire ecosystems.

The OCB has already initiated development of the LAA through its CFAR program, which the DEIS fails to acknowledge. If pursued in earnest, the CFAR program would deliver effective flood damage relief through flexible means, tailored to individual preferences and site-specific conditions for all levels of flooding, not just extreme floods. To date, more than \$50 million of state money has been spent developing the Proposed Project, while only approximately \$4 million has been invested in developing a LAA through the CFAR program. With a similar investment commitment, a Local Actions Program would provide a realistic means for the Chehalis Basin Strategy to achieve both flood damage reduction and habitat restoration and resiliency goals, simultaneously increasing the vitality and resiliency of this basin for all its communities, ecosystems, and species.

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