Puget Sound Nutrient Forum

Salish Sea Modeling Proposed Draft Scenarios

April 30, 2019

DEPARTMENT OF ECOLOGY
State of Washington

Welcome

Dustin Bilhimer

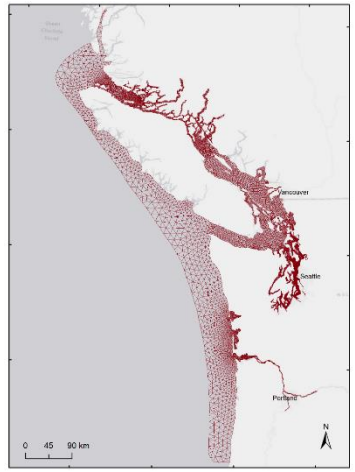
PSNSRP Project Manager

WA State Department of Ecology

Today's Agenda

10:00 a.m.	**Welcome & Introductions (Gretchen Muller, Cascadia Consulting)** • Overview of Forum and purpose of today's meeting • Puget Sound Nutrient Source Reduction Project schedule • Explain format for today's breakout groups
10:30 a.m.	**Draft Model Scenarios Presentation** • Introduction to draft scenarios for Year 1 modeling • Description of scenario questions and objectives • Q&A
11:00 a.m.	**Facilitated Breakout Discussion Groups: Model Scenarios 1 & 2** Attendees will be assigned to discussion groups. • Scenario 1: Watershed source reductions by basin • Scenario 2: Marine point source reductions by basin
12:15 p.m.	**Break for Lunch** *(lunch will not be provided)*
1:00 p.m.	**Facilitated Breakout Discussion Groups Continued: Model Scenario 3** • Scenario 3: Annual vs. Seasonal nutrient load reductions
1:30 p.m.	**Group Activity: Fish Bowl Style Discussion on Scenarios 4 & 5** This discussion activity will be with the whole group. • Scenario 4: Future population growth and climate change • Scenario 5: Everybody, everywhere
2:45 p.m.	**Wrap-up and Adjourn (Dustin Bilhimer)** • Overview of how we will incorporate Forum feedback on draft scenarios and future communications to the Forum on modeling decisions. • Upcoming meetings in 2019.
3:00 p.m.	**Adjourn**

Puget Sound Nutrient Source Reduction Project: Overview of Salish Sea Modeling Objectives and Draft List of Scenarios



April 30, 2019

Presented by Dustin Bilhimer and Kelly Ferron, WA Dept. of Ecology,
Water Quality Program

Salish Sea Modeling Timeline, Milestones, and Products

	Timeline	Objectives
Phase 1	**Bounding Scenarios Modeling** 2018	• Examine the DO problem under multiple years with a range of residence time • Understand the effect of nutrient reductions from different groups of POTWs • Answer questions about rates and parameters used in the model
Phase 2 (Optimization)	**Year 1 Modeling** July 2019 – June 2020	• Understand the significance of watersheds separate from marine sources. • Understand the range of future conditions, impacts, and potential improvements. • Define what it takes to meet water quality standards under existing conditions.
	Year 1 Model Milestone Summer 2020	• Ecology will release technical memo of first year modeling and share modeling results at Forum. • Discuss next scenarios to model based on what we learn from Year 1 modeling. • Confirm next set scenarios.
	Year 2 Modeling July 2020 – June 2021	• Evaluate new combinations of reductions from marine and watershed sources. • Evaluate remaining questions to inform decisions for facility planning and nutrient source reduction plan. • Evaluate a final set of nutrient load reduction targets for both marine and watershed sources that meet water quality standards.
	Year 2 Model Milestone Summer-Fall 2021	• Ecology will share modeling results at Forum meeting. • Ecology will publish a report of second year of modeling.
	Tentative Plan Development Summer 2021-End of 2022	• Develop Draft Puget Sound Nutrient Source Reduction Plan. • Public review

Objectives for Today's Forum

✓Improve our shared understanding of the Year 1 modeling scenarios

✓Receive input on Ecology's draft list of model questions and scenarios

- What questions do stakeholders want answered?
- Do those answers move us towards the final goal?
- What can we do to improve on these scenarios?
- Is there new data we can incorporate that we haven't before?

Ultimate Modeling Objectives

Answer Primary Nutrient Management Question:

What combination of anthropogenic nutrient source reductions will reduce the magnitude, duration, and spatial extent of human-caused DO stress on marine water quality to meet DO criteria?

Evaluate a range of potential nutrient management questions to answer:

- Can we meet DO standards?
- How much reduction is needed?
- Where is most important to focus implementation?
- Which source categories most effectively reduce/remove human nutrient load?

Balancing Constraints

Scope

- Work with the analytical tools we have
- Quality data for model inputs, at the right scale
- Need to end up with actionable information

Schedule

- 2 years
- Leverage existing work to save time
- Overflow scenarios will be added to Year 2 Scenario Parking Lot

Budget

- List of Year 1 scenarios must be completed within the staff resources available for Ecology's modeling team and PNNL collaboration

The choices for the final Year 1 list must balance all three constraints

How we plan to use today's feedback

May: Forum Summary

May-June: Internal-Ecology discussions to integrate feedback, weigh constraints, and finalize list of Year 1 scenarios and model runs

June: List of the final set of Year 1 scenarios with explanations of decisions and how we used Forum input

Scenario Parking Lot for Year 2

Terms you'll hear and use today

- Puget Sound basin
- Existing, Reference, and Future Conditions
- Model Year
- Management question
- Scenario
- Model run
- Advanced wastewater treatment
- Marine point sources
- Watershed sources

Building on results from the Bounding Scenarios

Puget Sound
Nutrient Source Reduction Project

Volume 1: Model Updates and Bounding Scenarios

DEPARTMENT OF ECOLOGY
State of Washington

January 2019
Publication No. 19-03-001

Inter-annual Variability Effect on Residence Time

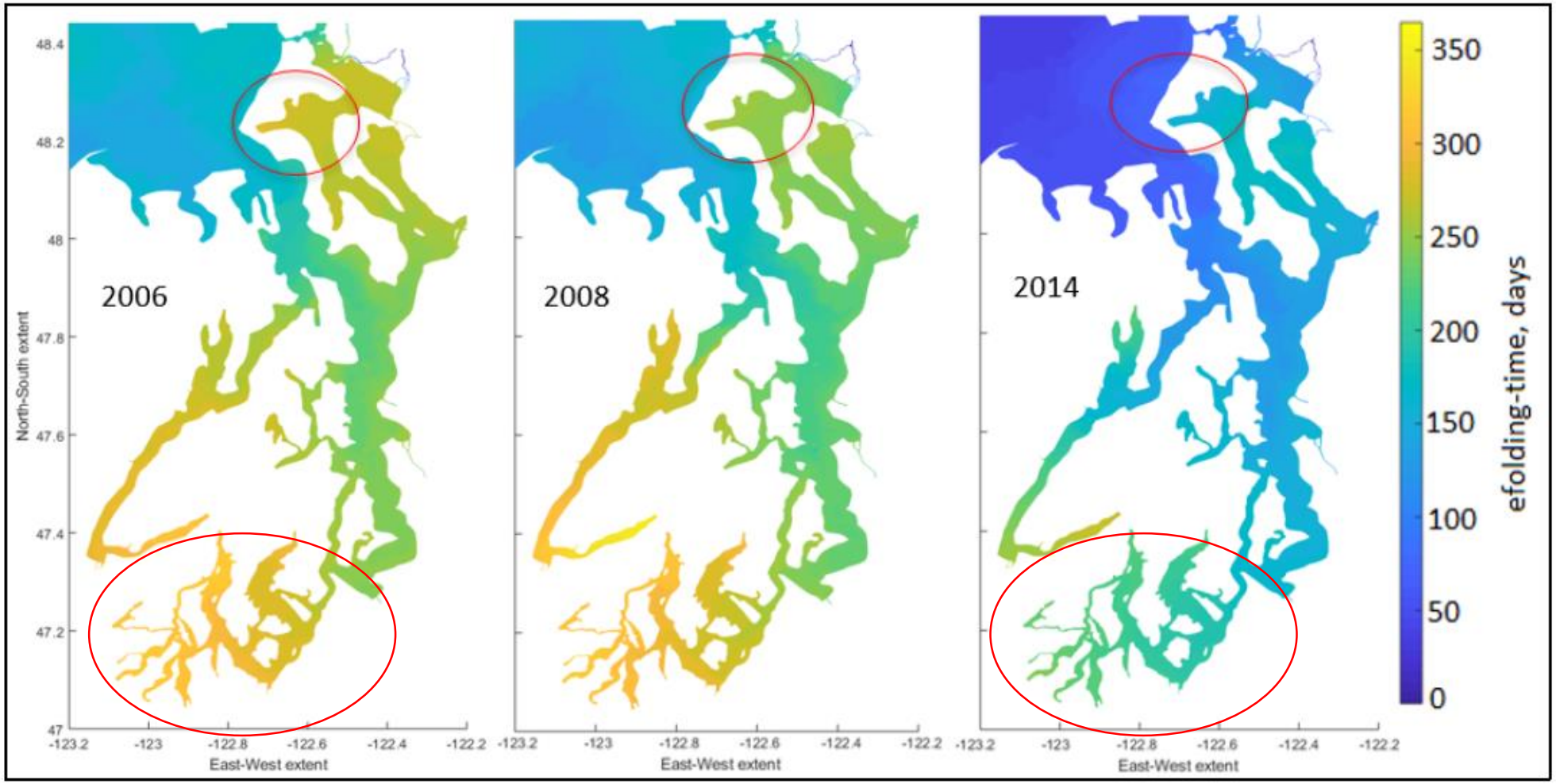


Figure 13. E-folding times (indicative of residence times) in Puget Sound for 2006, 2008, and 2014.

*

**Volume 1: Model Updates and Bounding Scenarios*. Pub. #19-03-001

Defining Existing Conditions

- Low-DO and hypoxia occur naturally, but human nutrient sources can make it worse.
- Existing anthropogenic nutrient loads affect areas terminal inlets and bays
- Total residence time affects the extent of noncompliant area

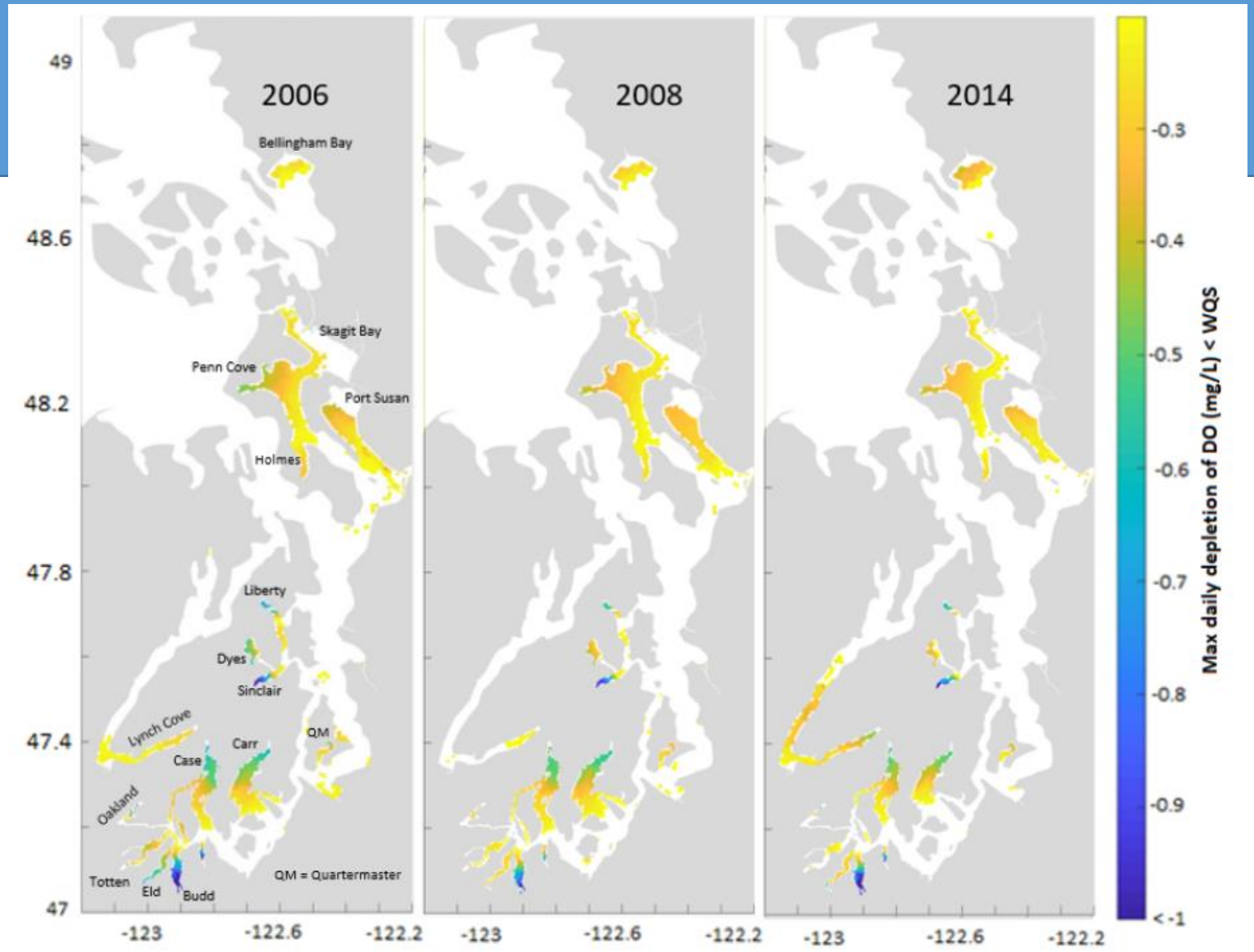


Figure 26. Maximum dissolved oxygen (DO) depletions from anthropogenic sources in 2006, 2008, and 2014, leading to noncompliance with the water quality standards (WQS).

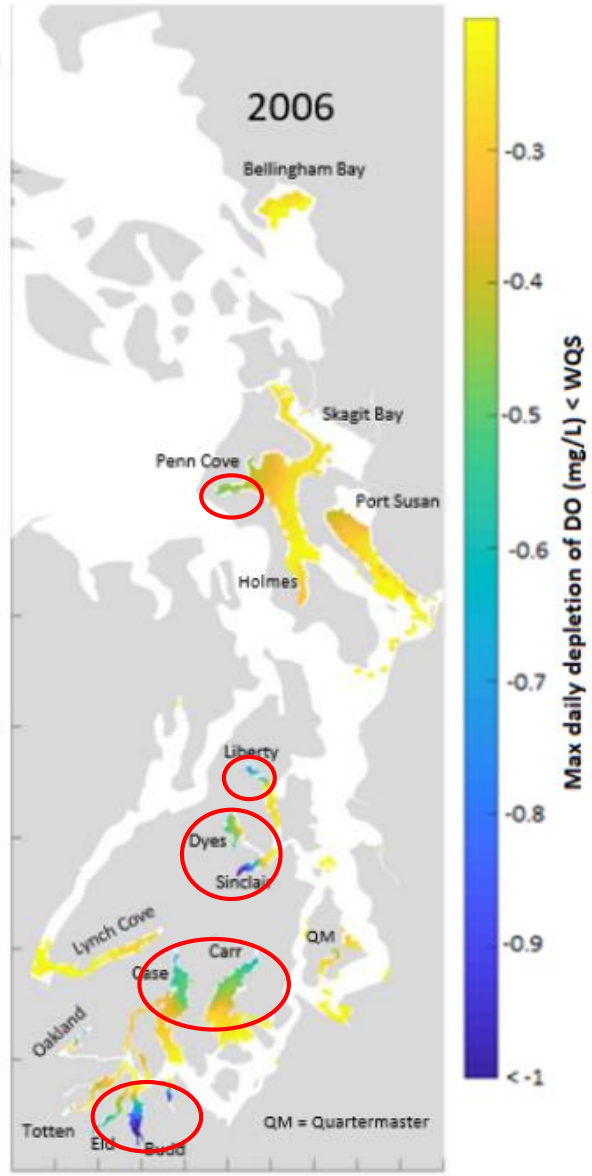
*Volume 1: Model Updates and Bounding Scenarios. Pub. #19-03-001

Extent and Magnitude of DO Depletion

Table 9. Anthropogenic maximum dissolved oxygen (DO) depletions causing standard noncompliance, total area of noncompliance, minimum DO, and number of cumulative noncompliant days in greater Puget Sound for 2006.

Maximum DO depletions (mg/L)		Noncompliant area		Minimum DO in noncompliant area (mg/L)		Cumulative noncompliance (days)	
from	to	acres	km^2	median	95th percentile	median	95th percentile
-0.2	-0.4	124,900	505.5	3.42	5.13	39	146
-0.4	-0.6	20,400	82.5	2.02	4.2	169	243
-0.6	-0.8	2,900	11.8	2.03	3.4	107	182
-0.8	-1	1,400	5.7	1.53	2.68	118	139
-1	-1.2	670	2.7	1.3	2.62	126	161
-1.2	-1.4	440	1.8	1.34	1.75	102	147
-1.4	-1.6	360	1.5	1.29	1.93	108	162
-1.6	-1.8	150	0.6	0.54	0.69	152	160
-1.8	-2	50	0.2	0.39	0.5	157	163

*Volume 1: Model Updates and Bounding Scenarios. Pub. #19-03-001



Duration of DO Depletion

- South Sound is most impacted
- Max (acute) depletion improves most in the Main Basin when all POTWs use advanced treatment
- Mean (chronic) depletions saw the largest improvements in all basins.

Will watershed reductions get us the rest of the improvement needed?

Table 16. Regional percent reduction in the maximum and mean daily dissolved oxygen depletion.

Region	year	Maximum depletion (existing condition, mg/L)	Mean depletion (existing condition, mg/L)	Reduction in maximum depletion (%)			Reduction in mean depletion (%)		
				BNR	BNR1000	BNR8000	BNR	BNR1000	BNR8000
Admiralty	2006	NA	NA	NA	NA	NA	NA	NA	NA
	2008	NA	NA	NA	NA	NA	NA	NA	NA
	2014	NA	NA	NA	NA	NA	NA	NA	NA
Bellingham Bay	2006	-0.27	-0.23	19	18	1	70	69	8
	2008	-0.31	-0.25	19	18	0.8	54	54	0.9
	2014	-0.40	-0.30	16	16	0.4	33	33	0.5
Hood Canal	2006	-0.29	-0.23	11	9	7	74	70	58
	2008	-0.24	-0.21	13	12	8	85	85	74
	2014	-0.46	-0.28	8	7	3	16	14	8
Main Basin	2006	-1.49	-0.34	56	3	2	57	36	31
	2008	-1.07	-0.34	51	5	4	59	34	29
	2014	-1.30	-0.41	52	3	2	48	25	11
South Sound	2006	-1.90	-0.44	3	2	1.6	24	20	13
	2008	-1.50	-0.36	4.6	3.7	2	36	30	19
	2014	-2.11	-0.42	4	3	1	29	24	12
Whidbey Basin	2006	-1.16	-0.28	3	2.6	1.8	57	42	26
	2008	-0.52	-0.27	10	7	4	66	52	32
	2014	-0.40	-0.26	21	14	7	66	52	24

*Volume 1: Model Updates and Bounding Scenarios. Pub. #19-03-001

Structure for developing scenarios

Question

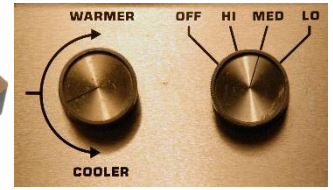
- What nutrient management questions will inform our decisions
- Sequence of analyses must build on what we learn from each question

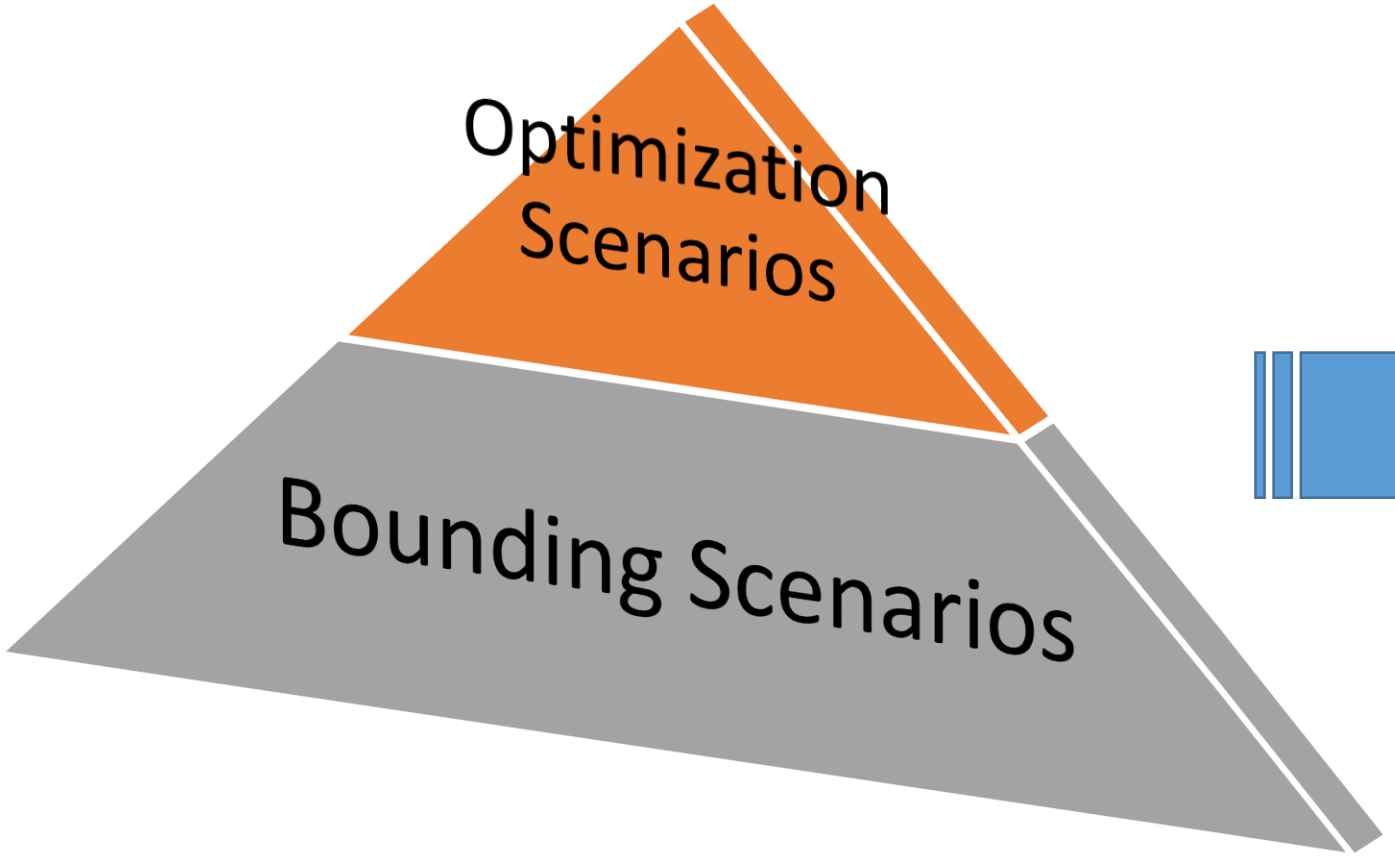
Scenario

- Modeling approach to answer the question
- Comprises multiple model runs to compare against each other

Model Run

- Model inputs or parameters that are perturbed to evaluate the marine water quality response to those changes
- Each run is for a single year





Finding Answers to Nutrient Management Questions

Draft Scenarios

Kelly Ferron

Draft Scenario Process

- Puget Sound Nutrient Reduction Project Steering Committee compiled 5 draft scenarios
- Discussion groups to gather feedback from Forum
- Ecology will incorporate feedback to finalize Year 1 modeling scenarios

Proposed Nutrient Management Questions

1. What is the significance of local watersheds in each Puget Sound Basin?

2. What is the impact of marine point source discharges within individual Puget Sound basins?

3. Do we get greater improvement in DO levels from annual vs. seasonal load reductions from marine point sources?

4. What impacts will future regional population growth and climate change have on dissolved oxygen in 2040?

5. What is the total nutrient reduction needed from both marine point sources and watersheds to improve DO in Puget Sound?

Draft Scenario Template

Management Question: Big picture question about where and when nutrient reductions are most important for improving water quality.

Objective: The value behind this question– each question answered should help us in developing a nutrient management plan.

Model Scenario: A brief description of the inputs we will use.

- Some scenarios will have more runs than others

Scenario 1: Watershed Sources by Basin

Management Question: What is the significance of nutrient inputs from local watersheds in each Puget Sound basin?

Objective: Understand the relative influence of different basin watersheds.

Model Scenario: Isolate the effects of watersheds within each Puget Sound Basin

- Keep focus basin at existing yield but set all other basin watersheds to reference levels
- Keep all marine sources at existing load levels
- Repeat for each basin

Scenario 2: Marine Point Sources by Basin

Management Question: What is the impact of marine point sources within individual Puget Sound Basins?

Objective: Understand the effect of marine point sources both within a basin and relative to other basins.

Model Scenario:

- Set marine point sources in focus basin at existing conditions and set other basin marine sources at reference levels
- Set watershed sources to existing conditions
- Repeat for each basin

Scenario 3: Annual vs Seasonal Reductions

Management Question: How much greater are DO improvements from annual load reductions vs. seasonal load reductions from marine point sources?

Objective: Understand wastewater seasonal nutrient load reductions compared to reductions in annual loading.

Model Scenario:

- Set marine point sources to assumed level of DIN performance operating at those levels year-round
- Compare to bounding scenario runs OR Scenario 5 depending on the assumed level of DIN performance in this run

Scenario 4: Future Population Growth and Climate Change

Management Question: What impacts will future regional population growth and climate change have on DO in 2040?

Objective: Understand the range of future conditions given increases in total municipal wastewater discharges from population growth and watershed hydrology changes due to climate change.

Model Scenario:

- Use OFM's high population growth projections and climate impacts on watershed hydrology
- Use OFM's low population growth projections and climate impacts on watershed hydrology

Scenario 5: Everybody, Everywhere

Management Question: What is the total nutrient reduction we need from both marine point sources and watersheds to meet water quality standards for DO in Puget Sound?

Objective: Understand the total reductions needed to meet DO criteria through testing the improvement from estimated maximum nutrient reductions from marine and watershed sources.

Model Scenario:

- Set marine point sources to advanced wastewater treatment levels
- Set anthropogenic DIN load fractions from watersheds to a reasonable maximum (i.e. 50% - 75% reduction)

Feedback on Draft Scenarios

On an individual scenario level:

- Is this the right nutrient management question to be asking?
- Does the proposed scenario move us toward answer the question we want answered?

When viewing scenarios as a package:

- Are we missing anything big?
- Is there something we should be addressing in this first year of modeling that we aren't?

Questions?

Discussion Groups

Scenario 1: Watershed Sources by Basin

Discussion Groups

Scenario 2: Marine Point Sources by Basin

Lunch

We will reconvene at 1pm.

Discussion Groups

Scenario 3: Annual vs. Seasonal Nutrient Load Reductions

Fishbowl Activity

Scenario 4: Population Growth and Climate Change

&

Scenario 5: Everybody, Everywhere

Scenario 4: Population Growth and Climate Change

Is this scenario valuable? Does this scenario help us answer the question we want answered?

Scenario 4: Population Growth and Climate Change

What model input assumptions should be used to define these scenarios?

· Future wastewater flows

· Climate change effects on watershed hydrology

· Future ocean boundary conditions

Scenario 4: Population Growth and Climate Change

Are there better inputs, available now, that we could use to understand future population growth effect on future wastewater flows?

Scenario 5: Everybody, Everywhere

Is this scenario valuable? Does this scenario help us answer the nutrient management question?

Scenario 5: Everybody, Everywhere

What nutrient loading assumptions for advanced wastewater treatment and potential watershed improvements should be used?

How we plan to use today's feedback

May: Forum Summary

May-June: Internal-Ecology discussions to integrate feedback, weigh constraints, and finalize list of Year 1 scenarios and model runs

June: List of the final set of Year 1 scenarios with explanations of decisions and how we used Forum input

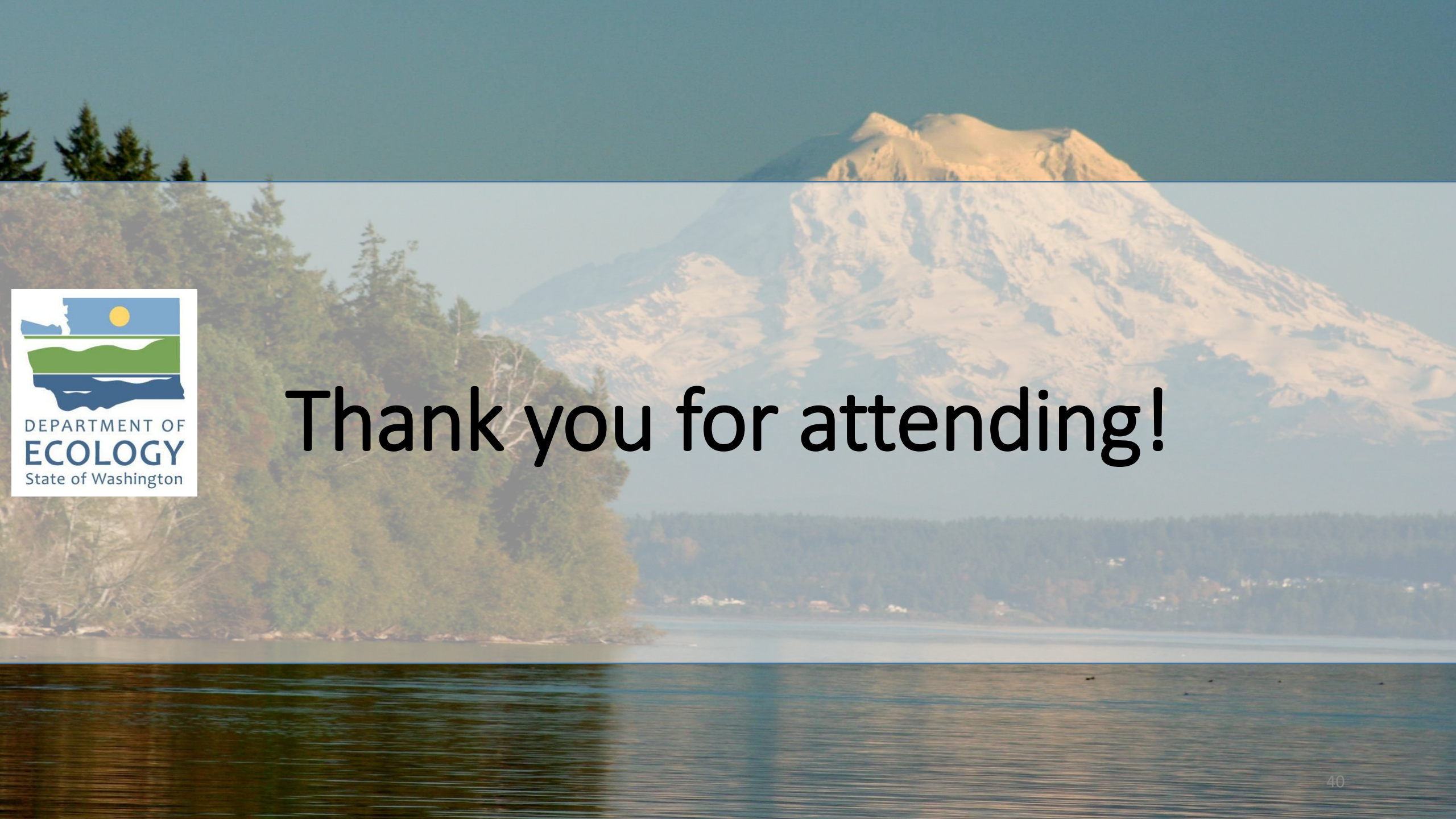
Scenario Parking Lot for Year 2

Next Forum Meeting

Puget Sound Nutrient Reduction Implementation Examples

Pierce County Environmental Services Building

June 4, 2019



Thank you for attending!