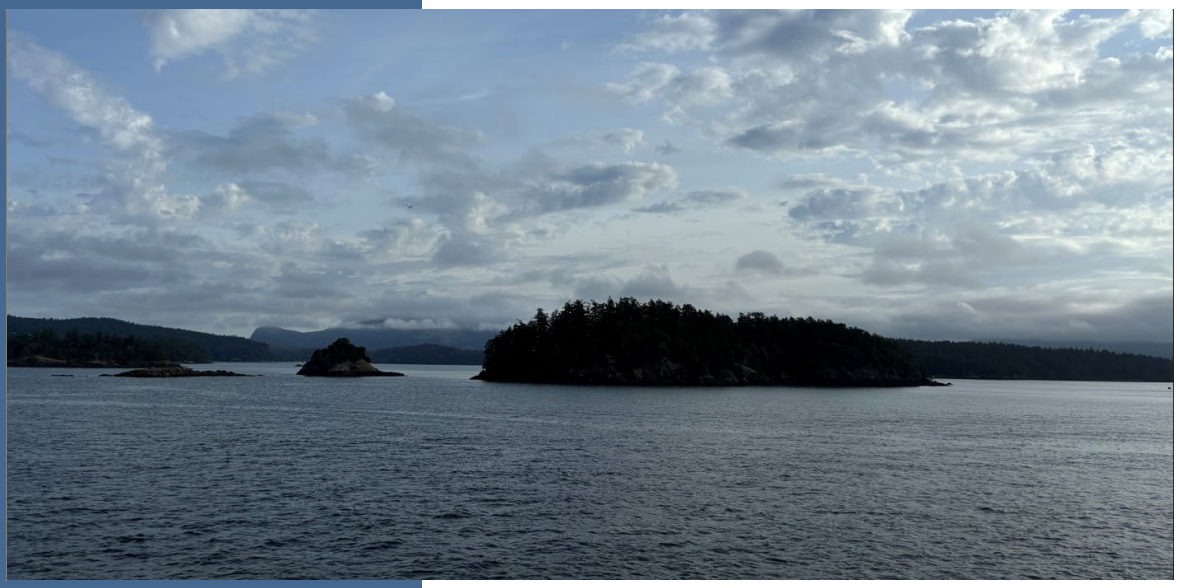

Draft Puget Sound Nutrient Reduction Plan

An advance restoration approach to recovering water quality in Puget Sound

Water Quality Program

Washington State Department of Ecology

Olympia, Washington

June 2025, Publication 25-10-038

DEPARTMENT OF ECOLOGY
State of Washington

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State of Washington

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Glossary, Acronyms, and Abbreviations

Glossary

303(d) list: Ecology's list of impaired waters not meeting water quality standards. Required under Clean Water Act Section 303(d). Also referred to as Category 5 waters.

Advance restoration plan (ARP): a near-term water clean-up plan designed to achieve water quality standards. Developed prior to developing a TMDL.

Basin: Port of Puget Sound waters that share hydrology, water residence time, bathymetry, geomorphology, geographic region, and other characteristics and the watersheds that drain to them.

Compliance schedule: a long-term plan that outlines the steps and deadlines a permittee must follow to meet requirements of an NPDES permit. Compliance schedules contain interim effluent limits that must be met in the short-term and water quality based effluent limits that will be met in the long-term.

Domestic Wastewater Treatment Plant(s): For purposes of this plan, this term is used to refer to those facilities meeting the definition of a "Domestic wastewater facility" in WAC 173-221-030, which are permitted under an NPDES permit, located in Washington State, and discharging to Puget Sound.

Industrial Facilities: For purposes of this plan, this term is used to refer to those facilities treating "Industrial wastewater" as defined by WAC 173-221-030, which are permitted under an NPDES permit, located in Washington State, and discharging to Puget Sound.

Interim effluent limit: a temporary pollution limit set in an NPDES permit that allows a permittee time to meet final water quality based effluent limits, while still working to reduce its pollution.

Load allocation: Total amount of pollution allocated to nonpoint sources of pollution in a TMDL.

Puget Sound: All Washington's waters of the Salish Sea, including Puget Sound (proper), Strait of Juan de Fuca, Strait of Georgia, Hood Canal, and all adjoining waters, such as Haro Strait, Rosario Strait, and Bellingham Bay.

Puget Sound region: All of Puget Sound's eight basins, collectively.

Salish Sea: a network of coastal waterways spanning north of Vancouver Island, British Columbia (Canada) to northwest Washington State (United States)

Target(s), TN Target(s), Nitrogen Target(s): The maximum amount of total nitrogen loading (lbs. TN/yr) to Puget Sound needed to meet dissolved oxygen water quality standards Puget Sound.

Total maximum daily load (TMDL): a study that identifies the maximum amount of pollution a waterbody can receive before becoming impaired, sets limits for all pollution sources

contributing to the water quality problem, and outlines a plan for implementing pollution reduction measures

Wasteload allocation: Total amount of pollution allocated to point sources in a TMDL.

Water quality based effluent limit (WQBEL): pollution control limit written into an NPDES permit that is designed to achieve water quality standards. Wasteload allocations developed in TMDLs are translated into WQBELs.

Acronyms and Abbreviations

Acronym	Spelled out term
AKART	All known available and reasonable treatment
ARP	Advance restoration plan
AU	Assessment Unit
BMP	Best management practice
CAFO	Concentrated animal feeding operation
CFR	Code of Federal Regulations
CSGP	Construction stormwater general permit
CWA	Clean Water Act
Clean Water Guidance	Voluntary Clean Water Guidance for Agriculture
DIN	Dissolved inorganic nitrogen
DO	Dissolved oxygen
EAGL	Ecology's Administration of Grants and Loans database
Ecology	Washington Department of Ecology
EPA	Environmental Protection Agency
FSA	Farm Service Agency
General Permit	Puget Sound Nutrient General Permit
ISGP	Industrial stormwater general permit
MSGP	Municipal stormwater general permit
NOAA	National Ocean and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPI	Nonpoint Implementation Tracking system
PIC	Pollution identification and control
RCW	Revised Code of Washington
STI	Straight to implementation
TIN	Total inorganic nitrogen
TMDL	Total maximum daily load
TN	Total nitrogen
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WAC	Washington Administrative Code
WQBEL	Water quality based effluent limit
WRIA	Water resource inventory area
WWTP	Waste water treatment plan

Executive Summary

Many portions of Puget Sound have dissolved oxygen (DO) levels below Washington state water quality standards established to protect aquatic life. As a result, the Washington State Department of Ecology (Ecology) has placed portions of Puget Sound not meeting water quality standards on our 303(d) list of impaired waters and has been working to characterize and address the DO problem in the Sound for more than twenty years. Results from modeling efforts have shown that excessive nutrient loading from human activities are lowering DO levels in multiple Puget Sound embayments, with domestic wastewater treatment plants contributing around two-thirds of the human-sourced nitrogen pollution.

The Puget Sound Nutrient Reduction Plan details Ecology's strategy to restore DO levels to achieve water quality standard levels across Puget Sound by 2050. This plan establishes total nitrogen targets for both the marine point sources discharging to Puget Sound and the watersheds draining into the Sound to achieve this goal (Table 5 and Table 6). The marine point source targets will be used to inform effluent limits in future reissuances of domestic wastewater treatment plant and industrial facility permits discharging into Puget sound, while the watershed targets will be the starting point for prioritizing, developing, and implementing water clean-up plans in watersheds draining to the Sound. As reducing nutrients in wastewater effluent and developing water clean-up plans will require significant investment, we have provided a compendium of financial resources available to support implementation.

The schedule and milestones (Table 9 and Table 10) provide a detailed roadmap of how Ecology and partners will achieve nutrient reductions and track progress over the next twenty five years. Major milestones for Ecology include:

- Developing our initial strategy for achieving nutrient reductions in Puget Sound watersheds in 2026
- Initiating development of two water clean-up plans in Puget Sound watersheds by 2027
- Establishing total nitrogen effluent limits as WQBELs for wastewater treatment plans and industrial facilities discharging to Puget Sound by 2031
- Completing development of all necessary water clean-up plans for watersheds draining to Puget Sound by 2048
- Publishing progress reports by 2042 and 2055 to evaluate the progress towards achieving total nitrogen targets and restoring DO in the Sound

Monitoring data will be an essential component to tracking milestone progress. We will utilize existing systems to track where implementation is occurring, then evaluate field collected nutrient and DO data from existing monitoring programs to evaluate the response. If implementation is occurring without available field data, additional site-specific monitoring data may be necessary to fill gaps. In the event our approach is not producing the nutrient reduction or DO response we were expecting, adaptive management will be used to correct course. We will continue to use the Puget Sound Nutrient Forum as our avenue to report progress, engage with project partners, and solicit feedback on our approach as we work towards our goal of restoring DO in Puget Sound by 2050.

Background

We recommend referring to the Glossary, Acronyms, and Abbreviations section as you read through this plan.

Regulatory framework

Under Washington's Water Pollution Control Act Chapter 90.48 RCW, the Washington Department of Ecology (Ecology) is the agency responsible for implementing the federal Clean Water Act (CWA) in Washington State. CWA Section 303(c) requires states to develop water quality standards, which describe the beneficial uses of a waterbody and the pollution thresholds and measures necessary to protect those uses. Ecology develops water quality standards for Washington and the U.S. Environmental Protection Agency (EPA), the agency responsible for overseeing implementation of the CWA, reviews and approves them. Section 303(d) then requires Ecology to identify a list of impaired waters not meeting water quality standards, known as our **303(d) list**, and requires Ecology to bring those waters back into compliance with water quality standards. Multiple implementation tools exist to restore water quality, but Section 303(d) also requires states to prioritize and develop **total maximum daily loads (TMDLs)** for all waterbodies on their impaired waters list.

A TMDL study identifies the maximum amount of pollution a waterbody can receive before becoming impaired, allocates this amount between all pollution sources contributing to the water quality problem, and outlines a plan for implementing pollution reduction measures. Pollution limits in TMDLs are broken up into two components, those assigned to point sources (from a pipe) and nonpoint sources (diffuse). Washington's State Water Pollution Control Act gives Ecology the authority to regulate point and nonpoint source pollution.

Section 402 of the CWA requires any point source discharging to a surface waters of the United States to get a **National Pollutant Discharge Elimination System (NPDES) permit**, which limits the amount of a pollutant the entity can discharge. The EPA has delegated administration of the NPDES permitting program in Washington State to Ecology. Ecology uses the point source limits from TMDLs, also known as **wasteload allocations**, to develop permit limits for any non-federally or Tribal owned point source[2] discharging waters of the state. Note a TMDL does not need to be in place for Ecology to set pollution limits in permits to comply with water quality standards. Nonpoint pollution limits in TMDLs are known as **load allocations**. EPA grants money to states annually to address and report progress on reducing nonpoint pollution under CWA Section 319. Ecology's Nonpoint Program is supported by this funding and uses a combination of voluntary, technical-assistance-based, and regulatory tools to meet nonpoint source pollution reduction goals (Ecology Publication 22-10-025).

This regulatory foundation is necessary for Ecology to improve and protect the quality of Washington's waters. The CWA requires that TMDLs be developed to bring impaired waters into compliance with water quality standards but does not preclude implementation of other

[2] EPA is responsible for permitting point sources on federal and Tribal land.

regulatory or control measures to restore water quality before a TMDL. In more recent years, EPA has acknowledged that the CWA allows other clean-up approaches to restore water quality, such as an **advance restoration plan (ARP)**. An ARP contains many of the same elements as a TMDL but provides more flexibility in how clean-up efforts are approached, with the goal of cleaning up water faster than a traditional TMDL. We discuss ARPs in more detail in the "Advance restoration plan approach" section.

This plan details our ARP approach to meet marine dissolved oxygen (DO) standards which will be implemented prior to development of a TMDL. In the event we cannot meet water quality standards with this approach, the requirement to develop a TMDL still remains.

Puget Sound

Puget Sound is a complex marine system located in northwestern Washington State. Puget Sound is part of the larger "Salish Sea", which is a network of coastal waterways spanning north of Vancouver Island, British Columbia (Canada) to northwest Washington State (United States) (Figure 1).

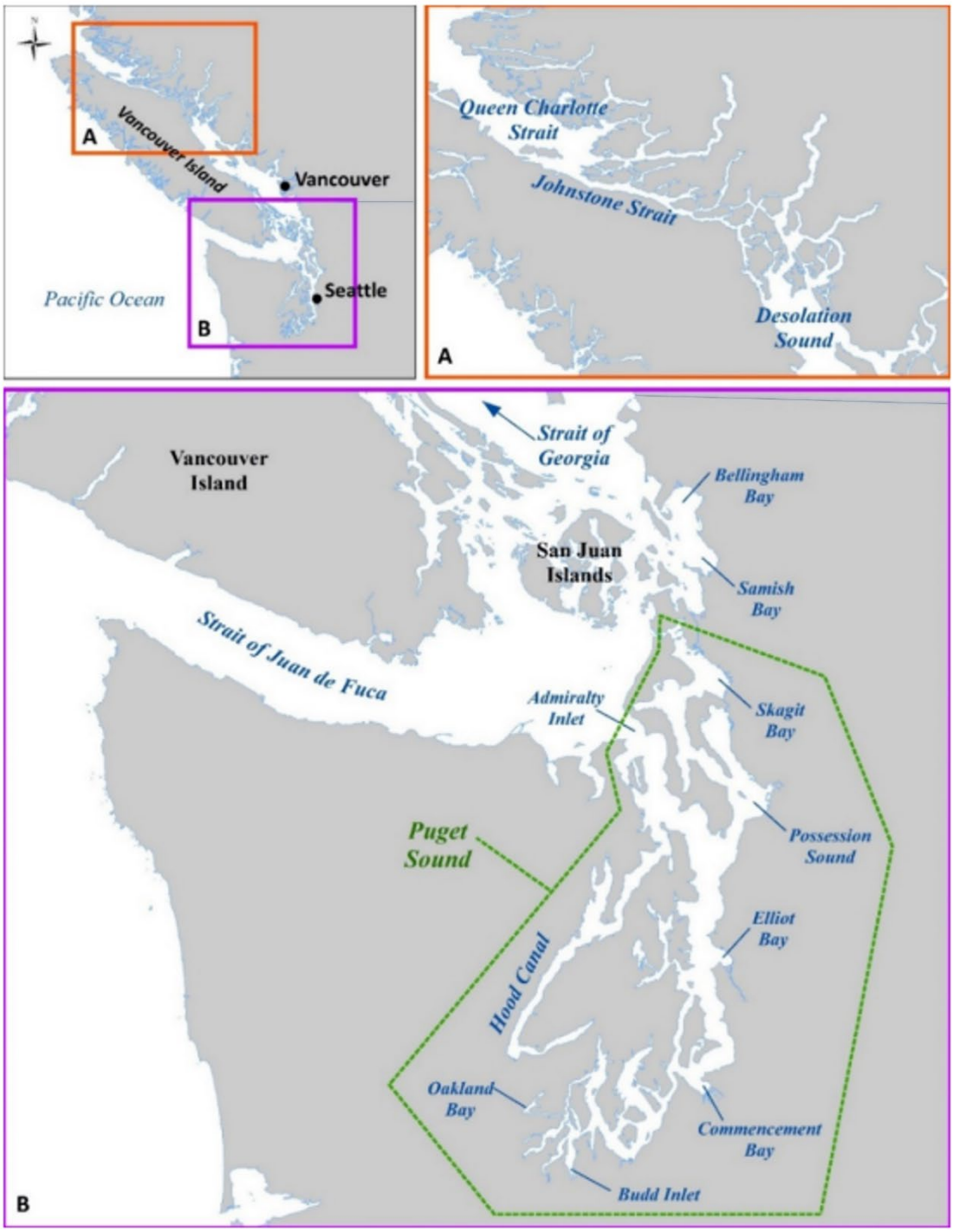

Figure 1. Regions of the Salish Sea (Strait of Juan de Fuca, Strait of Georgia, and Puget Sound), including Johnstone and Queen Charlotte Straits in Canada (from Ahmed et al, 2019).

Puget Sound is the United States' second largest estuary with a diverse array of fish species, marine mammals, birds, and benthic invertebrates. Approximately 13,920 mi^2, or 20%, of Washington State land drains into Puget Sound. Almost two-thirds (64%) of Puget Sound's drainage area consists of forest land, located primarily in the upper portions of watersheds and

on the Olympic Peninsula. Urbanized development represents the second most predominant land-use at 13%, concentrated around the mouth of many of the Sound's largest rivers. The Sound's deep fjords and many smaller bays and inlets were carved by glaciers and bounded by mountains uplifted by plate tectonics from an offshore subduction zone. Features formed thousands and millions of years ago play a role in the circulation and hydrology of the region (Williams, 2022). These features affect patterns of marine water circulation that play an important role in the nutrient dynamics in the Sound.

This plan addresses all of Washington's waters of the Salish Sea, including Puget Sound proper, Strait of Juan de Fuca, Strait of Georgia, Hood Canal, and all adjoining waters, such as Haro Strait, Rosario Strait, and Bellingham Bay. This plan refers to these waters collectively as "Puget Sound" or "the Sound". For purposes of establishing nutrient targets, we have also delineated Puget Sound and its watersheds into eight basins based on distinct characteristics, such as hydrology, water residence time, bathymetry, geomorphology, geographic region, and other features (Figure 2). Each basin represents a portion of Puget Sound and the corresponding watersheds that drains to that portion of the Sound. We refer to the combination of all Puget Sound's basins as the "Puget Sound region".

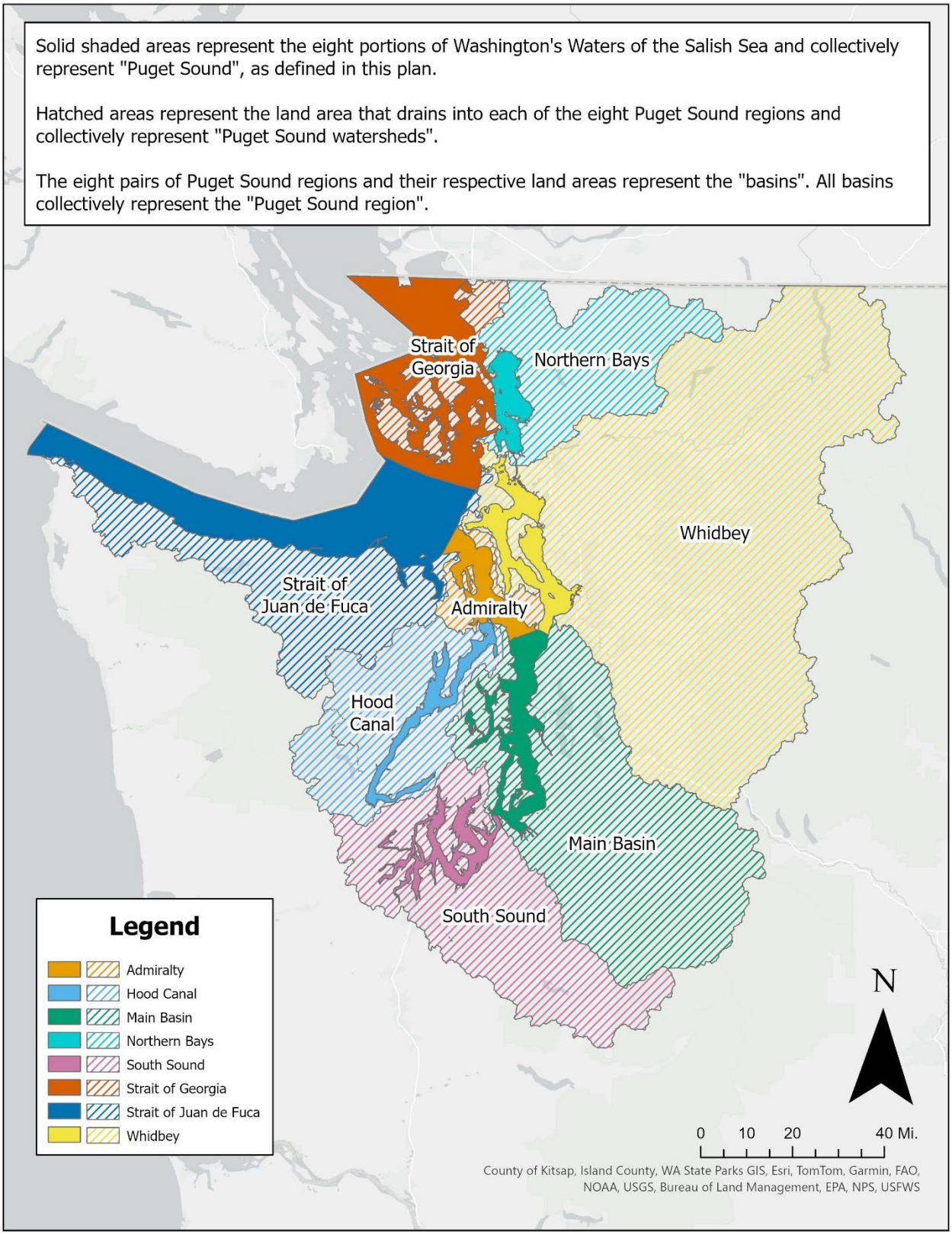

Figure 2. The eight basins of the Puget Sound region. Watersheds have been trimmed at the Washington/Canada border for visual purposes.

Nitrogen in the Sound

Nitrogen is an important nutrient for sustaining life in marine waters. However, too much nitrogen causes excessive algal growth and puts the health of Puget Sound off balance. When these algae and plants die, their decomposition uses up oxygen that marine animals, such as salmon, need to survive. (Figure 3).

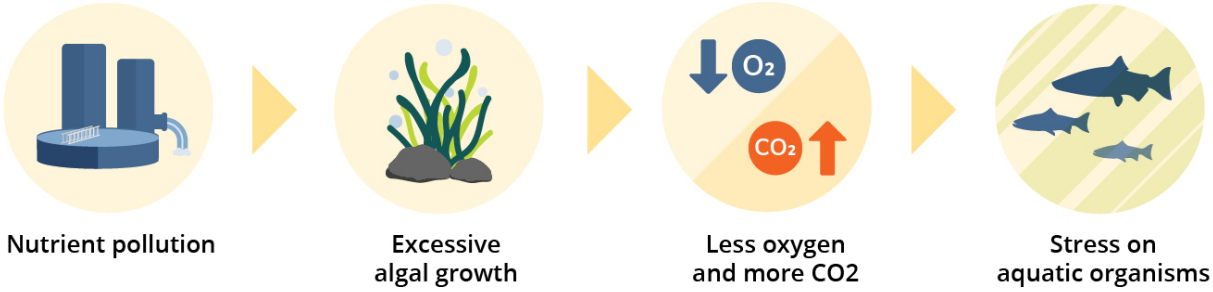

Figure 3. Simplified process which nutrient pollution impacts aquatic life.

Nitrogen enters the Sound though many pathways; discharges from pipes, flows from rivers, deposition from the atmosphere, release from sediments on the Sound floor, leaching underground along the shoreline, and inflow from the Pacific Ocean. It has been estimated that most of the total nitrogen entering Puget Sound comes from the ocean. At the Salish Sea entrance, approximately 98% of the nitrogen exiting the Salish Sea is of oceanic origin and a significant portion of that ocean nitrogen is not expected to remain in Puget Sound proper (Mackas & Harrison, 1979).

Natural sources of nitrogen to Puget Sound include decaying plant matter, terrestrial and aquatic animal waste and decaying matter, and atmospheric deposition. Humans can also be a significant source of nitrogen in the form of both point and nonpoint pollution. Nitrogen point sources to the Sound include domestic wastewater treatment plants (WWTPs) and industrial facilities, such as petroleum refineries, pulp mills, and other discharges that are regulated through environmental permits. Nonpoint sources include runoff from crop and animal agriculture operations, nutrients in stormwater from residential and commercial land, excess fertilizers used for residential purposes, residential onsite sewage systems, golf-courses, and municipal parks. Both point and nonpoint human-sourced nitrogen pollution may directly discharge into Puget Sound or may be indirectly transported to the Sound through one of the hundreds of rivers draining into it.

For over a decade we have known that humans deliver a significant amount of nitrogen to the Sound, which contributes to low DO levels (Ahmed et al., 2014; Albertson et al., 2002; Mohamedali et al., 2011; Roberts et al., 2014). Domestic WWTPs and industrial facilities discharging into Puget Sound represent around two-thirds of the total human nitrogen load to the Sound (Ahmed et al, 2019, Figueroa-Kaminsky et al. 2025). This plan sets target levels for nitrogen loading into Puget Sound to reduce human-sourced point and nonpoint nitrogen pollution and restore DO levels to achieve water quality standards. We also acknowledge that many of the practices used to reduce nitrogen loading to aquatic systems can have other

positive environmental outcomes, such as limiting harmful algae bloom occurrences and reducing discharges of toxic pollutants.

Efforts to address dissolved oxygen problems

Portions of Puget Sound were first placed on our 303(d) list of impaired waters for not meeting DO water quality standards as early as 1992. We began investigating the DO problem in Puget Sound in the early 2000s through early work of developing a TMDL to address DO impairments in Budd Inlet, the southernmost inlet of Puget Sound. We then expanded our focus to addressing nutrients in central and southern Puget Sound, where modeling found that excessive nutrient loading from both marine point sources and watershed inflows in south and central Puget Sound were contributing to low dissolved oxygen levels in several bays and inlets south of Edmonds (Ahmed et al, 2014). We have since expanded our efforts to address DO across all of Washington's waters of the Salish Sea. Additionally, we completed the Budd Inlet DO TMDL in 2022 (Ecology Publication 22-10-012), which addresses DO 303(d) impairments in Budd Inlet near Olympia, WA.

In 2017, Ecology began scoping a project to address nutrients in Puget Sound. This broad strategy for Puget Sound is known as our "Puget Sound Nutrient Source Reduction Project". To invite broader engagement on the project, in 2018 we launched the Puget Sound Nutrient Forum (Nutrient Forum), an advisory group. Ecology invited decision makers from wastewater treatment and stormwater regulated community, environmental groups, local/state/federal agencies, and Tribal governments to participate in the Nutrient Forum. The Nutrient Forum has met regularly since 2018 to discuss, learn, and provide input on how to reduce human sources of nutrients entering Puget Sound and to provide feedback on Ecology's approach to addressing nutrients in the Sound. See Appendix A for more information on the Nutrient Forum.

In 2019, we published our first Reduction Project report, known as the Bounding Scenarios Report (Ahmed et al., 2019). The primary objective of the study was to use the Salish Sea Model (see next section) to evaluate the impacts of human nutrient sources on DO across a range of modeled years. Significant findings from the study include:

- Approximately 20% of Puget Sound does not meet DO standards.
- Domestic marine WWTPs (those located in Washington State and discharging into Puget Sound) were the largest contributor of human-sourced nitrogen loading to the Sound.
- Discharges from domestic marine WWTPs can affect DO concentrations far from where discharges occur.

The study concluded that we need a combination of nutrient reductions from both point source dischargers into the Sound and watersheds draining into the Sound to meet DO standards.

The next two technical studies; Optimization Phase 1 (Ahmed et al., 2021) and Optimization Phase 2 (Figueroa-Kaminsky et al., 2025) were then designed to investigate the importance of watershed nutrient reductions relative to domestic marine WWTPs and ran several combinations of WWTP and watershed reduction scenarios to evaluate DO response to reductions. A primary goal of these studies was to identify a nutrient reduction distribution that meets water quality standards and is also equitable and reasonable between the WWTPs and

watershed sources. The final Phase 2 report contains the details of the modeled nutrient loading scenario selected as the basis for the nitrogen targets in this plan (See "Selected model scenario" section for more information).

Salish Sea Model

In 2008, the Pacific Northwest National Laboratory, in collaboration with Ecology and EPA, began developing the Salish Sea Model to understand and quantify the scope of the DO problem across Puget Sound. This work was guided by recommendations from a technical advisory committee that included key Tribal, government, and academic experts. The model uses physical and chemical water quality data inputs to estimate nutrient and DO conditions across Puget Sound and simulate DO's response to different levels of nutrient reduction scenarios. This tool allows us to evaluate human impacts on DO in Puget Sound using the best available information and data. After ten years of model development, improvements, calibration, and evaluation (Khangaonkar et al, 2012; Pelletier et al, 2017; Khangaonkar et al, 2018; Ahmed et al., 2019), Ecology was confident the model performance was adequate for evaluating the cumulative impacts of human caused nutrient loads on DO and for determining what nutrient reduction scenarios can achieve DO standards.

Sources of nitrogen to the Salish Sea within the model include rivers that drain watersheds, marine point sources, benthic sediment fluxes, and oceanic nitrogen. Human sourced nitrogen loads within the model are divided into two categories: marine point sources and watershed inflows. Marine point sources include domestic WWTPs and industrial facilities discharging into the Salish Sea and some facilities discharging near river mouths. The watershed inflows include nutrient loads from all watersheds discharging into the Salish Sea and represents all upstream nitrogen sources, including point sources. When running model simulations, we can adjust the human-source nitrogen contribution within these two categories and simulate the response to DO. The previously mentioned Bounding Scenarios and Optimization Scenarios Phase 1 and Phase 2 technical reports document the numerous model scenarios run, quantify background and anthropogenic nutrient loads, and help us understand the effect of nutrient loading changes on marine DO to guide the development of reduction targets needed to achieve DO water quality standards in Puget Sound (Ahmed et al., 2019 & 2021, Figueroa-Kaminsky, et al. 2025). Results of the Phase 2 report have demonstrated that to restore water quality in Puget Sound, marine point sources and nutrient sources within watersheds draining to Puget Sound will need to significantly reduce their nutrient loading in the coming years.

The Salish Sea Model Quality Assurance Project Plan provides more details on model development, applicability, accuracy and calibration (McCarthy et al, 2018).

Puget Sound Nutrient General Permit

Based on results of the Salish Sea Modeling work, Ecology determined that domestic WWTPs discharging to Puget Sound had a "reasonable potential" to cause or contribute to the DO water quality impairments noted on the 303(d) list[3]. With this determination, federal law requires that limitations be established on permitted dischargers to restore water quality as soon as possible (40 CFR 122.44(d)(1)). Ecology gathered public input on a preliminary decision to develop a new general permit to set those limitations in a consistent and timely manner. After receiving comments, which were generally supportive of the approach, we worked with an advisory committee to develop and issue the Puget Sound Nutrient General Permit (General Permit) in 2021.

The General Permit is a NPDES permit designed to manage nutrient pollution from publicly owned domestic WWTPs in Washington that discharge to Puget Sound. The first phase of the permit, effective from January 1, 2022 through December 31, 2026 (2022 General Permit), set narrative water quality-based effluent limitations for nitrogen discharged from the fifty-eight publicly owned WWTPs covered by the permit. The permit required standardized effluent monitoring for nitrogen parameters and evaluations documenting how facilities can reduce their nitrogen loading through plant optimization and infrastructure upgrades. The permit categorized WWTPs in three different size categories (dominant, moderate, small[4]), with permit requirements varying based on size category. Table 1 summarizes the requirements of the permit by facility size category. The 2022 General Permit conditions set action levels for total inorganic nitrogen (TIN) loading at existing discharge levels for large and moderate-sized facilities and required the facilities to take specific actions if the reported TIN level exceeds the action level.

[3] Refer to the 2022 Puget Sound Nutrient General Permit Fact Sheet for more information on basis for Ecology's reasonable potential determination (Ecology, Puget Sound Nutrient General Permit Fact Sheet. Issued: December 1, 2021)

[4] dominant = > 2,000 lbs. total inorganic nitrogen (TIN)/day, moderate = 100 to 2,000 lbs. TIN/day, small = < 100 lbs TIN/day. Dominant loaders cumulatively constitute greater than 80% of the TIN load to Puget Sound, while moderate loaders and small loaders represent approximately 19% and less than 1%, respectively

Table 1. Summary of 2022 Puget Sound Nutrient General Permit requirements by facility category size (modified from Ecology Publication 23-10-006).

WWTP category	TIN action level[a]	Action level exceedance corrective action[b]	Nutrient optimization plan[c]	Nutrient reduction evaluation[d]	AKART analysis[e]	Influent and effluent monitoring
Dominant	X	X	X	X	X[d]	X
Moderate	X	X	X	X	X[d]	X
Small			X		X	X

TIN = total inorganic nitrogen; AKART = all known, available and reasonable methods of prevention, control and treatment

[a] If the total inorganic nitrogen TIN action level for individual WWTPs or the bubbled action levels listed for single jurisdictions are exceeded, the permittee must employ corrective actions.

[b] With the next Annual Report after an action level exceedance, permittees must propose an approach to reduce the annual effluent load below the action level. If a permittee exceeds an action level two years in a row, or for a third year during the permit term, the permittee must begin to reduce nitrogen loads by implementing the proposed approach submitted. This provision was stayed because of an appeal of the permit.

[c] Each permittee must develop, implement, and maintain a Nitrogen Optimization Plan to evaluate and implement operational strategies for maximizing nitrogen removal from the existing treatment plant during the permit term. Permittees must document their actions taken and apply an adaptive management approach at the WWTP. Permittees will quantify results with required monitoring under the General Permit.

[d] All dominant and moderate category permittees must prepare and submit an approvable Nutrient Reduction Evaluation to Ecology for review by December 31, 2025. Permittees that maintain an annual TIN average of < 10 mg/L and meet their action level throughout the permit term must submit a truncated Nutrient Reduction Evaluation. Permittees that meet their action level throughout the permit term and maintain an annual average of < 10 mg/L TIN and a seasonal average of < 3 mg/L do not have to submit the Nutrient Reduction Evaluation. The Nutrient Reduction Evaluation must include an AKART analysis to evaluate treatment alternatives for TIN.

[e] Permittees must prepare and submit an approvable AKART analysis to Ecology for purposes of evaluating reasonable treatment alternatives capable of reducing TIN. Permittees must submit this report by December 31, 2025. Permittees that maintain an annual TIN average of < 10 mg/L and do document an increase in load through their discharge monitoring reports (DMRs) do not have to submit this analysis.

In February 2025, the Pollution Control Hearings Board invalidated the 2022 General Permit "insofar as it is mandatory for already-permitted dischargers" and remanded the permit to Ecology for further action (Puget Soundkeeper Alliance et al. v. Ecology, PCHB No. 21-08c, February 25, 2025). The Board's decision did not preclude Ecology's authority to regulate nutrient discharges to Puget Sound but rather clarified the tools Ecology can use to do so. In April 2025 we sent a letter to permittees terminating coverage and describing possible next steps (Appendix B). We still consider the General Permit an appropriate tool for our long-term strategy to reduce nutrient discharges and improve water quality in the Sound. At the time of

this plan, Ecology has begun the process to reissue the General Permit to offer voluntary coverage for facilities that want to continue under the General Permit to address nitrogen reduction requirements. We currently plan to propose minimal edits to the permit through a public process with opportunities to review and provide comments. Facilities that do not opt-in to the General Permit coverage will see nutrient reduction requirements moved to their individual permits. As Ecology renews expired individual permits or modifies existing individual permits, the draft documents containing nutrient requirements will be made available for formal public comment before final issuance.

Whether permittees choose the voluntary General Permit or individual permits, the nitrogen targets in this plan will be used to inform their future nutrient limits (See “Implementation” section for more information).

Advance restoration plan approach

While TMDLs are effective at addressing pollution, they are not the only water clean-up tool available to address impaired waterbodies. States may pursue restoration approaches in advance of developing a TMDL where they believe that approach may provide a more immediately beneficial or practicable path to restore water quality. EPA discussed these plans in their 2013 Vision memo, 2022 Vision memo and the 2016 Integrated Report memo. (EPA, 2013, 2022 and 2016). EPA refers to such plans as advance restoration plans (ARP).

Similar to a TMDL, an ARP identifies causes and sources of pollution and describes management measures and strategies to achieve water quality standards. However, these plans provide states flexibility in how they can begin making more immediate progress towards restoring water quality. Once developed, states should periodically evaluate ARPs to determine if such approaches are still expected to be more immediately beneficial or practicable, in the near-term, at achieving water quality standards, rather than pursuing a TMDL. If not, the ARP should be re-evaluated to determine whether a higher priority for TMDL development should be assigned to the impaired waterbody.

Ecology's broader Puget Sound Nutrient Source Reduction Project has been a collaborative effort with Puget Sound communities and interested parties to address human sources of nutrients. Through this project we have remained committed to working directly with impacted communities to explore innovative solutions to reduce nutrient pollution. Consistent with this commitment, Ecology has chosen to develop an ARP to address DO impairments in Puget Sound, in advance of a TMDL. This approach will not only allow us to move more directly to reducing nutrient pollution but also provide flexibility to those that need to make significant investments in pollution reduction. We have utilized the technical rigor of the Salish Sea Model to develop nitrogen targets and will rely on the same permitting and nonpoint implementation tools that are foundational in TMDLs. More specifically, this plan:

- Establishes total nitrogen loading targets for both the marine point sources discharging to Puget Sound and the watersheds that drain into Puget Sound
- Describes implementation tools we will utilize to achieve nitrogen targets
- Identifies financial support necessary to reduce nutrient loading to Puget Sound
- Details a schedule with measurable milestones to achieve our nitrogen targets by 2050
- Outlines a monitoring approach to track progress for adaptive management purposes
- Defines our adaptive management process

We are confident the measures in this ARP will reduce nutrients in Puget Sound and set Washington state on a path to meeting water quality standards in the Sound.

Scope of Plan

Waterbodies and pollutants addressed

This plan sets goals for nutrient pollution reductions within Washington state to restore DO levels in Puget Sound and comply with the Puget Sound aggregate load bubble allocations for nutrients in the Budd Inlet DO TMDL. As such, the geographic scope of water quality impairments covered by this plan includes Washington's waters of the Salish Sea but excludes marine waters addressed by the Budd Inlet DO TMDL. This plan refers to the waters addressed by this plan as "Puget Sound". Washington's 2018 Water Quality Assessment includes 179 Assessment Units (AU), or waterbody segments as defined by Washington's Water Quality Assessment, within Puget Sound listed as Category 5 (303(d) impaired) for DO and an additional 289 AUs identified as Category 2 (waters of concern) for DO[5]. Appendices C.1 and C.2 identify these Category 5 and Category 2 segments addressed by this plan.

Figure 4 shows the waters this plan covers (dark grey), the spatial distribution of Category 5 and 2 waters, and the DO-impaired portion of the Sound addressed by the Budd Inlet DO TMDL (Category 4A). Upon EPA acceptance of this plan, Category 5 and Category 2 waterbodies will be placed into Categories "5R" and "2R", respectively. These categories still reflect the respective impaired and concerned status, but communicate to EPA, Tribes, partners, and the public that we have developed and are actively implementing a restoration approach different than a TMDL. This approach is consistent with EPA guidance (EPA, 2024).

In future water quality assessments, any waters identified as impaired or waters of concern for DO within Puget Sound's marine waters should be considered addressed by this plan, as the targets in this plan represent a nutrient loading scheme which will achieve attainment of DO standards across the Puget Sound study area. Ecology will subsequently move these waters into Categories 5R and 2R, respectively.

[5]Ecology submitted the candidate 2022 303(d) list of impaired waters to EPA on April 25, 2025 and is currently awaiting review and decision.

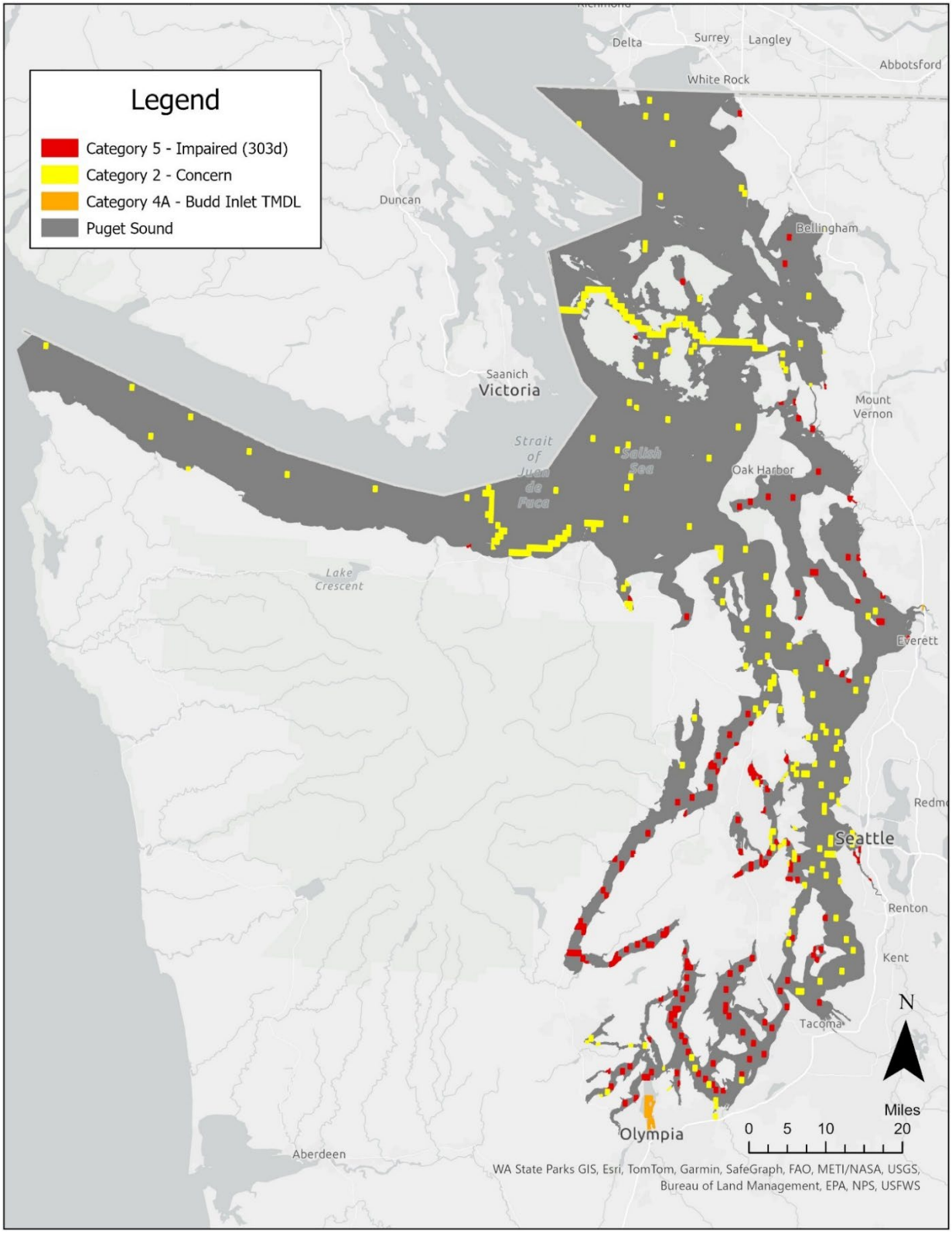

Figure 4. Puget Sound waters designated as 303(d) impaired (Category 5), waters of concern (Category 2), and those impaired waters addressed by the Budd Inlet TMDL (Category 4A) in the 2018 Water Quality Assessment.

Budd Inlet DO TMDL's Puget Sound Aggregate Bubble Allocation

The Budd Inlet DO TMDL (Ecology Publication 22-10-012) was written to restore DO levels in Budd Inlet's marine waters to state water quality standards. Along with waste load allocations for point source dischargers and load allocations to nonpoint sources draining to the inlet, the TMDL established an aggregated "bubble" load allocation for human-sourced nitrogen and carbon entering Budd Inlet from the rest of Puget Sound. Specifically, the TMDL bubble allocation is established as daily load allocations for total nitrogen (TN), dissolved inorganic nitrogen (DIN), total organic carbon, and dissolved organic carbon for the open boundary of Budd Inlet. The bubble allocation, when paired with the other allocations in the TMDL, represents the maximum amount of nutrients that can flow into Budd Inlet from the Sound and still attain DO standards. Before finalizing the targets in this plan, we confirmed and have documented the nitrogen targets meet the requirements of the bubble allocation in the Budd Inlet TMDL (Figueroa-Kaminsky et al. 2025, Appendix O).

Designated uses of waterbodies

The Water Quality Standards for Surface Waters of the State of Washington, Chapter 173-201A WAC (further referred to as "Washington's water quality standards") define the designated uses for all of Washington's surface waters of the state. The designated use relevant to dissolved oxygen impairments is our "aquatic life" use, which our marine water quality standards define as follows (WAC 173-201A-210):

> (1) Aquatic life uses. Aquatic life uses are designated using the following general categories. It is required that all indigenous fish and nonfish aquatic species be protected in waters of the state.
>
> (a) The categories for aquatic life uses are:
>
> (i) Extraordinary quality. Water quality of this use class shall markedly and uniformly exceed the requirements for all uses including, but not limited to, salmonid migration and rearing; other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning.
>
> (ii) Excellent quality. Water quality of this use class shall meet or exceed the requirements for all uses including, but not limited to, salmonid migration and rearing; other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning.
>
> (iii) Good quality. Water quality of this use class shall meet or exceed the requirements for most uses including, but not limited to, salmonid migration and rearing; other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning.

(iv) Fair quality. Water quality of this use class shall meet or exceed the requirements for selected and essential uses including, but not limited to, salmonid and other fish migration.

Table 2 describes where the specific aquatic life use categories defined above apply within portions of Puget Sound.

Table 2. Aquatic life uses in Puget Sound (Modified from Chapter 173-201A-612 WAC, Table 612).

Use Designations	Aquatic Life Use
Budd Inlet south of latitude 47°04'N (south of Priest Point Park).	Good
Commencement Bay south and east of a line bearing 258° true from "Brown's Point" and north and west of a line bearing 225° true through the Hylebos waterway light.	Excellent
Commencement Bay, inner, south and east of a line bearing 225° true through Hylebos waterway light except the city waterway south and east of south 11th Street.	Good
Commencement Bay, city waterway south and east of south 11th Street.	Fair
Drayton Harbor, south of entrance.	Excellent
Dyes and Sinclair inlets west of longitude 122°37'W.	Excellent
Elliott Bay east of a line between Pier 91 and Duwamish Head.	Excellent
Everett Harbor, inner, northeast of a line bearing 121° true from approximately 47°59'5"N and 122°13'44"W (southwest corner of the pier).	Good
Guemes Channel, Padilla, Samish and Bellingham bays east of longitude 122°39'W and north of latitude 48°27'20"N.	Excellent
Hood Canal.	Extraordinary
Mukilteo and all North Puget Sound west of longitude 122°39'W (Whidbey, Fidalgo, Guemes and Lummi islands and State Highway 20 Bridge at Deception Pass), except as otherwise noted.	Extraordinary
Oakland Bay west of longitude 123°05'W (inner Shelton harbor).	Good
Port Angeles south and west of a line bearing 152° true from buoy "2" at the tip of Ediz Hook.	Excellent
Port Gamble south of latitude 47°51'20"N.	Excellent
Port Townsend west of a line between Point Hudson and Kala Point.	Excellent
Possession Sound, south of latitude 47°57'N.	Extraordinary
Possession Sound, Port Susan, Saratoga Passage, and Skagit Bay east of Whidbey Island and State Highway 20 Bridge at Deception Pass between latitude 47°57'N (Mukilteo) and latitude 48°27'20"N (Similk Bay), except as otherwise noted.	Excellent

Use Designations	Aquatic Life Use
Puget Sound through Admiralty Inlet and South Puget Sound, south and west to longitude 122°52'30"W (Brisco Point) and longitude 122°51'W (northern tip of Hartstene Island).	Extraordinary
Sequim Bay southward of entrance.	Extraordinary
South Puget Sound west of longitude 122°52'30"W (Brisco Point) and longitude 122°51'W (northern tip of Hartstene Island, except as otherwise noted).	Excellent
Strait of Juan de Fuca.	Extraordinary
Totten Inlet and Little Skookum Inlet, west of longitude 122°56'32"W (west side of Steamboat Island).	Extraordinary

Water quality criteria

Washinton's water quality standards contain numeric DO criteria for marine waters in Chapter 173-201A-210(1)(d) WAC for the protection of aquatic life uses. These criteria protect all indigenous fish and non-fish species, such as shellfish and marine mammals, from lethal and sublethal effects of low dissolved oxygen levels and are often referred to as the "biologically-based numeric criteria". Table 3 defines the DO criteria for each aquatic life uses category. All DO concentrations are measured as a 1-day minimum. Concentrations of DO should not fall below these criteria more than once every ten years on average [WAC 173-201A-210-1(d)(ii)]. Figure 5 displays where aquatic life uses, and the respective DO numeric criteria apply in Puget Sound.

Table 3. Aquatic life dissolved oxygen criteria in marine water [WAC 173-201A-210 WAC, Table 210 (1)(d)].

Category	Lowest 1-Day Minimum
Extraordinary quality	7.0 mg/L
Excellent quality	6.0 mg/L
Good quality	5.0 mg/L
Fair quality	4.0 mg/L

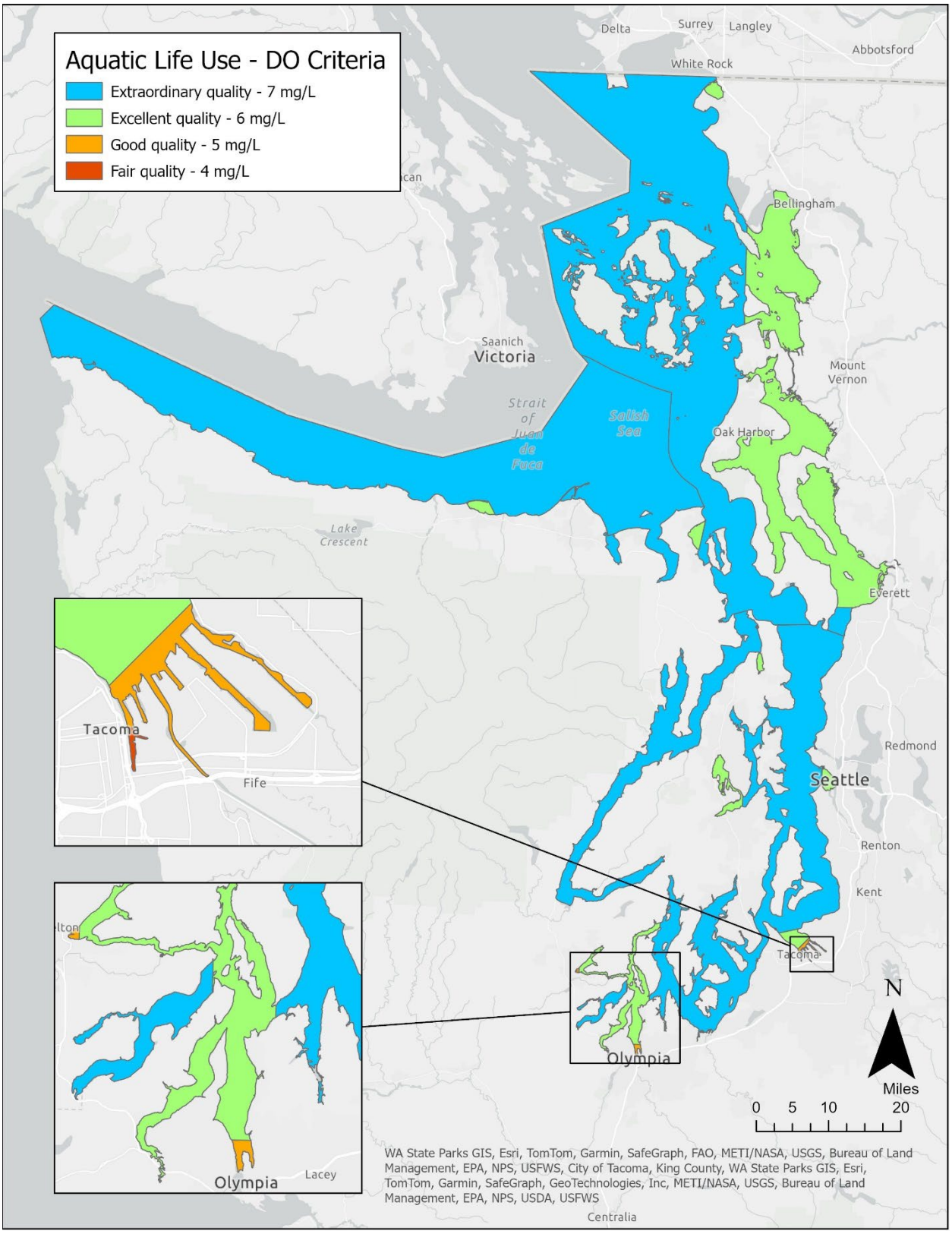

Figure 5. Aquatic life uses and respective dissolved oxygen numeric criteria in Puget Sound.

In addition to the numeric biologically based criteria, Washinton's water quality standards have historically included natural conditions provisions. Natural conditions criteria have been a part of Washington's surface water quality standards since the first regulations were adopted in 1967.[6] These provisions, also known as natural conditions criteria (NCC), recognize that conditions in some waterbodies naturally do not meet biologically based aquatic life criteria, due to natural processes or seasonal conditions. Natural conditions criteria are protective of aquatic life because they represent water quality conditions before any anthropogenic impacts. Aquatic organisms have adapted over time to these site-specific water quality conditions which support their survival, growth, and reproduction. The NCC provides a human use allowance of 0.2 mg/L below natural conditions to local and regional sources of human-caused pollution. "Local and regional sources" are sources of pollution caused by human actions which originates from within the boundaries of the Washington state or within the boundaries of a U.S. jurisdiction abutting Washington state. See WAC 173-201A-210(d)(i).

Washington's water quality standards also include provisions for antidegradation in WAC 173-201A Part III. In this section the standards define "measurable change" as a DO decrease of 0.2 mg/L or greater [WAC 173-201A-320(3)(b)]. Additionally, because Puget Sound DO levels do not meet DO criteria, the Tier I requirements in section 310 apply. This plan achieves the "appropriate and definitive steps" required by WAC Section 310(2) to "bring the water quality back into compliance with the water quality standards."

For this plan, Ecology targets the applicable numeric and natural conditions water quality criteria in its modeling scenarios. Ecology considers results acceptable where DO concentrations are above the numeric criteria or where local and regional sources do not cause more than a 0.2 mg/L decrease in DO below the natural condition. As detailed in this plan, modeling shows that the recommended actions within this plan will restore DO in Puget Sound to meeting water quality standards.

[6] In November 2021 EPA reviewed, reconsidered, and ultimately disapproved several of Ecology's natural conditions provisions, which were submitted in 2003 and 2006 (2006 provisions). In 2024, Ecology adopted new natural conditions provisions. We designed our modeling and this plan to consider the DO 0.2 mg/L human use allowance. The new natural condition provisions limit Ecology's ability to assign the human use allowance only to "local and regional sources of human-caused pollution." The plan does not provide any of the human use allowance to non-local and regional sources such as climate change and Canada. See Appendix D for more information on the EPA natural conditions disapproval decision, the prior standards, and the newly adopted natural conditions provisions.

Nitrogen Loading Targets

This plan sets total nitrogen (TN) loading targets for Puget Sound's marine point sources and watersheds at a level that attains DO standards across the Sound. The targets are designed to meet the biologically based numeric criteria or limit the impact of local and regional sources of human-caused nutrient pollution on DO to 0.2 mg/L, where applicable. Targets are informed by the technical work and considerations documented in the Salish Sea Model Optimization Scenarios Phase 2 report (Figueroa-Kaminsky, et al. 2025) and the previous Phase 1 and Bounding Scenario Reports. The Phase 2 report reinforced conclusions of our previous modeling reports: we need significant load reductions from both point sources and watersheds to achieve standards.

Targets in this plan are assigned to marine point sources and watersheds, consistent with the structure of nutrient loading inputs in the Salish Sea Model. Targets are aggregated to each of the eight basins in Puget Sound. Total nitrogen was selected as the parameter of interest for targets as it is inclusive of all nitrogen species. Basin-wide TN targets provide flexibility in the implementation tools available to achieve reductions. While we have not assigned targets for carbon, this section describes the assumptions in organic carbon reductions associated with meeting TN targets. Organic carbon assumptions are based on previous evaluations of nutrient removal technologies at WWTPs (Tetra Tech, 2011).

Selected model scenario

The nitrogen targets are derived from the loading scenario specified in Salish Sea Model scenario "Opt2_8" detailed in the Optimization Scenarios Phase 2 report. As with all the refined Phase 2 scenarios, nutrient load reductions were applied by reducing nitrogen and carbon concentrations relative to their 2014 concentrations. Flows were kept constant at 2014 levels. This approach was applied to both marine point sources and watershed loads.

The Opt2_8 marine point source (domestic WWTPs and industrial facilities discharging to Puget Sound) nutrient reduction framework was applied as follows for the 2014 model year, with the twelve months of the year divided into three seasons: cool (November – March), warm (April – June, and October), and summer (July – September):

- All domestic WWTPs discharging more than 22 lbs. TN/day **and** more than 13 lbs. dissolved inorganic nitrogen (DIN)/day[7] in Northern Bays, Whidbey, Main, and South Sound basins were set at average DIN concentrations of 8 mg/L in the cool season, 5 mg/L in the warm season, and 3 mg/L in the summer season. Additional reductions were applied to domestic WWTPs discharging to more recalcitrant portions of the Sound:
    - The three domestic WWTPs discharging to Sinclar Inlet we set at assumed average DIN concentrations of 3 mg/L year-round.

[7] Loads represent max monthly daily average load. Converted from 10 kg TN/day and 6 kg DIN/day, respectively. Facilities discharging at or below these loads meet the definition of "Small Loaders" in the 2022 General Permit, but have a distinctly smaller nutrient load than the other Small Loaders discharging above these levels.

- Domestic WWTPs not treating combined sewage **and** discharging greater than 2,000 lbs. TN/day[8] into the Main basin were set at assumed average DIN concentrations of 3 mg/L during the warm season (rather than just in the summer season).
- All WWTPs discharging less than 22 lbs. TN/day or less than 13 lbs. DIN/day **or** discharging effluent into Hood Canal, Admiralty, Strait of Juan de Fuca, or Strait or Georgia basins were set at 2014 nitrogen loads.
- All industrial facilities were set at 2014 nitrogen concentrations and loads.

Dissolved inorganic nitrogen was used as the target nitrogen species for applying nitrogen reductions from marine point sources in the model based on previous technical and economic evaluations of biological nitrogen removal (BNR) at wastewater treatment plants (Tetra Tech, 2011). Our modeling approach assumed that all facilities reducing DIN loads would also achieve an annual average carbonaceous biochemical oxygen (CBOD) concentration of 8 mg/L year-round (Tetra Tech, 2011), which is translated to a facility specific reduction in dissolved organic carbon (DOC) load in the model (McCarthy et al., 2018).

The Opt2_8 watershed nutrient reduction framework included applying percent reductions to all forms of anthropogenic nitrogen and organic carbon loads in the model (Example: If a watershed was assigned a 53.4% reduction, the anthropogenic loads from all forms of nitrogen and all forms of organic carbon were reduced 53.4%). Table 4 below describes the watershed specific nutrient reductions applied as the basis for the watershed targets in this plan.

Table 4. Watershed reduction framework applied in Salish Sea Model scenario Opt2_8.

Basin(s)	Reduction in Anthropogenic Nitrogen and Organic Carbon Loads
Northern Bays Whidbey	67.7% in large watersheds* 61.2% in all other watersheds
Main Basin	90% in watersheds draining to Sinclair Inlet and Liberty Bay 67.7% in large watersheds* 61.2% in all other watersheds
South Sound	90% in watersheds draining to Carr and Henderson Inlets 67.7% in large watersheds* 61.2% in all other
Hood Canal	90% in watersheds draining to Lynch Cove 53.4% in all other watersheds
Admiralty	53.4% in all watersheds
Strait of Juan de Fuca Strait of Georgia	No reductions

*Defined as average daily anthropogenic TN load greater than 1,000 kg/day

[8] Definition of "Dominant Loaders" in the 2022General Permit

To ensure the Opt2_8 would meet the Budd Inlet TMDL open boundary bubble allocation, we ran a scenario where we set the nutrient loads for the Budd Inlet marine point sources and watersheds equal to their allocations specified in the TMDL and applied the Opt2_8 framework for all other model inputs. The results met the bubble allocation and resulted in the same level of noncompliance as the Opt2_8 scenario (See Salish Sea Model Optimization Phase 2 Report Appendix O).

See the Nutrient Forum appendix (Appendix A), Bounding Scenarios and Optimization Scenarios Phases 1 and 2 technical reports for more information on how the nutrient reduction scenarios were theorized, generated, and simulated in the Salish Sea Model.

Scenario Opt2_8 was selected as the basis for the nitrogen targets in this plan because it required a lower amount of nutrient reductions, relative to other scenarios, while achieving DO standards throughout the Sound when the bottom two vertical layers are aggregated. The Phase 2 report did not include results with bottom averaging, but here, we explored that option due to the shallow nature of the assessment units. Other DO studies have also explored this question. For example, the Budd Inlet TMDL utilized a model that stratified the water column into up to nineteen layers but ultimately aggregated DO values to three vertical layers based on habitat considerations and tidal range, vertical stratification, and biological productivity in the euphotic zone.

In the Opt2_8 scenario, aggregating the bottom-two-layers (comprising approximately 33% of the water column depth) of these shallow waterbodies based on an assumption of similarity in habitat and biochemical conditions, results in zero noncompliance throughout the Sound.

The Phase 2 report showed that without vertical aggregation, Scenario Opt2_8 reduced the temporal and spatial extent of predicted DO noncompliance by greater than 99.9%. The remaining predicted DO noncompliance in this scenario occurred in the lowest vertical layer of three small assessment units in Sinclair Inlet and the lowest layer of one assessment unit in Henderson Inlet. The predicted DO values were 0.1 mg/L DO below the human use allowance of the criteria. Model scenarios that applied additional localized reductions to address the remaining predicted noncompliance only marginally improved the temporal and spatial extent of predicted noncompliance, despite a significant additional increase in nutrient reductions at WWTPs and watersheds draining to these waterbodies reducing anthropogenic nutrient loads by 90%.

Marine point source targets

The marine point source targets represent basin-wide annual loading targets for NPDES permitted domestic WWTPs and industrial facilities located in Washington and discharging to Puget Sound (Figure 6). We have divided the basin-wide target loads by state issued NPDES permits for domestic WWTPs (State WWTP), state issued NPDES permits for industrial facilities (State Industrial), and EPA issued NPDES permits for domestic WWTPs and industrial facilities (Federal) (Table 5), as the tools and programs responsible for implementing these targets in permits vary. However, the targets apply at the basin wide level to allow flexibility to adjust the distribution of loads between facilities and across permit types within each basin. The total target for the basin should not be exceeded to ensure attainment of water quality standards

and the spatial and temporal distribution of loads should be heavily considered to avoid localized water quality issues. See Appendix E for the marine point source model inputs loads used to calculate the basin-wide targets. These model inputs represent a starting point Ecology may use when calculating water quality based effluent limits (WQBELs, limits set in permits that are designed to meet water quality), in each facility's respective NPDES permit.

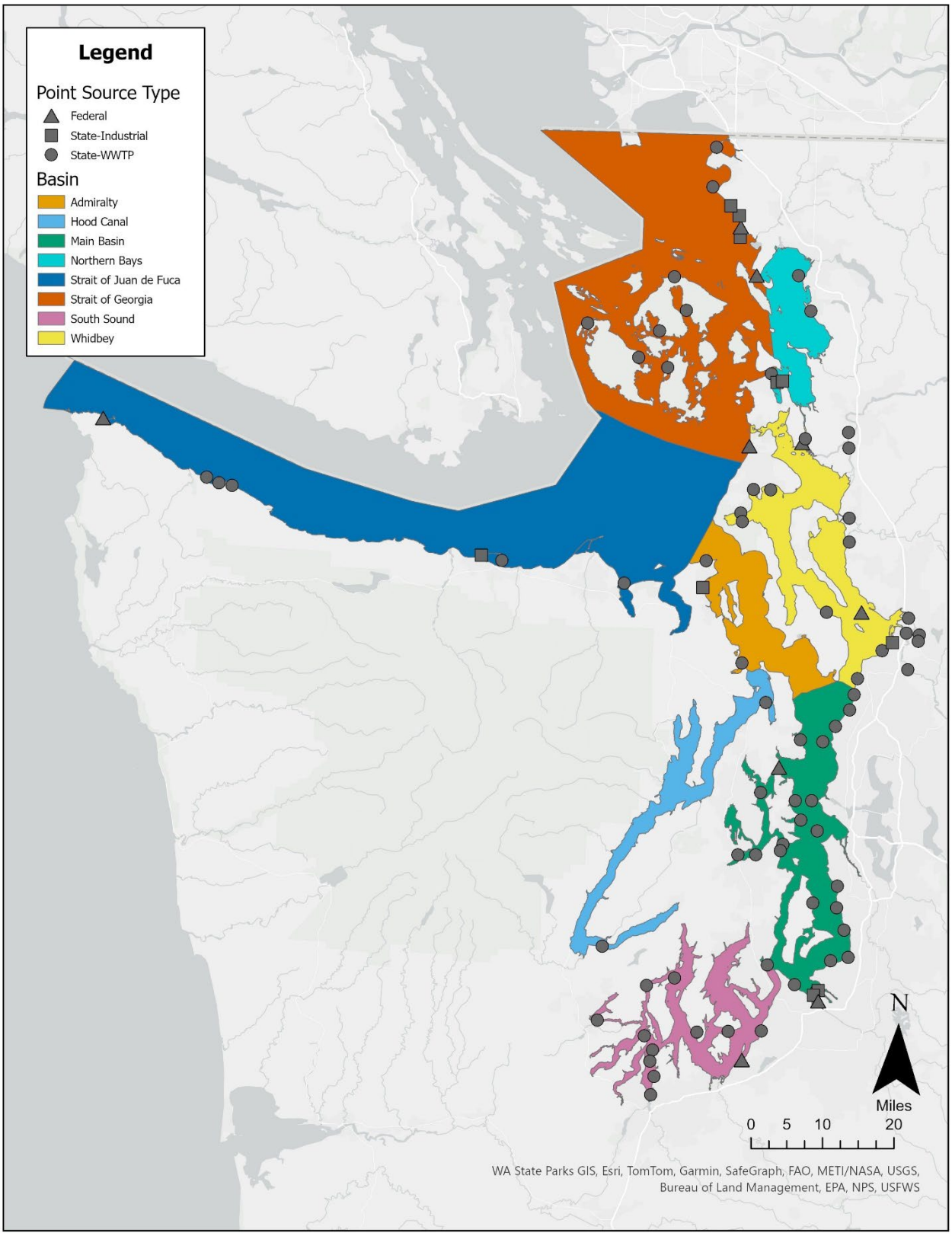

Figure 6. Marine point sources by facility type within basins in Puget Sound.

Table 5. Marine point source total nitrogen (TN) annual targets for Puget Sound's eight basins by permitted source. Total annual targets for each basin are rounded to three significant figures. All other loads are rounded to nearest whole number.

Basin	State WWTP (lbs. TN/year)	State Industrial Facilities (lbs. TN/year)	Federal Facilities (lbs. TN/year)	Total Annual Target (lbs. TN/year)
Northern Bays	307,232	141,623	0	449,000
Whidbey	1,113,680	0	12,068	1,130,000
Main	6,619,298	56,542	127,306	6,300,000
South Sound	838,814	0	59,591	898,000
Hood Canal	823	0	0	823
Admiralty	34,449	19,903	0	54,400
Strait of Juan de Fuca	172,982	52,953	7,542	233,000
Strait of Georgia	309,587	233,981	19,612	563,000

Note that the 2014 model scenario run to generate these TN targets included nutrient loads for one state WWTP and two state industrial facilities that have since terminated their NPDES permits and/or are no longer actively discharging to Puget Sound. For these facilities, their 2014 TN loads from the Salish Sea Model were included in the above targets as a margin of safety and/or reserve capacity that could be allocated to another nutrient source in the basin. See Appendix E for more facility specific information.

We acknowledge other types of permitted discharges within Puget Sound have not received a portion of the marine point source nitrogen targets. The implementation section (page 40) describes the reasoning for this approach and the tools we're utilizing to limit nitrogen loading from these potential sources.

State issued WWTP permits

Ecology issues NPDES permits that regulate the wastewater discharges into Puget Sound from domestic WWTPs. The state WWTP portion of the marine point source targets were calculated using the reduction frameworks described in the section above for the sixty eight state domestic wastewater treatment plants discharging to Puget Sound in 2014. The TN loads in Table 5 are the basis for calculating WQBELs in future reissuances NPDES permits for domestic WWTPs. See Appendix E.1 for state WWTP model inputs used to calculate basin-wide targets.

State issued industrial permits

Ecology regulates discharge of wastewater effluent from industrial facilities through individual NPDES permits. The state industrial loads in Table 5 were calculated based on setting the nitrogen and organic carbon loading for industrial facilities at 2014 levels. As of 2025, nine state permitted facilities were actively discharging to Puget Sound. As these permits are up for renewal in the future, the targets in this plan will serve as the foundation for calculating TN

WQBELs. See Appendix E.2 for state industrial model inputs used to calculate the basin-wide targets.

EPA issued WWTP and industrial permits

The EPA issues NPDES permits for WWTPs and industrial facilities on federal and tribal-owned land. The model scenarios included nine federally permitted NPDES discharges to Puget Sound as of 2014. Targets were calculated using the same reduction strategies as the state WWTPs. These loads serve as the basis for calculating TN WQBELs in future NPDES re-issuances. See Appendix E.3 for the EPA issued permits' model inputs used to calculate the basin-wide targets.

Watershed targets

The watershed targets are represented as a single annual TN load for each of the eight Puget Sound basins (Table 6). Note that these loads represent all upstream nonpoint and point sources of TN in the 163 distinct watersheds draining to Puget Sound, stormwater discharges to Puget Sound not addressed by the marine point source targets (Figure 7, Examples: municipal and industrial stormwater), and any diffuse shoreline pollution (Example: on-site septic systems). Flexibility is available to adjust the distribution of loads within a basin between watersheds. However, the total target for the basin should not be exceeded to ensure attainment of water quality standards and the geographic distribution of loads should be heavily considered to avoid potentially localized water quality issues. See Appendix F for the specific reduction framework and TN loading model inputs for each watershed within each basin. The loads listed in Appendix F will serve as the starting point for prioritizing and developing water clean-up plans in these watersheds.

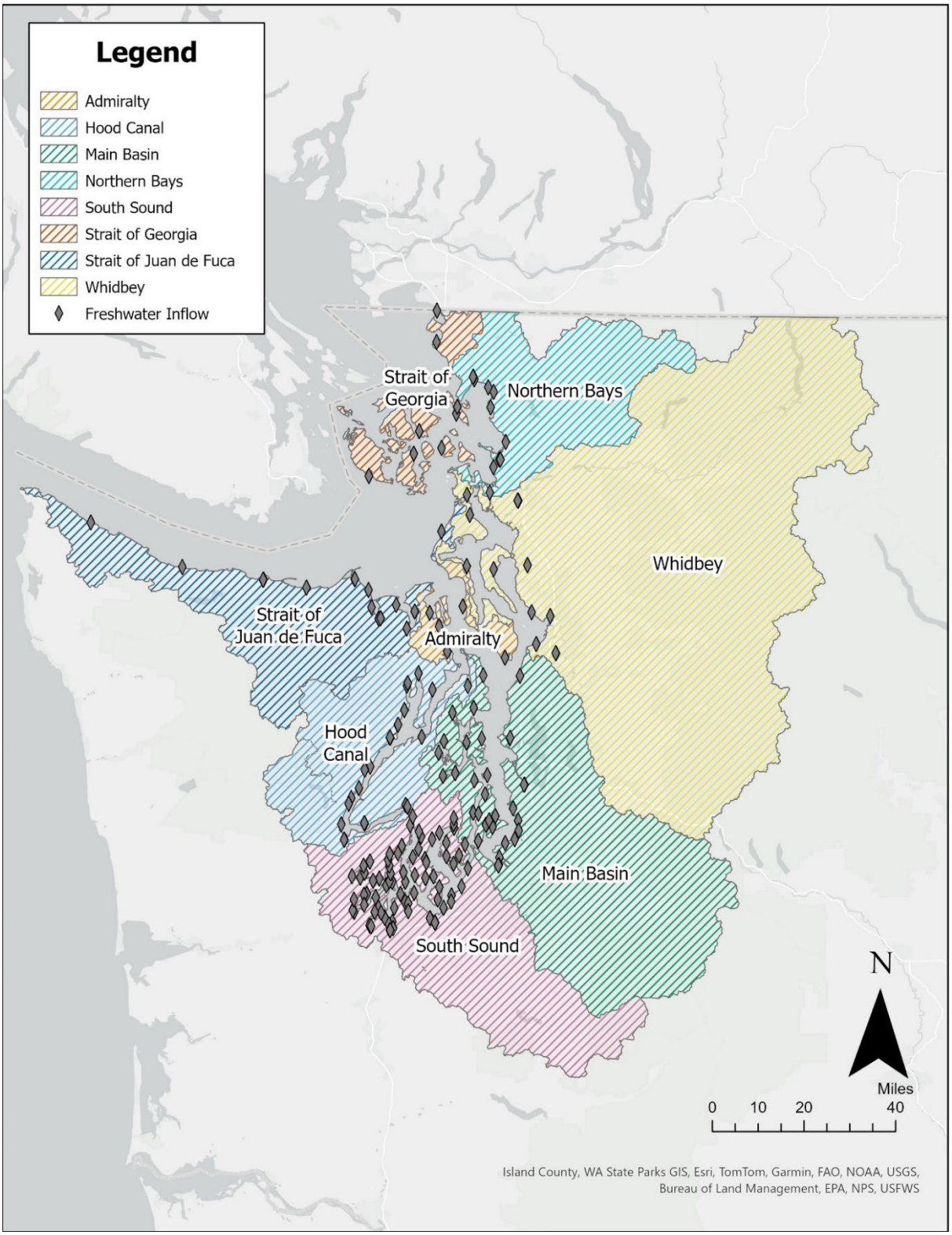

Figure 7. Watershed extents for each basin with freshwater inflow points. Freshwater inflow features represent the outlet of each watershed into Puget Sound, represented as inputs to the Salish Sea Model. Puget Sound watersheds have been trimmed at the Washington/Canada border for visual purposes.

Table 6. Watershed TN annual targets by basin. Targets are rounded to three significant figures.

Basin	Watershed Targets (lbs. TN/year)
Northern Bays	3,390,000
Whidbey	11,900,000
Main	4,330,000
South Sound	2,940,000
Hood Canal	1,030,000
Admiralty	50,100
Strait of Juan de Fuca	929,000
Strait of Georgia	1,070,000

The watershed nutrient reductions in this plan are needed to meet DO criteria in Puget Sound and were not evaluated to address any freshwater DO impairments. Existing freshwater DO impairments within watersheds that do not have a water clean-up plan prescribed to address impairments will be addressed through future water clean-up plan development, which may require additional controls for nutrients contributing to these impairments (phosphorus, rather than nitrogen, is generally the limiting nutrient in freshwater systems). For those existing approved nutrient TMDLs in watersheds, additional nutrient controls may be needed to meet the targets in this plan (See Implementation: Water clean-up plans section).

Non-local and regional sources

Besides Washington's marine point sources and watersheds, there are non-local and regional sources of nutrient pollution to Puget Sound. These external sources include Canadian wastewater treatment plants and rivers, atmospheric deposition, the open ocean boundary, and changes in nutrient loading and dynamics resulting from climate change. While their nutrient contributions and simulated effects on DO are components of the Salish Sea model (See McCarthy et al., 2018), we have not allocated a portion of the 0.2 mg/L DO human use allowance to these sources, and they were not assigned nutrient targets.

This plan is focused on limiting the impacts of nutrient pollution on Puget Sound from those local and regional pollution sources within Washington. Under the Climate Commitment Act[9], Ecology's Cap and Invest Program is aggressively reducing greenhouse gas emissions in Washington and investing in climate resiliency projects to combat climate change, which is a global problem. Additionally, past research has shown that atmospheric deposition into Puget Sound's waters is a minor source of nitrogen (Ahmed et al., 2019) and a significant portion of nitrogen entering Puget Sound from the open ocean boundary is circulated back out to the ocean (Mackas and Harrison, 1997).

[9] https://ecology.wa.gov/air-climate/climate-commitment-act

Implementation

The primary actions for attaining the TN targets in this plan are (1) establishing water quality based nitrogen effluent limits for the marine point sources to Puget Sound, and (2) prioritizing, developing and implementing water clean-up plans for the watersheds draining into Puget Sound. Both tactics involve understanding the individual point source or watershed's relative proportion of the larger, basin-wide target (in Appendixes E and F) and utilizing implementation programs to meet those targets. However, there are several other tools that are needed to ensure that meeting the nitrogen targets in the plan will result in attaining DO standards in Puget Sound. These tools range from continued implementation of existing programs and nonpoint regulatory authority that effectively manage nutrients, to limiting new sources of nutrients within the Puget Sound region.

While the nitrogen targets in the plan represent the sum of the allowable load from point sources and watershed inflows to the Sound, it's important to remember that the targets are assigned at the basin-wide scale. Ecology took this approach to allow flexibility in distributing loads between multiple potential sources of nitrogen within each basin, so long as the TN load for that basin is not exceeded. Careful consideration should be taken when redistributing loads to avoid localized water quality issues.

Marine point sources

The marine point source targets in this plan are only applicable to domestic WWTPs and industrial facilities discharging into the Salish Sea and some facilities discharging near river mouths. Permitting tools are our primary means for achieving the marine point source targets.

Marine Domestic WWTP and Industrial NPDES Permits

Ecology issues NPDES permits for WWTPs and industrial facilities discharging treated wastewater to waters of the state. EPA issues NPDES permits for WWTPs and industrial facilities on Tribal or federal land. The CWA limits the length of NPDES permits to five years, with mechanisms in place for extensions when needed.

Currently, none of the WWTPs or industrial facilities discharging to Puget Sound have numeric effluent limits protective of dissolved oxygen across the Sound. The fifty-eight domestic WWTPs originally covered under the 2022 General Permit will be given the opportunity to opt-in to a reissued General Permit that will reestablish nutrient monitoring, reporting, and planning requirements similar to those found in the 2022 permit. Facilities that do not opt-in may see nutrient monitoring, reporting, and planning requirements added to their individual permits through permit renewals or modifications, or through administrative orders (See Puget Sound Nutrient General Permit section). Most EPA-permitted facilities are currently required to conduct nutrient monitoring and have reporting and planning requirements that mirror those found in the 2022 General Permit. Similarly, all nine privately owned domestic WWTPs (i.e. those not eligible for General Permit coverage) and most state industrial facilities are currently required to monitor for nutrients.

The marine point source nitrogen targets (Table 5) will be translated into WQBELs in the future reissuance the General Permit, individual domestic WWTP permits and industrial permits. Permit effluent limits do not need to be identical to the targets in the plan, but WQBELs in permits must be consistent with targets set by this plan. Ecology is currently evaluating strategies for developing WQBELs for nutrients (Appendix H) being discharged into Puget Sound. Furthermore, the Salish Sea Model identified two pollutants which must be limited to achieve compliance with the DO standards; nitrogen and organic carbon. Ecology plans to develop a Technical Advisory Committee comprised of Puget Sound cities, counties, and water and sewer districts, the scientific community, universities, environmental organizations, state and federal agencies, and Tribes to seek recommendations and support for the development and implementation of WQBELs.

Recognizing the significant nutrient reductions needed from marine point sources, WQBELs could be implemented using additional permitting tools such as the establishment of compliance schedules, interim WQBELs and/or water quality standards variances (40 CFR 131.14).

No new WWTP or industrial discharge into Puget Sound will be permitted unless it can be demonstrated targets in Table 5 will be met.

Compliance schedules

Washington's water quality standards allow the use of compliance schedules in permits to provide permittees with a reasonable amount of time to implement improvements necessary to comply with WQBELs and water quality standards (WAC 173-201A-510(4)). Ecology establishes compliance schedules in permits according to requirements in WAC 173-220-140, WAC 173-226-180 and 40 CFR 122.47, which specify that the length of the schedule shall be the "shortest reasonable period of time necessary to achieve compliance". The standards also require that permits with compliance schedules must establish interim effluent limits for the duration of the compliance schedule. Interim limits must remain in permits until the permittee can meet the WQBEL. Consistent with state and federal regulations, Ecology or EPA may evaluate and adjust interim limits during each permit renewal.

Due to the potential large difference between the current nitrogen effluent levels discharged from marine point sources and the effluent levels required to meet the nitrogen targets in this plan, we acknowledge that permittees may need to make large investments in treatment plant infrastructure to add nutrient reduction technologies necessary to meet their WQBEL. Construction of such infrastructure can take many years, and in some cases, decades to complete. As a result, compliance schedules coupled with interim limits may provide permittees the time needed to properly plan, design, and construct the facilities necessary to meet WQBELs, while also requiring them to make step-wise progress in reducing nutrient loading. For those WWTPs covered under the 2022 General Permit, nutrient reduction evaluations and AKART analyses we will receive will include essential information Ecology can use in establishing any compliance schedules and interim loading limits in the next and future phases of the General Permit.

Nutrient Credit Trading

Water quality trading is a market-based strategy for improving water quality. Trading programs assign pollution reduction activities, such as nitrogen removal from WWTP discharge, an improvement value, or credit, which can then be traded on a local market (Figure 8). Facilitating exchanges of credits can be an effective approach to reducing pollution, especially when there are multiple sources of the same pollutant within an area, like Puget Sound. EPA has supported trading as an efficient and flexible approach to achieving water quality goals (EPA, 2023) and several states have implemented trading programs to help meet their restoration goals. For more background on general concepts and considerations for implementing trading in Washington's waters, refer to Ecology's framework for water quality trading (Ecology Publication 10-10-064).

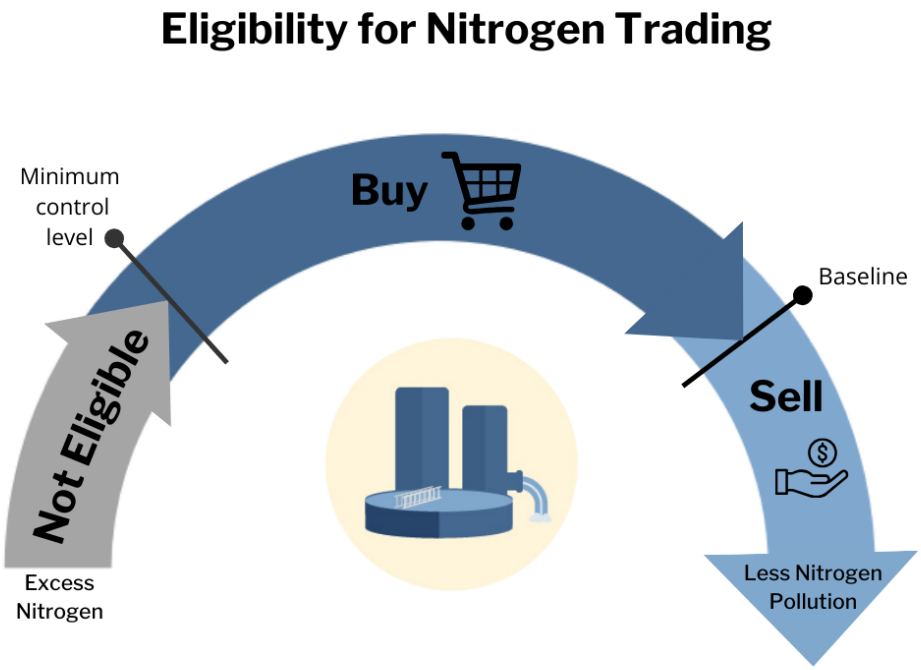

Figure 8. Simplified representation of how a discharger could determine their eligibility to participate in a water quality trading program. Entities that reduce pollution load below "baseline" levels (Example: required nitrogen WQBELs) can sell credits to those that are meeting "minimum control levels" (Example: nitrogen technology based effluent limitations) (Ecology Publication 23-10-035).

In 2022, Ecology was directed by the Washington State Legislature to research and recommend how to structure and establish a water quality trading program to address nutrient pollution in Puget Sound. The goal of such a program would be to provide a potentially more cost-effective strategy to reducing nutrient pollution to the Sound. Ecology submitted recommendations for a Puget Sound nutrient credit trading program in a report to the legislature in 2023 (Ecology Publication 23-10-007). The recommendations included:

- Limit initial trading eligibility to facilities covered under the Puget Sound Nutrient General Permit.
- Develop trade ratios, or multipliers, and geographic boundaries to reduce risk and uncertainty and prevent localized water quality degradation.
- Restrict trading to facilities within the same basin or only allow trading between certain basins.
- Ecology oversees the program, but permittees negotiate trades.
- Establish procedures to determine compliances with NPDES permits.
- Ecology verifies credit generation before trades occur.

We intend to build off the recommendations and continue to explore establishing a nutrient credit trading program for the domestic WWTPs discharging to Puget Sound. Such a program could incentivize early adoption of nutrient control technologies, while offering a temporary pathway to permit compliance for those facilities that are unable to meet their permit limits in the short-term but can identify an eligible partner to offset their nutrient contribution while they are working towards implementing nutrient reduction technologies. Our next step in the process is to conduct a market feasibility analysis, a study which evaluates water quality targets, WWTP facility performance, risk and uncertainty measures, trading boundaries, and several other factors to determine the potential supply and demand of credits within a trading area. We intend to initiate a market feasibility analysis in 2026.

However, the success of a water quality trading program in Puget Sound hinges on whether dischargers are interested in participating in such a program. Ecology will also begin engaging with permittees in the coming years to identify the level of interest. In the event there is broad interest for a program, we will work directly with permittees, Tribes, environmental groups, and other interested parties to establish a program that is feasible for those participating but also meets the collective goal of cleaning up Puget Sound.

In the event there is broad support for a program and the market feasibility analysis identifies a viable market for trading, Ecology would plan to offer nutrient credit trading as part of future marine WWTP NPDES permits and will provide permittees with all necessary guidance to implement such a program. Such guidance will include information for:

- determining minimum control levels (the expected level of treatment that a facility is technically able to achieve and therefore can buy credits)
- determining baselines (nitrogen WQBEL and therefore threshold which a facility can sell credits)
- identifying eligible trading partners
- establishing and applying trade ratios and other mechanisms for addressing uncertainty
- specify reporting requirements
- other necessary components.

Note that trades cannot result in a lowering of water quality. Therefore, Ecology will carefully consider impacts to water quality when developing the tools necessary for addressing risk and accounting of credits.

Reclaimed water

Reclaimed water is domestic wastewater that has been highly treated for safe use again for applications such as irrigation of landscaping or certain food crops, industrial processes, or for some environmental enhancement activities. As part of the 2007 amendments to Washington's Reclaimed Water Use law (RCW 90.46), the state legislature recognized that reclaimed water can "contribute to the restoration of Puget Sound by reducing wastewater discharge." To accomplish the legislative goals of RCW 90.46, Ecology and the Washington State Department of Health jointly regulate reclaimed water in the state with Ecology designated as the lead agency for most projects. As the lead agency, Ecology issues reclaimed water permits to domestic WWTPs to authorize the production, distribution, and use of the reclaimed water according to the restrictions listed in the Reclaimed Water Rule (Title 173-219 WAC). The rule establishes requirements for reclaimed water facility planning, design, construction, operation and maintenance, permitting, and treatment standards.

By turning wastewater into reclaimed water for reuse, some facilities in the Puget Sound region are already reducing the discharge of nutrient rich water into Puget Sound. Seven WWTPs located in Main and South Sound basins currently produce reclaimed water for a variety of beneficial uses. Examples include the following: LOTT in Thurston County operates two separate reclaimed water production facilities. Their Budd Inlet facility uses a sand filter system to produce water used for irrigating parks, streetscapes, and a golf course while their Martin Way facility uses a membrane bioreactor to produce water suitable for recharging groundwater. King County (Brightwater WWTP and South WWTP) along with treatment plants operated by the Cities of Blaine, Sequim, and Shelton also produce reclaimed water for a variety of beneficial uses.

In addition to reducing the volume of effluent discharged to surface water, many reclamation facilities also utilize biological nutrient reduction to meet lower nitrogen effluent limits, another meaningful way to reduce their nitrogen load for water discharged to the Sound. Reclaimed water may be a tool other communities can consider in long-range planning to satisfy existing and future wastewater capacity needs along with reducing their nutrient loads, especially for those facilities currently discharging directly to Puget Sound. In evaluating the appropriateness of reclaimed water as a nutrient reduction strategy, communities must carefully consider future growth and whether viable uses of the water are available, along with the degree of treatment needed to produce reclaimed water suitable for the use.

Permits not included in targets

There are **Commercial Salmon Net Pen Water Quality Permits** in Puget Sound that receive individual NPDES permits from Ecology (Table 7). In 2024, the sites became inactive and in March 2025 the Department of Natural Resources adopted a new rule to disallow the leasing of state aquatic land to commercial salmon net pen facilities. As a result, these facilities have not received a portion of the nitrogen targets established in this plan. In the event these facilities intend to resume aquaculture activities, permits will need updates, with requirements controlling nutrient discharges that are consistent with the nitrogen targets set in this plan.

Table 7. Active individual NPDES Commercial Salmon Net Pen Permits and the basin each permit resides in.

Facility Name	Permit No.	Basin	Waterbody
Cook Aquaculture Pacific, LLC –Clam Bay	WA0031526	Main	Clam Bay
Cook Aquaculture Pacific, LLC –Fort Ward	WA0031534	Main	Rich Passage
Cook Aquaculture Pacific, LLC –Orchard Rock	WA0031542	Main	Rich Passage
Cook Aquaculture Pacific, LLC – Port Angeles	WA0040894	Strait of Juan de Fuca	Port Angeles Harbor
Cook Aquaculture Pacific, LLC – Site 1	WA0031569	Admiralty	Rosario Strait
Cook Aquaculture Pacific, LLC – Site 3	WA0031585	Admiralty	Rosario Strait
Cook Aquaculture Pacific, LLC – Site 4	WA0031593	Whidbey	Skagit Bay

EPA issues a general NPDES permit for **tribal salmon enhancement and federal research marine net pen facilities**. Ecology issues one permit for a Washinton Department of Fish and Wildlife salmon enhancement net pen facility (Table 8). In total, eight non-commercial s net pen facilities are currently operating. The six tribal facilities and one state-owned facility can rear young salmon in pens from four to six months, while National Ocean and Atmospheric Administration's (NOAA) facility can be operational year-round. The EPA general permit for tribal and federal net pen facilities require all facilities to monitor for DO and conduct benthic sediment surveys. These facilities operate at a small scale and not in a continuous, annual manner. The nutrients from these non-commercial, small-scale and seasonal operations are *de minimus* and the permits will provide continued assurance.

Table 8. Noncommercial net pen facilities.

Facility Operator (permit number)	Basin	Waterbody
Suquamish Tribe (EPA WAG132000)	Main	Agate Pass
Suquamish and Muckleshoot Tribe (EPA WAG132000)	Main	Elliot Bay
Squaxin Island Tribe (EPA WAG132000)	South Sound	Peale Passage
Washinton Department of Fish and Wildlife (WA0040878)	South Sound	Pearle Passage
Port Gamble S'Klallam Tribe (EPA WAG132000)	Hood Canal	Port Gamble
Skokomish Indian Tribe (EPA WAG132000)	Hood Canal	Quilcene Bay
NOAA (EPA WAG132000)	Main	Clam Bay
Lummi Tribe (EPA WAG132000)	Admiralty	Lummi Bay

Several NPDES **Boatyard General Permit, Bridge and Ferry Terminal Washing General Permit, and Vessel Deconstruction General Permit facilities** are currently active within Puget Sound. However, these permittees are expected to discharge an insignificant amount of nitrogen and thus do not receive a target. In the future, if it is determined that these facilities are a nutrient load source of concern, permit writers will work with permittees to access a portion of the marine point source targets.

Watersheds

The watershed targets in this plan encompass all nonpoint and point sources of nutrients in the watersheds draining to Puget Sound, stormwater point sources with a discharge to Puget Sound which is not addressed by the marine point source targets and any diffuse shoreline pollution. Due to the diversity of nitrogen sources and the wide variability of environmental characteristics in these watersheds, reducing nutrient loading from the watersheds will require both individualized solutions and deliberate actions where priority sources are identified.

To ensure we are planning our work holistically and adjusting our nutrient reduction efforts based on results, our regional offices will be taking on three rounds of prioritizing future watershed water clean-up work over the next twenty-five years. Each round will include development of a **watershed prioritization strategy**. Strategies will focus on, but are not limited to, the following primary elements:

- Identifying high priority watersheds for clean-up plans and a schedule for completion of all needed clean-up plans
- Developing a roadmap for achieving nutrient reductions from permitted point sources in watersheds using permitting tools and their incorporation into water clean-up plans
- Identifying nonpoint pollution control priority watersheds and approaches for achieving nutrient reductions

Each region will develop their own distinct region-specific strategy. During the development of the prioritization strategy, Ecology will determine the appropriate watershed scale for which water clean-up plans will be developed. In some cases, plans will be developed for watersheds as identified in Appendix F, while in the cases of larger watersheds, plans will be developed at the sub-watershed scale. Reviewing and evaluating the success of implementing previous prioritization strategies will inform the development of subsequent strategies. The following section describes these three primary elements that will be the foundation for developing our prioritization strategies and achieving the watershed targets.

Water clean-up plans for watersheds

In many watersheds, nutrient reductions will be addressed primarily through development and implementation of water clean-up plans, such as TMDLs, straight to implementation plans (STIs), or ARPs. The development of future water clean-up plans will be incorporated into Ecology's existing water clean-up plan prioritizing, scoping, and development process.

Every year Ecology's Northwest and Southwest regional offices have the opportunity to scope and propose new water cleanup plans to be initiated with available resources and staff capacity. We prioritize waters based on the severity of their pollution, risks to public health and/or threatened and endangered species, vulnerability of the water to degradation, need for permit limits on point sources, local support, environmental justice, and other potential considerations (Water Quality Program Policy 1-11 Chapter 1, Section 1H). We also look for projects that will address several impairments and/or multiple pollutants concurrently. While the TMDL approach remains Ecology's primary mechanism for planning clean-up of impaired waters, we also implement STI [10] or ARP approaches, which can result in faster implementation. We believe STIs and ARPs are in general most effective in watersheds with clear implementable nonpoint source remedies and those with pollution problems that benefit from innovative or flexible approaches to achieving reductions. To ensure consistency and transparency in our prioritization process, we seek feedback and engage directly with the public, Tribes, and other interested parties along the way.

All waters within the Puget Sound region will be considered in future regional prioritization processes for developing water clean-up plans to address marine DO impairments. The watershed targets in this plan will serve as the starting point for developing water clean-up plans for the watersheds draining to Puget Sound. Specifically, the watershed loads detailed in Appendix F represent the total nitrogen load for each of the 163 watersheds that discharge to Puget Sound, while meeting dissolved oxygen standards in the receiving marine water and not contributing to water quality standards violations in other parts of the Sound. Therefore, future watershed clean-up plans allocations/targets should be consistent with the targets in Appendix F to ensure attainment of marine DO standards.

For watersheds with NPDES permitted point sources, such as municipal WWTPs or industrial facilities, TMDLs may be needed to set wasteload allocations consistent with the TN targets, that will allow the TN targets to be met at the mouth of each watershed. However, there may be situations where we determine an ARP is more appropriate to achieve nutrient reductions. For those smaller watersheds with no point sources and where agriculture or forestry is the predominant source of nonpoint pollution, STI or ARP approaches may be an effective clean-up tool prior to development of a TMDL. Work to address nutrients may have already started in some of these watershed and Ecology encourages broad nutrient reduction work in all watersheds even before initiating clean-up projects.

We will be looking for watershed clean-up projects that not only address the DO impairments in the Sound, but also nutrient-related impairments in the watershed of interest. Note that achieving the TN loads in Appendix F does not ensure protection of freshwater designated uses, as this was outside the scope of the Salish Sea Model. As a result, future plans may set allocations or targets at levels lower than loads in Appendix F and may require controls for additional nutrients contributing to freshwater DO impairments (examples: phosphorous, carbon, or specific forms or species of nitrogen).

[10] https://ecology.wa.gov/water-shorelines/water-quality/water-improvement/straight-to-implementation

There are many possible approaches to aggregating and prioritizing clean-up plans for the 13,920 mi^2 of land draining to Puget Sound[11], or all of Water Resource Inventory Areas (WRIAs) 1 through 19. Clean-up plans will need to be geographically based and could focus on single watersheds, multiple watersheds draining to an inlet or bay of interest, all watersheds in a WRIA, or at the sub-watershed level. Below are a few, but not all, key factors that should be considered for each watershed when scoping and prioritizing future clean-up plans:

- Magnitude of TN load and/or yield (mass per unit area) and TN load reductions set in this plan
- Proximity of watershed discharge to marine waters not meeting DO water quality standards
- Extent of freshwater DO impairments
- Presence of point sources likely to contribute nutrients which may need effluent limits
- Existing or already-initiated water clean-up plans targeting nutrients
- Size of watershed

Ecology partnered with U.S. Geological Survey to develop a spatially refined version of the SPARROW model, which estimates nutrient loads and sources of nutrients from watersheds discharging to Puget Sound (Figueroa-Kaminsky et al., 2022, Schmadel, et al. 2025). At the time of this plan, the refined SPARROW model was only just being made available. We will be evaluating this model as a potential tool to help prioritize water clean-up plan development and potentially as the basis for developing plans.

Our regional offices will be tasked with developing strategies for prioritizing nutrient reduction efforts with other clean-up plans. We recognize the challenge of developing nutrient clean-up plans for Puget Sound's watersheds given our existing resource constraints. However we expect opportunities to mutually address other pollutants in watersheds, such as bacteria, toxics, and stream temperature, will arise.

Permitted point sources

A primary outcome of watershed clean-up plans will be identifying the tools, and where necessary, wasteload allocations or targets that will be translated into permit limits for point sources in the watersheds. The permitted point sources relevant to the watershed targets include stormwater discharges into Puget Sound that are not addressed by the marine point source targets (i.e. point sources that are not a WWTP or industrial facility) and permitted sources discharging to freshwaters that drain to Puget Sound. These discharges may or may not have potential to contribute nutrients. Many of those discharges with a potential to contribute are already required under existing permits to implement best management practices designed to reduce their nutrient inputs. Below we have identified the specific permitted point sources implicitly included within watershed targets and describe how we will utilize the regulatory mechanisms to meet watershed targets and future water clean-up plan goals. Note, all future

[11] This number includes portions of watersheds located in Canada. Future watershed clean-up plans will only address sources of pollution within Washington's jurisdictional control.

nutrient permit limits will be consistent with the TN targets in this plan and permitted point source work can begin prior to the finalization of watershed water clean-up plans.

Several domestic **WWTPs and industrial facilities** discharge to surface waters that drain to Puget Sound. Most of these facilities are currently required to monitor for nutrients under their existing individual permits. Facilities lacking adequate nutrient monitoring data will be identified during the development of watershed prioritization strategies or water clean-up plan scoping phase and nutrient monitoring requirements will be amended into permits as appropriate. This monitoring data from permitted facilities is necessary to have prior to beginning any detailed modeling work supporting clean-up plans. Water clean-up plans will develop nutrient wasteload allocations or targets, which will be translated into WQBELs in future permit reissuances. Similar to the marine WWTPs and industrial sources described in the marine point sources section, watershed WWTPs and industrial facilities will likely need to utilize permitting tools, such as compliance schedules and reclaimed water, to meet future permit limits.

We regulate stormwater runoff discharged from municipal separate storm sewer systems (MS4s) through our NPDES **Municipal Stormwater Permits**. The Phase I Municipal Stormwater General Permit applies to the cities of Seattle and Tacoma and the unincorporated areas of Pierce, King, and Snohomish counties. The Western Washington Phase II Municipal Stormwater General Permit applies to numerous cities and portions of counties thorough the Puget Sound Region. Portions of the Washington State Department of Transportation Municipal Stormwater Permit coverage are also located in the Puget Sound region. These permittees may discharge stormwater into Puget Sound or waters that drain into the Sound. Future water clean-up plans in watersheds will set wasteload allocations/targets for permittees consistent with achieving water quality standards and identify any additional best management practices that may be needed to achieve reductions. Data collected from the Stormwater Action Monitoring (SAM) program[12], a collective stormwater monitoring program funded by permittees, will help inform future wasteload allocation or targets. Allocations or targets will be translated into WQBELs established in future reissuances of these permits, where applicable. In the meantime, continued implementation of these permits and their required Stormwater Management Programs, will include planning, monitoring, best management practice (BMP) implementation, and mitigating discharges of anthropogenic sources of nutrient pollution.

Our NPDES **Construction Stormwater General Permit (CSGP)** regulates discharges from construction sites greater than one acre discharging stormwater to a surface water of the state. Construction activities are temporary, and permit coverage is terminated once construction is complete. This makes tracking the status of coverage and its impact across the Puget Sound region difficult. We know there are CSGP sites discharging to Puget Sound and its watersheds. Our current CSGP includes best management practices to manage the discharges of nutrients off-site. However, the permit does not include limits or require monitoring for nutrients. Future reissuances of the CSGP may include nutrient monitoring requirements for sites located in

[12] https://ecology.wa.gov/regulations-permits/reporting-requirements/stormwater-monitoring/stormwater-action-monitoring

Puget Sound watersheds to better characterize nutrient loadings. These monitoring data will be used to inform allocations or targets for CSGPs in future water clean-up plans, which will be translated into WQBELs in permit reissuances.

Stormwater runoff from private industrial facilities can pick up pollution from the site and carry that pollution to surface waters. We use the NPDES **Industrial Stormwater General Permit (ISGP)** to control pollutants in stormwater before it can leave these sites. There are several ISGP facilities discharging either into Puget Sound, surface waters in watersheds, and MS4s located in the region. Facilities engaged in industrial activity that is likely be a source of nutrients currently have applicable nutrient benchmarks in the permit to ensure the facility is implementing best management practices to minimize nitrogen in its discharge. Implementation of the stormwater BMPs required under the permit will continue to be effective at managing nutrient pollution from these facilities. Future TMDLs or other water clean-up plans will derive nutrient wasteload allocations/targets for ISGP permittees. Through the watershed prioritization strategy or water clean-up plan development process, we will identify all ISGP sites in the project area and will determine whether additional nutrient monitoring is needed to characterize nutrient loads from industry sectors not currently required to monitor for nutrients under the existing permit. Such additional data may be needed to adequately characterize ISGP nutrient loads and derive allocations or targets.

Other permitted operations located in Puget Sound watersheds with the potential to discharge nutrients **include Concentrated Animal Feeding Operation (CAFO) General Permits, Sand and Gravel General Permits**, and **Upland Finfish Hatching and Rearing General Permits**. All these permits contain best management practices aimed at managing discharges of nutrients and some require monitoring of nutrients in certain circumstances. Future watershed prioritization strategies and water clean-up plans will identify all CAFO, Sand and Gravel GP, and Upland Finfish General Permits holders in the project area and review existing monitoring data and other information to characterize loads for wasteload allocation/target development. Additional monitoring requirements may need added or amended to permits to better characterize nutrient loads. Water clean-up plans will also identify any additional best management practices that may need amended into permits to meet nutrient allocations/targets.

Nonpoint pollution control

Ecology's Nonpoint Source Pollution Program will be fundamental to achieving our watershed targets. Our program strives for voluntary implementation of BMPs to achieve the needed load reductions. However, when education and outreach, technical assistance, and financial assistance are unsuccessful, nonpoint staff utilize their enforcement authority to reduce nonpoint pollution.

The Washington Pollution Control Act (Chapter 90.48 RCW) authorizes Ecology "to control and prevent the pollution of…waters of the state of Washington.", which includes both point and nonpoint sources of water pollution. This statute also makes it unlawful for any person to contribute pollution to waters of the state and authorizes Ecology to issue enforcement orders to address sites that not only pollute state waters, as well as any site that has *substantial potential* to pollute state waters. In other words, we have statutory authority to remedy and

prevent nonpoint source pollution. Court decisions have affirmed our authority to require implementation of BMPs in these situations (Lemire, 178 Wn.2d at 233). We will continue to prioritize collaboration with partners to achieve clean water in Puget Sound through technical and financial assistance but acknowledge that enforcement is a necessary tool to addressing nutrient loading from nonpoint pollution.

Figure 9 outlines Ecology's general approach to correcting nonpoint pollution problems. For more detailed information on our approach, refer to Washington's statewide nonpoint plan (Ecology Publication 22-10-025). This approach is applied statewide, and with sustained engagement in watersheds, is a framework that results in progress towards cleaning up nonpoint pollution.

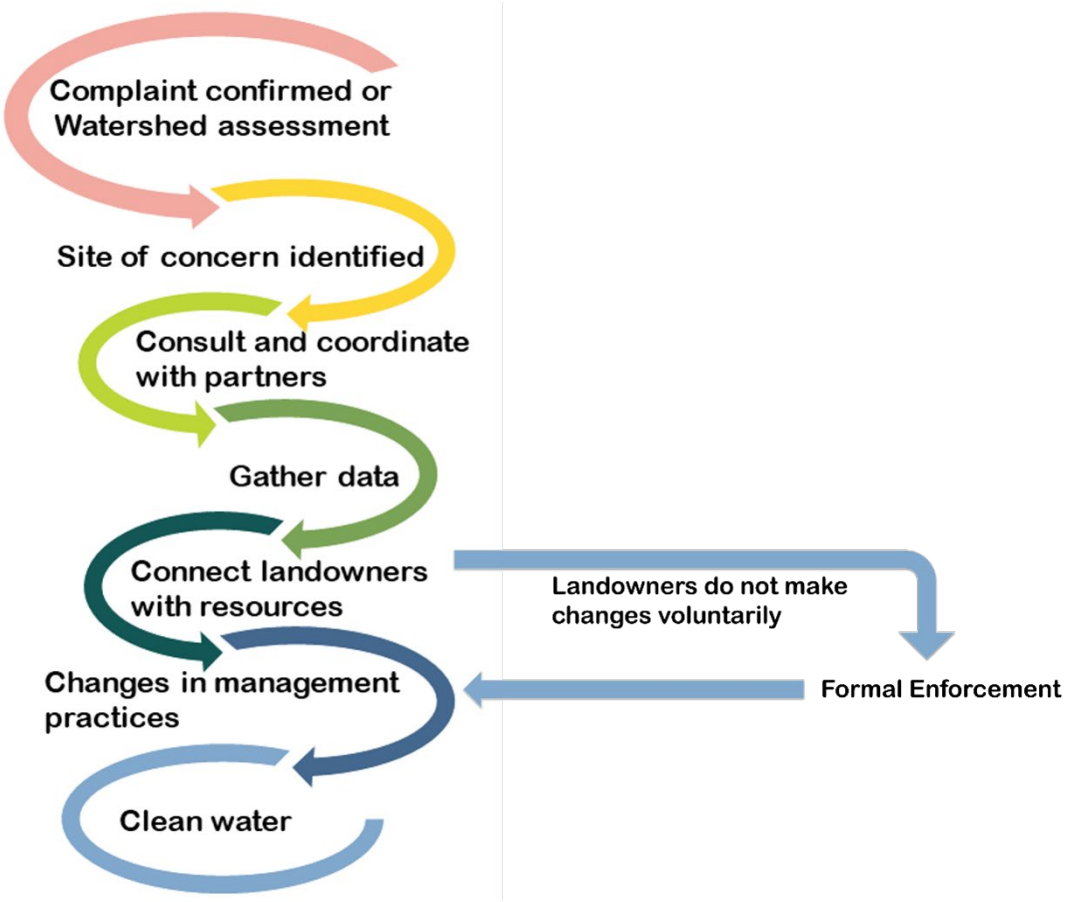

Figure 9. Ecology's Nonpoint Pollution Control Program general workflow for cleaning up nonpoint source pollution.

Ecology's Voluntary Clean Water Guidance for Agriculture (Clean Water Guidance), which is a compendium of technical resources for agricultural producers that recommends BMPs to protect water quality, is a foundational element of technical assistance work. We have completed several chapters of our Clean Water Guidance, and plan to finalize the entire guidance by the end of 2025. The following chapters include best management practices used to manage agricultural nutrient sources, prevent the transport of nutrients to surface waters, and attenuate nutrients before they can enter surface waters.

Managing Nutrients

- Nutrient Management (Chapter 3)
- Grazing Management (Chapter 10)
- Animal Confinement Manure Handling & Storage (Chapter 11)

Transport and Treatment

- Tillage and Residue Management (Chapter 1)
- Crop Systems (Chapter 2)
- Sediment Control Vegetative (Chapter 5)
- Sediment Control Structural (Chapter 6)
- Field and Subsurface Drainage Management (Chapter 8)
- Runoff Control from Agricultural Facilities (Chapter 9)
- Riparian Areas & Surface Water Protection (Chapter 12)

Our Clean Water Guidance and most recent Nonpoint Program annual reports are found on our website[13]. Annual reporting of our Nonpoint Program to EPA is required as a stipulation of receiving Section 319 nonpoint source pollution funding. These reports are an opportunity for us to discuss the challenges and document the activities and accomplishments we have undertaken to address nonpoint source pollution in Washington and achieve our nonpoint pollution goals laid out in our statewide nonpoint plan. These reports are also a useful resource for understanding our current nonpoint priority areas. The watershed nitrogen targets above, the watershed specific loading frameworks in Appendix F, and understanding the relevant contribution of nonpoint sources on nutrient loads within watersheds will be factors for our program to consider when prioritizing future nonpoint work. The recently released USGS SPARROW mapping tool may be useful tool for nonpoint prioritization efforts.

[13] https://ecology.wa.gov/water-shorelines/water-quality/nonpoint-pollution

Financial Assistance

Implementing the strategies necessary to achieve the nutrient targets to restore Puget Sound will require significant investment. Fortunately, several state, federal, and even private resources are available to assist implementers in offsetting the costs associated with capital improvement projects, nonpoint pollution best management practices, restoration, and other activities that manage nitrogen pollution.

The resources below are well-established grant, loan, and technical assistance programs that will play a pivotal role in implementation. While it is a comprehensive list, it likely does not represent all potential funding sources. This list focuses on programs supporting projects that will control nutrient pollution specifically. Program details and requirements can change regularly. Therefore, program webpages are generally the most effective strategy for getting current information.

We structured resources into two categories: wastewater treatment plants and nonpoint and other activities. The wastewater section focuses on grant and loan programs that can help wastewater treatment plants optimize and install the technology necessary to meet their future WQBELs. The nonpoint and other activities section casts a broader net, identifying programs supporting various types of projects that directly and indirectly reduce nitrogen loading from urban, agricultural, and forested environments.

Wastewater

Implementing the technology at WWTPs necessary to meet the marine point source nitrogen targets will come at a significant financial cost to most communities. For perspective, a 2011 economic evaluation of nutrient removal at WWTPs in Washington found that capital improvement, operating, and maintenance costs of implementing nutrient removal technology to treat WWTP effluent to 8 mg TIN/L during the dry season in WRIA 1 (greater Bellingham region) alone would cost $166.3 million, in 2010 dollars (Tetra Tech, 2011). That investment, if not planned for, often results in increased costs to ratepaying residents within the community. The following resources are currently available to support wastewater treatment plants in planning, designing, and implementing reduction strategies necessary to achieve these targets, with a goal that these programs can alleviate this financial burden and allow cost savings to be passed on to ratepayers in the community.

Note that while the marine point source targets pertain to the treatment plants with discharges to Puget Sound, achieving the watershed targets will require reductions from facilities discharging to freshwaters flowing to Puget Sound. Therefore, the majority of these programs are available and will be a valuable resource for treatment plants discharging to Puget Sound and those discharging to freshwaters within watersheds with nutrient targets.

Ecology's Puget Sound Nutrient Reduction Grants Program supports planning efforts, monitoring and operational efficiencies to meet requirements of the General Permit. The funding is eligible to entities covered under the General Permit. The first phase of funding included $9 million for state fiscal years 2021-2023. All these funds have since been allocated to

permittees. The legislature has since appropriated $10 million supporting this program from state fiscal years 2025-2027. Ecology will solicit applications from permittees beginning in August 2025. This funding would be incorporated into the Water Quality Combined Funding Program[14]. Permitted communities would be eligible to access this funding on a competitive basis.

Ecology's Water Quality Combined Funding Program combines grant and loan funding from seven state and federal funding sources to support projects that improve and protect water quality. Total annual funding amount range from $100 to 200 million. Project categories funded under the program include wastewater, stormwater, nonpoint, and onsite sewage systems. Eligible wastewater project types include planning, design, and construction for sewer collection systems, treatment plants, abatement of combined sewer overflows (CSOs), and reclaimed water facilities. Eligible entities include counties, cities, towns, federally recognized tribes, quasi-municipal corporations, and sewer districts. Funding amounts, award limits, loan interest rates, fund matching requirements, and other program details can vary by funding cycle and project type. The largest fund source of the Water Quality Combined Funding Program includes the Clean Water State Revolving Fund[15] (CWSRF). This funding program provides low interest loans and forgivable loans (loans that don't need to be repaid) for water quality improvement projects which includes planning, design and construction of wastewater and stormwater treatment, as well as projects that address nonpoint sources of pollution. Continued federal appropriations supporting wastewater treatment capital improvements will be necessary to meet the wastewater treatment plant targets in this plan.

Several state, federal, nonprofit, and private funding opportunities are available to support wastewater treatment plant planning, capital improvements, and maintenance. Support can include financial or technical assistance. Program webpages are a useful resource for understanding the current details of each program:

- Washington Department of Commerce Public Works Board Financing and Technical Assistance[16]
- EPA's Water and Infrastructure Finance Innovation Act (WIFIA)[17]
- Puget Sound National Estuary Program Stormwater Strategic Initiative[18]
- CoBank's Rural Water and Wastewater Lending[19]
- National Rural Water Association's Rural Water Loan Fund[20]

[14] https://ecology.wa.gov/About-us/Payments-contracts-grants/Grants-loans/Find-a-grant-or-loan/Puget-Sound-Nutrient-Reduction
[15] https://ecology.wa.gov/about-us/payments-contracts-grants/grants-loans/find-a-grant-or-loan/water-quality-combined
[16] https://www.commerce.wa.gov/pwb/
[17] https://www.epa.gov/wifia/what-wifia
[18] https://pugetsoundestuary.wa.gov/
[19] https://www.cobank.com/corporate/industry/water
[20] https://nrwa.org/members/products-services-portfolio/rural-water-loan-fund/

EPA's WIFIA Funding in Action

WIFIA is a federal financing program administered directly by EPA that is available to communities for high-cost wastewater projects that are otherwise eligible for the Clean Water State Revolving Fund. King County, Seattle Public Utilities, and the City of Tacoma, have utilized more than $725 million combined WIFIA funding to make significant investments in improving wastewater treatment and reducing discharges from CSOs. Projects funded include:

- Upgrading the electrical distribution system at Tacoma's Central WWTP
- Controlling CSOs through the Ship Canal Water Quality Project led by Seattle Public Utilities (in partnership with King County)
- Financing King County's Georgetown CSO treatment plant
- Multiple improvement projects at their three regional wastewater treatment plants

- United States Department of Agriculture's (USDA) Water and Waste Disposal Guaranteed Land Program[21]
- USDA's Revolving Funds for Financing Water and Wastewater Projects[22]
- United States Economic Development Administration Economic Adjustment Assistance[23]
- United States Housing and Urban Development Community Development Block Grant Programs[24]
- EPA's Environmental Finance Center[25]
- EPA's Closing America's Wastewater Access Gap Initiative[26]
- USDA's Water and Waste Disposal Predevelopment Planning Grants[27]

Nonpoint and other activities

Ecology, other state and federal agencies, and conservation/restoration entities have funding available for projects that directly or indirectly control nutrients. These programs fund a wide range of nonpoint BMP implementation, restoration, and conservation. While developing water clean-up plans in the watersheds draining to Puget Sound will more closely link site-specific nonpoint projects to financial assistance, we can use these resources now to begin making progress towards the watershed targets.

Ecology's Water Quality Combined Funding Program[28] awards millions of dollars annually to nonpoint source projects that effectively control nutrient discharges. Relevant eligible projects include implementation of agriculture and urban stormwater BMPs, pollution and identification

[21] https://www.rd.usda.gov/programs-services/water-environmental-programs/water-waste-disposal-loan-guarantees
[22] https://www.rd.usda.gov/programs-services/water-environmental-programs
[23] https://www.eda.gov/economic-adjustment-assistance
[24] https://www.hud.gov/program_offices/comm_planning/communitydevelopment
[25] https://www.epa.gov/waterfinancecenter/efcn
[26] https://www.epa.gov/water-infrastructure/closing-americas-wastewater-access-gap
[27] https://www.rd.usda.gov/programs-services/water-environmental-programs/water-waste-disposal-predevelopment-planning-grants
[28] https://ecology.wa.gov/about-us/payments-contracts-grants/grants-loans/find-a-grant-or-loan/water-quality-combined

control (PIC) programs, and restoration planning and implementation. The fund also supports activities that indirectly support long-term nutrient reduction efforts, such as implementing conservation plans, watershed plans, or water quality monitoring.

Below are additional funding sources for nonpoint activities. Some of the programs are less stable and financial assistance programs available by these agencies can vary year to year. Program webpages are a useful resource for understanding the current assistance available, types of projects funded, requirements, funding availability, and other details:

- Ecology's Coastal Protection Fund (Terry Husseman Grants)[29]
- Ecology's Floodplain by Design Program[30]
- Puget Sound National Estuary Program Shellfish and Stormwater Strategic Initiatives[31]
- Salmon Recovery Funding Board Salmon Recovery Funds[32]
- Washington State Conservation Commission Grants[33]
- Farm Service Agency's (FSA) Conservation Reserve Program[34]
- FSA's Conservation Enhancement Program[35]
- FSA's CLEAR 30 Program[36]
- Natural Resource Conservation Agency's Environmental Quality Incentive Program[37]
- NRCS 's Regional Conservation Partnership Program[38]
- Bonneville Power Administration's Fish and Wildlife Program[39]
- Washington Department of Natural Resources Forestry and Riparian Easement Program[40]

[29] https://ecology.wa.gov/About-us/Payments-contracts-grants/Grants-loans/Find-a-grant-or-loan/Coastal-protection-fund
[30] https://ecology.wa.gov/about-us/payments-contracts-grants/grants-loans/find-a-grant-or-loan/floodplains-by-design-grants
[31] https://pugetsoundestuary.wa.gov/
[32] https://rco.wa.gov/grant/salmon-recovery/
[33] https://www.scc.wa.gov/grant-programs
[34] https://www.fsa.usda.gov/resources/programs/conservation-reserve-program
[35] https://www.fsa.usda.gov/resources/programs/conservation-reserve-enhancement-program-crep
[36] https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/fsa-clear30_factsheet.pdf
[37] https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives
[38] https://www.nrcs.usda.gov/programs-initiatives/rcpp-regional-conservation-partnership-program
[39] https://www.bpa.gov/environmental-initiatives/efw/fish-wildlife-program#:~:text=The%20BPA%20F%26W%20Program%20improves,improves%20scientific%20knowledge%20through%20research
[40] https://pugetsoundestuary.wa.gov/rfp/

Schedule and Milestones

Figure **10** outlines the broader schedule for achieving the nitrogen targets established in this plan with support from the financial resources previously discussed. The schedule focuses on reissuances of permits and the development and implementation of water clean-up plans in the watersheds.

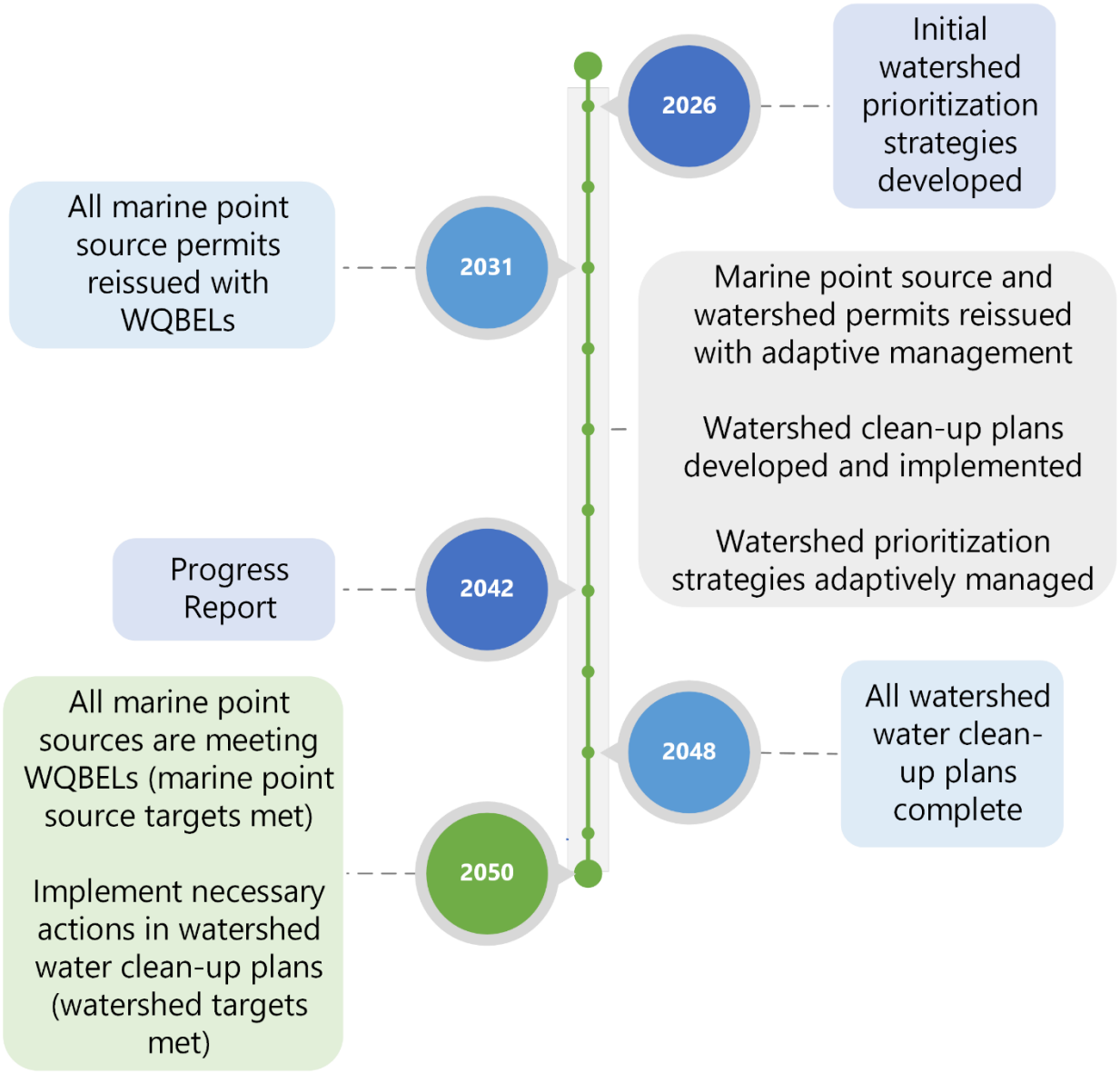

Figure 10. Schedule of major implementation steps to achieve nitrogen targets.

The next reissuance of the marine point source permits will be crucial, as Ecology and EPA will establish WQBELs consistent with the TN targets in this plan for WWTPs and industrial facilities discharging to Puget Sound that will achieve water quality standards. These permits will likely contain tools permittees can utilize to achieve compliance in the short-term, such as

compliance schedules and interim limits, until WQBELs can be met. The Clean Water Act limits the duration of NPDES permits to five years. Assuming all permits are renewed before their five-year expiration date, our goal is for all marine point source permits to be updated with WQBELs by 2031. In a future reissuance of the General Permit, we intend to provide a framework for a nutrient credit trading program to incentivize early adoption of nutrient control technologies, while offering a temporary pathway to permit compliance for those facilities that are unable to meet their permit limits in the short-term. Any trading program established may not be permanent but rather a temporary measure to incentivize early adoption and allow time for dischargers to upgrade. With each reissuance of the marine point source permits, we will be evaluating progress towards achieving TN targets identified in this plan and adjusting permit requirements as needed to achieve both compliance with the permitted WQBELs and targets in this plan by 2050.

We intend to finish all necessary water clean-up plans in Puget Sound's watersheds by 2048 and have all necessary implementation measures in place to achieve our watershed targets by 2050. The initial watershed prioritization strategies our NWRO and SWRO will be completing in 2026 will lay the roadmap for developing and implementing clean-up plans. These strategies will be adaptively managed over the next twenty-five years to ensure we are staying on schedule and making progress towards the watershed targets.

Achieving the watershed targets set forth in this plan is an ambitious goal, as Puget Sound's collective watershed spans nineteen WRIA's containing various sources and pathways for nitrogen transport. However, this goal is achievable under the following assumptions and approaches which we will consider while developing watershed prioritization strategies:

- An STI or ARP approach, which generally takes significantly less time to complete and implement than a TMDL, will be a more appropriate strategy for achieving nitrogen reductions in a large portion of Puget Sound's watersheds. Many watersheds do not have point sources requiring wasteload allocations.
- Ecology can utilize partnerships with county PIC programs to develop clean-up projects that directly remove sources of nutrient pollution. While many of these programs are focused on bacteria, bacterial sources often include nutrient sources as well.
- Tackling the more complex water clean-up plans sooner will allow more time for their development and implementation.
- Many water clean-up plans will be completed prior to 2048, allowing for more time for implementation to occur in these areas.
- We do not need a water clean-up plan to begin addressing nonpoint sources of pollution; our nonpoint program can start immediately. Our nonpoint program is already active in many of Puget Sound's watersheds and is supporting implementation of Clean Water Guidance BMPs that are shown to achieve water quality standards.

To achieve this schedule, we have developed a list of measurable milestones that will allow us to track progress over the next twenty-five years. We've separated milestones into those with a concrete due date (**Table 9**) and those reoccurring tactics that are necessary to meet our targets (**Table 10**). We've also developed several milestones that incorporate adaptive management tools, which will allow us to adjust to our approach as needed. As the agency

responsible for developing this plan and implementing many of the plan's regulatory measures, the milestones mostly focus on tangible actions Ecology can take to achieve target reductions. We recognize that many of these strategies, both regulatory and voluntary, will require coordination with EPA and resources and/or support from municipalities, Tribes, government agencies, and local partners. We are confident these milestones are achievable and will be effective at restoring DO in Puget Sound.

Table 9. Measurable milestones along with the relevant TN targets and due date for each milestone.

Measurable Milestones	Relevant Targets	Timeframe
Ecology solicits funding requests for the Puget Sound Nutrient Reduction Grants Program[41]	Marine point	2025
Ecology issues voluntary General Permit	Marine point	2025
Ecology regional offices complete initial watershed prioritization strategies	Watershed	2026
Ecology initiates development of one water clean-up plan in NWRO and one in SWRO	Watershed	2027
Ecology completes nutrient credit trading market feasibility analysis[42]	Marine point	2027
Ecology establishes TN WQBELs for all state issued marine domestic WWTP and industrial permits[43]	Marine point	2031[44]
EPA establishes TN WQBELs for all EPA issued marine WWTP and industrial permits	Marine point	2031[44]
EPA establishes nutrient monitoring requirements for EPA issued NPDES permitted point sources in watersheds	Watershed	2031[44]
Ecology and/or partners initiate watershed clean-up plans addressing 30% of the target anthropogenic TN load reductions	Watershed	2032
Ecology and/or partners initiate watershed clean-up plans addressing 60% of the target anthropogenic TN load reductions	Watershed	2040
Ecology gathers all readily available data through 2040 to: (1) evaluate progress to achieve marine point source and watershed targets and (2) runs Salish Sea Model to evaluate status of DO levels in Puget Sound	Marine point, Watershed	2040
Ecology publishes progress report towards achieving TN targets and necessary adaptive management steps	Marine point, Watershed	2042
Ecology and/or partners establish watershed clean-up plans covering all of Puget Sound's watersheds requiring TN reductions	Watershed	2048
Ecology and partners have fully implemented this plan	Marine point, Watershed	2050
Ecology gathers all readily available data through 2050 to: (1) evaluate progress to achieve marine point source and watershed targets and (2) runs Salish Sea Model to evaluate status of DO levels in Puget Sound	Marine point, Watershed	2053
Ecology publishes progress report toward achieving TN targets and necessary adaptive management steps	Marine point, Watershed	2055

[41] Assumes we receive funding in FY25 legislative cycle.
[42] Assume we have discharger interest and broader partner support in a water quality trading program.
[43] For domestic WWTPs, WQBELs will be set in either General Permit or individual permits.
[44] Timeframe assumes agency is able to update permits before five-year expiration date. Reissuance date unique to each permit.

Table 10. Reoccurring milestones along with the relevant TN targets for each milestone.

Milestone	Relevant Targets	Frequency
Ecology coordinates internally to review upcoming reissuances of permits and adaptively manages	Marine point, Watershed	As needed
Ecology and EPA coordinate to review upcoming reissuance of EPA issued permits and adaptively manages	Marine point, Watershed	As needed
Ecology reviews and updates, as needed, nutrient monitoring requirements and best management practice implementation requirements for the following watershed permits: WWTPs, industrial facilities, MS4, ISGP, CAFO General Permits, Sand and Gravel General Permits, and Upland Finfish Hatching and Rearing General Permits	Watershed	As identified through strategy/watershed clean-up plan development
Ecology establishes WQBELs and updates any best management practices, where applicable, for the following watershed permits: WWTPs, industrial facilities, MSGP, ISGP, CAFO General Permits, Sand and Gravel General Permits, and Upland Finfish Hatching and Rearing General Permits	Watershed	As identified through watershed clean-up plan finalization
Ecology regional offices review and update watershed prioritization strategies	Watershed	Two updates before 2050
Ecology solicits feedback on water clean-up priorities and provides updates on current water clean-up plan work through annual webinar	Watershed	Annually
Ecology nonpoint staff conduct watershed evaluations in four Puget Sound watersheds and report progress in annual reports	Watershed	Annually
Of the sites identified via watershed evaluation, Ecology nonpoint staff utilize technical assistance letters to initiate contact with at least five sites per watershed	Watershed	Annually
At 100% of sites, Ecology nonpoint staff utilize the Clean Water Guidance BMPs to provide recommendations	Watershed	Annually
Ecology reports on use of graduated compliance to address nonpoint pollution sites of concern	Watershed	Annually
Ecology nonpoint staff respond to 100% of Environmental Report Tracking System (ERTS) complaints	Watershed	Annually
Ecology solicits applications for Water Quality Combined Funding Program funding and provides grant and loan funding for projects that help meet the targets this in this plan	Marine point, Watershed	Annually
Ecology provides progress updates and solicits feedback from Puget Sound Nutrient Forum	Marine point, Watershed	Annually

Effectiveness Monitoring

Effectiveness monitoring will be essential to restoring DO in Puget Sound. Monitoring is not only needed to track progress and determine whether we have achieved our nitrogen targets and goal of meeting water quality standards in the long-term, but also to inform whether our implementation approach is working in the near-term. Thus, both routine environmental monitoring and robust implementation tracking information will be needed throughout the duration of this project. When water quality data suggests water quality standards are being met, monitoring should continue to ensure long-term effectiveness of implementation and that standards are consistently met going into the future. The following sections detail the types of data needed, current availability and limitations, recommendations for future monitoring, and how these data will be used to track success. Types of monitoring can be broken into the following categories:

- Implementation tracking - including both point source implementation via permit reporting requirements and nonpoint source BMP implementation and restoration efforts
- Marine point source nitrogen loads - monitoring wastewater effluent
- Watershed nitrogen loads - monitoring of freshwater inflows to Puget Sound
- Puget Sound DO levels - monitoring DO levels in marine waters

We generally emphasize the benefits of collecting meaningful implementation data, prior to initiating new water quality data collection efforts. However, we should not delay water quality data collection efforts, as it provides baseline data, tracks changes, and supports adaptive management. Monitoring alongside implementation ensures limited resources are used efficiently and enables timely adjustments to achieve meaningful improvements in water quality.

While this monitoring strategy focuses on nutrients and DO's subsequent response, we acknowledge that other information may support future evaluations of the broader health of Puget Sound in response to implementation. Examples of such datasets may include sediment and biological data from Ecology's marine monitoring program[45], algae bloom information collected from Ecology's Eyes Over Puget Sound project[46], or algae and macroinvertebrate data from Ecology's SAM program.

All data collection efforts should be consistent with our Credible Data Policy (Ecology Publication 21-10-032).

[45] https://ecology.wa.gov/water-shorelines/puget-sound/sound-science/marine-sediments
[46] https://ecology.wa.gov/research-data/monitoring-assessment/puget-sound-and-marine-monitoring/eyes-over-puget-sound

Implementation tracking

To prioritize future water quality monitoring efforts effectively, it is important to consider the extent and nature of implementation activities aimed at improving water quality. Therefore, tracking implementation of the strategies detailed in this plan is our first step in evaluating progress.

Routine reporting requirements under NPDES programs makes tracking implementation from permitted point sources straight-forward. This will be the case for both the marine point sources identified in this plan and the watershed point sources which will be identified and reviewed during watershed prioritization strategy or clean-up plan development.

Monitoring the implementation of nonpoint source reduction activities can be more challenging though due to the lack of a standardized regulatory framework for reporting, diversity in projects, stakeholders, and funding sources. However, our Nonpoint Program does track nonpoint BMP implementation in annual reporting to EPA.

The quantitative metrics found in these annual reports that are relevant for monitoring implementation actions that will achieve the nitrogen reductions in this restoration plan include, but are not limited to, nonpoint BMPs and restoration projects funded by Ecology, including quantifiable size and scale of projects (example: feet of riparian habitat restored) and estimated nutrient reductions (example: lbs. of nitrogen removed), TMDL and other water clean-up plan development progress, and discussion of technical assistance and nonpoint enforcement actions taken. Some of these metrics are more useful for measuring progress towards achieving nitrogen load reductions than others. Though collectively, they provide insight into where we are focusing our nonpoint funding and staff resources across the state. This information is useful for adaptive management purposes.

We gather many of these reporting metrics from databases and tools that Ecology manages. Ecology's Administration of Grants and Loans (EAGL) database tracks financial and implementation milestones for nonpoint projects funding through Ecology's Water Quality Combined Funding Program. Our Nonpoint and Implementation Tracking Systems (NPI) allows our nonpoint field staff to log and monitor location of nonpoint source problems and pollution sources, site conditions over time, communications with landowners, and best management practices implemented. However, we generally are only able to consistently track implementation actions Ecology funds, which can be a limitation to both systems. There are several other agencies and organizations funding and implementing projects that reduce nitrogen pollution, even on properties which our nonpoint staff are regularly monitoring in our NPI system. These projects are much more difficult for our nonpoint staff to track and gather accurate implementation metric information. Additionally, a lack of standardized metrics across implementation reporting systems increases the difficulty of consistent tracking and evaluation of funded and unfunded actions, which is crucial to supporting adaptive management and informed decision-making. This is a clear gap in our implementation monitoring strategy and one that we are actively working with implementation partners to address through promoting the importance of transparency in public funds, consistency in procedures for implementation

data collection, and sharing of data with partners and the public. Addressing these limitations will improve our ability to monitor progress and adapt strategies effectively.

We acknowledge that the goals of funding programs vary, and that best management practice and restoration activities can have multiple benefits. Some other grant programs provide similar nonpoint implementation metrics for tracking progress of nonpoint project implementation, such as the Washington State Governor's Salmon Recover Office's Salmon Recovery Portal. However, when reviewing such projects, it will be important to consider the relevancy of the BMP or restoration activity implement in context of the goals of this plan. We should prioritize monitoring implementation of projects that are consistent with our Clean Water Guidance and that will have direct impacts on nitrogen loads and as a result, and downstream dissolved oxygen levels in Puget Sound.

Marine point source nitrogen loads

Monitoring nitrogen in wastewater effluent from the permitted point sources discharging to Puget Sound will be crucial for evaluating progress towards achieving the marine point source targets. All marine point sources identified in this plan will have TN WQBELs in future phases of their respective permits, along with requirements to monitor and report nitrogen levels to the relevant permitting agency. These reports are commonly known as Discharge Monitoring Reports, or DMRs. For facilities with permits issued by Ecology, effluent data are made available through Ecology's Permitting and Reporting Information System (PARIS). For EPA issued permits wastewater treatment plans and industrial facilities, effluent data are stored in EPA's Enforcement and Compliance History Online (ECHO) tool.

As discussed in the Implementation section of this report, achieving nutrient reductions will likely require the use of compliance schedules to allow time to construct necessary infrastructure improvements. When compliance schedules are used as an implementation tool, facilities must meet specific progress milestones identified in their permits. Permits also require periodic submissions of written reports to monitor progress. Ecology's PARIS database will contain copies of these status reports and EPA's ECHO tool will show whether facilities with EPA permits comply with their requirements.

Permit managers are tasked with evaluating data and other permit requirements, such as adherence to compliance schedule milestones, to determine whether permittees maintain compliance with their permit requirements. Any facility that fails to comply with permit requirements are considered in violation of their permit and may face enforcement action. Therefore, data and reports will not only be used to track marine point source nitrogen reductions over time, but also to identify when an enforcement action may be needed to compel corrections.

Watershed nitrogen loads

Nitrogen concentration and flow data at the mouths of watersheds draining to Puget Sound will be used to evaluate progress towards achieving the watershed targets. While it is unlikely that existing or future monitoring programs could holistically collect data across all Puget sound

watersheds, leveraging existing monitoring programs and careful prioritization of future monitoring efforts can be used to track progress at the stream, watershed, or even larger scale.

Currently, few ambient monitoring programs routinely collect and provide readily available nitrogen and flow data at the mouths of tributaries to Puget Sound. Ecology's freshwater monitoring program utilizes continuous nitrogen monitoring at eight large rivers in the Puget Sound region (Figure 11, dark blue dots). These stations came online in 2021 thanks to Washington State Legislature funding. Data from these stations can be paired with near-by Ecology or U.S. Geological Survey (USGS) flow monitoring gages to calculate nitrogen loads. These eight stations represent eight different watersheds, spanning four of the eight basins, including the four basins with the most human development and future development pressure. Based on the breakdown of TN targets by watershed in Appendix F, these stations represent roughly between 39 to 87% of the TN watershed inflow targets for their respective basins (Table 11). Therefore, these stations will not only allow us to monitor nitrogen loads at their individual watershed scale but also help us track progress towards basin-wide targets in the Northern Bays, Whidbey, Main, and South Sound basins.

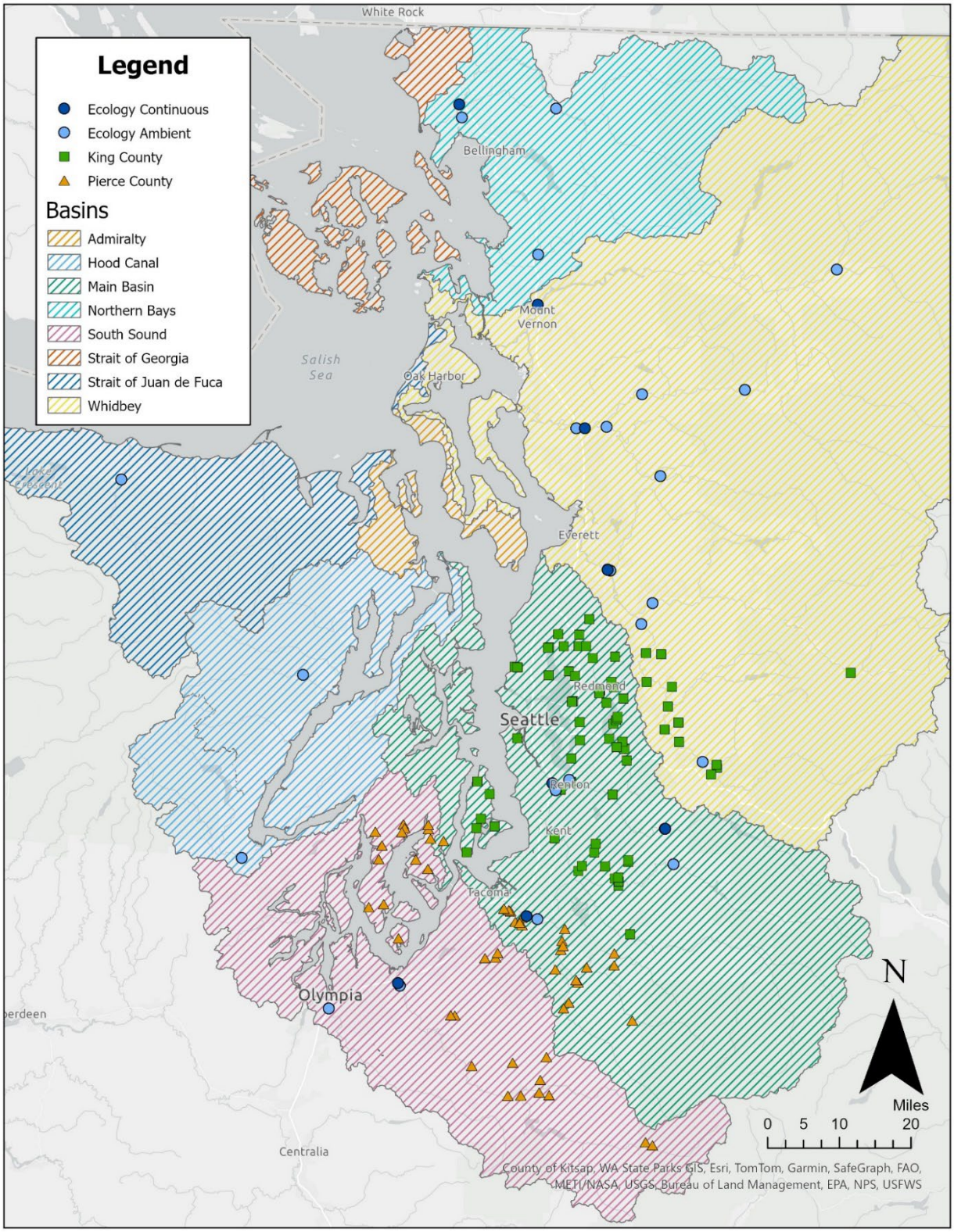

Figure 11. Ambient monitoring stations with nutrient data in Puget Sound watersheds. All stations currently gather samples at a monthly interval or more frequent. See Appendix G.1 for more information on monitoring stations. Note Puget Sound watersheds have been trimmed at the Washington/Canada border for visual purposes.

Table 11. Ecology continuous nitrogen monitoring stations and the proportion of the basin-wide TN watershed inflow targets the stations represent.

Basin	Monitoring station(s)	Watershed(s)	Proportion of basin TN loading target*
Northern Bays	Nooksack R. at USGS Ferndale	Nooksack	80%
Whidbey	Skagit R. Near Mount Vernon Stillaguamish R. at Blue Stillaguamish Park Snohomish R. at Snohomish PUD	Skagit Stillaguamish Snohomish	87%
Main	Cedar River at Rail Road Grade Rd. Duwamish River at Foster GC Rd. Puyallup River at USGS Puyallup	Lake Washington Green Puyallup	72%
South Sound	Nisqually R. at Wa-He-Lut School	Nisqually	39%

*__Note__: Estimated by multiplying the respective watersheds load in Appendix F by the proportion of drainage area the gauge represents within its watershed and comparing normalized loads to the basin-wide loading targets in Table 6.

Ecology's ambient freshwater monitoring program and other agencies are routinely collecting discrete nitrogen samples in tributaries to Puget Sound. These monitoring stations span thirty watersheds and all basins but most are in the Main and South Sound basins. Many of these stations are far upstream of river mouths, making them potentially not representative of nitrogen conditions at the outlet of the watershed. Additionally, the forms of nitrogen monitored at these monitoring stations varies by program and many do not have nearby flow data available. These factors make it difficult to calculate TN loads for direct comparison with the targets in this plan. However, we can utilize these long-term ambient datasets to evaluate the trends in nitrogen concentrations within specific streams overtime, which is still a valuable metric. Additionally, the latest technical tools such as the previously mentioned SPARROW mapper and EPA Region 10's River Basin Export Reduction Optimization Support Tool (RBEROST, Detenbeck et al., 2024, tool in development) may be helpful for understanding total nitrogen loads along stream networks and contributing sources.

The monitoring stations in Figure 11 do not represent all current nutrient monitoring efforts in Puget Sound watersheds, but rather a subset of monitoring stations with publicly available data and adequate information to determine the data would meet Washington's credible data requirements (RCW 90.48.580). We acknowledge that other monitoring programs may exist and that we will need to evaluate all readily available historical, current, and future datasets for quality and relevancy to this plan's efforts.

There are several factors that can be considered when planning, identifying, and prioritizing future monitoring efforts for tracking nitrogen loads in Puget Sound's watersheds. However, focusing on a limited set of factors can simplify this process. For direct evaluation of the watershed inflow loads in this plan, we recommend the following:

- Prioritize watersheds where documented implementation has occurred to inform adaptive management. In watersheds where no implementation has occurred, monitoring can still provide valuable information of the nitrogen loads discharging to Puget Sound, but it will not be prioritized
- Focusing monitoring stations at the outlets of watersheds to Puget Sound or near any existing flow monitoring stations close to outlets to Puget Sound
- Collect water samples at a monthly interval, or more frequent
- Analyze samples for TN or analyze for nitrogen constituents that can be used to calculate TN
- Regularly evaluate the costs and benefits of monitoring strategies to ensure efficient use of resources and prioritize efforts that provide the most meaningful data for adaptive management
- Submitting data to our Environmental Information Management (EIM) database[47]

We should also note that the development and implementation of water clean-up plans will inform the design of freshwater nutrient effectiveness monitoring studies at watershed or multi-watershed scale. Effectiveness monitoring at this scale focuses on tracking progress in areas of documented implementation to assess reductions in nutrient loads or improvements in dissolved oxygen levels over time. These smaller-scale studies are not only less resource-intensive and complex but also provide actionable insights that can be scaled up to inform a Puget Sound-wide monitoring framework. Clear alignment between current monitoring programs and future monitoring needs is essential to ensure long-term tracking of progress toward nutrient reduction goals.

Puget Sound dissolved oxygen

The primary goal of this plan is to restore DO levels in Puget Sound to meet water quality standards. Therefore, monitoring the status and trends of DO across the Sound in the coming decades will be essential to achieving our goal. We will utilize ambient dissolved oxygen data in Puget Sound and future runs of the Salish Sea model (or future model equivalent) with updated model inputs to monitor progress.

Figure 12 plots the distribution of sixty-seven current ambient monitoring stations collecting dissolved oxygen data in Puget Sound. Many of these stations have been collecting at a minimum monthly depth-integrated DO measurements for decades. Some programs are collecting at more frequent intervals and some stations represent permanent moorings collecting real-time continuous DO data. Collectively, these sites are spatially distributed well across Puget Sound, representing all eight basins and most of the main bays and channels within them. Based on the frequency of data collection and spatial distribution, we will utilize these existing stations for tracking dissolved oxygen improvements over time, at both a Puget Sound-scale and bay, inlet, or other waterbody specific scale. However, some of the smaller bays in the Main and South Sound basins demonstrating noncompliance with the dissolved oxygen standard within the Salish Sea Model are not currently being monitoring (noted by black

[47] https://ecology.wa.gov/research-data/data-resources/environmental-information-management-database

circles in Figure 12). Collecting long-term ambient dissolved oxygen data in these areas would allow us to track whether dissolved oxygen is improving in these critical areas. Additionally, targeted monitoring in receiving waters of watersheds where water clean-up plans are being actively implemented will be a priority for future monitoring efforts.

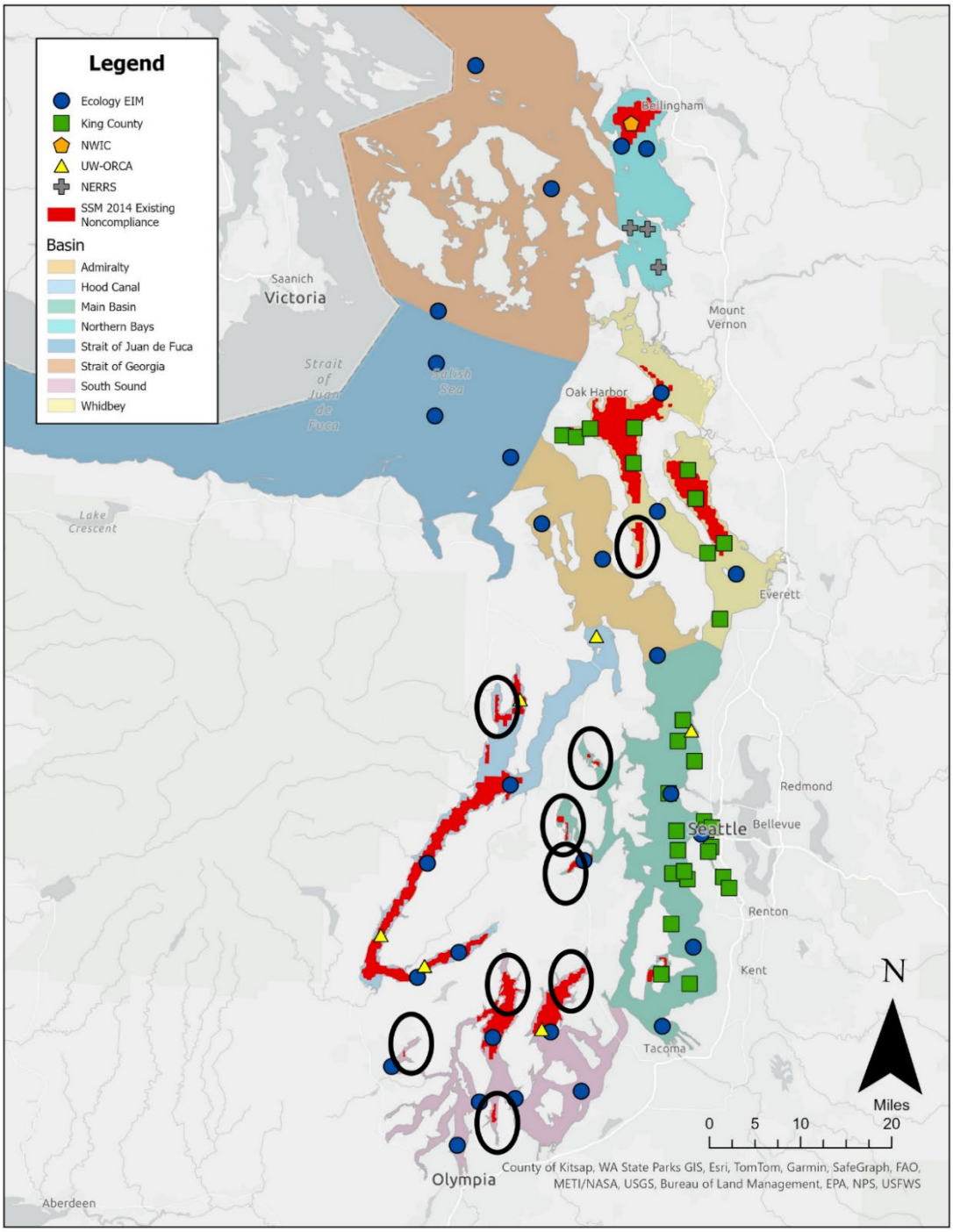

Figure 12. Existing ambient monitoring stations collecting dissolved oxygen data and responsible program. Black circles denote areas where Salish Sea Model predicts noncompliance of the dissolved oxygen standard (see SSM Phase 2 report) that would benefit from data collection. See Appendix G.2 for more information on monitoring stations.

The monitoring stations in Figure 12 do not represent all current dissolved oxygen monitoring efforts in Puget Sound, but rather a subset of monitoring stations with publicly available data and adequate information to determine the data would meet Washington's credible data requirements (RCW 90.48.580). We acknowledge that other monitoring programs may exist and that we will need to evaluate all readily available historical, current, and future datasets for quality and relevancy to this plan's efforts.

To monitor progress towards achieving DO standards across all of Puget Sound, we have set milestones to re-run the Salish Sea Model, or its equivalent, in 2040 and 2053, three years following our target date for plan implementation. Both future model runs will require the most current water quality data to develop model inputs to drive the physical and biogeochemical processes to predict DO noncompliance. This updated data will include the formerly mentioned marine point source data gathered from discharge monitoring reports and nutrient data at the watershed inflows, as well as all other physical and water chemistry data that serves as an input to the Salish Sea Model. The Salish Sea Model Quality Assurance Project Plan describes all input parameters into the Salish Sea Model (McCarthy et al, 2018).

Note the three-year delay between when we plan to achieve standards and running the Salish Sea Model to determine whether we have met our goal is needed to account for the time necessary for data collectors to properly quality assure and make data available and adequate time for the Salish Sea Modeling team prepare, run, quality assure, and disseminate model results. In the meantime, the ambient monitoring dissolved oxygen data collected in Puget Sound will allow us to monitor improving DO levels.

Adaptive Management

Natural systems are complex and dynamic. There is always a degree in uncertainty of predicting how an ecosystem will respond to changes. Therefore, adaptive management, or strategic "trial and error", is a crucial tool for ensuring success of any environmental restoration efforts. Adaptive management involves testing, monitoring, evaluating strategies, and incorporating newly gained knowledge into future implementation efforts. In the context of water clean-up projects, Ecology uses adaptive management to assess whether identified actions are working as initially scoped. Adaptive management allows us to make course-corrections and try new strategies as we move towards achieving our goal.

Effective adaptive management is not an instant process. It requires time to identify and gather the appropriate data, evaluate said data, recognize needed improvements, and develop strategies to implement improvements. It can also require multiple iterations of adjustments to achieve desired outcomes. However, it is a crucial component of water clean-up plans to ensure we are on the trajectory of meeting our water quality goals.

The reductions needed to achieve the targets in this plan should be achievable by 2050. We will work closely with partners to monitor progress towards achieving reductions and our DO goals and adjust implementation strategies as necessary. We will use adaptive management when water quality monitoring shows that TN targets are not being met or implementation activities are not achieving the anticipated result. If water quality standards are achieved across all of Puget Sound but the targets are not fully met, the goal of this plan will be considered satisfied.

Adaptive management for this plan will consist of a feedback loop (Figure 13) that includes the following steps:

Step 1. The implementation activities in this plan are put into practice.

Step 2. Implementation activities are evaluated for technical adequacy of design and installation.

Step 3. The effectiveness of the activities is evaluated by assessing new monitoring data and comparing it to the data used to set the plan targets.

> **Step 3a.** If the goals and objectives are achieved, the implementation efforts are adequate as designed, installed, and maintained. Project success and accomplishments should be publicized and reported to continue project implementation and increase public support.
>
> **Step 3b.** If the goals and objectives are not achieved, then BMPs and the implementation activities will be modified or new actions identified. The new or modified activities are then applied as in Step 1.

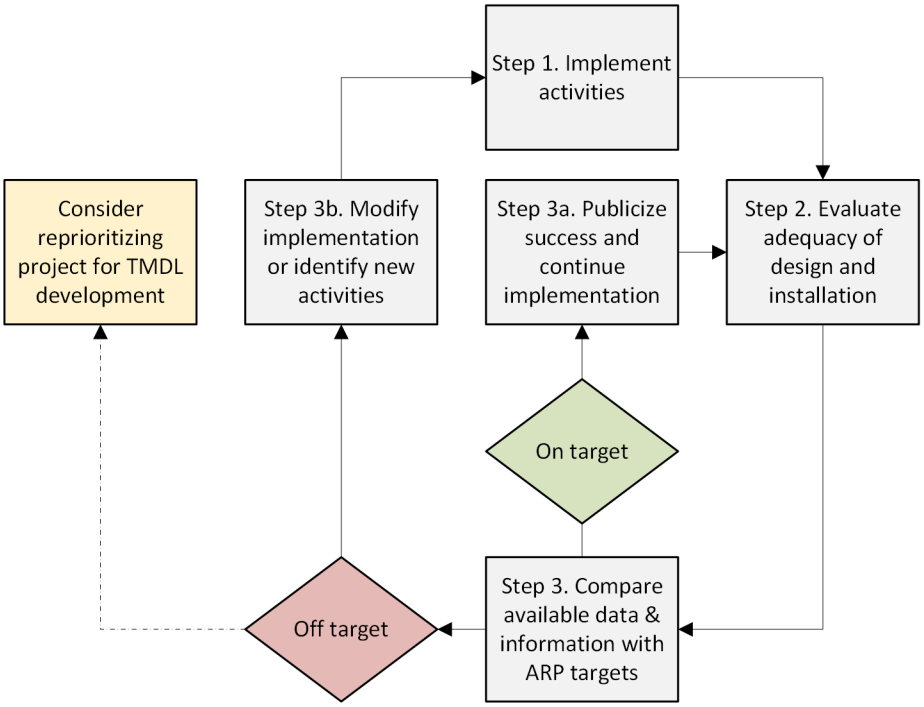

Figure 13. Adaptive management feedback loop (modified from Ecology Publication 22-10-012).

Additional monitoring may be necessary to better isolate the pollutant sources so that new BMPs can be designed and implemented to address all sources of DO deficit in Puget Sound. It is ultimately Ecology's responsibility to assure that implementation is being actively pursued and water quality standards are achieved.

If through the adaptive management process in Figure 13 we identify that we are off target and cannot identify viable options to adjust our implementation strategy, we will evaluate whether this project should be reprioritized for TMDL development.

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Appendices List

Appendices A through H are available at:
https://apps.ecology.wa.gov/publications/SummaryPages/2510038.html

Appendix A. Puget Sound Nutrient Forum

Appendix B. April 2025 letter to Puget Sound Nutrient General Permit Permittees

Appendix C. Listings Addressed

Appendix C.1. Waterbodies on the current (2018) 303(d) impaired waters list (Category 5) for dissolved oxygen addressed by this plan.

Appendix C.2. Waterbodies of concern (Category 2) in the current (2018) Water Quality Assessment for dissolved oxygen addressed by this plan.

Appendix D. Natural Conditions Provisions in Washington's Water Quality Standards

Appendix E. Marine Point Source Model Inputs

Appendix E.1. State WWTPs loads

Appendix E.2. State industrial facilities loads

Appendix E.3. Federal facilities loads

Appendix E.4. Marine point source maps

Appendix F. Watershed Model Inputs

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Appendix F.2. Watershed maps

Appendix G. Monitoring Stations

Appendix G.1. Existing freshwater ambient monitoring stations collection nitrogen data

Appendix G.2. Existing marine ambient monitoring stations collecting dissolved oxygen data

Appenidx H. Preliminary Considerations for the Development and Implementation of Water Quality Based Effluent Limitations