Strait Climate Change Resiliency Technical Workshop

Part of the September 10, 2021 (virtual) Strait ERN Summer Quarterly Meeting

Technical Workshop Notes & Next Steps

Objective: To gain a common technical understanding of Climate Change Resiliency findings on the North Olympic Peninsula, along the Strait of Juan de Fuca (and the balance of eastern Jefferson County), to date, and to identify additional relevant ecological or sociological data (or other information, such as in-process assessments yet to be completed), as well as data gaps that need to be filled.

Goal: To begin to help our communities and ecosystems better prepare for climate-induced changes, including human migration of climate refugees to the North Olympic Peninsula.

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Breakout Facilitators: Kristin Hayman and Erin Ryan-Peñuela, Puget Sound Partnership; and John Cambalik, Strait ERN

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Presentation and Video links – by Matt Stevenson (https://drive.google.com/drive/folders/1p0mWC-7uxcdhy0Kk4p4bwU-H6k4Kxfkn)

Thank you, Participants!

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Technical Workshop Notes

Note: A high-level staff summary of identified major data gaps or barriers is offered at the end of each section, as ideas for possible next steps to help improve ecosystem and community resilience on the North Olympic Peninsula along the Strait of Juan de Fuca. In addition, a list of overall "Next Steps" as a follow up to this workshop is offered on the last page of this document.

A. Ecosystems Breakout Session:

Upland Habitat; Carbon Sequestration potential (e.g., within forests, soils, etc.)

- Local Forest-Related Carbon Sequestration and Storage Studies – We need models of scenarios for the carbon that the land can sequester. What should our carbon sequestration baseline be for our forests? Perhaps we should compare commercial, private, local and state publicly owned, and the federal forests (Olympic National Forest). Local 20/20 is working on a second draft of a report, currently titled "*Forest and Tree Greenhouse Gas Inventory for 2001 through 2016*". That report will cover only Jefferson County and will include many carbon inventory subtopics, including carbon sequestration, storage, and emissions. The report utilizes the *New Tool for Measuring Forest Emissions and Sequestration* from the International Council for Local Environmental Initiatives (ICLEI). Does the tool include a GIS spatial analysis component?
- Other Forest-Related Carbon Sequestration and Storage Studies – Another study to consider is from Michigan State University, Department of Forestry's Forest Carbon and Climate Program, titled "*Modeling the impacts of forest management on carbon sequestration and storage: a collaborative exercise with state partners*"
- Agricultural-Related Carbon Sequestration and Storage Studies – What do we know about the carbon sequestration potential of other lands, like agricultural lands and associated soils? Is the carbon sequestration and storage in our forests of such a large magnitude that it makes other land uses irrelevant? The ICLEI tool includes forests; trees outside of forests; harvest cropland; wetlands; and grasslands, but it's unclear how much it focuses on agricultural lands, including sustainable no-till agriculture. To date, we haven't focused on the carbon sequestration potential of our soils.

Major Data Gaps or Barriers:

An understanding of the:

- *Carbon sequestration potential of our forests in Clallam County that's analogous to the current efforts in Jefferson County*
- *Carbon sequestration potential of our agricultural lands and soils across the North Olympic Peninsula along the Strait of Juan de Fuca.*

Marine Shoreline and Nearshore Habitat; Carbon Sequestration potential (e.g., within kelp, eelgrass, sediments, etc.)

- "Blue Carbon" Sequestration and Storage – The National Estuarine Research Reserve System's Science Collaborative is conducting a study titled "*Pacific Northwest Carbon Stocks and Blue Carbon Database Project*" that might be a good resource for our geography. Carbon sequestration within salt marshes might be fairly well understood, but the potential for kelp is perhaps less so. The 2021 Kelp Expedition project's work along the Strait from the Puget Sound Restoration Fund might be informative here.
- Marine Habitat and Species Vulnerabilities – How vulnerable are our marine shorelines and nearshore habitats as well as species to sea level rise and increases in water and air temperatures (*e.g.*, recent heat waves during lower tides when intertidal areas are exposed)? The *Climate Change and the Olympic Coast National Marine Sanctuary: Interpreting Potential Futures* report might help to inform the vulnerability of marine species along the Strait of Juan de Fuca. Also, a new rapid vulnerability assessment, led by Katie Wrubel at the Sanctuary, is now underway and might be informative as well. Which marine species will be focus of this rapid assessment? Vulnerabilities analyses need to couple exposures with ecosystems and species adaptive capacity. For example, we need to understand how climate change and ocean acidification will affect kelp viability and its ability to sequester carbon. Can kelp beds mitigate the effect of ocean acidification in some way?

Major Data Gaps or Barriers:

An understanding of the:

- *Carbon sequestration potential of our kelp forests along the Strait of Juan de Fuca*
- *Vulnerabilities of marine and nearshore habitat, as well as species, to the effects of sea level rise, tidal surge, ocean acidification, and increases in water and air temperatures, particularly during heat wave events along the Strait of Juan de Fuca.*

Invasive Species (*i.e.*, aquatic, and terrestrial)

- Animal Species-Shift Assessments – While some species shifts (or range extensions) are expected, are we able to predict the arrival and associated implications of climate change-induced aquatic and terrestrial, potentially invasive, species to terrestrial areas or within marine/nearshore areas? What about bird species shifts? Our local Audubon organizations might be working on this for birds. Can Tribal, commercial, and recreational observations or catch records be used to detect species shifts of

marine fish and shellfish to our waters? Can these fishers be encouraged to record a GPS point using a phone app when they incidentally catch or harvest such species for GIS mapping? While some real-time detections for invasive species are being conducted (*e.g.*, European Green Crab and perhaps Zebra Mussels), other species efforts are more ad-hoc. We need more well-designed long-term surveys for such species shifts. Trying to make climate change-induced predictions or forecasting of species shifts, to be able to plan for and manage them, can be a bit murky. Then, if such animals are detected and confirmed, what are the possible interventions or mitigation measures needed to respond to these species shifts?

- Plant Species-Shift Assessments – Are there any efforts to detect species shifts (or range extensions) of terrestrial and marine/nearshore plant species in our forests and along our marine shorelines, respectively? Can the county weed boards help here? Again, if such plants are detected and confirmed, what are the possible interventions or mitigation measures needed to respond to these species shifts? The long-term intertidal monitoring that Olympic National Park has conducted may help detect species shifts and invasives (and provide other data), though it's not along the Strait. Other sources of data, such as ambient monitoring work possibly conducted by the Tribes, WDFW, and the Coastal Watershed Institute, might help answer some of these questions.
- Marine Species are Out of Sight, Out of Mind – Generally, invasive marine species, let alone species shifts, garner far less attention than terrestrial species, because they are mostly out of sight and not readily noticed by most human residents and visitors.
- Invasive Species vs Species Shifts – Should we be differentiating between exotic / invasive species and species shifts due to range extensions? Is the latter detrimental to our local ecosystems and resident terrestrial and marine/nearshore species? Are these two categories functionally the same? Should we also be concerned about parasites that might come with such species?

Major Data Gaps or Barriers:

- *Well-designed, long-term, terrestrial and marine species-shift surveys, that also includes associated parasites and diseases, within our forests and along our marine shorelines, respectively.*

<u>Ocean Acidification</u>

- Monitoring – While WDNR has deployed sensors at dozens of sites in marine waters to measure pH for about 2 years, it's unclear if any are located within the Strait of Juan de Fuca waters. The Jamestown S'Klallam Tribe has deployed sensors within Sequim Bay.
- Vulnerable Species – While we might understand that exposure to low pH conditions is expected to be detrimental for some species, we do not have a comprehensive picture as to which are most vulnerable. We do have a sense as to the vulnerability of Tribal and commercially important species including larval forms of oysters, Manila clams, geoduck, crab.
- OA Management – Can we manage for OA at the local level? Do we have meaningful ways to adapt to OA conditions at the local level or are those options limited? Culturing kelp in local coastal waters may have some potential to mitigate for OA, but recent work in this regard does not appear to be promising. One notable example of adaptation is the response to oyster seed failures in Hood Canal due to OA. Those failures prompted a shift to establish seed culturing facilities in Hawaiian waters, up to the larval stage.

Major Data Gaps or Barriers:

- *A comprehensive understanding as to which marine species along the Strait of Juan de Fuca are most vulnerable to ocean acidification*

Marine Water Quality

- Monitoring – The Jamestown S'Klallam Tribe conducts real-time toxic algal and temperature monitoring in Sequim Bay near shellfish beds.
- Predictive Modeling – There is some amount of modeling for marine water temperature changes but there is a lot of inherent variability in the Salish Sea. The implication of such temperature increases at the local level is unclear. Clearly, the June heat waves we experienced during low tides however was quite the eye opener. Can we predict the frequency with which those kinds of air temperature extremes may occur, particularly when they coincide with other drivers, like low tides, that collectively have the potential to drive significant and rapid changes in the nearshore ecosystem? Also, projections for marine oxygen levels along the Strait may help us understand how marine organisms might be distributed and available for harvest in the future.
- Compounding Drivers – The risk of a major oil spill along the Strait, due to increasing vessel traffic would compound the effect of OA and temperature increases along our shorelines. Stormwater discharges along our shorelines also have the potential to compound the OA problem. Are there other compounding drivers?

Major Data Gaps or Barriers:

- *Heat wave predictions along the Strait of Juan de Fuca that account for the compounding effects of other negative ecosystem drivers on marine organisms, such as low tides, oil spills, and stormwater discharges*

B. Freshwater Resources Breakout Session:

The Puget Sound Partnership's Vital Signs for freshwater includes quantity (*i.e.*, Summer Stream Flows) and quality (*i.e.*, Freshwater Quality). Freshwater quality refers to many aspects of water in rivers and streams including dissolved oxygen, pH, temperature, bacteria, nitrogen, phosphorus, suspended sediment, and turbidity. Freshwater quantity and quality throughout Puget Sound is affected by many different factors including weather and climate patterns, water withdrawals and diversions, erosion and stormwater runoff, discharges from wastewater treatment plants and industries, nutrient input and other pollution. These Vital Signs tell us about the condition of the freshwater that is vital to people, fish and wildlife populations by monitoring trends in water quantity and quality, as well as the ecological function of rivers and streams in Puget Sound.

Water Quantity (surface and groundwater)

- Groundwater (Quantity) Resources – Back in the 1990's and into the 2000's we had far more ambient monitoring of the static water levels and wells of our aquifers by state and federal agencies than we do today. A couple of examples were noted, including:

- Dungeness River Watershed - Clallam County was involved in that effort within the Dungeness watershed where 15-20 private wells were monitored monthly then later quarterly and later only 10 wells were sampled. The last report from this effort was published in 2009. Public wells, like Sequim's, are still monitored regularly. Also, whenever a new well is drilled, data is collected in the well logs. WDOEs groundwater monitoring is minimal. The City of Sequim paid the Pacific Groundwater Group to assess groundwater supplies and trends for housing and irrigated areas within the Dungeness Valley, producing a report in 2001. We need ambient groundwater monitoring to understand what has happened since 2008.
- Elwha River Watershed – Around 2016 or so, the City of Port Angeles became very concerned about the Elwha as a water source for the city, prompted by so very low water years to the point that it became physically difficult to withdraw water from the river. The city hired a consultant to conduct a survey to determine whether other water sources might be feasible. Due to the geology of the area, the results were not very encouraging; however, they did not do any drilling to determine groundwater resources as part of this study. It's unclear if a report from that work was ever published. Once the rains seemed to come back in 2017, there seemed to be less concern about water availability. Right now, the Elwha is the only source of drinking water for the city.
- Chimacum Creek Groundwater Model – In 2013, the USGS Washington Water Science Center completed a study of projected increases in population and development in northeastern Jefferson County, Washington, that are expected to lead to increased groundwater withdrawals in the Chimacum Creek Basin.

- Private Wells – All new wells are now required to be metered (Dungeness watershed?) and you must purchase a mitigation certificate for outdoor use. Grandfathered wells without meters could, however, be using a lot of water. Private wells are those that could use less than 5,000 gallons per day to water a half-acre of lawn or garden, but these wells are not monitored, so we really don't know actual water usage. The wintertime(?) average usage is estimated to be about 50(?) gallons per day that includes some outside usage. Summer usage might go up to about 100(?) or 120(?) gallons per day. (*Note: These estimates need to be confirmed at a later date.*) Washington Water Trust may have a better handle on these estimates.
- Public Water System Planning – What are the population growth projections for our cities, like Port Angeles, and its implications on water demand? These projections would be a part of our public water system planning documents, which for Port Angeles, is updated every 10 years (or 6 years?). In the recent past the population of the city has grown less than 1% per year. It's unlikely that historical population growth patterns will be a good predictor for the future; we're no longer in a steady state. Cities have a pretty good handle on water usage through metering, which is less than 150 (*need to confirm this estimate*) gallons per household per day, on average, for indoor used water.
- Groundwater for Agriculture – Within the Dungeness River watershed there are very few groundwater rights for agriculture. Some of those groundwater rights are now likely used for watering more lawns, than gardens, which is not per se "agriculture".
- Summer Stream Flows – WDOE runs the stream flow monitoring program using USGS stream gauging stations as their data source. We do need more stream flow monitoring, particularly in smaller drainages like Chimacum Creek, an important agricultural area, as we do not have a good picture of these flows. Here, people are trying to farm in what is essentially a cedar bog or

wetland. Flooding is also an issue. This watershed would really benefit from a detailed hydrological study to inform a scientifically informed approach for water needs of and usage by the community. While in the Dungeness this picture is much clearer, however, we do need to know how well the future water conservation projects will fill the needs gap within the watershed, particularly when you compare early September with late September usage by irrigators. NOSC, Streamkeepers, and the Jefferson Conservation District might also have stream flow information. So, what we seem to have are isolated pockets of stream flow information that are not "speaking to each other" and nowhere near the comprehensive and well-integrated body of information, with all the interests taken into account, that we need to have to plan for climate change. These water issues, as we know, can become politically charged very quickly.

- Water Rights – WRIA 17, for example, is a closed basin as per the Watershed Plan. With that in mind, one big data gap, at least in Chimacum Creek, is a lack of understanding of who has water rights and who doesn't. We also need to understand who is irrigating and diverting water. USGS may have conducted a groundwater study for the Chimacum Creek drainage. NOSC and the Jefferson CD have good working relationships with farmers in the Chimacum and Salmon/Snow drainages, which might help inform science-based answers to these questions.
- Smaller Drainages – There seems to be a general lack of information, or data gap, around water quantity issues associated with smaller rain-fed streams on the North Olympic Peninsula.
- Water Storage – To plan for future climate change scenarios (altered hydrology including less snow and more rain), we need to be able to capture and store water when it's more abundant for use during the hotter summer months. It's important to remember however that water storage includes both surface water storage as well as aquifer recharge. While we may have water quantity data gaps, as well as water quality data gaps as discussed below, we do already have a lot of science behind the storage and other solutions we're trying to implement in this regard. What we do need is to better understand what the priorities are for each watershed and specifically where to do those interventions.

Major Data Gaps or Barriers:

- *Comprehensive streamflow and groundwater monitoring, within each drainage basin regardless of size*
- *Comprehensive understanding of existing water rights within each drainage basin regardless of size*
- *Interjurisdictional population growth projections, preferably by drainage basin or at a minimum by Watershed Resource Inventory Area (WRIA), that includes climate-migrant estimates to help understand the implications for future water demand*

<u>Water Quality (surface and groundwater)</u>

- Groundwater Quality – Years ago, Clallam County was also involved in water quality testing of groundwater and found high nitrates in some areas within the Dungeness watershed. This may still be a concern within the Dungeness watershed and perhaps other areas like around Port Angeles and Port Townsend where potable water comes from groundwater. Nitrate samples are still taken as part of the building permit requirements and the results are retained within a database at Clallam County to watch for hotspots. This work was far more active in years past (1990s), than it is

today due to grant funding limitations. After that work the attention shifted more toward groundwater quantity issues.

- Saltwater Intrusion– With sea level rise and storm surge predictions in mind, what's known and not known about saltwater intrusion of drinking water wells for parcels along the marine shoreline? One way to collect baseline information is to require chloride testing of all new wells, along with already required nitrate testing. Often however, new wells are drilled deeper to avoid possible saltwater inundation, which may make it appear like there isn't a problem. Such testing could, however, also be conducted on existing shallower wells. While the State does not currently require chloride testing for saltwater intrusion, counties may be able to require such testing. The last time this issue was studied was in the 1990s. Sea level rise and storm surges apply pressure to shallow aquifers leading to possible saltwater intrusion, as well as pollutants from septic systems, entering drinking water wells.
- Stream Temperatures – The stream temperature maps that were shown are rather alarming. Historically, the solutions to increasing stream temperatures are to improve riparian shading, and possibly the removal of invasive plants, like reed canary grass, which are powerful tools in our toolbox. With the kind of heat waves that we've recently experienced, however, it's unclear if these solutions will continue to be effective into the future. Much will depend on the source water for each stream. Groundwater fed streams from forested areas will likely fare better than those that are primarily fed from surface waters that are affected by development. Higher water temperatures also lead to lower dissolved oxygen levels. Clearly, more work needs to be done to identify and implement watershed-specific interventions to mitigate for higher stream temperatures.
- Stream Temperature Monitoring – Several of our member governments and organizations have collected water quality data over the years, including for example the Jamestown S'Klallam Tribe on the low-flow choke points on the Dungeness; Clallam County Streamkeepers; and both the Jefferson and Clallam Conservation Districts. Much of that data collection in recent years, however, has focused on fecal coliform and nutrients. Regular and frequent water quality monitoring, that includes stream temperature that's not normally required, needs to be a part of any of the interventions discussed above, so we can 'connect the dots' to determine effectiveness over the longer-term. Using well-trained volunteers to conduct ambient and possibly project-specific stream temperature monitoring, over the longer-term, goes a long way for a relatively small amount of funding. A good example of a volunteer effort, at least for fecal coliform, was the work of Streamkeepers on the five urban streams in Port Angeles for the NPDES permit requirements which led to the identification and correction of a pollutant source. What's needed for such volunteer efforts is consistent organizational funding to keep ambient and project specific monitoring programs going to avoid data gaps, as well as the ability to regularly enter the data into databases and then analyze the data collected. We also need to ask ourselves if the ambient monitoring that we're currently conducting is going to inform the effectiveness of such water temperature interventions, or do we need to do it in a different way.
- Reclaimed Water – We need to identify acceptable uses for reclaimed water, like repurposed gray water or the City of Sequim's wastewater treatment plant effluent, even if it's not as clean as we would like it to be for mitigation use or groundwater recharge. What's the best and highest use for reclaimed waters? The State of Washington has restrictions on how such waters can be used. The work in Island County in this regard might be informative here.

Major Data Gaps or Barriers:

- *Scientifically informed predictions of saltwater inundation and septic system-derived pollution of drinking water wells along the Strait of Juan de Fuca shoreline*
- *Comprehensive and long-term stream temperature monitoring within each drainage basin, regardless of size*
- *Identification of and enhancements to acceptable uses of reclaimed water or gray water to recharge groundwater supplies*

C. Human Well-Being Breakout Session:

Shellfish and Finfish Aquaculture and Harvest (*e.g.*, availability and accessibility)

- Finfish Aquaculture – Finfish aquaculture is needed because 80% of the fish we eat is being trucked in from somewhere else. This is particularly important for the Tribal communities. While the intersection of wild fish, hatchery fish, and net pen fish is controversial, access to finfish is part of the Tribe's Treaty Rights and is central to their wellbeing, culture, and all their sacred ceremonies. One member did express concerns about fish pens along our shorelines. What we need is more education and transparency (*e.g.*, future webcam installation by Ferro Marine Life Center) on why this is so important. Kurt Grinnell was instrumental in helping me understand how important it is. (Sissi Bruch and Kim Williams)
- Shellfish Aquaculture – Ocean acidification in our local waters has prompted the need to develop shellfish seed sources in Hawaii for use here (*e.g.*, see the work by the Jamestown S'Klallam Tribes), which seems to be working, at least for now. Also, the Tribe has monitoring data on algal blooms and toxins. Also see this SeaChange article in the Seattle Times on ocean acidification effects on dissolving a vital part of the marine ecosystems food web.
- Catch Record Data – We need to understand catch record data for crab harvests, at least on the recreational side. Catch records for salmon catching however, are accomplished using an archaic phone survey. Regional Fisheries Enhancement Groups (RFEG) are working statewide with WDFW to try to get them to do a catch record card for salmon, so that we can improve data collection. This might have to be a legislative change, however.
- Fish Survey Data – The Coastal Watershed Institute (CWI), as well as others, are conducting regular surveys of various species at the mouth of the Elwha River and Salt Creek. Such data could be useful to help understand population changes and to see how many juveniles make it to maturity.
- Heat Dome Events - Tribes are starting to collect some data on the number of shellfish that have died due to recent heat waves (*e.g.*, Head Dome events). Collecting this type of data will be important to better understand the effects of these heat waves on local shellfish populations.
- Ocean Acidification and Salmon – What's known about the effects of ocean acidification on the lower portions of the food chain, including phytoplankton and zooplankton particularly in regard to the production and abundance of juvenile salmon? This seems to be a huge data gap that needs to be filled. Nina Bednarz with UW, who works with NOAA, might be a good resource here.

Major Data Gaps or Barriers:

An understanding of:

- *Tribal Treaty Rights regarding finfish and shellfish aquaculture, particularly within the context of the effects of climate change*
- *Catch record data for commonly harvested species, such as Dungeness Crab and salmonids, and how the analyses of that data might help to inform changes in harvest rates that result from the effects of climate change*
- *Fish survey data and how it will inform changes in population sizes that might result from the effects of climate change*
- *Effects of "Heat Dome" events on shellfish populations*
- *Effects of ocean acidification on the plankton (i.e., phytoplankton, zooplankton, and larval stages) portions of the marine food web*

Cultural Areas (*e.g.* preservation)

- Climate Grief – We need to understand how climate change is affecting the culture of our community's and human wellbeing. How deep are those feelings? Are people depressed about it? How can we determine what our communities need? How can we work to meet those needs? (Kim Williams)
- Archaeological Sites – Sea level rise will negatively affect coastal archaeological sites (e.g., Tse-whit-zen in Port Angele Harbor; river mouths). In addition to the Tribes, State Parks is concerned about these sites. What can be done to protect them?
- Cultural Resources – Trees in our forests, like Western Red Cedar, are showing signs of drought stress. Plants harvested from our forests are important cultural resources (e.g., Tribal basket making). We need assessments to determine the risks to these important cultural resources.

Major Data Gaps or Barriers:

An understanding of:

- *How climate change is and will affect our local community's mental health and wellbeing ("Climate Grief is a real thing! John C.)*
- *Effects of sea level rise and tidal surge on vulnerable coastal archeological sites*
- *Olympic Natl Park monitors coastal archeological sites and may have some data on vulnerability (though coastal SLR projections differ for outer coast and Strait).*
- *How harvestable cultural resources will be negatively affected by climate change*

Locally Produced Foods (*e.g.*, availability and accessibility of harvested and farmed foods)

- Frost Dates – As Matt's slide indicated, we're already experiencing changes in frost dates (fall and spring). How will these changes affect the productivity and availability of foods from our small farms and local gardens?
- Water for Farms and Fish – Concern was expressed about how changes in the hydrologic regimes (*e.g.*, drought and floods) will affect farmland within our watersheds. For example, will the off-channel reservoir, irrigation efficiency improvements, and aquifer recharge efforts within the Dungeness watershed be sufficient to minimize these effects on farming activities? We need to better enable organizations, such as WSU Extension and Mount Vernon Research Station, Conservation Districts, and Organic Seed Alliance, to do the necessary research on new crop varieties and to provide direct

assistance to both crop and livestock farmers to help them adapt to these changing local growing conditions and topography.

- Weather Stations – To respond to these changes, we may need additional localized weather information due to our varied topography and microclimates. The current suite of weather stations may not be sufficient to help farmers adapt to these changing conditions.

Major Data Gaps or Barriers:

An understanding of:

- *Additional localized weather information that will better serve our varied topography and microclimates on the North Olympic Peninsula*
- *How changes in frost dates (both in the spring and fall) will change the productivity and availability of locally grown and harvestable foods*
- *How changes in the hydrologic regimes (e.g., drought and floods) will affect farmland within each of our drainage basins*

Outdoor Activity Areas (*e.g.*, availability and accessibility)

- Recreation Infrastructure (human and on-the-ground) – With the expected movement of "climate migrants" and visitors to Clallam and Jefferson counties, as a highly desirable place to live and play, do we have the carrying capacity and recreational infrastructure (*e.g.*, within ONP, ONF, wilderness areas, state and county parks, trails, campgrounds, etc.) to handle that population increase in all seasons? Though, with the loss of snowpack, winter may not be an issue here. The Great American Outdoors Act and funding is focused on planning for this infrastructure need within the ONP and ONF. What are the planning gaps? There does seem to be a need for coordinated planning among recreation providers, however. What about implementation funding for those plans?

Major Data Gaps:

- *An understanding of how to coordinate and enhance our all-season recreational infrastructure (i.e., both human capacity and on-the-ground) to meet the needs of expected "climate migrants" and additional visitors to the North Olympic Peninsula*

Human Health and Wellbeing (*e.g.*, temperature, smoke, fire, algal blooms)

- Air Quality Predictions – While we have real-time air quality information (*e.g.*, for temperature and smoke), what seems to be significantly lacking is the technology and/or programs to predict air quality on the North Olympic Peninsula. Here's a link to smoke forecasts: https://enviwa.ecology.wa.gov/home/text/421#Forecast. The smoke monitoring station in Port Angeles is on top of the Fire Department building on 5th Street between Lincoln and Laurel.
- Air Quality Monitoring – We need additional air quality monitoring stations on the North Olympic Peninsula as they are currently quite geographically limited.
- Community Wildfire Planning – As one local fire chief recently pointed out, fire experts need to develop local community wildfire prevention plans for our area, including but not necessarily limited to the urban / wildland interface, such as fire-wise programs within the foothills. One example of the work was

completed by Dwight Barry, Peninsula College, and Shay McDonald completed in 2009 was the Clallam County Wildfire Protection Plan. Reed Wendel did fire analysis of the Geyser Valley in the Elwha while at UW CFR. Olympic National Park's Fire Management Plan would have good fire history for the Peninsula, primarily for wildlands and not the WUI, and not in the face of current climate conditions. The Halofsky, Petersen et al, 2011 publication Adapting to Climate Changeat Olympic National Forest includes a discussion of vegetation changes in the face of climate and increasing fire, and includes some modeling data for outside the federal park and forest.

- Homelessness – How ready are we to handle a possible increase in homelessness and associated human health effects that might result from climate migration to the North Olympic Peninsula?
- Tracking Health Issues – Due to HIPAA privacy regulations, it's difficult to track the physical, mental, and behavioral health of our local population hence, our ability to respond to those needs is really limited, particularly in the face of climate change. Our limited ability to track rates of disease, respiratory issues, diabetes, loss of traditional or wholesome foods, to name a few, creates a huge data gap. As a result, it's unclear if we have the right mix of health professionals on the North Olympic Peninsula to properly respond to those coming needs. How can local elected officials and our public health leaders effectively respond to those coming needs without filling those data gaps? Finally, we need to look to our local public health leaders to understand what questions need to be answered in response to the effects of climate change to better inform their, every 5-year, community needs assessments.
- Infectious Diseases – How can we use what we've learned from our collective experience with transmissibility of COVID19 to improve our ability to respond to other novel infectious diseases that might be exacerbated by the effects of climate change? One study in Ohio recently raised concerns about COVID within deer populations who do not exhibit symptoms but may be able to transmit the disease to humans. This raises a concerns for those who hunt or handle deer. Chronic Wasting Disease is another potential newcomer for ungulates and those who harvest.
- Access to Traditional Foods – As the risk of wildfires goes up, large sections of our forests are closed limiting access to traditional foods and other gathering practices. How these limitations affect the physical and mental health of our population is unclear.
- Toxic Algal Blooms – Within commercial shellfish growing areas and recreational harvest areas, we need more testing for biotoxins and harmful algal blooms that might be exacerbated by ocean acidification. There seems to be some good existing databases that could be a start in this regard.
- Mortality Rate Data – Mortality rate data, by county, sortable by cause of death can be found at the National Institute of Health web-portal titled *An Ecosystem of Health Disparities and Minority Health Resources*.

Major Data Gaps:

- *Additional air quality monitoring stations that inform a, yet to be developed, localized air quality predictive modeling program that's relevant to North Olympic Peninsula communities*
- *Local community wildfire prevention plans that are tailored to the variable topography and geography on the North Olympic Peninsula*
- *Community plans to respond to increased homelessness and associated human health effects that might result from climate migration to the North Olympic Peninsula*
- *An understanding of our community's current health needs, including illness and mortality rates, as a baseline to predict future needs that might be exacerbated by the effects of climate change on the North Olympic Peninsula*

- *An understanding of the effects of wildfire-induced limitations on access to traditionally harvested foods from our forests*
- *Comprehensive and long-term testing for biotoxins and harmful algal blooms that might be exacerbated by ocean acidification*

Community Planning

- Water Resources Planning – Speaking of infrastructure, should we be looking at laying pipes to accommodate gray water, reclaimed water, and even desalinization systems as part of planning for current construction projects in anticipation of future water demands? For example, where we're growing local foods now might not be where it will have to be grown in the future, therefore our water resource infrastructure that services these activities may need to change.
- Land Use Planning – To better respond to the effects of climate change and our community's needs, we need to revise our residential codes and development mitigation requirements. For example, the current, relatively easy, mitigation on site or within the direct vicinity (*e.g.*, for construction on 5,000 square foot lots in Port Townsend) might not be the best approach for our communities needs in response to the effects of climate change. Another example is that we might need to relocate homeowners out of harm's way and to better enable restoration actions, instead of installing very expensive infrastructure to serve a relatively small number of these residences within urban areas (*e.g.*, bridge repair over Valley Creek in Port Angeles). Local planners at the cities and counties, who already have limited capacity and funding to access the latest technology, do need to be a part of this important discussion in advance of their work to update their respective Comprehensive Plans. How can we build local planner capacity and the funding necessary to enable them to participate? These local capacity and funding limitations need to be discussed during the regional planning forums sponsored by the Washington Department of Commerce (WDOC), like the Olympic Peninsula Chapter of the Washington Planning Association, and during the development of local climate action plans. We also need to better connect land use and shoreline use planning research that's going on within our universities and colleges to planning staff working on local policies. Finally, when we factor in the effects of climate change, we need to shift our thinking from relatively short-term to much longer-term land use planning efforts. The past is not actually a good guide here on what we'll be facing in the future with climate change.

  Note: WDOC staff are very interested in the work that we've started here and were invited to this workshop. The State Legislature allocated an initial $1.6 M for WDOC to develop a model climate change chapter within the next 2 years for GMA Comprehensive Plans that will include elements of mitigation and resilience. WDOC will consult with WDOE, WDNR, WDOH, WDFW, and some local jurisdictions to help construct this chapter.)

- Shoreline Planning – How can sea level rise and the frequency and intensity of storms and surge predictions best inform our local shoreline planning efforts in places like Three Crabs and Port Townsend, for example? How do these predictions effect public and private infrastructure, like waste treatment plants, stormwater facilities, and on-site septic systems currently located and continued to be built along our shorelines, in terms of public health? These areas of concern need further study. Can places like Golden Sands as a Pollution Identification and Correction site be used as a model success story in this regard? We do now have several powerful tools available to help us do that planning, including the UW Climate Impacts Group Relative Sea Level Rise Projection maps and the NOAA Sea

Level Rise Viewer. In Port Townsend, shoreline planners have used flooding maps to inform policy, but not regulations at this time.

- Property Buy-Back Program - We need a well-funded buy-back program for parcels that are and will soon be flooded, or otherwise negatively affected, because of climate change. With such a program, we need to make sure we're using taxpayer dollars wisely and not paying full price for parcels that will be devalued because of the risks from climate change, but instead are helping the ecosystem become more resilient. Departments of community development within our cities and counties need the capacity to be able to administer such local programs. The NODC climate change planning grant might be able to provide some level of assistance in this regard.

  Note: It's important to note that data on wave energy and run-up as it relates to the length of fetch, is important to consider, in addition to sea level rise and storm surge mapping data. Also note the work on photo documentation work on "King Tides" events in Port Townsend and Port Angeles.

- Transportation Planning – Another important aspect is local transportation planning; how we get around and the emissions from that activity affects our climate. In addition, the additional stress on human well-being caused by flooding and traffic congestion along our transportation corridors, exacerbated by climate migrants to our areas, that might prompt the need to expand our existing roads and/or construct new ones. If transportation planning is not done properly, it also can damage habitat.
- Awareness, Education, Public Involvement – Progress on human wellbeing needs to be made through awareness, education, and public involvement activities that recognize the intersection between the ecosystem and the built environment to help build community support for achieving our common goals
- Regional Planners Forums with Commerce and American Planning Association (APA) – This is a good resource for local planning.
- Climate Change and Art – Art can play an important role when informing and educating the public about climate change issues. For example, see the planned March 2022 exhibit on the topic of climate change and laborers at the Method Gallery in Seattle.

Major Data Gaps or Barriers:

- *An understanding of where to plan for and install the infrastructure necessary to meet the anticipated water resource needs that will be exacerbated by climate change to better serve the future needs of our local communities (and associated activities)*
- *Local planning capacity, funding, and policy improvements to fully utilize the latest research, technologies, and programs designed to better respond to the effects of climate change when updating and implementing local comprehensive, shoreline, stormwater, water and wastewater treatment, and transportation plans*
- *Enhancements to planning professional education, development, and internship programs designed to meet these future local capacity needs for land use, shoreline, stormwater, water and wastewater treatment, and transportation planning*
- *Community understanding of the intersection between and interdependence of the ecosystem and the built environment to help build support for achieving our common climate resiliency goals and objectives*
- *Programs designed to use various forms of artistic expression to help inform and educate the public and to encourage action in response to climate change*

NEXT STEPS

Strait ERN Website – Consider developing and maintaining a new *Strait Climate Change Resiliency* page on the Strait ERN website with links to the climate-related work of member governments and organizations. In the interim, the final notes from today's workshop will be posted within the "Our Current Work" section of the "Our Work" page on the Strait ERN website. Also, the North Olympic and Jefferson land trusts will provide a short paragraph and a favorite image to illustrate their joint climate resiliency project to add to the Success Stories section of the Strait ERN webpage.

Additional Technical Workshops – Each additional technical workshop should focus on a specific topical area.

Strait ERN Climate Resiliency Led Efforts – Efforts organized by the Strait ERN should be designed to help inform the ongoing local climate action planning work by our four member Tribes, North Olympic Development Council, five local governments, and two land trusts.

Technical Workshop Planning Team – Meet with the members of the Technical Workshop Planning Team (see above) to identify the specific topical areas and develop associated objectives for each additional technical workshop. Invite others to help in these planning efforts whose expertise seems appropriate to meet the objectives of each additional technical workshop.

Goal for Additional Technical Workshops – The goal of the additional technical workshops might be to seek funding (*e.g.*, National Estuary Program annual LIO Directed Funding or RFPs, other funding sources) to accomplish specific identified actions that will fill identified major data gaps or eliminate barriers to help achieve climate resiliency on the North Olympic Peninsula along the Strait of Juan de Fuca.

Task Force Member Participation – Members of the four Strait ERN task force groups (i.e., Technical, Climate, Oil Spill, and Legislative) and action owners and partners should be invited to participate in additional topic specific technical workshops of interest.

Virtual Miro or Mural Boards – Consider using these online tools for brainstorming, gathering, and organizing information during each of the additional technical workshops.

Record Technical Workshops for Notes Purposes Only – To enable free and open discussion, additional (virtual) technical workshops should only be recorded for the purpose of drafting and finalizing notes and next steps, then discarded, as per the Strait ERN usual protocol. A transcription service, like *Temi*, should be used to create very rough notes from each additional technical workshop for interpreting and editing later.

Public Workshops – Organize and hold public workshops to help inform, educate, and involve the public, as well as Tribal, local government, and 24th Legislative District elected officials, in local climate resiliency efforts.