May 30 Nutrient Forum Notes

Background:

On May 30, 2018 the second Puget Sound Nutrient Forum meeting was held at the Red Lion Hotel, Seattle Conference Room, in SeaTac WA as well as be WebEx online. We had approximately 50 people attend in person and as many as 71 people connecting by WebEx at any one time. Forum participants represented a range of interests from local municipalities, counties, tribes, conservation districts, state and federal agencies, consultants, and environmental and public advocacy groups.

Meeting Objectives:

The objectives for this meeting were to:

- Provide a big-picture overview of nutrient over-enrichment and what we know about its effects on Puget Sound water quality and indicators of eutrophication.
- Discuss how modeling is used in decision making and why the Salish Sea model is an appropriate and best tool for making decisions about nutrient reduction in Puget Sound
- Provide an introduction to the inputs and other parameters in the Salish Sea model to begin to explain how eutrophication indicators are built into the model
- Describe the State's dissolved oxygen standards, where they came from, and our justification for why they are protective of designated uses
- Describe the Puget Sound recovery process and how strategic initiatives and implementation strategies are part of that process
- Describe and discuss the inter-relationship Ecology is building between the MWQ Implementation Strategy and the Nutrient Forum, as well as how they will be used to inform modeling and the development of a Puget Sound Nutrient Management Plan

Links to supporting documents:

- Meeting Agenda
- DO Criteria guidance
- Implementation Issues Questionnaire Responses

Slide decks for:

- Christopher Krembs (Ecology): *Marine Water Quality, and Indicators of Eutrophication*
- Ben Cope (US EPA): *Regulatory Models and Salish Sea Model Status*
- Teizeen Mohamedali (Ecology): *Nutrient loading into Puget Sound and the Salish Sea Model*
- Bryson Finch (Ecology): *WA State's Marine Dissolved Oxygen Criteria: Application to Nutrients*
- Kari Stiles (Puget Sound Partnership): *Implementation Strategies: Strategic Recovery Plans for Puget Sound Vital Signs*
- Dustin Bilhimer (Ecology): *Connecting the Forum to the Implementation Strategy*

Questions & Answers from the presentations

The following questions were recorded on flip charts during the meeting or transcribed as best as possible to represent the questions as asked. Questions were answered during the meeting and are summarized and updated here by the speakers, *answers are in italics*.

Questions from morning session (speakers: Christopher Krembs, Ben Cope, and Teizeen Mohamedali)

- **Are water quality anomalies/trends distributed more in certain areas of the Sound with lower circulation than areas that are more flushed with higher circulation? Are there more regional differences?**
    - *Yes there are but there is a statistical problem when one focuses on an area because the number of values in the analysis (n) is reduced to make the trends less significant, but the silicate to nitrogen ratio tends to shift more in South Sound while chlorophyll decreases more in Whidbey Basin, so there are regional differences. So we are trying to work more with King County and merge datasets to get at a few of these answers and increase our number of values (n) and increase our statistical power that way.*
- **Does Ecology have any information of eutrophication indicators prior to 2011? There's a paper from the early 1900s that talks about Noctiluca blooms back then, so is there anything other sources of information to draw on?**
    - *Yes, we've looked at newspaper reports back to the 1930s, and it is interesting that in 1942 there was a report about Noctiluca, and then there was a long pause where nothing happened until the early 1970s when it was reported again. And now we are seeing it consistently reported over about the last 15 years (just qualitatively looking at images). So the point is that we have a lot of eutrophication indicators that appear on a massive scale and nobody has been quantifying them so there is a big information gap there.*
- **Are there any plans to do a sensitivity analysis for the biological parameters and results from the Salish Sea Model?**
    - *Part of the modeling work has involved lots of sensitivity analyses and plan to do more. We've looked at algal group changes (changing the half-saturation rate for nitrate uptake for example), and we appreciate hearing ideas about other parameters to evaluate.*
- **How well does the SSM simulate/address biological indicators that Christopher mentioned?**
    - *The model is a simplification of biology, we are grouping algae into two algal biomass (not individual species) variables. One group is for spring time thrivers and the second algae group thrive in the later summer to account for the bimodal algae blooms that are observed over the course of those seasons. Many models use just these two groups because as you begin to add more groups in the model, there isn't much benefit from the added complexity. A limitation can surface when improving the model: there is often not enough data to go into the model to characterize those improvements accurately... The model provides a general connection between nutrients, algal biomass, and oxygen.*
- **Is there concern over the uncertainty of some parameters between the observed vs modeled data in Ben's slides?**
    - *Of course, the goal is to make it line up and minimize the difference as much as possible, and it is tough to accurately model biological systems, but it is within the expected range of how good we can make the estimations fit the data. We should expect a little more uncertainty around the algal concentrations, and the nitrogen and DO predictions*

actually do a little better than expected. We should not expect it to be perfect, so we have to live with a little uncertainty. Sometimes there's data issues and the measurements are not perfect and/or representative either.

- **Can we generally describe how algal carbon can be differentiated from other carbon sources?**
    - *Yes, if the question refers to external carbon sources then that carbon and/or surrogates for that carbon is measured so one can estimate what's coming in from outside the system. The model is simulating the algal biomass as a state variable so it's actually simulating that and the degradation into other forms of carbon.*
- **How are sources in Canada characterized in the model, what data is used to represent those areas outside the jurisdiction of the EPA and WA state, how does that play into boundary condition models about what you can affect?**
    - *Ocean boundary condition are obtained from Department of Ocean Fisheries Canada.*
    - *We also use data collected in Canadian watersheds by Environment Canada and individual wastewater facilities in order to include their existing nutrient loads entering the Salish Sea*
- **When you talk about removing point sources are you removing sources from Canada and Oregon as well as within Washington?**
    - *The Canadian sources are in the model and can be turned on or off. We don't plan to run scenarios to capture changes that might occur beyond our domain i.e. we do not plan to remove Canadian sources in the scenarios we have planned to date, even though the capability is there to do that.*
- **What lessons can we learn from Chesapeake Bay's modeling approach to reduce uncertainty in the SSM and understanding if "we" are going to be able to make a difference in water quality? By comparing the Chesapeake Bay model to other models they were able to improve the Chesapeake Bay model, has Ecology talked to colleagues in the Chesapeake Bay area about their experiences over the last 5 years.**
    - *We are aware there are multiple models being developed there, and there are multiple models out here too but not really at the same level, focus, and scale as the Salish Sea Model. UW tends to be more focused on the open ocean side of modeling and monitoring. We don't have a budget to support a community of models and we barely have the budget to support the Salish Sea model (from EPA's perspective) from a wider Puget Sound perspective there are other models from UW and a USGS model that is focused on sediment transport and sea-level rise...*
- **What were the most important predictor variables for the regression model to predict river nitrate/nitrite?**
    - *It's primarily a function of stream flow and time of year (i.e. seasonality), applied to the monthly nitrate/nitrite concentration data from Ecology's ambient monitoring network. It's not specific to land use.*
- **Does the model account for wastewater treatment plants that discharge to rivers?**
    - *Not directly. The watershed inputs in the model integrate all upstream human and natural sources, so the load at the mouth of a river does include all upstream sources, including wastewater treatment plants. However, we cannot isolate the effect of individual wastewater treatment plants that discharge to rivers using this model – we would need a watershed model along with more refined monitoring data to isolate upstream point sources from the river load.*
- **Do the model outputs show/reflect inter-annual ocean variability from La Nina or El Nino years?**
    - *Yes, but we have not really analyzed model results in the context of El Nino/La Nina years. We have model inputs for 2006, 2008, and 2014, and intend to model other years*

as well. While we have not specifically analyzed model inputs and results in the context of El Nino/La Nina, the model does reflects hydrological and ocean conditions for each of this years, e.g. high/low flows brought about by El Nino or La Nina conditions. When we have more years to compare to, we could potentially explain some of the inter-annual variability in model results to ocean variability from La Nina and El Nino.

- **Can the model be used to calculate historical non-oceanic nitrate trends based on historical input data, and if so how would those compare to non-oceanic nitrate trends derived from the corrected water quality data presented earlier?**
    - *We don't have that historic data that goes back in time far enough, that's why we have to make estimates of reference conditions. We don't have data to know what rivers were bringing in before people lived in Puget Sound so we have to do statistical estimates. We probably have even less data at the ocean boundary so we are definitely limited by data as we go back in time. We have about 20 years of data for rivers, some rivers are going up some are going down. We also have to be aware of how climate cycles play a role in the trends.*
- **Considering impacts from climate change and the likelihood of earlier snowmelt and precipitation patterns, how will that change nutrient loading into Puget Sound and will those changes or land cover changes be considered in the SSM?**
    - *We published some earlier results in a 2014 report of future impacts from growth and climate change based on downscaled climate information from UW[1], and found that in general, climate change and land use would increase overall nutrient loads from rivers, and shift the timing of delivery to Puget Sound due to changes in the timing of snowmelt and precipitation. We are hoping to update assumptions with the latest IPCC estimated future climate conditions and add impacts from projected population growth to see what kind of impacts that will have. This latter portion of the work has not been funded yet, but we hope that we will secure funding to work with the UW Climate Impact Group to obtain downscaled global model for future year scenarios.*
- **You mention that the ocean is the biggest source of nutrient loading, can we quantify nitrogen flux from the ocean and how much enters Puget Sound? It seems like there is a much bigger flux from the ocean than from rivers and POTWs, and the graphs don't give us a good feel for that.**
    - *Davis, et. al.[2](2014) wrote a paper which addresses fluxes in and out of the Strait of Juan de Fuca. We know that there is a huge flux coming in from the ocean and there's a lot going back out, according to Davis et. al. about 98% of outgoing waters are of oceanic origin. We do not have an analogous estimate at Admiralty Inlet which is the entrance to Puget Sound. While we have not focused on calculating fluxes in this work, the Salish Sea Model does take into account both incoming and outgoing circulation and mixing. We agree that waters of oceanic origin constitute a large influence. Because of all the uncertainties and the likelihood that the marine water quality response from increasing*

[1] Roberts, M., T. Mohamedali, B. Sackmann, T. Khangaonkar, and W. Long. 2014. Puget Sound and the Straits Dissolved Oxygen Assessment: Impacts of Current and Future Human Nitrogen Sources and Climate Change through 2070. Washington Department of Ecology, Publication 14-03-007.

[2] Davis, Kristen A., Banas, Neil S., Giddings, Sarah N., Siedlecki, Samantha A., MacCready, Parker, Lessard, Evelyn J., Kudela, Raphael M., Hickey, Barbara M. 2014. Estuary-enhanced upwelling of marine nutrients fuels coastal productivity in the U.S. Pacific Northwest. Journal of Geophysical Research: Oceans. Vol 119, Issue 12. Pp. 8778-8799.

human loads will get more seasonally acute as the climate changes; focusing on how we can reduce our loads locally becomes that much more important.

- **To isolate the influence of regional sources here in Washington and Canada, do you just keep the ocean fluxes the same, so in other words are you able to just isolate just how much is coming from sources locally?**
    - *Right, absolutely. When we compare model outputs for current and reference conditions we are not changing the ocean input so we are essentially able to isolate local anthropogenic effects. What really matters is how much of that oceanic nitrogen makes its way to the surface layers in the euphotic zone, it's not really so much about looking at the overall nitrogen budget but really looking at what is the fraction of nitrogen that makes it into the euphotic zone so it can be converted into organic material.*
- **How are nearshore stormwater outfalls or nonpoint sources that go directly into the Sound included in the model inputs?**
    - *We have monitoring locations that are as close to the mouths of rivers as possible to capture those watershed source loadings, but we know that misses some parts of the watersheds that are further downstream or along the shoreline. We are pretty confident that when we extrapolate from the monitoring location to the mouth of each watershed (by using a scaler that takes into account area and precipitation), we are capturing most of the nonpoint source and stormwater load in the nearshore area, but we don't have individual storm drains explicitly represented. We have calculated the difference between our extrapolation and estimates of septic system loads or groundwater loads that go directly into marine waters and we found those percentages to be pretty small. So, for now we think our extrapolation captures those. It's not 100% perfect but we think it is not a significant difference.*
- **Are you looking at particulate nutrients from rivers?**
    - *Yes, we include particulate organic carbon, and total nitrogen and inorganic nitrogen and then calculating the particulate and dissolved organic fractions.*
- **For existing ambient freshwater water quality monitoring programs, what types of data and data analyses would be helpful to collect now to help the model?**
    - *For select rivers, continuous monitoring of rivers would be helpful to capture specific storm events and better temporal resolution than what we are using now, and then measuring organic and inorganic nutrient forms would help us get a better handle on those ratios of those parameters. That should happen at some of the larger watersheds but doesn't need to happen at all of them.*

Questions for Bryson Finch

- **So you've attributed the rule-making back in 1967 to the Federal guidance document that came out in 1968. Did you find written records that they actually looked at that or are you looking at similar timing?**
    - *Yes, I looked more at the timing aspects. I've looked at the records in the archives but it is a mess and it will take a very concerted effort to get through it all, so at this time we don't have explicit written records making that connection.*
- **Is Ecology going to review the existing DO criteria and consider changes based on a more current technical basis?**
    - *We started to look into the literature and there's not a whole lot on marine DO and Puget Sound fish requirements. If we were to reopen the standards now, with the requirement for Endangered Species Act (ESA) consultation it is likely that new criteria could be more stringent. At 5mg/L DO which is our "good" water quality, which is right*

on the cusp of to where we start to see sublethal effects and that is something that wouldn't be fully protective.

- **Is Ecology considering reassigning where designated uses apply (i.e. should Hood Canal's criteria be 7mg/L?) and where they should be applied in the water column?**
    - *The Chesapeake Bay delineation of where the criteria applies is a great model, but developing something on that scale would have to be considered in the timeframe for our tri-ennial standards review and we don't feel that our standards are that far off based on protection of marine organisms. We have the natural conditions standard that we fall back on, so if the biologically based numeric criteria are violated then we look at natural conditions using the Salish Sea model and then apply the human allowance for DO depletion.*
- **The Vaquer-Sunyer & Duarte (2008)[3] paper you shared focuses on east coast species and also shows that temperature plays a role in the sensitivity of species to low DO and the role of temperature should be considered with DO concentrations.**
    - *Ecology conducts a triennial review of our standards, and we are committing to looking over the literature available to see if our standards are on par with where we should be with those criteria. We are looking at the most sensitive species requirements which will drive the numeric criteria. Although a few of the experiments cited in the paper did have compounding temperature effects, the paper does not correlate temperature to biological effects... The paper states: "hypoxia often occurs in concert with other stressors in nature, and although some experiments addressed thresholds of hypoxia in the presence of additional stressors (e.g. high temperature, sulfide), most experiments used reduced oxygen as the single treatment variable". Raquel Vaquer-Sunyer, the paper's primary author,* mentioned to us that they specifically looked at the modulation of hypoxia thresholds by different stressors such as sulphide or temperature[4] in other papers. *We recognize that more research, with native benthic species, would be helpful to inform these questions.*
- **One of the slides indicated sampling once per day. Is the criteria applied based on one sample per day? How is diurnal variation accounted for?**
    - *No it doesn't necessarily mean that we only sample once per day, its' just based on the minimum concentration over a diurnal period. Of course the DO is higher during the day and lower during the night because of photosynthesis during the day and respiration at night.*
- **Are there archived records from when the criteria were first adopted in 1967 that identify that as the basis for the 0.2mg/L? I'm wondering if using that is a position that has evolved after the fact.**
    - *We would have to go back and look again at the record, but we believe both the 0.2mg/L DO depletion and 0.3degC anthropogenic change for temperature come from the instrument measurement accuracy at that time to conform to the criteria of no measureable change from natural conditions if the numeric criteria cannot be met under natural conditions.*

[3]Vaquer-Sunyer, Raquel, and Duarte, Carlos M. 2008. Thresholds of hypoxia for marine biodiversity. Proceedings of the National Academy of Sciences of the United States of America. Vol. 105, Issue 40. pp. 15452-15457. http://www.pnas.org/content/105/40/15452

[4] Vaquer-Sunyer, R. and Duarte C., Temperature effects on oxygen thresholds for hypoxia in marine benthic organisms, Global Change Biology (2011) 17, pp. 1788–1797.

- **Why do lake class criteria not allow any change from a natural condition while the marine criteria have the anthropogenic allowance?**
    - *The guidance doesn't cover that and we weren't prepared to answer that question. We would have to go back and do a little research on that and then get back to you on that.*
- **It sounds like the regulations will come down on nitrogen, so you will be using these different criteria to translate to limits on nitrogen. So will the Forum be the process where stakeholders are engaging with Ecology on how we are applying and interpreting these various standards in the modeling process and the ultimate implementation strategy process?**
    - *Yes we will be having discussions about how we are applying the criteria and we will be describing what we are doing. We've been thinking about how we apply this too, and how do we apply something that has high spatial and temporal resolution like the model output where we can determine at any time of the year and in any place in the Salish Sea and within 10 different layers how the water quality is changing over time. That is not something that is described in our criteria or Water Quality Policy 1-11. Our assessment policy for determining category 5 (or polluted waters) does not include using modeled results, so we won't be using the model to identify new category 5 polluted waters, but we will be using the model to show how we are meeting a recovery target, which has to account for seasonal variation, duration, and magnitude. We might get into some discussions about how to improve that criteria, but we won't be getting into a rule revision process.*
- **So the anthropogenic allowance is 0.2mg/L below a natural level. How do you know that the model can discern that limit?**
    - *We routinely do this type of analysis between existing conditions (or hindcast condition for a previous year) and subtract from it the model reference condition which is analogous to the natural condition. Using the variance of the differences approach, one can estimate the root mean square error (RMSE) of the difference between two models. Essentially in this case, subtracting two model outputs that are based on the same model, just different loadings, the result is that the model bias is subtracted out. A root mean square error is then calculated for that difference and it can be less than 0.2mg/L.*

Questions for Kari Stiles and Dustin Bilhimer

- **How will the nutrient reduction strategy support one of the Strategic Initiatives? How are those implementation strategies related to the Strategic Initiatives which are the priorities for resources and energy to protect and restore Puget Sound?**
    - *The nutrient reduction strategy is related both to marine water quality and dissolved oxygen which right now falls under the Stormwater Strategic Initiative, but is also directly related to the shellfish and habitat related vital signs. Any strategies developed to improve marine water quality and improve dissolved oxygen would also improve things under the shellfish initiative we think. Nutrient over-enrichment is an issue that not only effects hypoxic conditions but other aspects of marine water quality and health too. The Marine Water Quality Implementation Strategy is an opportunity to have the discussion about the broader ecological effects and make connections with the other Implementation Strategies in the Vital Signs wheel.*
- **I'm not fully understanding the connection between the Near Term Actions and the Strategic Initiatives which are meant to address a combination of Vital Signs, and the work we are engaging in here (at the Forum) which is leading to wastewater treatment plant regulation; I don't see that anywhere in the Near Term Actions and the Strategic Initiatives. Can you explain how they are connected and how and why regulating wastewater treatment plants**

isn't a prioritized near term action and one of the strategic initiatives if we are driving towards that so how is that a priority.

- *The priorities for the 2018 Action Agenda were developed last summer (2017) when there wasn't a marine water quality implementation strategy. If those come out as priorities during this process they would get into the next Action Agenda update. How that worked in the Habitat Strategic Initiative for the 2018 Action Agenda, is that there are 4 existing implementation strategies that was pulled from (Shoreline Armoring, Land Development & Cover, Floodplains, and Estuaries) and the highest priority near term strategies from those implementation strategies and the technical advisory committee called the Strategic Initiative Advisory Team (SIAT) for Habitat, and they looked through the content in the implementation strategy and they advanced some of those things as priorities. But because marine water quality did not have an implementation strategy, the priority for this Action Agenda is make the MWQ IS as soon as possible and inform the Action Agenda so we can begin acting on the priorities.*

- **Is there a comprehensive list or analysis of the pressures in Puget Sound and of that list which are being addressed by the Puget Sound Partnership in this process and which are not being addressed?**
  - *Yes, there was a Puget Sound Pressures Assessment[5] that done in 2014/2015, a number of you in the room may have been involved in that assessment; through an expert elicitation process a ranking of Puget Sound pressures and their impact on specific ecosystem endpoints. Some of which relate to the Vital Sign, but it is broader than that. So the Implementation Strategies are explicit in the pressures they are focused on, both the sources of pressure like land development, as well as the associated stressors whether that's conversion of habitat or increased impervious surface leading to runoff problems. So the Implementation Strategies are explicit about which pressures they are focusing on, but we don't have a list right now of which pressures the Implementation Strategies and therefore the Action Agenda are currently focusing on and which they are not and how that relates to the highest rated pressures. But we could develop that pretty easily, that's a good question and it would be interesting. We are looking a lot at how we focus our efforts on common pressures or common threats.*
- **In an earlier presentation we saw how the flow from Central Puget Sound wastewater treatment plants haven't really increased probably due to a change in human behavior since population has gone up and flows didn't increase so something changed in the behavior. How is human behavior and modifying human behavior addressed by the Puget Sound Partnership? It seems to be a key driver of anthropogenic change, so is it education through the school system, or what?**
  - *The Implementation Strategies are specifically designed and intended to address those factors contributing to the problems and also represent the opportunities for changing the system and changing the outcomes. Implementation Strategies should look at all of those human behaviors and what's driving them, whether it's perceptions that are real or not, or whether it's preferences, or lack of incentives, whatever it is the Implementation Strategies are specifically designed to look at those factors that are underlying certain behaviors that we might need to change and focus strategies on those behaviors. Either understanding them better or changing them, either using regulatory, technical, or financial incentives, or education and outreach. Whatever strategy or combination of strategies to change those specific behaviors should be*

[5] https://www.eopugetsound.org/articles/2014-puget-sound-pressures-assessment

identified through the Implementation Strategies. So we have in the Action Agenda, all of those different strategies to influence human behavior, we have to continue figuring out how to use them most effectively.

- **You mention wastewater treatment upgrades, are you also looking at alternative methods for handling sewage as Europe, Japan, and other countries are already doing?**
    - *As we mentioned before, there is space for creativity. If we think about the range of wastewater treatment plants that we have here in Puget Sound, there's small lagoons and small treatment systems that serve small communities ranging all the way up to the large metro and service areas; so when we are talking about what kinds of permitting strategies would make sense for us in Puget Sound, we might look at things we could do that might not necessarily include capital investments and changing treatment technology, there might be changes in operations that can be cost effective. And there could be significant investments that are needed for the really large areas and then what do we do with those in between as those facilities in the middle continue to grow, how do we help them achieve targets over time and maybe all of that is not a burden on the wastewater treatment plants. It's a worthwhile discussion and we want to use this Forum to have that discussion with all of you.*
- **There was a brief discussion about cost and affordability of solutions dealing with nutrients and low DO, but with all of the regional competing needs like toxics in fish or shoreline armoring, etc., is there a plan to look more broadly at where a nutrient management plan might rank in a larger list of regional environmental priorities?**
    - *Yeah, that's a good question, what's more important? Stormwater, wastewater, habitat restoration? I don't have a clear answer to that yet, but one of the things that I would like for us to be thinking about is how can we achieve multiple objectives with solutions. So a solution for a wastewater treatment plant to remove nutrients might also help get at removing some pollutants of concern. I think these are discussions we need to have in addition to how we deal our waste and storm water, there is also a land use question and how do we restore a watershed's ability to naturally attenuate nutrients. So how do we get nature to do some of that work for us, and I think some of those things are already happening when we talk about Salmon Recovery projects and Floodplains by Design and floodplain reconnection. I think there's a wide range of solutions and that will be part of our discussion over the next year.*
- **To build off of a previous question, how will that prioritization work? I thought that was what the Puget Sound Partnership did was to help with that prioritization.**
    - *I don't have a clear vision of that yet but we will be working on defining that. We will add that to the parking lot for issues. We will be talking about and prioritizing solutions and priorities in this process in relation to nutrients and its effects on eutrophication indicators and we'll draw connections with solutions that can provide benefits in other aspects too from metals or toxics reduction or TSS reductions, etc. But I'm not quite sure that we are having the larger discussion in the Forum about whether nutrient reduction is more important than stormwater or more important than other kinds of solutions for reducing toxics. I don't have a clear answer, that's a tough question and we're starting with discussion.*

Parking Lot items:

- What are the percentages of the marine source loading fraction compared to the total loading from natural, oceanic, and watershed sources?

- How do we prioritize nutrient reduction solutions with other necessary, significant pollution reduction activities?

Attendees

The following attendees either participated in person and signed in or participated via Webex.

Name	Organization Representing
Abby Barnes	Washington State Department of Natural Resources
Aimee Kinney	University of Washington
Alyssa Barton	Puget Soundkeeper Alliance
Andrea Hood	WA Department of Health
Angela Adams	US Environmental Protection Agency
Bart Christiaen	WA Dept. of Natural Resources
Becca Conklin	WA Dept. of Ecology
Ben Cope	US Environmental Protection Agency
Ben Larson	King County
Bill Backous	
Bobbi Lindemulder	Snohomish Conservation District
Brad Gluth	City of Oak Harbor
Brian Mattax	
Bruce Wishart	Puget Soundkeeper
Bryce Figdore	HDR
Carla Vincent	Pierce County Planning & Public Works
Chad Newton	Gray & Osborne
Chanele Holbrook	WA Dept. of Ecology
Chelsea Morris	WA Dept. of Ecology
Chery Sullivan	WA Dept. of Agriculture
Chris Townsend	King County
Chris Burke	City of Tacoma
Christopher Krembs	WA Dept. of Ecology
Cristiana Figueroa-Kaminsky	WA Dept. of Ecology
Dale Norton	Department of WA Dept. of Ecology
Dan Thompson	City of Tacoma
Darlene Schanfald	Sierra Club
Daryl Williams	Tulalip Tribes
David Winfrey	Puyallup Tribe Shellfish Department
Debbie Meisinger	King Conservation District
Debra Bouchard	King County

Name	Organization Representing
Dennis Burke	Environmental Energy & Engineering Co.
Don Seeberger	Coalition for Clean Water
Douglas Navetski	King County
Dustin Bilhimer	WA Dept. of Ecology
Elsa Pond	WA Dept. of Transportation
Gabriela Hannach	King County
Gary Wilburn	WA State Legislature
Gordon Holtgrieve	University of Washington
Greg Pelletier	WA Dept. of Ecology
Greg Kongslie	City of Sumner
Heather Kibbey	Washington Association of Sewer and Water Districts
Heather Earnheart	Alderwood Water & Wastewater District
Ingrid Wertz	Seattle Public Utilities
Jason Flowers	Murray Smith & Associates
Jason Van Gilder	City of Sumner
Jay Mirro	King Conservation District
Jeff Lafer	King County, Wastewater Treatment Division
Jim Gibbons	Seattle Shellfish
John Gala	WA Dept. of Ecology
Joseph Old Elk	Snoqualmie Tribe
Josiah Hartom	Alderwood Water & Wastewater District
Judith Scott	City of Tacoma
Julie Watson	WA Dept. of Fish & Wildlife
Kaila Turner	Port Townsend Paper Co.
Karen Dinicola	WA Dept of WA Dept. of Ecology
Kari Stiles	Puget Sound Partnership
Katherine Brooks	Pierce County Planning & Public Works
Ken Miller	Lakehaven Water and Sewer District
Kerri Love	WA Dept. of Agriculture
Keunyea Song	WA Dept. of Ecology
Kevin Ruuhela	Snohomish County - Office of Energy & Sustainability
Kimberle Stark	King County Dept. of Natural Resources & Parks
Laura Fricke	WA Dept. of Ecology
Liane Monroe	Port Townsend Paper Co.
Lincoln Loehr	Consultant with City of Everett
Lisa Dally Wilson	
Lisa Dennis-Perez	LOTT Clean Water Alliance

Name	Organization Representing
Lisa Redfern	Seattle Shellfish
Liz Carr	
Lizbeth Seebacher	Dept of WA Dept. of Ecology
Marilyn Guthrie	King County
Matt DeBoer	Brown & Caldwell
Meg Chadsey	University of Washington
Meg Harris	Whatcom Conservation District
Melissa Gildersleeve	WA Dept. of Ecology
Michael Isensee	WA Dept. of Agriculture
Michelle Wilcox	US Environmental Protection Agency
Mindy Roberts	Washington Environmental Council
Minna Carey	Anchor QEA
Molly Du	Lakehaven Water and Sewer District
Neil Harrington	Jamestown S'Klallam Tribe
Nichole Embertson	Whatcom Conservation District
P. Wendling	City of Bellingham
Patrick Burke	Jacobs Engineering Group
Patrick Kongslie	Pierce County
Paul Williams	Suquamish Tribe
Ralph Svrjcek	WA Dept. of Ecology
Rebecca Fox	City of Anacortes
Renee LaCroix	City of Bellingham
Renee Scherdnik	Kitsap County
Rich Doenges	WA Dept. of Ecology
Rick Dinicola	US Geological Survey
Rick Haley	Skagit County
Sam Russell	WA Dept. of Ecology
Sheelagh McCarthy	WA Dept. of Ecology
Sheila Helgath	
Simone Alin	National Oceanic & Atmospheric Agency
Stacey Callaway	WA Dept. of Ecology
Stefan Kamieniecki	Pierce County Sewer Division
Stella Vakarcs	Kitsap County
Stephanie Jaeger	King County Dept. of Natural Resources & Parks
Susan Braley	WA Dept. of Ecology
Susan Blake	Washington State University
Susan McCleary	City of Olympia

Name	Organization Representing
Tanya Roberts	Puget Sound Institute
Tawni Dalziel	City of Sammamish
Teizeen Mohamedali	WA Dept. of Ecology
Tiffany Knapp	King County
Tim Campbell	Midway Sewer District
Tim Berge	Southwest Suburban Sewer District
Tim Trumbull	Sonoco
Tim Weissman	Jefferson County
Todd Hunsdorfer	King County
Tom Giese	BHC Consultants
Tyler Rockhill	WA Dept. of Transportation
Wendy Steffensen	LOTT Clean Water Alliance