HOOD CANAL COORDINATING COUNCIL

HOOD CANAL LANDSCAPE ASSESSMENT AND PRIORITIZATION TOOL

Phase II Report

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Author: Jay L. Watson, PhD, Environmental Policy Matters, LLC

LAP Tool Technical Development Team: Gretchen Peterson, PetersonGIS, GIS Specialist and Team Lead
Naomi Kalman, Valley Spatial, Data Scientist
David Puckett, Bright Rain, Web Designer

HCCC Information: hccc.wa.gov and ourhoodcanal.org

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Summary: The Hood Canal Coordinating Council (HCCC) developed the Landscape Assessment & Prioritization (LAP) Tool to visualize environmental data, land use policies and projected future conditions; and explore relationships and causal connections between those data. It was also intended to explore the effectiveness of past, and help plan future, restoration projects, acquisitions, and land use policies. In this Phase II of the project, the refinement of existing data layers, as well as the addition of new data layers, have honed the LAP Tool to enable it to focus more specifically on the features and conditions which are most relevant to watershed health in general and salmon (summer chum) habitat.

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Executive Summary

The Landscape Assessment & Prioritization (LAP) Tool is a geographic information system (GIS)-based decision aid. It enables viewing of electronic maps on a webpage. Those views are built by adding various data layers over a base map of the Hood Canal and Eastern Strait of Juan de Fuca (HC&ESJF) watershed.

In its current configuration, **the LAP Tool is focused on the analysis of watershed health in general and salmon (summer chum) habitat.** It does this by applying the most relevant data available. These data consist of over 80 data layers which are grouped into three categories and overlay a **Base Map** with physical features, such as water bodies, roads, place names, etc. The substantive data categories are:

- ▷ **Current Ecosystem Conditions** (e.g., land cover, natural features & functions, salmon impediments & projects, etc.)
- ▷ **Land Use Policies & Management** (e.g., land use regulations, conservation easements, protected lands, etc.)
- ▷ **Future Priorities, Projections & Conditions** (e.g., climate change factors, priority habitats, priority habitat actions, etc.)

Those data come from government agencies, companies, nonprofit groups, and academic institutions, as well as data developed by the Hood Canal Coordinating Council itself.

The LAP Tool allows for a variety of approaches to those data, depending on the type of questions that are being asked or the issues being investigated, as well as the type of results that are desired. Those approaches include:

- ✓ **Visualization –** displaying one or more data layers as a snapshot of current conditions, at various scales.
- ✓ **Exploration –** ranging over various areas of the HC&ESJF in an unstructured fashion.
- ✓ **Hypothesis testing –** seeking causal connections between various states of the watershed and activities or conditions which might cause or contribute to those states.
- ✓ **Identification –** finding areas of concern which merit further diagnosis or investigation.
- ✓ **Projection –** looking at the landscape and projecting its current condition forward in time.
- ✓ **Definition –** focusing on, and describing in detail, an area and its present conditions.

In the future, the LAP Tool might be modified or augmented to address additional concerns, such as other ESA listed salmon species, other flora/fauna which are endangered or of concern, population growth, human wellbeing as it relates to the landscape, the additional impacts of climate change, etc. The types of problems or issues that the LAP Tool might be applied to in the future are only limited by the creativity of the user and the available data.

Ultimately, the paramount goal of the LAP Tool is to inform action by providing the best available data, and enabling the best analysis of those data. **Its conclusions are intended to help make resource allocation decisions as efficient and effective as possible, provide a basis for policy discussions and a justification for policy actions that may be taken.**

1. Introduction & Background

The Hood Canal Coordinating Council (HCCC) is a council of governments whose mission is to work with partners and communities to advance a shared regional vision to protect and recover Hood Canal's environmental, economic, and cultural wellbeing. The Hood Canal watershed comprises a large area, dissected by many local jurisdictions' boundaries. This creates a unique challenge for ecosystem recovery, where species and habitats ignore jurisdictional boundaries, but land use policies and land management activities have a direct impact on the landscape.

The HCCC Board of Directors envisioned a tool to compile and visualize a variety of land use and other data on the landscape, overlaying priority areas for habitat protection and restoration, in order to highlight the specific policy or conservation actions needed in precise locations. The development of the Hood Canal Landscape Assessment and Prioritization (LAP) Tool has been a longstanding priority action in HCCC's Integrated Watershed Plan (IWP) – the strategic priorities to recover Hood Canal's social-ecological system (learn more about the IWP at OurHoodCanal.org).

1.1. Pilot Phase

In the LAP Tool's initial Pilot Phase, HCCC set out to develop and test the concept at a reduced scale. Its goal was to develop the LAP Tool's conceptual approach to compile and analyze land use data in the Hood Canal region. HCCC piloted the tool to assess its utility and identify next steps for advancement. An advisory committee of local land use experts from the HCCC's member governments reviewed the tool to further guide its development to be able to inform planning efforts.

HCCC worked with a Geographic Information Systems (GIS) consultant (PetersonGIS) to build the LAP Tool. The Advisory Group suggested relevant data to include (land use, habitat, and other Hood Canal ecological data), and HCCC worked closely with the GIS analyst to incorporate their suggestions into the LAP Tool's design and build.

1.1. Phase II

This Phase II of the LAP Tool Project builds on the efforts in the Pilot Phase. It does this by focusing on the capacity to evaluate watershed health in general and salmon (summer chum) habitat in particular. Phase II emphasizes the incorporation of data layers that are particularly relevant to those two areas of attention.

This Phase II effort also refines the selection of LAP Tool data layers, as well as the data layers themselves, to further reflect the concerns of, and direction given by, the Advisory Group in the Pilot Phase. HCCC staff convened the Advisory Group during the Pilot Phase to obtain expert feedback, and recommendations for the following LAP Tool components:

- Conceptual approach/design
- Usefulness of the LAP Tool to member governments' planning efforts

- Prioritization criteria and an analytical approach for incorporating desired data inputs
- Pilot focus areas to prioritize for the LAP Tool's application
- Policy areas of focus and opportunities for habitat restoration, protection, and science-based tools to assist land use decision-making to align with Hood Canal IWP goals
- Objectives for the next phase of this effort

Advisory Group members were convened for a series of three meetings to share their perspectives on the above topics and to provide feedback on the LAP Tool as it was developed. Participants are shown in the following:

LAP Tool Advisory Group participants

HCCC Member Jurisdiction	Representative
Jefferson County	Patty Charnas, Director, Community Development
Kitsap County	Jim Bolger, Assistant Director, Department of Community Development Kathy Peters, Natural Resources Coordinator, Department of Community Development
Mason County	Kell Rowen, Planning Manager
Port Gamble S'Klallam Tribe	Paul McCollum, Natural Resources Director (HCCC board member)
Skokomish Indian Tribe	Dave Herrera, Policy Advisor (HCCC board member)

That direction included the need to understand that local governments have significant resource limitations to address environmental issues. With that context, they were hopeful that the LAP Tool would help them be as efficient with their efforts and actions as possible.

They also believed that a focus on protection as a primary principle was a more cost effective and efficient strategy than the restoration of degraded areas. That protection focus included emphasizing high priority habitats, undisturbed areas and undeveloped lands that might be developed in the future. It was hoped that the LAP Tool could help identify and prioritize areas for conservation and areas where potential future negative impacts might be avoided.

2. What is the LAP Tool?

The Landscape Assessment & Prioritization (LAP) Tool is a geographic information system (GIS)-based decision aid. It is essentially a webpage that provides a customized interface with the HCCC's GIS. It draws on, and displays, the most relevant data from that GIS to enable a person to construct and view electronic maps. The following figure depicts the LAP Tool process.

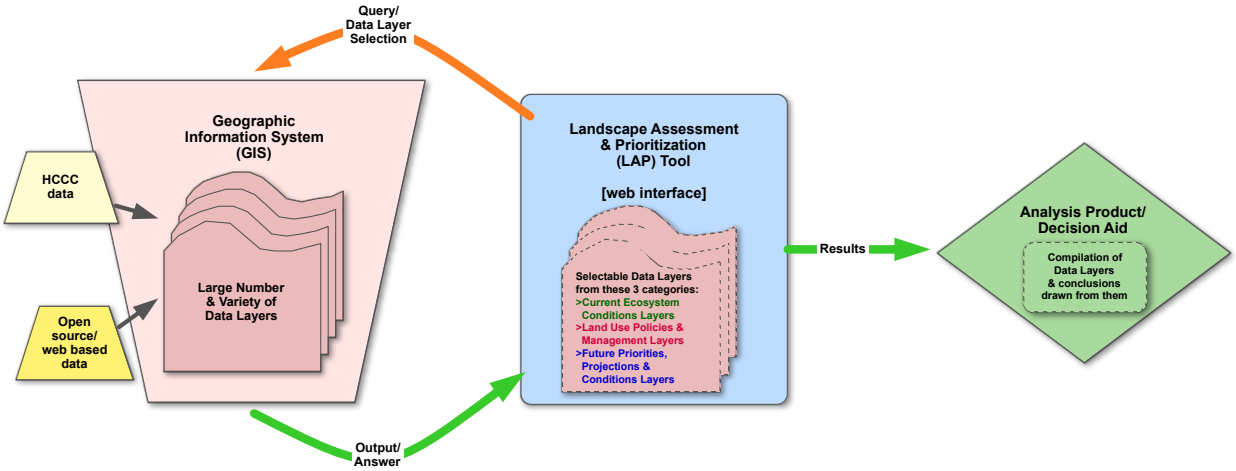

Figure 1. LAP Tool process graphic.

The LAP Tool is a purpose-built web-interface focused on watershed health and salmon habitat. It allows for the selection and display of data layers applicable to those issues. In building the LAP Tool, environmental, salmon biologist and land use experts reviewed and selected the data layers for inclusion based on their relevance to watershed health and salmon habitat. They drew from a mass of over 200 data layers currently housed in the HCCC's GIS. Some of those data layers were created by the Hood Canal Coordinating Council for its specific purposes (including for the LAP Tool), others are data sets that are publicly available from a variety of government agencies, companies, nonprofit groups, academic institutions, etc. The GIS that serves the LAP Tool is an ArcGIS online (AGOL) application (from Environmental Systems Research Institute, Inc. – I) with its data stored in cloud-based servers.

LAP Tool visualizations can be made by selecting various data layers for display on its webpage. Those visualizations can be exploratory – displays of single data layers of interest (e.g., prioritized summer chum habitat, etc.), or can test relationships – viewing multiple data layers which might be related (e.g., various land uses and riparian function, etc.). In addition to visualizations, more sophisticated hypothesis testing, and prioritization of areas and strategies for action, are also possible with the LAP Tool. Depending on their complexity, more effort could be required to construct those queries and more support may be needed from the HCCC's GIS Team to answer them.

The final step in the LAP Tool process would be to develop a product from its analysis. That product could take the form of a presentation of map views (active display of the LAP Tool with its webpage visualization, screen shots of its displays, printed maps, etc.). It could take the form of data compiled in tables, graphs, etc. It could also be in the form of a written report, describing the problem, issue, or question that the LAP Tool investigated, the methods that were used, the results that were obtained and any interpretation of those results. It could also contain conclusions, as well as possible courses of action, depending on the report's intended audience and their desires.

3. What Data are in the LAP Tool?

There are a variety of data layers which are selectable in LAP Tool. Those data layers are grouped into three categories, plus a **Base Map**, for ease of use. Those categories are:

- **Current Ecosystem Conditions**
- **Land Use Policies & Management**
- **Future Priorities, Projections & Conditions**

When opening the LAP Tool webpage, the first thing that is displayed is the Base Map. It is always visible and is the base onto which the variety of selectable data layers in the LAP Tool can be added. It works as an automatic background and cannot be deselected (turned off). The other three categories contain the selectable data layers and form the analytic heart of the LAP Tool.

3.1. Base Map

Starting with the Base Map, it is a custom product developed specifically for the LAP Tool. It is composed of four base layers:

- **Base Layer 1: Various Features**
- **Base Layer 2: Hydrography**
- **Base Layer 3: Various Feature Labels**
- **Base Layer 4: Marine Labels**

Each of these data layers is described in greater detail in the following table.

Table 1. Base Map Layers.

Data Layer Name	Description/Metric	Data Source	Rationale for Inclusion
Base Layer 1: Various Features	Some water features (excluding streamlines), cities, parks, landmarks, building footprints and administrative boundaries.	ESRI, HERE, Garmin, FAO, NOAA, USGS, ©OpenStreetMap contributors, and the GIS User Community. https://www.arcgis.com/apps/vtseditor/en/#/styles	Background/reference and orientation.
Base Layer 2: Hydrography	National Hydrography Data (NHD) Flowline data.	From USGS. https://www.arcgis.com/apps/vtseditor/en/#/styles	Background/reference and orientation.
Base Layer 3: Various Feature Labels	Highways, major roads, minor roads, railways; water feature, city, park, landmark, and administrative labels.	ESRI, HERE, Garmin, FAO, NOAA, USGS, ©OpenStreetMap contributors, and the GIS User Community. https://www.arcgis.com/apps/vtseditor/en/#/styles	Background/reference and orientation.

Table 1. Base Map Layers, Continued.

Data Layer Name	Description/Metric	Data Source	Rationale for Inclusion
Base Layer 4: Marine Labels	Commonly known marine place name labels.	A curated dataset by the Hood Canal Coordinating Council using in-house knowledge. https://www.arcgis.com/apps/vtseditor/en/#/styles	Background/reference and orientation.

3.2. Current Ecosystem Conditions

After the Base Map, the first category of selectable data layers in the LAP Tool is listed under the Current Ecosystem Conditions tab. This category consists of various physical features that relate to how the watershed currently functions, with some historical features as well. The individual data layers in this category are:

- ✧ **Land Cover - Time Series**
- ✧ **Watersheds (HCCC delineated)**
- ✧ **Wetlands (National Inventory)**
- ✧ **Floodplains**
- ✧ **Riparian Function**
- ✧ **Bed Scour**
- ✧ **Fine Sediment**
- ✧ **Woody Debris**
- ✧ **Confinement - Hydromodifications**
- ✧ **Historical Stream Temperatures**
- ✧ **Tidal Connectivity**
- ✧ **Fish Passage Barriers**
- ✧ **Salmon Restoration Projects**

Each of these data layers is described in greater detail in the following Table 2.

Table 2. Current Ecosystem Conditions Data Layers.

Data Layer Name	Description/Metric	Data Source	Rationale for Inclusion
Land Cover - Time Series	Annual views of high resolution photography between 2014 and 2022.	From the Wayback digital archive of the ESRI World Imagery base map.	Shows land cover (vegetation and development) changes over time.
Watersheds (HCCC delineated)	Watersheds in the Summer Chum ESU that reflect the EDT study area groupings.	Modified from USGS National Hydrography Dataset (HUC12); HCCC data layer updated 12/12/22.	They depict the LAP Tool's Assessment Units (AU) – the minimum scale for data collection and analysis.

Table 2. Current Ecosystem Conditions Data Layers, Continued.

Data Layer Name	Description/Metric	Data Source	Rationale for Inclusion
Wetlands (National Inventory)	National Wetlands Inventory of freshwater emergent wetland, freshwater forested/ shrub wetland, and estuarine and marine wetland types.	US Fish and Wildlife Service; HCCC data layer updated 11/30/22.	Endangered and threatened fish like salmon, trout, and steelhead rely on wetlands as a safe place for juveniles to feed and grow.
Floodplains	A land area susceptible to being inundated by floodwaters from any source.	Federal Emergency Management Administration; HCCC data layer updated 1/3/23.	Floodplains are vital to the health and viability of Pacific salmon runs because they provide important habitat during the freshwater phase of the salmon life cycle.
Riparian Function	Measure of riparian function that has been altered within the reach.	See EDT Stream Reach website at: https://ourhoodcanal.org/stream-reach/ Source: *EDT Modelling Assessment of Summer Chum Performance in Hood Canal and the Eastern Strait of Juan de Fuca*, 10/22.	key freshwater habitat attribute important for productive and properly functioning habitat.
Bed Scour	Average depth of bed scour in salmonid spawning areas during the annual peak flow event over approximately a 10-year period.	See EDT Stream Reach website at: https://ourhoodcanal.org/stream-reach/ Source: *EDT Modelling Assessment of Summer Chum Performance in Hood Canal and the Eastern Strait of Juan de Fuca*, 10/22.	key freshwater habitat attribute important for productive and properly functioning habitat.
Fine Sediment	Percentage of fine sediment within salmonid spawning substrates, located in pool-tailouts, glides, and small cobble-gravel riffles.	See EDT Stream Reach website at: https://ourhoodcanal.org/stream-reach/ Source: *EDT Modelling Assessment of Summer Chum Performance in Hood Canal and the Eastern Strait of Juan de Fuca*, 10/22.	key freshwater habitat attribute important for productive and properly functioning habitat.

Table 2. Current Ecosystem Conditions Data Layers, Continued.

Data Layer Name	Description/Metric	Data Source	Rationale for Inclusion
Woody Debris	Amount of wood (large woody debris or LWD) within the reach.	See EDT Stream Reach website at: https://ourhoodcanal.org/stream-reach/ Source: *EDT Modelling Assessment of Summer Chum Performance in Hood Canal and the Eastern Strait of Juan de Fuca*, 10/22.	key freshwater habitat attribute important for productive and properly functioning habitat.
Confinement - Hydromodifications	Extent that anthropogenic structures constrict flow or restrict flow access to the stream's floodplain; or that the channel has been ditched or channelized, or has undergone significant streambed degradation due to channel incision/ entrenchment.	See EDT Stream Reach website at: https://ourhoodcanal.org/stream-reach/ Source: *EDT Modelling Assessment of Summer Chum Performance in Hood Canal and the Eastern Strait of Juan de Fuca*, 10/22.	key freshwater habitat attribute important for productive and properly functioning habitat.
Historical Stream Temperatures	Mean August stream temperature (in °C) from 1993-2011.	USDA Forest Service, Rocky Mountain Research Station (NorWeST); updated 2/1/22.	Water temperatures have a large impact on the productivity and diversity of freshwater ecosystems. Pacific salmon require cool fresh waters throughout their life cycles.
Tidal Connectivity	Represents impacts of tidal restrictions in large river deltas.	From WDFW, Cramer Fish Services mapping. https://geodataservices.wdfw.wa.gov/hp/tidal-restrictions/	Juvenile salmonids, particularly, chum salmon, need access to intertidal habitats for rearing in early marine life history.
Fish Passage Barriers	Physical, anthropogenic blockages to migration.	Extracted from the Washington Department of Fish and Wildlife's (WDFW) Fish Passage and Diversion Screening Inventory (FPDSI) database.	Fish populations struggle if barriers prevent them from reaching the upstream habitat where they breed and grow.
Salmon Restoration Projects	Project types include: assessments, acquisitions, riparian planting & restoration, culvert/passage barrier removal, LWD/ELJ emplacement, CMZ remediation, etc.	Habitat Work Schedule Database, Sept. 2019, for the Hood Canal region.	These impediments to salmon migration and habitat directly impact salmonid abundance, productivity and distribution.

3.3. Land Use Policies & Management

The second category of selectable data layers in the LAP Tool is listed under the Land Use Policies & Management category. It is composed of a variety of governments' land uses, ownerships, policies, laws, arrangements, and boundaries, as well as some private protective ownerships. The individual data layers in this category are:

- ✧ **Summer Chum ESU Boundary**
- ✧ **County Parcels**
- ✧ **Critical Areas**
- ✧ **Aquatic Parcels & Reserves**
- ✧ **Natural Resource Conservation Areas, Natural Area Preserves & Parks**
- ✧ **National Parks, Forests & Wilderness**
- ✧ **Conservation Easements**
- ✧ **Rural Areas Designated for Growth**
- ✧ **Zoning**

Each of these data layers is described in greater detail in the following table.

Table 3. Land Use Policies & Management Data Layers.

Data Layer Name	Description/Metric	Data Source	Rationale for Inclusion
Summer Chum ESU Boundary	Boundary of the Hood Canal summer chum evolutionarily significant unit (ESU).	Established by National Oceanographic and Atmospheric Administration – (NOAA) Fisheries as a part of the ESA recovery plan for Hood Canal summer chum.	This boundary shows the extent of stocks which must be recovered to de-list an Endangered Species Act (ESA) listed species.
County Parcels	County Tax parcels.	Data from Jefferson, Kitsap and Mason County Assessors' Offices. Updated 1/6/22.	For identifying specific properties & boundaries for use in outreach, acquisition and restoration projects.
Critical Areas	County-designated Critical Areas including: wetlands, critical aquifer recharging areas, frequently flooded areas, geologically hazardous areas, and fish and wildlife habitat conservation areas.	Derived from Jefferson, Kitsap and Mason Counties' Critical Areas Ordinances, enabled by RCW 36.70A.030(5).	The protection of these areas is vital for salmon and overall watershed health.

Table 3. Land Use Policies & Management Data Layers, Continued.

Data Layer Name	Description/Metric	Data Source	Rationale for Inclusion
Aquatic Parcels	Aquatic parcels listed by owner.	From Washington Department of Natural Resources (DNR) at: https://aquarim.dnr.wa.gov/default.aspx. Downloaded on 1/22.	Aquatic lands are passageways for salmonids in their spawning and rearing phases, as well as indicators of general ecosystem health and function.
Natural Resource Conservation Areas, Natural Area Preserves & Parks	WA Dept. of Natural Resources (DNR) designated protected lands as well as State Parks.	DNR data from 2021. WA State Parks data from 12/28/22.	Protected lands which contribute to the preservation of the HC & ESJDF watershed.
National Parks, Forests & Wilderness	National Park, National Forest and National Forest Wilderness designated lands.	From the WA DNR NonDNR Major Public Lands data set. https://geo.wa.gov/datasets/wadnr::wa-major-public-lands-non-dnr/about	Protected lands (at various levels – Forests are working landscapes) which contribute to the preservation and conservation of the HC & ESJDF watershed.
Conservation Easements	Conservation easements are properties which are either owned outright or have restrictive easements for the purpose of protecting the natural functions of those lands.	National Conservation Easement Database (NCED); conservationeasement.us Updated 1/8/23.	Conservation easements provide protections for the natural function of the landscape.
Rural Areas Designated for Growth	Rural areas designated for growth by county Comprehensive Plans. These are either Limited Areas of More Intensive Rural Development (LAMIRDs), Rural Activity Centers (RACs), Rural Village Centers, (RVCs), or Hamlets, depending on the county.	Kitsap County from Comp Plan; data downloaded 9/13/2019. Mason County from UGA RAC Hamlets; data downloaded 9/13/2019. Jefferson County from zoning districts; data downloaded 6/4/2019.	Developed/ing areas generally have negative impacts to natural systems and must be factored into any assessment of watershed health and salmon habitat.
Zoning	County zoning - recategorized to form similar land use types across all three Counties.	Custom crafted for HCCC from Jefferson, Kitsap, Mason County zoning designations.	Land use and zoning control development, which has various impacts on the ecosystem, depending on a variety of factors. Those factors must be accounted for in any analysis of watershed health or salmon habitat.

3.4. Future Priorities, Projections & Conditions

The last category of selectable data layers in the LAP Tool is listed under the Future Priorities, Projections & Conditions category. It is composed of future oriented projections and priorities. The individual data layers in this category are:

- ✧ **Sea Level Rise**
- ✧ **Projected Stream Temperature Change**
- ✧ **Prioritized Summer Chum Salmon Habitat**
- ✧ **Prioritized Forage Fish Habitats for Conservation**
- ✧ **Prioritized Forage Fish Habitats for Restoration**
- ✧ **Action Guidance for Summer Chum**

Each of these data layers is described in greater detail in the following Table 4.

Table 4. Future Priorities, Projections and Conditions Data Layers.

Data Layer Name	Description/Metric	Data Source	Rationale for Inclusion
Sea Level Rise	Projected sea level rise, in 1-foot increments, up to 10 feet.	From NOAA Digital Coast; downloaded 6/19. https://coast.noaa.gov/slrdata/	Sea level rise can impact salmonids by changing the physical, biological and chemical structure of nearshore habitats, which are crucial to their migration and spawning life-stages.
Projected Stream Temperature Change	Projected temperature change (in ℃) over an ~20 year period (to 2040).	USDA Forest Service, Rocky Mountain Research Station (NorWeST); updated 1/22.	Water temperatures have a large impact on the productivity and diversity of freshwater ecosystems. Pacific salmon require cool fresh waters throughout their life cycles.
Prioritized Summer Chum Salmon Habitat	Top ten Summer Chum salmon stocks to focus recovery effort.	From: *2015 Guidance for Prioritizing Salmonid Stocks, Issues, and Actions for the Hood Canal Coordinating Council.*	Considered the most important summer chum habitat in the Hood Canal & E. Strait of Juan de Fuca watershed.
Prioritized Forage Fish Habitats for Conservation	Highest Priority opportunities for conservation of beach forming processes.	Draft data retrieved from Coastal Geologic Services Inc. on 6/8/2019.	Healthy forage fish populations are essential for salmon recovery because salmon rely on them as a high energy food source. They also help reduce predation of juvenile salmon because other fish, marine mammals and birds also consume forage fish.

Table 4. Future Priorities, Projections and Conditions Data Layers, Continued.

Data Layer Name	Description/Metric	Data Source	Rationale for Inclusion
Prioritized Forage Fish Habitats for Restoration	Highest Priority opportunities for restoration of beach forming processes	Draft data retrieved from Coastal Geologic Services Inc. on 6/8/2019.	Healthy forage fish populations are essential for salmon recovery because salmon rely on them as a high energy food source. They also help reduce predation of juvenile salmon because other fish, marine mammals and birds also consume forage fish.
Action Guidance for Summer Chum	Prioritized actions to take and issues to address (through assessments, in their natal estuaries and in freshwater) for the recovery of summer chum in the ESU.	From: *2015 Guidance for Prioritizing Salmonid Stocks, Issues, and Actions for the Hood Canal Coordinating Council.* https://ourhoodcanal.org/action-guidance/	prioritized actions to take and issues to address for summer chum.

To gain further insight into the sources of the LAP Tool's data, and how up to date those data are, each selectable layer has a 'metadata' link. Those links lead to ArcGIS Online pages with data sources, dates of development and downloads, and source agency information. Additionally, they offer more detailed explanations of the data, and how they were developed, modified or derived for use in the LAP Tool.

It must be noted that each of these data layers, whether created by the HCCC or downloaded from other sources, must be considered provisional. Caution must be used in any application of these data, whether for project or acquisition planning, education and outreach efforts, or policy or regulation development. Data changes over time and accuracy diminishes with data age.

The LAP Tool, and its data are intended to stimulate further study and discussion. They should be considered a starting point in any investigation, not an end point. More study of any LAP Tool results must be completed prior to their being used as a definitive basis for any decisions. With those caveats, the LAP Tool can be an excellent vehicle for the exploration of ideas and visualizations of data about Hood Canal environmental problems or issues on the landscape.

4. What can the LAP Tool do and how do you use it?

The LAP Tool, with its many data layers available for display, offers several methods to investigate those data. It can also address a variety of questions using those data.

4.1. Original LAP Tool Goals

When the LAP Tool was first conceived, a variety of goals were advanced for it. Those goals were voiced by HCCC member governments and others. They were also drawn from previous planning efforts, including the Hood Canal Summer Chum Salmon Recovery Plan and the HCCC's Integrated Watershed Plan. Throughout those goals, a preference for a focus on protection over restoration was expressed. It was thought that protection was a less costly/more efficient overall approach to addressing salmon habitat and watershed health.

Those goals included assessing the effectiveness of past efforts to restore and preserve salmon habitat (particularly for summer chum) through restoration projects and conservation easements/acquisitions. They also included looking for new opportunities for outreach, and planning for new projects and acquisitions.

Other LAP Tool goals were to look at land use policies, regulations and management practices. Specifically, they identified regulations for zoning, critical areas and rural areas designated for growth as important. They included assessing their protective effects, as well as their consistency across jurisdictional boundaries. This included the recognition that these land use regulations were not easy to change, had to balance a variety of interests and other factors, and were the exclusive purview of the county governments. In addition to land use regulations, a focus on non-regulatory policy approaches to land use was also desired, such as: transfer of development rights (TDRs), conservation easements, fee-simple acquisitions for protection, outreach programs, educational efforts, best management practices (BMPs), etc.

Focusing specifically on salmon habitat, they aimed at assessing habitat quality (looking for the best and worst), and being able to analyze the factors that contribute to those conditions. They also suggested having an ability to relate the status of salmon stocks to the condition of their natal and associated habitats.

And, at the broadest scale, a goal for the LAP Tool was to be able to look at factors and trends that might impact overall watershed health in the future. Some of those might include climate change, population growth, invasive species, etc.

4.2. Overview of LAP Tool Approaches

A variety of approaches can be taken to the LAP Tool data, including:

- ✓ **Visualization –** displaying one or more data layers as a snapshot of current conditions, at various scales; e.g., specific habitats, deleterious conditions in various areas, development density, current land cover, etc.

- ✓ **Exploration –** ranging over various areas of the Hood Canal and Eastern Strait of Juan de Fuca (HC&ESJF) in an unstructured fashion; a notional activity without a completely fixed purpose.
- ✓ **Hypothesis testing –** seeking causal connections between various states of the watershed and activities or conditions which might cause or contribute to those states; e.g., activities on the landscape and degraded environmental conditions, like silvicultural practices, and wetland or stream conditions, etc.
- ✓ **Identification –** finding areas of concern which merit further diagnosis or investigation; these might include focused searches for specific conditions, e.g., fish passage blockages, disruptions in tidal connectivity, etc.
- ✓ **Projection –** looking at the landscape and projecting its current condition forward in time based on changing environmental conditions or build-out within existing land use regulations; these might include projecting sea level rise, future temperature changes, etc., to identify future vulnerabilities for planning purposes.
- ✓ **Definition –** focusing on, and describing, an area and its conditions; this could be done in preparation for exploring possible courses of action.

These different approaches can be used singly, with single data layers, or in combinations, with combinations of data layers. The use of each approach would depend on the type of questions or problems being investigated and the type of results desired. A caveat must be added that all of these exercises will require ground-truthing and additional research to ensure the validity of any conclusions drawn from them.

4.3. Scale of Use

Another aspect of LAP Tool use is scale. The character of each of the previously discussed ways of LAP Tool usage changes depending on the scale at which it is employed. Zooming out renders a broad overview of the watershed, where details are lessened. Zooming in to focus on specific areas allows for a much more detailed view, however it comes with the loss of that broader picture. While zooming in and out can be done at a number of incremental levels, there are generally four scales at which the LAP Tool might be most useful. They are views of:

- ✧ **The Whole HC&ESJF Watershed**[1] – This large-scale view is initially useful for orientation. It can identify large features or effects that might occur across the whole watershed (e.g., projected sea level rise, continuous types of similar land cover, etc.). It can compare features or conditions of watersheds that are not adjacent (e.g., Salmon/Snow and Union). It can also compare land management policies across the watershed.
- ✧ **Multiple Watersheds Simultaneously or Large Nearshore/Marine Segments** – This large area view is similar to the whole HC&ESJF watershed, except that it is not trying to find features or trends across the whole watershed, but is more interested in

[1]This definition of the HC&ESJF watershed represents the Hood Canal summer chum's evolutionarily significant unit, or ESU; it is the geographic extent of the spawning and rearing area of this species, as determined by NOAA Fisheries on September 2, 2005 in 70 FR 37159.

large/coextensive areas or adjacent watersheds. It can contrast or compare specific watersheds' features (e.g., land cover, topography, stream function, etc.) or jurisdictions' land management policies (federal, state, county, tribal, etc.) across large areas and at their boundaries.

- ✧ **Single Watersheds** – This scale looks at an individual watershed's function and health. It can also be the starting place for more intensive, large-scale analysis, planning and problem solving.
- ✧ **Sub-watershed Areas or Features** – This might be a view of stream segments, nearshore/beach segments, areas with specific topographic or land cover features, or even at the multi-parcel or individual parcel level. This scale may be most useful for outreach, project or acquisition planning, or other focused efforts to address localized problems.

4.4. Specific Applications & Examples

As an example of a simple LAP Tool visual display of data at the larger watershed scale, Figure 2, on the right, shows Priority Summer Chum Habitat.

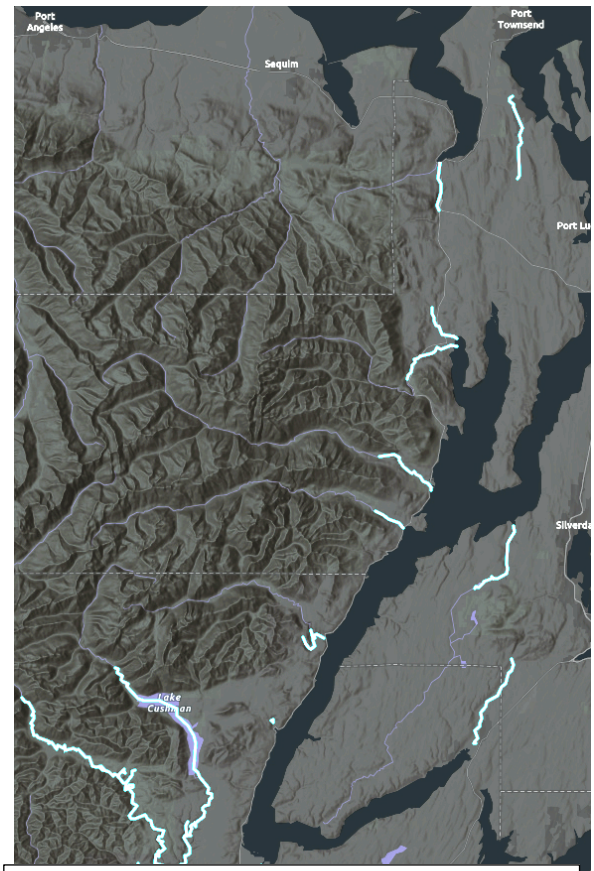

Figure 2. Watershed-wide Priority Summer

In Figure 3, to the left, that display is augmented with a status of Riparian Function data layer, which shows areas which have from slightly impaired function (light colored) to significantly impaired function (in red).

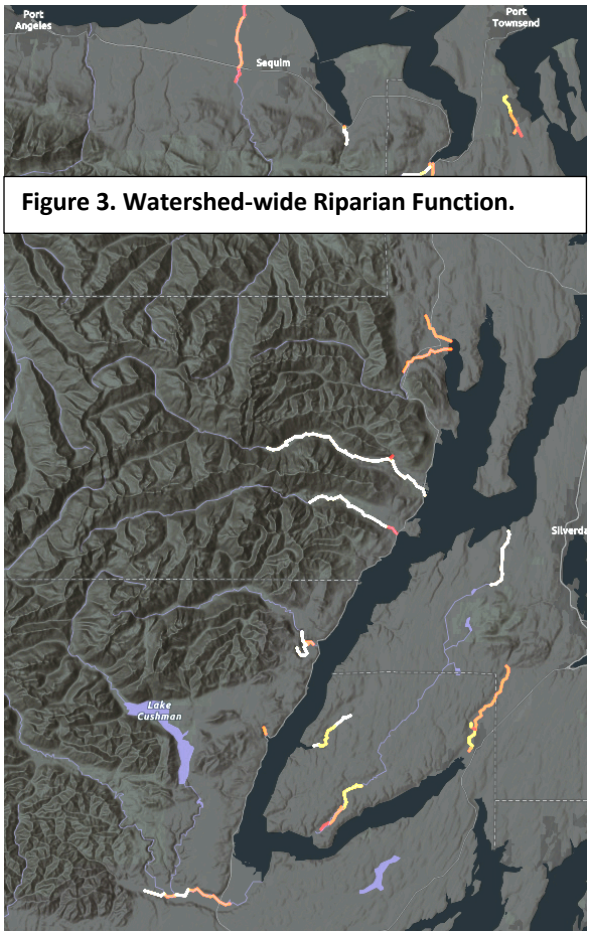

Figure 3. Watershed-wide Riparian Function.

Moving to a smaller scale example, the Union River Watershed can be seen in more detail. The Union River is located in the south east portion of the HC&ESJF watershed (at the terminal end of the hook area of Hood Canal), as shown in Figure 4 to the right.

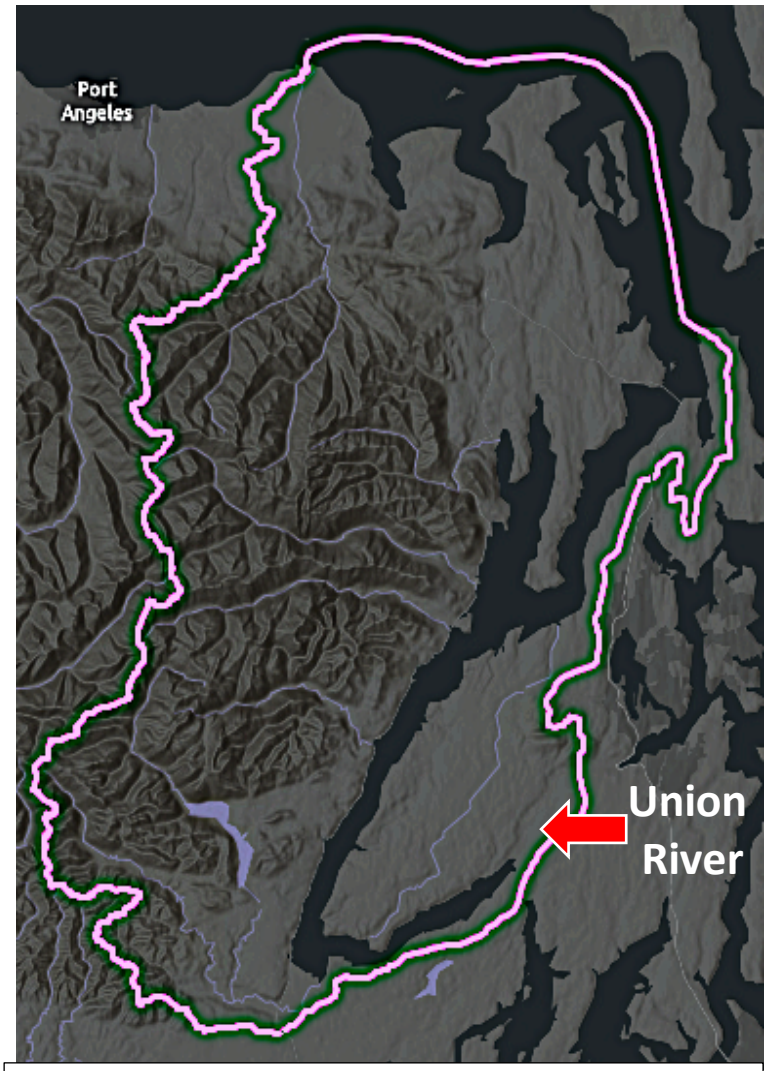

Figure 4. Hood Canal & Eastern Strait of Juan de Fuca watershed.

That watershed, surrounded by the pink line, represents the Hood Canal summer chum salmon's ESU (evolutionarily significant unit), or the area in which summer chum must be recovered to delist them from their ESA (endangered species act) status. It is also the maximum operational area of the LAP Tool.

In Figure 5 on the following page, four attributes of the Union River are depicted over the river's full extent: Riparian Function, level of Bed Scour, Fine Sediment loading and amount of Woody Debris. Each of these conditions is indicative of problematic river function.

In each case, lighter colors indicate little to no problem; orange, red and dark red indicate progressively worse conditions. In addition to the severity of the various attributes, it is also worth noting (at the blue arrows) that there are transitions between the severity of the problem with each attribute. Riparian Function improves in the lower river; Bed Scour degrades significantly mid river; Fine Sediment increases in the lower river; and Woody Debris also is lower in the lower river, albeit to a lesser extent. Also, of particular note is that three attributes, Function, Sediment and Wood, all transition to different levels of severity in the same proximity. This suggests that something is happening in that transition area that is having a significant impact.

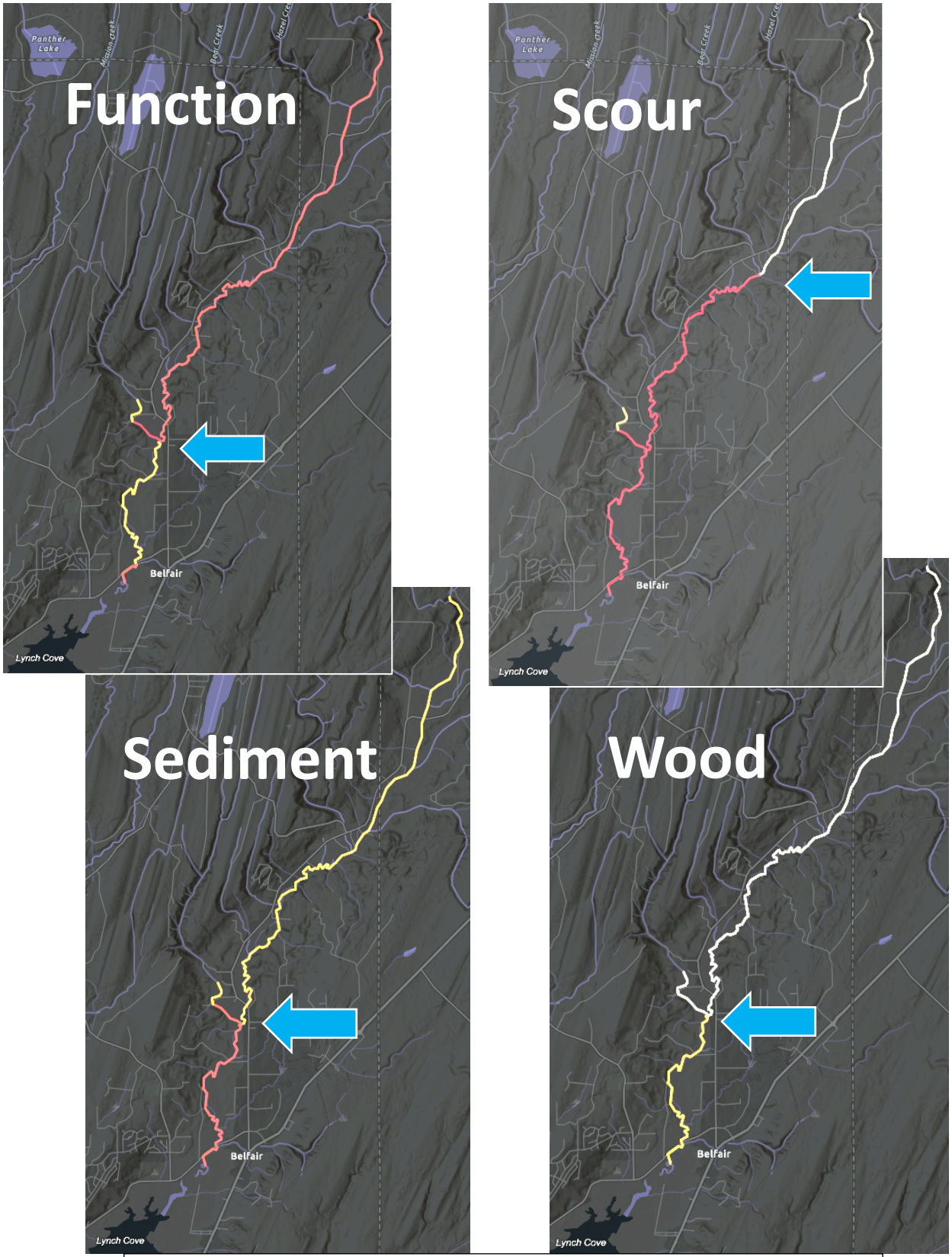

Figure 5. Depictions of the Status of Four Environmental Attributes in the Union River.

A further look at that transition area, at a smaller scale, shows a small tributary entering the Union River. Whether this tributary is directly contributing to these changes, or other factors such as land use practices are having an impact, the LAP Tool is indicating that this is an area that merits further investigation. LAP Tool data also indicate that there has been no salmon habitat project activity or conservation related acquisitions in this area. At the very least, this suggests that some sort of outreach effort should be considered if a further diagnosis indicates that preservation or restoration work might ameliorate these degraded conditions.

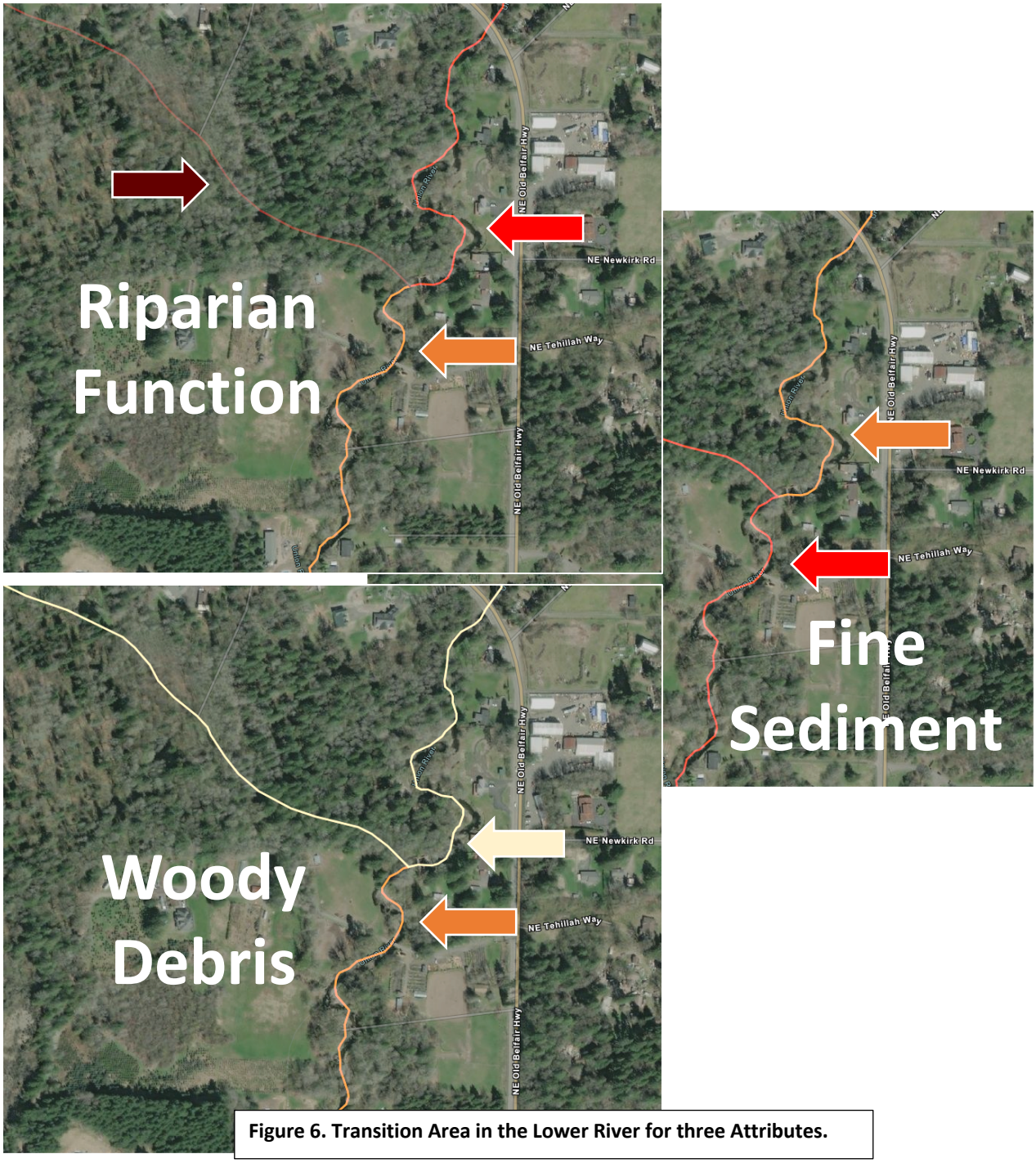

Figure 6. Transition Area in the Lower River for three Attributes.

On this and the following page, another degraded area in the lowest reach of the Union River is shown. This is an area of degraded Riparian Function. It is also an area that might be further degraded in the future by sea level rise.

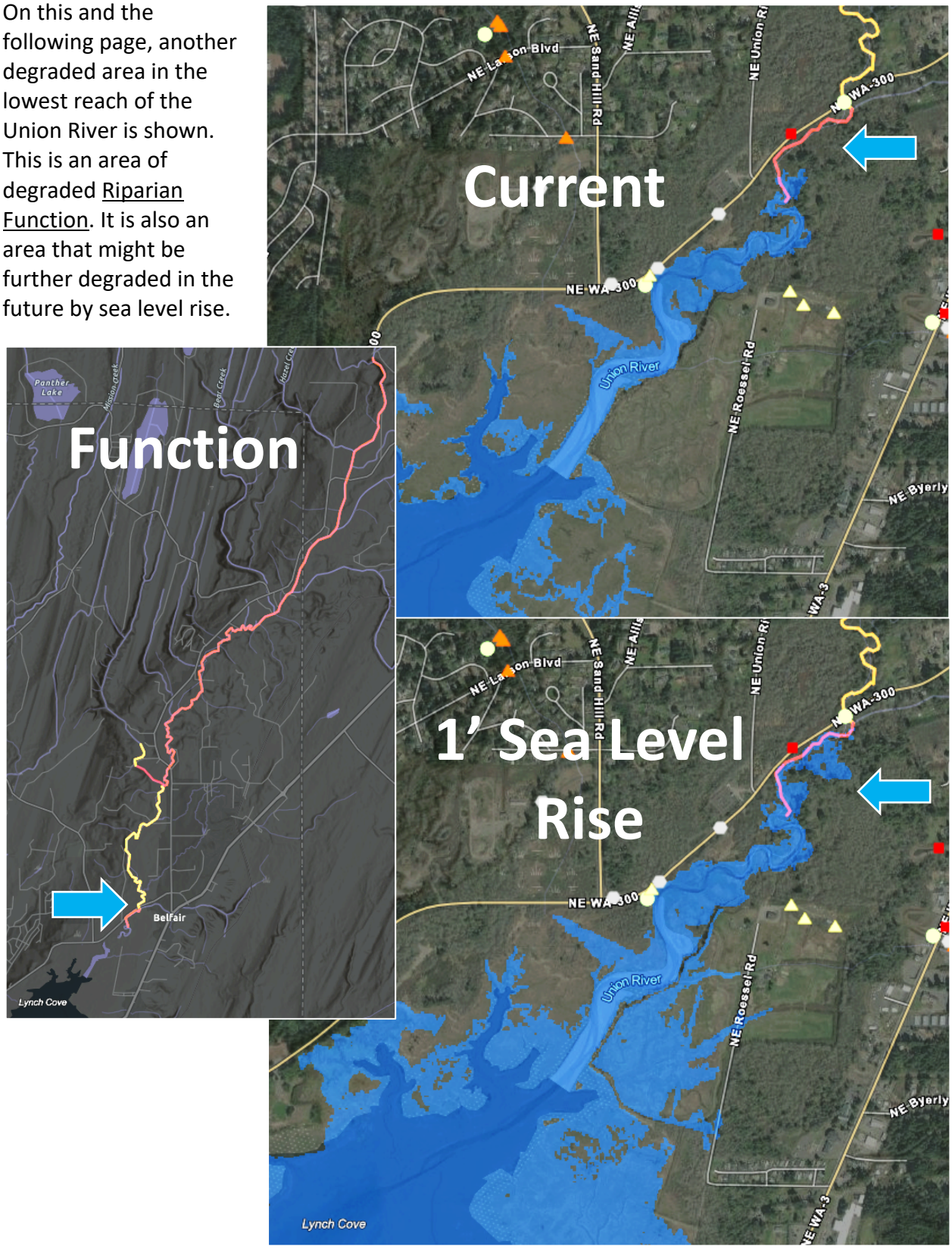

Figure 7. Degraded Riparian Function and Sea Level Rise.

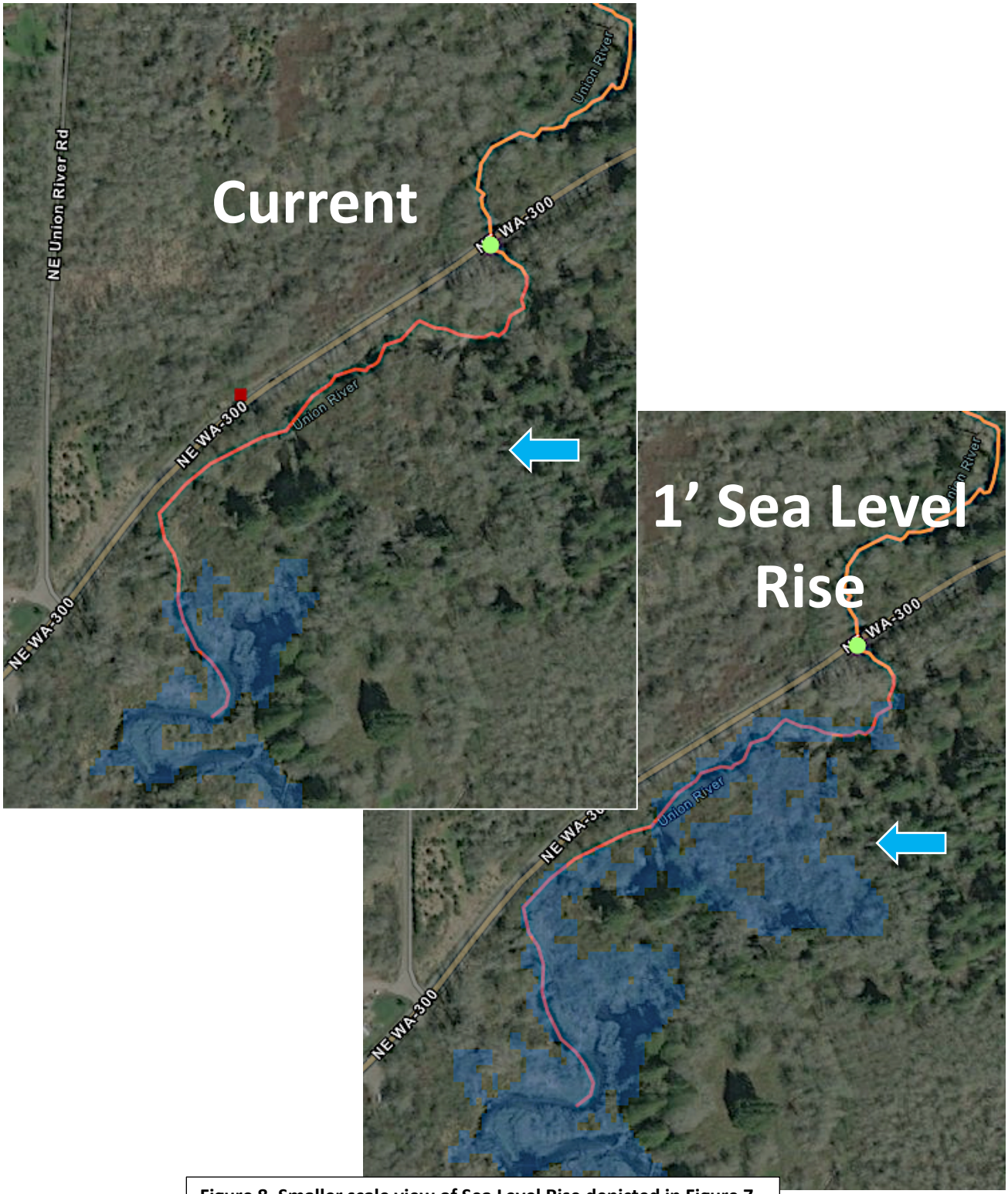

Figure 8. Smaller scale view of Sea Level Rise depicted in Figure 7.

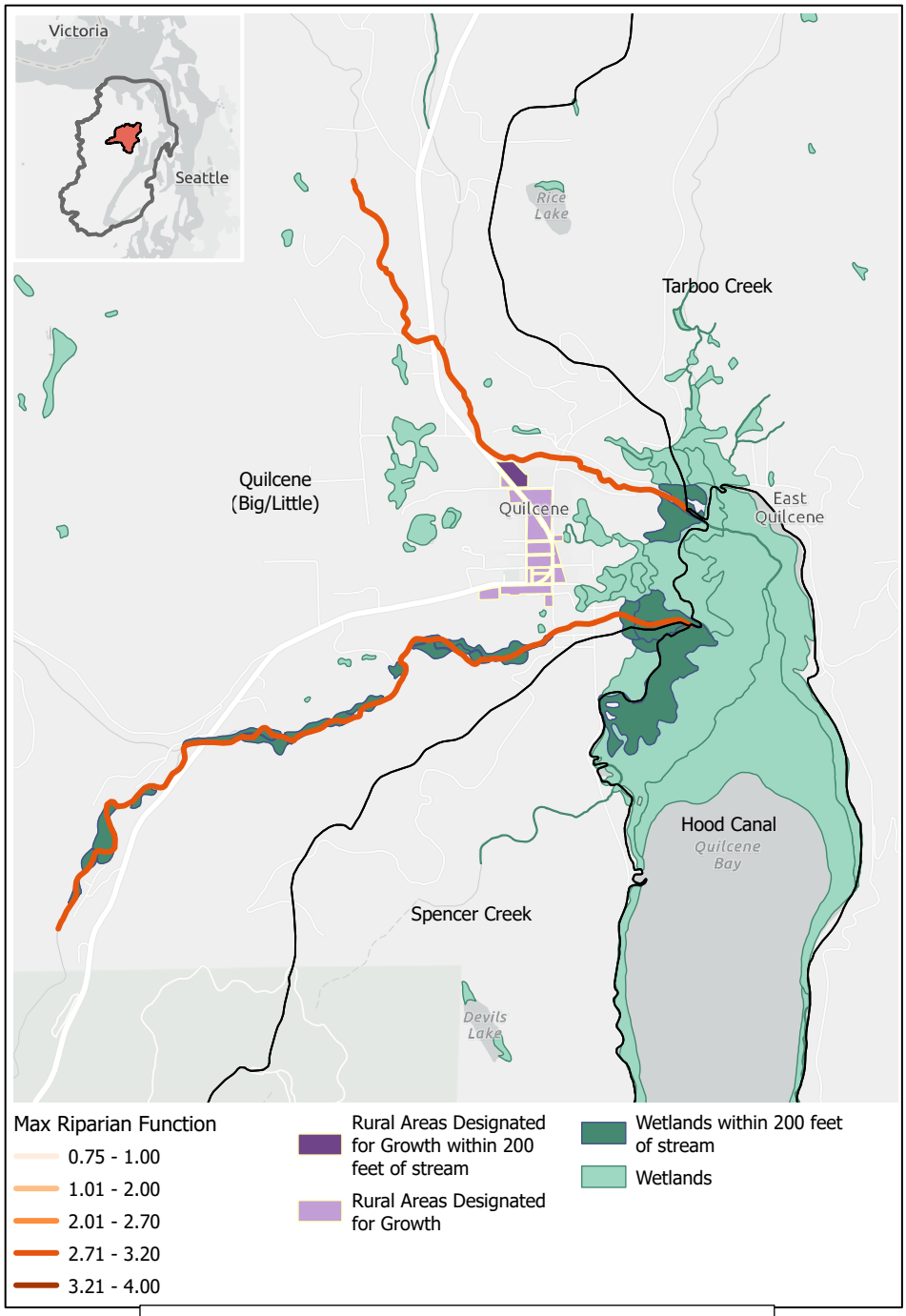

Figure 9. Proximity Analysis in the Quilcene Watershed.

An example of another type of analysis is shown in Figure 9 on the left in Jefferson County. It is called proximity analysis. It shows all Wetlands and Rural Areas Designated for Growth (two selected variables) which are within a certain proximity (200 feet selected in this case) of the Big and Little Quilcene Rivers.

Ultimately, the paramount goal of the LAP Tool is to support decision making by providing the best available data, and enabling the best analysis of those data. Its conclusions are intended to help make resource allocation decisions be the most efficient and effective as possible, and provide a basis for policy discussions as well as a justification for policy actions.

5. Conclusions

The LAP Tool will always be a work in progress, not in the sense that it is not currently functional, but in the sense that it will always be evolving. That evolution will be based on updates and changes to its data, the desire to pose additional questions to it and the lessons learned from its usage. Outreach and engagement included a Habitat Strategic Initiative Lead Webinar. A presentation and discussion was also provided for the HCCC Board of Directors at which time comments and recommendations were compiled and incorporated into this report.

5.1. Additional LAP Tool Testing

In the short term, the LAP Tool will need further calibration and de-bugging to address the inevitable glitches that occur with any complex system. Again, most of those can be addressed as they arise during the LAP Tool's regular usage. Others may need more attention to ensure the LAP Tool's continuing functionality and the accuracy of its results.

Currently, the LAP Tool's interface is primarily a visualization and investigation tool. It has additional capabilities, as noted in Section 4, but some of those capabilities go beyond the current capacity of its user interface. Undertaking deeper analysis of the LAP Tool data, such as posing questions about correlations, or cause and effect, may require assistance from the HCCC's GIS specialist to construct those queries, compute them and compile the results. While this is a technical usage issue, those current interface constraints of the LAP Tool application should not limit the questions that a user desires to pose to it and its data base.

Questions coming from LAP Tool users will help grow the application to its maximum usability. Iterations of the LAP Tool to address practical user questions will be the most valuable guide in making refinements and increasing the future value of the LAP Tool to those users.

5.2. Future Potential

The LAP Tool can be flexible and evolve. Its existing data are constantly being updated. Additional data sets are being investigated and researched. And new data sets can be added as new questions are posed in the future. In addition to the current data layers which are accessible through the LAP Tool, a variety of other data could be loaded into the LAP Tool. They can be added as other issues arise if it is determined that the current data layers do not adequately address those issues or if other data layers are identified which might more directly address those issues.

With its current data layers, the LAP Tool is aimed at analyzing watershed health and salmon habitat. In the future, the LAP Tool might be modified or augmented to more fully address those concerns, as well as address additional concerns, such as human wellbeing as it relates to the landscape (such as recreational, cultural, and culinary access and use, etc.); other species of concern, such as shellfish, endangered plants, terrestrial wildlife such as elk, etc.; or habitat of other Salmonidae, more specifically Chinook, steelhead and bull trout.

Some of those other potential data layers which might be explored for inclusion in future iterations of the LAP Tool could include:

- **Population data** (by census block and tract)
- **Human wellbeing/human values survey data** (access to nature recreation, natural foods, cultural resources, etc.)
- **Additional/more detailed climate change data** (precipitation, heat, drought, flooding, snowpack status, wildfire vulnerability, etc.)
- **Chinook, steelhead and bull trout habitat data** (extending the summer chum habitat data already in the LAP Tool)
- **Salmonidae stocks' status data**
- **Additional infrastructure data** (water & sewer/OSS [onsite sewage systems] infrastructure which might be susceptible to climate change and/or other natural events)
- **Other uplands and bedlands owned or managed by state and federal agencies**
- **More detailed land use regulation/ownership information**
- **Topographic elevations**
- **Soils data**
- **Additional land cover data**
- **Select terrestrial flora/fauna information** (terrestrial endangered species, other species of interest elk, plants of medicinal/cultural value, etc.)
- **Bathymetric depths**
- **Marine water quality data** (acidification/hypoxia)
- **Submarine vegetation** (eel grass beds, kelp forests, etc.)
- **Groundwater data** (surface water connectivity, saltwater intrusion)
- **Other data** (new data not yet developed; other data not yet considered or identified as relevant)

Ultimately, the types of problems or issues that the LAP Tool might be applied to in the future are only limited by the creativity of the user and the availability of relevant data.

6. References

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LAP Tool data layer references are listed in the Tables in Section 3 of this report.

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