

**APPENDIX E: SCIENCE NEEDS IDENTIFIED DURING ACTION
AGENDA UPDATE**

Appendix E - Science Needs Identified During Action Agenda Update

As part of the strategy development process for the Action Agenda Update, interdisciplinary teams of scientists, conservation practitioners, policy analysts, and other stakeholders were convened. Teams were focused on either a topic (e.g., land development, runoff from the built environment, nearshore ecosystems) or a geographic area (e.g., San Juan Action Area or South Sound Action Area) and worked together to determine priority strategies and near-term actions. During this process, teams and working groups were also asked to use conceptual models to systematically assess and document areas of scientific uncertainty and decision critical needs.

The following are “science needs” as determined by Interdisciplinary Teams during development of Soundwide strategies and near-term actions of the Action Agenda Update. They are organized into the relevant sections of the Action Agenda Update outline.

A. Protect and Restore Terrestrial and Freshwater Ecosystems

A1 - Focus land development away from ecologically important and sensitive areas

- Continue to collect, refine, analyze, integrate and overlay landscape characterization information and data using information from existing assessments, and local and regional work including PSNERP, Salmon recovery plans, Aquatic Landscape Prioritization, local assessments and shoreline inventories, WDFW priority habitats and other sources.

C. Reduce and Control Sources of Pollution to Puget Sound

C1 – Reducing the Sources of Toxic Chemicals Entering Puget Sound

- Conducting scientific investigations of topics such as chemical causes of endocrine disruption (apparent as reproductive impairment) in Puget Sound fish, studies of the amount, fate, and transport of petroleum releases from drips and leaks, and gathering source data for PBT chemicals that were not included in the Puget Sound Toxics Loading Study.

C2 - Reducing Pressures on the Puget Sound Ecosystem from Runoff from the Built Environment

- Will there be any effects on groundwater (i.e., hydrology or quality) from increased infiltration of stormwater?
- Do we need better treatment than basic (80% TSS removal) for discharges to Puget Sounds? (refers to pollutants not binding to sediments, like oil and grease and dissolved metals and nitrogen). If yes, for which pollutants, and under which circumstances (from which land uses)? Is it better to provide a higher level of treatment for some portion of an area, or provide basic treatment to a broader geographical area? (Tacoma is one resource for this – they’re modeling this – how dense do we need to put in BMPs to reduce impacts of effects?)
- Our region will benefit from a better understanding of the benefits and limitations of LID.
- How much retrofit is needed to meet goals? What “level” of effort is needed, in terms of number of projects and acreage retrofitted?

C3- Prevent, reduce and/or eliminate pollution from centralized wastewater systems

- Support for DOH's ongoing work on technologies for nutrient reduction from on-site sewage systems.
- Fate and impact of micropollutants on groundwater quality from reclaimed water discharges to land or wetlands.
- Effect of wastewater plant designs on micropollutant removals.

The following are “science needs” as determined by other working groups during development of strategies and near-term actions of the Action Agenda Update.

Salmon Recovery Team

Water Quantity

- There continues to be much uncertainty around the level and consistency of water in all the rivers where salmon live. Technical and policy work is needed to advance our regional understanding and work to implement protective water quantity measures.

Water Quality

- There is currently a lot of work regionally around significant work across Puget Sound to improve water quality. The key uncertainty around existing water quality programs and the implementation of the salmon recovery plans is whether this work is supporting the needs of salmon recovery or whether it needs to be directed in a different way.

Monitoring and Adaptive Management

- There is a significant gap in our understanding of landscape changes and how this impacts our ability to recover salmon. Investment in watershed-based habitat status and trends monitoring, as well as project effectiveness monitoring, is key to our understanding of how to adequately adapt the implementation of the plans

Nearshore Ecosystem Team (WDFW, WDNR, PSNERP)

(Note: This is an excerpt of nearshore science/analysis needs identified in the peer-reviewed but still-in-progress “Strategies for Nearshore Protection and Restoration in Puget Sound.”)

- A more broadly developed estimate of the ability of beach systems to provide ecosystem services that incorporates additional physical attributes like slope, sediment source, watershed condition, and stream mouth structure, as well as biogenic structure like eelgrass, kelp, or coastal forest condition, while resolving the extreme variation of beach system length for the purposes of prioritization and planning, and using more precise estimates of sediment source.
- An assessment of the potential and degradation of individual barrier-type embayments and coastal inlets that considers a mix of both physical and biogenic habitat attributes, the relative importance of barrier features, as well as the condition of those up-drift sediment systems anticipated to affect each barrier feature.
- Identification of discrete or overlapping units for evaluating ecosystem potential and degradation at a scale larger than a process unit. This would better support analysis of rarity and representation at a scale. This could involve division of Puget Sound based on circulation patterns.
- A more robust consideration of rarity and other aspects of landscape composition and configuration in the evaluation of potential restoration actions. This requires a finer definition of what kind of sites attributes are relevant to rarity evaluation, such that variation in their spatial distribution strongly controls the quantity or quality of ecosystem services.
- Models of landscape use by target species, for the purpose of comparing past, current, and proposed future landscapes to provide ecosystem services specific to target organisms.
- Data resources and modeling strategies for cost effective planning of protection and restoration of sediment supply in diverse and complex sediment systems.

- A more robust evaluation of current and potential protection status of ecosystem sites, including an assessment of the distribution of existing protected lands in the nearshore. Such an analysis would better define the relative threat to ecosystem services by anticipated landscape change as compared to the existing intensity and sustainability of regulatory, educational, and acquisition measures. This may involve a re-evaluation of the use of parcel density as an indicator of degradation in the Beach Strategy.
- Evaluate sites where roads and railroads along shorelines provide the primary source site degradation, as a mechanism to identify where restoration can collaborate with transportation projects to increase shoreline function.

The following are “science needs” as determined by Local Integrating Organizations during development of strategies and near-term actions of the Action Agenda Update. (Note: Not all Action Areas identified science needs.)

South Sound Action Area

- Monitoring of rate at which shorelines are being armored
- Monitoring rate of conversion of hard armoring to natural shorelines
- Monitoring rate of conversion of private to public shoreline
- Deep submerged habitats
- Explanation of relationship between water quality dissolved oxygen and survivability of salmon redds
- Bacteria re-growth in sediments as a source of contamination in shellfish beds
- Link between restoration projects and salmon production (e.g. Red Salmon Slough coho)
- Total amount of habitat lost to date in South Puget Sound Action Area (establishment of a baseline)
- Impacts of road building on habitat in smaller coves and bays (fragmentation and sediment input especially)
- Locations of on-site septic systems in South Puget Sound Action Area
- Large-scale versus small-scale impacts of restoration activities (e.g. OSS maintenance issues)
- Comprehensive food web study in South Puget Sound, including historic biomass and species partitioning (especially in relation to coho and steelhead survival)
- Usability of clean dredge spoil in habitat restoration projects
- Forage fish and shoreline armoring: how much armoring is too much for forage fish?
- Causes of low juvenile salmonid survival in South Puget Sound Action Area

Strait of Juan de Fuca Action Area

- Clean Water District Plans - Eastern Jefferson County Water Quality Program: Continue to conduct pollution identification and correction projects to locate and correct failing oss, inadequate animal waste management practices, and illicit connections to storm water systems.
- Clean Water District Plans - Sequim-Dungeness Bay - Pollution Identification and Correction: At minimum, would include 4 tasks from the Clean Water Strategy Action Plan:
- Sample all seeps flowing into Dungeness Bay (and other investigative sampling) over the course of a year (to capture summer-time and winter-time results/potential temporal patterns) for fecal coliform, nutrients, metals and pesticides, possibly including Microbial Source Tracking, to identify pollution sources.
- Clean Water District Plans - Sequim-Dungeness Bay - Water quality monitoring/assessment: This would include additional water quality monitoring and further review of recent and historical water quality monitoring data for research (such as landscape analyses of water quality (including use of GIS) and/or further nutrient analyses) to help with understanding mechanisms of pollutant distribution in Bay and watershed .

- Climate Change Mitigation, Adaption, and Implementation of Programs and Plans - Forest and Farming Resources: Support projects and programs that: b.) Assess wildfire risk (e.g., USFS and DNR lands)
- Climate Change Mitigation, Adaption, and Implementation of Programs and Plans - Marine and Estuarine Shorelines: a.) Assure effects of sea level rise and intensity and frequency of storms are accounted and planned for within updates of SMPs by local jurisdictions (e.g., increased and rolling setbacks, buffers, and easements, clustered coastal development, relocation incentives, etc.)
- Climate Change Mitigation, Adaption, and Implementation of Programs and Plans – Outreach, Education, and Planning Efforts: Support: c.) Identification of hazardous areas, including those areas that may become more hazardous in the future
- Climate Change Mitigation, Adaption, and Implementation of Programs and Plans – Ocean Acidification: Support funding for continuous monitoring programs and projects (e.g., mooring buoys)
- Elwha River Ecosystem Recovery – Stock Preservation and weir operation: Stock preservation and weir operation. The weir will be critical to obtain broodstock for stock preservation. Preservation is defined as bringing fish into the hatchery to prevent complete loss due to sedimentation resulting from dam removal and potential adult relocation above the dams to initiate natural production, nutrient improvements, and protection fro catastrophic loss. All juvenile will be released from the station. The number brought into the hatchery will be determined by 1) hatchery space availability, 2) stock maintenance requirements, and 3) genetic considerations. Stocks not listed (i.e., even year pinks, sockeye, summer run steelhead, cutthroat) are left of for stock verification and/or due to potential for natural recolonization from in-basin stocks (i.e., kokanee, resident rainbows)
- Elwha River Ecosystem Recovery – Monitoring (adults, smolts, tagging, etc.): Required to adaptively manage the project. Are adults returning, numbers increasing, productivity.
- Forest Practices – Culvert Inventory for Private Lands: Complete inventory of culverts on small forestlands, like through the Family Forest and Fish Program
- Forest Practices – Culvert Inventory for Clallam and Jefferson County Roads: Inventory fish passage barriers (no program currently)
- Landfill Assessments, Closure, and Remediation – Port Angeles Landfill Sediment Characterization – Chemical Analysis
- Landfill Assessments, Closure, and Remediation – Port Angeles Landfill Sediment Characterization Plan Development
- Forest Practices – Adaptive Management Incentives: Support funding for adaptive management and incentives (state and federal) including wetlands mitigation (See Adaptive Management Element of the Forest HCP for specific projects)
- Marine Resource Plans – Clallam MRC: Marine and Nearshore Trend Monitoring – Monitor marine population trends in the nearshore of birds, sediment and macro invertebrates (supports Shoreline Master Program update)
- Landfill Assessments, Closure, and Remediation – Port Angeles Landfill Sediment Characterization – Ecological (Vegetation and Benthic)
- Marine Resource Plans – Jefferson MRC Eelgrass Surveys and Protection
- Marine Resource Plans – Jefferson MRC Olympia Oyster Surveys and Monitoring

- Migration Corridor Integrity – Support and Promote Adult Salmonid Investigations along Strait of Juan de Fuca: Improve understanding of adult salmonid use of habitat along entire Strait of Juan de Fuca
- Migration Corridor Integrity – Support and Promote Juvenile Salmonid Investigations (including Kelp Habitat) along Strait of Juan de Fuca: Improve understanding of habitat use by juvenile salmonids, including a focus on use of kelp habitat along entire Strait of Juan de Fuca
- Migration Corridor Integrity – Support and Promote Ocean Conditions Investigations on Salmonids along Strait of Juan de Fuca: Improve understanding of effect of ocean conditions on salmonids along entire Strait of Juan de Fuca
- Outreach, Education, Public Involvement – B. Technical Assistance – Jefferson Conservation District Water Quality Monitoring – Monitor water quality on Andrews, Snow and Salmon Creeks
- Port Angeles Harbor Ecosystem Recovery - Port Angeles Harbor Marine Wood Waste Analysis / Characterization and Removal / Remediation
- Port Angeles Harbor Ecosystem Recovery - Clean Up and Restore Port Angeles Harbor "Baywide Toxic Sites", including Rayonier Mill Site (Note: Additional sampling and analysis may be needed.)
- Salmon Recovery Plans Hood Canal Coordinating Council LE - 3-Year Work Plan: Implement the 3-Year Work Plan (Note: See assessment and monitoring projects.)
- Shoreline Master Program - Clallam County SMP Adaptive Management: Develop a method for adapting the results of monitoring the No Net Loss indicators.
- Shoreline Master Program Intergovernmental Coordination and Implementation - Ecosystem Valuation: Develop the economic baseline for the ecosystem functions that will be monitored by the No Net Loss indicators.
- Shoreline Master Program Intergovernmental Coordination and Implementation - Enhanced Shoreline Protection - Identify and implement a framework for measuring and tracking No Net Loss.
- Stormwater Management Program Update and Implementation - Clallam County Stormwater Monitoring and Data Analysis: Provide baseline conditions for stormwater throughout the county. Continue Streamkeepers' ambient monitoring program & analyze all available data for trends
- Stormwater Management Program Update and Implementation - Clallam County Land use analysis: Assess the impact of land development on stormwater quality and quantity. Interpret landscape changes at a sub-basin level using CCAP data
- Watershed Planning Detailed Implementation Plan - WRIA 17 East Jefferson Watershed Council (EJWC) Phases II and III of Water Demand, Supply, and Availability Study: Phase II: assess agricultural demand for water, and develop and study strategies to mitigate mismatches in water demand, supply, and availability in WRIA 17. Phase III: conduct a detailed, comprehensive evaluation of the mitigation strategies deemed most promising in Phase II.
- Watershed Planning Detailed Implementation Plan - WRIA 17 East Jefferson Watershed Council (EJWC) Comprehensive Surface and Groundwater Monitoring Plan (Develop and Implement): Develop and implement a comprehensive surface and groundwater monitoring program to differentiate between the cumulative effects of human-caused impacts and natural conditions. Ensure data collected complies with appropriate scientific methods and is archived and shared

appropriately. Coordinate with the comprehensive monitoring program in the Hood Canal Action Area.

- Working Lands and Tidelands Protection - Adaptive Management Incentives: Support funding for adaptive management and incentives (state and federal) including wetlands mitigation and Forest Riparian Easement Program and Riparian Open Space Program (See Adaptive Management element of Forest HCP for specific projects)
- Salmon Recovery Plans North Olympic Peninsula LE - 3-Year Work Plan: Implement the 3-Year Work Plan (Note: See assessment and monitoring projects.)

San Juan Action Area

*(Note: items to be approved in consideration of public comment per San Juan AA working group. * indicates submission by one commenter; + indicates item relates to Marine Stewardship Area Monitoring Plan)*

- Investigate effects of increasing ocean and air temperature on local species*
- Investigate effects of ocean acidification on local species*
- Investigate effects of invasive species on native species and communities*
- Investigate the causes of failure of pinto abalone to repopulate the region*
- Investigate the extent to which intertidal and subtidal communities are changing as physical conditions change, and which species are most affected*+
- Identify key areas of aquifer recharge and develop methods of protecting them*
- Investigate habitat and prey resources used by juvenile salmon
- Investigate causes of Orca population decline or failure to increase
- Investigate nature, extent and frequency of toxic algal blooms
- Investigate the causes of failure of rockfish populations to recover+
- Investigate interactions between rockfish and potential predators
- Investigate extent and degree of bull kelp population decline+
- Investigate causes of marine bird declines+
- Complete Cascade Creek Streamflow analysis as baseline research to support future instream flow decisions and to protect newly secured in stream flow.

Hood Canal Action Area

- Develop a state of the science summary of the current low dissolved oxygen and determine gaps or research left to be completed.
- Explore pathways to mitigate natural inputs into nitrogen in the Hood Canal.

Whidbey Action Area

(Note: Science needs relate to climate change only. Information from Whidbey Basin Science Symposium September 30, 2011. Items should be considered in draft form and are under review)

- Need to develop information on the non-ecological costs of climate change, so people can see the costs in context of their own lives. Speak in terms of currencies that people care about. Some examples might include:
 - Human health costs
 - Jobs lost
 - Ecological communities lost

- Develop sea level rise estimates at finer scales – down to the parcel level, in some cases
- What local actions affect NO_x and So_x?
- Reduce uncertainty surrounding the variety of factors that are contributing to increasing flood frequency
- Best Management Practices for adaptation and resilience to climate change
- Develop adaptive management and monitoring plans
- Information on existing conditions in specific ecological communities – such as forests –would help inform an understanding of how those conditions interact with existing (and future) land use, plus existing (and future) climate change
- How do future climate scenarios inform our management and land use strategies for specific landscape types? Should we be protecting and/or restoring more, or harvesting less?
- What is the suite of ecosystem services that we want to maintain, and what are the costs/benefits of those strategies?
- Where are current opportunities for building resilience/adapting?
- Will development pressures shift from lower watersheds to upper watersheds, as flooding and rising sea levels cause people to move away from the coast?
- How can we maintain water availability for all users in the future?
- With higher sea levels in the future, how will stormwater management infrastructure need to change?
- How does Shoreline Master Program guidance need to be adapted in light of the challenges presented by climate change?
- How would food bills, energy bills, etc. change under different climate change scenarios?