

Puget Sound National Estuary Program

MARINE WATER QUALITY VITAL SIGN BASE PROGRAM ANALYSIS

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Readers should note that the strategies described in this report were developed beginning in 2018. The first draft of this report was completed in 2022. Finalization of the Implementation Strategy package, including this document, was delayed for several reasons. In the intervening years, the Department of Ecology has made significant progress advancing their Puget Sound Nutrient Reduction Project. We have made several edits to reflect new developments and publications, but this final version may contain some analysis that is somewhat out of date given the amount of time that has passed since it was originally written.

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EXECUTIVE SUMMARY

Implementation Strategies are a planning tool intended to accelerate progress towards Puget Sound ecosystem recovery targets. This report is an appendix to the Marine Water Quality Implementation Strategy Narrative, which identifies five strategies to reduce nutrient loading to Puget Sound in order to make progress towards meeting a dissolved oxygen recovery target. This report focuses on analysis of existing programs that could support operationalization of these five strategies. The companion State of Knowledge appendix provides additional information about the scientific basis for the indicator target and strategies.

The National Estuary Program (NEP), administered by the U.S. Environmental Protection Agency (EPA), was established to protect and restore the water quality and biological integrity of estuaries of national significance. The Puget Sound Partnership (PSP) is a Washington State agency created to coordinate the Puget Sound NEP by bringing together partners to mobilize action around a common agenda. PSP developed a portfolio of Vital Signs to report on and guide assessment of progress toward Puget Sound recovery goals, as well as indicator targets to provide quantitative milestones reflecting expectations for improving the condition of Puget Sound. Implementation Strategies are a planning tool designed by PSP to accelerate progress for individual Vital Signs and their indicator targets.

Between 2011 and 2022, Marine Water Quality was one of four Vital Signs representing PSP's statutory goals for water quality. Water quality parameters including dissolved oxygen, temperature, nutrients, and chlorophyll-a were tracked to provide information about changes in Puget Sound water conditions relevant to eutrophication. A recovery target for dissolved oxygen in marine waters was adopted in 2011: *By 2020, human-related contributions of nitrogen do not result in more than 0.2 mg/L reductions in DO levels anywhere in Puget Sound.* This target was not met. Dissolved oxygen concentrations had decreased by more than 0.2 mg/L at multiple locations due to anthropogenic nutrient inputs (see Figure 1), indicating that nutrient reductions are needed to address human-related oxygen depletion. Reduction efforts are focused on four sources of anthropogenic nitrogen loading: wastewater, municipal stormwater, agricultural runoff, and onsite sewage systems. In addition to effects of dissolved oxygen depletion on pelagic and benthic species, impacts of excess nutrients can include changes in primary production and phytoplankton community structure; increases in harmful algal blooms; and alterations in seagrass and macroalgae abundance (Bricker et al. 2007).

Development of a Marine Water Quality Implementation Strategy began in 2018. The process was led by the Washington Department of Ecology (Ecology) with support from EPA, PSP, Puget Sound Institute (PSI), and Cascadia Consulting Group. An Interdisciplinary Team of 25 subject matter experts contributed to the design of strategies and identification of actions to improve management of anthropogenic nitrogen inputs. The five strategies developed during the Implementation Strategy process are:

- (1) Reduce Wastewater Nutrient Loads
- (2) Reduce Urban Stormwater and Agricultural Runoff

- (3) Restore Natural Nutrient Attenuation
- (4) Develop Anthropogenic Nutrient Load Reduction Targets
- (5) Advance Marine Waters Monitoring and Research Programs

The Implementation Strategy was developed concurrent with Ecology water quality improvement studies and regulatory actions. Several Puget Sound waterbody segments do not meet state Water Quality Standards for dissolved oxygen, so Ecology is obligated under the federal Clean Water Act to quantify needed pollutant reductions and identify management actions necessary to bring impaired waters into compliance with EPA-approved standards. PSP's dissolved oxygen indicator target is related to Water Quality Standards for dissolved oxygen, which were the source of the 0.2 mg/L value. However, its application differs because it is a means to understand ecosystem condition and a non-regulatory goal for Puget Sound recovery as opposed to an enforceable legal standard.

The Marine Water Quality Implementation Strategy includes a mix of regulatory and non-regulatory approaches. Regulatory components will be executed by Ecology per the state Water Pollution Control Act and federal Clean Water Act (§303 and §402). Non-regulatory elements will be implemented through the Stormwater Strategic Initiative Lead, an Ecology partnership with the Washington Department of Commerce and the Washington Stormwater Center that distributes EPA Puget Sound Program geographic and NEP funding (Clean Water Act §320). Non-regulatory and regulatory elements of Ecology's Nonpoint Pollution Program (Clean Water Act §319) will also play a significant role in advancing priorities identified in the Implementation Strategy.

This report provides a brief overview of the five strategies and, consistent with EPA (1993) guidance on NEP base program analysis, focuses on analysis of existing programs that could support operationalization of the strategies. We begin with an introduction to Puget Sound NEP recovery planning and Ecology regulatory actions associated with marine dissolved oxygen standards. The remaining sections cover the five strategies. Each begins with a short description of the strategy and its objectives, followed analysis of the specific approaches the Interdisciplinary Team recommended to help attain strategy objectives. These sub-sections include review of supporting literature; discussion of key programs, barriers, opportunities, and innovative models that could be replicated; descriptions of potential studies to answer key questions raised during the strategy development process; and identification of non-regulatory implementation actions suitable for NEP partners.

REDUCE WASTEWATER NUTRIENT LOADS STRATEGY

Wastewater treatment plants (WWTPs) are the largest anthropogenic source of nutrients to Puget Sound. In December 2021, Ecology issued a Puget Sound Nutrient General Permit covering 58 WWTPs that discharge to Puget Sound marine waters. The permit established "action levels" for each WWTP based on current annual average nitrogen in their effluent. If an action level is exceeded during the permit term, corrective actions to decrease loads must be

identified and implemented. The permit also set an expectation that lower effluent limits will be included in future permit cycles and required permittees to begin long-term planning for capital upgrades. The Pollution Control Hearings Board invalidated the Puget Sound Nutrient General Permit in February 2025. Ecology subsequently gave permittees the option to voluntarily continue coverage under the general permit or have nitrogen reduction requirements included in their individual permits.

Financial barriers associated with adding advanced nutrient removal technology to existing WWTPs are significant. Capital costs are likely to exceed \$2 billion region wide (see Table 1). The intent of the Interdisciplinary Team's **Develop a Funding Pathway Sub-strategy** is to encourage alignment of federal, state, and local funding sources in support of advanced treatment upgrades. In addition to several long-standing state and federal programs that provide funding for water infrastructure, three new sources are available since the Interdisciplinary Team developed this strategy. Washington's Legislature created the Puget Sound Nutrient Reduction Grant Program to provide grants to entities subject to the permit, and two large federal stimulus packages appropriated funding specifically for water infrastructure (Infrastructure Investment and Jobs Act) or that can be used for water infrastructure (American Rescue Plan Act). Despite hundreds of *millions* in new appropriations, there remains a significant gap between available funding and the *billions* of projected costs. Interdisciplinary Team members expressed concerns about the impact on local ratepayers in the absence of additional state and federal support.

There was a limited window of opportunity for permittees to access the stimulus appropriations and delays associated with permit appeals could lead to the region missing out on federal infrastructure funding. We identify potential changes to Ecology Clean Water State Revolving Fund policies that could improve access to this funding for permit-associated upgrades: (1) affordability criteria used to determine eligibility for hardship interest rates and principal forgiveness loans could be revised in accordance with newer EPA guidance, and (2) loan limits could be raised and allocated based on a per local government basis instead of a per project basis so that regionalized systems that serve more than one community compete for funding on a level playing field.

The Interdisciplinary Team expressed interest in improving the flexibility and economic efficiency of compliance with new nitrogen limits through the **Develop a Water Quality Trading Program Sub-strategy**. Water quality trading is a market-based mechanism that takes advantage of differentials in the cost of control measures for various pollutant sources, and trading programs for nutrient pollution have been developed in other large estuarine systems. Our analysis identifies several potential barriers to development of a program that would allow point-nonpoint trades in the Puget Sound region, including the magnitude of point source reductions under consideration and baseline requirements for nonpoint trading. Fewer policy barriers would be associated with point-point trades and trading to address growth in effluent loads.

Since nutrient loading from wastewater facilities increases as population size increases, any Ecology nutrient limits may have implications for planning required by Washington's Growth

Management Act. For example, adding new treatment streams may consume available plant footprint and limit opportunities for future capacity expansion to serve growing populations. It is important to manage any actual or perceived tradeoffs between regional water quality improvement goals and the priority land development goal of directing growth into urban areas. Increases in already high water utility costs could exacerbate differences in housing affordability between rural and urban areas.

Opportunities for NEP partners to support strategy implementation identified in this section include:

- Support Ecology efforts to inform permittees about the Water Quality Combined Funding Program application cycle with additional outreach about the more favorable terms and short timeline associated with federal stimulus funding (e.g., larger share eligible for additional subsidization, ability to use American Rescue Plan block grants to meet non-federal match requirements). If needed, direct assistance putting together application materials could be provided to smaller under-resourced permittees.
- Support Ecology and Commerce in identifying opportunities for regionalization/consolidation of wastewater services to increase cost efficiency. In this context regionalization does *not* involve centralization of physical facilities, but rather the assumption of smaller providers by larger ones. Since Special Purpose Districts and Public Utility Districts do not have authority for land use planning, assumption by a local government could potentially advance decentralized treatment options. Partners could disseminate information about options for different governance models and the consolidation process.
- Provide financial and/or technical to support for integration of planning required for long-term capital upgrades and under the Growth Management Act to ensure wastewater infrastructure is able to accommodate anticipated population growth. Attention can be focused where the land use planning jurisdiction and the wastewater treatment provider are different entities (e.g., where Special Purpose Districts or Public Utility Districts provide wastewater service).
- Conduct a cost-benefit analysis, building on work by Northern Economics, to support regional prioritization of specific strategies and actions. This could involve a formal cost effectiveness (e.g., cost per pound of nitrogen removed) for point and nonpoint reduction strategies by subbasin, as well as an evaluation of distributional equity (e.g., who pays and who benefits from permit requirements)

REDUCE URBAN STORMWATER AND AGRICULTURAL RUNOFF STRATEGY

This strategy aims to reduce nonpoint source nutrient loading from urban stormwater and agricultural runoff. Runoff from most urbanized areas is regulated via stormwater general permits, while runoff from agricultural lands is largely managed through a variety of existing programs that provide technical assistance and financial incentives for voluntary adoption of best management practices (BMPs) to reduce or prevent nonpoint loading.

The **Implement Agricultural BMPs Sub-strategy** seeks to increase voluntary adoption of BMPs. These BMPs include the installation of riparian buffers; nutrient management practices such as targeted fertilizer application, adoption of cover cropping and conservation tillage; and livestock management practices such as fencing to keep animals out of streams and roofs over manure collection areas. Riparian buffers have important co-benefits for salmon and newer regional guidance seeks to maximize those benefits by recommending buffers that are wider relative to Farm Bill programs. Farmers generally have a strong preference for narrower buffers to minimize loss of productive land, so as long as programs are voluntary there may be limited opportunity to increase adoption without additional financial incentives (i.e., payments to make up for lost production as opposed to payments for costs to establish and maintain). With respect to other types of agricultural BMPs, Ecology's watershed nutrient reduction efforts would benefit from coordinated tracking of data about BMP implementation via various programs, additional effectiveness monitoring, shared data access and targeting mechanisms to place the "right practices in the right places" within watersheds.

The **Reduce Stormwater Nutrient Loads Sub-strategy** focuses on mitigating and managing stormwater-associated nutrient loads from developed areas using existing regulatory and other programs. Currently, the nutrient focus of some key stormwater tools (e.g., the Stormwater Management Manual for Western Washington and the Stormwater Action Monitoring Program) is not nitrogen but phosphorus; however, Ecology can make necessary changes to identify stormwater BMPs that could reduce nitrogen loading. In the meantime, expanded enforcement of existing stormwater permit requirements was recommended by participants in Implementation Strategy development. The Construction Stormwater General Permit and the Illicit Discharge Detection and Elimination requirement of the Municipal Stormwater General Permit were identified as particularly important.

The Interdisciplinary Team emphasized that current funding sources for nonpoint nutrient reduction programs are not likely to be sufficient for reducing nutrient loads to the extent needed to achieve expected watershed targets. The **Increase and Stabilize Funding for Nutrient Reduction Programs Sub-strategy** is intended to reduce dependence on grants by supporting the development of new state and/or local sources of revenue that provide stable and dedicated funding for local program operations.

Opportunities for NEP partners to support strategy implementation identified in this section include:

- Develop an agricultural riparian buffer incentive program similar to the Washington Department of Natural Resources' Forest Riparian Easement Program. This program compensates qualifying landowners for the market value of timber in the required riparian buffer in exchange for a 50-year conservation easement.
- Provide support to develop coordinated geo-referenced implementation tracking and effectiveness monitoring of all agricultural incentive programs operating in the region. Formal data sharing agreements, like examples provided from other states, may be necessary due to rules prohibiting disclosure of personal information about Farm Bill program participants.

- Encourage local jurisdictions to develop funding mechanisms for Pollution Identification and Control programs and On-Site Sewage System management and repair programs by providing analysis of existing funding gaps, communicating about recent examples of new clean water property assessments, and/or developing model ordinances.
- Support development and expansion of programs that improve the public's knowledge of nutrient impacts and incentives for behavior change through funding of pilot programs, sharing of materials/resources, and dissemination of social marketing best practices.

RESTORE NATURAL NUTRIENT ATTENUATION STRATEGY

This strategy aims to implement projects that restore or maintain natural nutrient attenuation functions in watersheds and estuaries. Natural nutrient attenuation involves the removal of nitrogen and phosphorus after they have entered a waterbody. Restoration of nutrient assimilation services typically occurs by creating or enhancing habitats to support ecological processes that transform, store, or remove nutrients from ambient waters (e.g., aquatic plants, complex stream habitat, wetlands, shellfish).

The **Leverage Existing Restoration Funding Sub-strategy** focuses on expanding knowledge of natural nutrient attenuation to improve the design of restoration projects to increase benefits for water quality, and then promoting implementation of projects with key design features via programs such as Floodplains by Design, Salmon Recovery Funding Board, and Estuary and Salmon Restoration Program. The **Identify Priority Watershed Areas Sub-strategy** seeks to improve understanding of where natural nutrient attenuation functions can be protected or restored to create significant load reductions.

DEVELOP ANTHROPOGENIC NUTRIENT LOAD REDUCTION TARGETS

The objective of this strategy is to quantify the nutrient reductions needed to achieve marine dissolved oxygen water quality standards, then identify an optimal combination of point source and watershed reductions that would be protective of sensitive inlets and bays. For the **Develop Nutrient Load Reduction Targets Sub-strategy**, Ecology used the Salish Sea Model to determine the assimilative capacity of Puget Sound sub-basins and evaluate different nutrient reduction scenarios to identify those that result in the most improvement.

Ecology is also leading the **Develop Watershed Modeling Capacity Sub-strategy** with the intent of identifying modeling tools that could be used to quantify nutrient contributions from different anthropogenic sources within individual watersheds to specify reductions for each source. The Interdisciplinary Team identified acquisition of data inputs to feed a regional watershed model as a priority, and NEP partners are well suited to support this non-regulatory strategy element:

- Facilitate collection and curation of robust data on baseline nutrient concentrations in rivers/streams, point source discharges, verification of land use source loading assumptions, and nitrogen removal effectiveness of BMP for input into watershed models. Enhance coordination and consistency among different monitoring organizations and watersheds.

ADVANCE MARINE WATERS MONITORING AND RESEARCH PROGRAMS

This strategy aims to improve understanding of physical, biological, and biogeochemical impacts of excess anthropogenic nitrogen in marine waters by maintaining/expanding existing monitoring networks and improving collaboration amongst programs. The accompanying State of Knowledge appendix captures input from the Interdisciplinary Team about specific priorities and proposes several critical analyses to address data gaps. EPA Puget Sound funding, and existing NEP programs/tools like the Puget Sound Ecosystem Monitoring Program and PSP's Science Work Plan, are well-positioned to directly support identified priorities and coordinate the multiple organizations needed to carry out this complex research agenda.

ACRONYMS AND ABBREVIATIONS

AKART	All Known, Available, and Reasonable Methods of Treatment
ARPA	American Rescue Plan Act
BIL	Bipartisan Infrastructure Law
BMPs	Best Management Practice
CAFO	Concentrated Animal Feeding Operation
CCA	Conservation Cooperator Agreements
CCF	Centum Cubic Feet
CEC	Contaminants of Emerging Concern
Commerce	Washington Department of Commerce
CNMP	Comprehensive Nutrient Management Plan
CREP	Conservation Reserve Enhancement Program
CSP	Conservation Stewardship Program
CTA	Conservation Technical Assistance
CWSRF	Clean Water State Revolving Fund
DNMP	Dairy Nutrient Management Program
DO	Dissolved Oxygen
DOH	Washington Department of Health
Ecology	Washington Department of Ecology
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
GMA	Growth Management Act

HHS	U.S. Department of Health and Human Services
IDT	Interdisciplinary Team
IUP	Intended Use Plan
LID	Low Impact Development
LIHEAP	Low-Income Home Energy Assistance Program
LIHWAP	Low-Income Household Water Assistance Program
LO	Lead Organization
LQI	Lowest Quintile Income
MHI	Median Household Income
MOU	Memoranda of Understanding
MS4	Municipal Separate Storm Sewer System
MWQ	Marine Water Quality
NEP	National Estuary Program
NNA	Natural Nutrient Attenuation
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
NRCS	Natural Resources Conservation Service
OSS	On-site Sewage System
P3s	Public-Private Partnerships
PIC	Pollution Identification and Control
PII	Personally Identifiable Information
PSEMP	Puget Sound Ecosystem Monitoring Program

PSI	Puget Sound Institute
PSNGP	Puget Sound Nutrient General Permit
PSP	Puget Sound Partnership
QAPP	Quality Assurance Project Plan
RCO	Recreation and Conservation Office
RCPP	Regional Conservation Partnership Program
RCW	Revised Code of Washington
SIL	Strategic Initiative Lead
SSM	Salish Sea Model
SWMMWW	Stormwater Management Manual for Western Washington
TAPE	Washington State Technology Assessment Protocol
TBEL	Technology-Based Effluent Limit
TDML	Total Maximum Daily Load
TIN	Total Inorganic Nitrogen
U.S.C.	U.S. Code
USDA	U.S. Department of Agriculture
VSP	Voluntary Stewardship Program
WAC	Washington Administrative Code
WQBEL	Water Quality-Based Effluent Limit
WQS	Water Quality Standards
SCC	Washington State Conservation Commission
WWTP	Wastewater Treatment Plant

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1. INTRODUCTION

The National Estuary Program (NEP) was established to protect and restore the water quality and biological integrity of estuaries of national significance. It is administered by the U.S. Environmental Protection Agency (EPA). The Puget Sound Partnership (PSP) is a Washington State agency created in 2007 to coordinate the Puget Sound NEP by bringing together partners to mobilize action around a common agenda. PSP focuses the region's collective effort through development of a shared vision and strategy articulated in the [Action Agenda for Puget Sound](#). This comprehensive plan helps to allocate federal, state, and local recovery investments.

PSP developed a portfolio of biophysical and human dimensions [Vital Signs](#) to report on and guide assessment of progress toward Puget Sound recovery goals. These Vital Signs represent overarching measures used to communicate the health of Puget Sound and gauge improvements or declines. Each Vital Sign has one or more specific and measurable metrics, called indicators. Some indicators have targets which highlight valued aspects of the socio-ecological system and articulate a regional vision for a healthy and resilient Puget Sound. These indicator targets are quantitative milestones reflecting the region's commitments to, and expectations for, significantly improving the condition of Puget Sound.

1.1 MARINE WATER QUALITY VITAL SIGN

Marine Water Quality was one of four Vital Signs representing PSP's statutory goal for water quality.² The others communicate data about levels of toxic contaminants in marine sediments and fish, as well as water quality and biological parameters in freshwater streams, rivers, and lakes.

Water quality parameters including dissolved oxygen, temperature, nutrients, and chlorophyll-a have been tracked via the Marine Water Quality Vital Sign to provide information about changes in Puget Sound water conditions relevant to eutrophication (PSP 2022).

Box 1. What is Eutrophication?

Eutrophication is a process caused by nutrient additions to water bodies.

High inputs of nitrogen promote excessive growth of phytoplankton and macroalgae that can progress to more serious eutrophic conditions. Symptoms include low dissolved oxygen, loss of submerged aquatic vegetation, and changes in nutrient ratios that alter planktonic species composition potentially resulting in harmful algal blooms.

Source: Bricker et al. 2007

² A change from "Marine Water Quality" Vital Sign to "Marine Water" Vital Sign was finalized after development of the Implementation Strategy began. Section 1.1.3 provides information about the revisions being made to associated indicators.

In addition to effects of dissolved oxygen depletion on pelagic and benthic species, impacts of excess nutrients can include changes in primary production and phytoplankton community structure; increases in harmful algal blooms; and alterations in seagrass and macroalgae abundance. Section 4 of the State of Knowledge appendix describes all of these potential impacts in detail.

Nutrient reduction efforts in Puget Sound are focused on four sources of anthropogenic nitrogen loading: wastewater, municipal stormwater, agricultural runoff, and onsite sewage systems. Section 5 of the accompanying State of Knowledge report and Ecology's [Nitrogen in Puget Sound Story Map](#) provides information about the relative contributions of nitrogen loading from these and other sources.

During development of the Marine Water Quality Implementation Strategy, there were two indicators associated with the Marine Water Quality Vital Sign:

- The Marine Water Condition Index measured changes against a reference period (1999 - 2008) to indicate if water quality is improving or declining. It was calculated from monitoring data.
- The dissolved oxygen (DO) indicator reported on DO depletion caused by nitrogen and carbon inputs associated with human activities. A computer model was used to quantify the DO impacts of natural versus anthropogenic nutrient loads.

1.1.1 MARINE WATER QUALITY INDEX

The Marine Water Condition Index is a numeric score that integrates data on 12 variables—consisting of proxies for eutrophication as well as oceanographic state parameters—to detect shifts in median tendencies, or anomalies, at long-term monitoring stations (Krembs 2012). It communicates a very large amount of data collected as part of the Washington Department of Ecology's (Ecology) Marine Monitoring Program. The Marine Water Condition Index incorporates results from monthly sampling at 18 Puget Sound region monitoring stations sited to represent ambient water conditions. Measurements are taken and samples are collected in the upper 50 meters of the water column with a Conductivity-Temperature-Depth (CTD) package lowered through an opening in the floor of a seaplane.

Pressure, temperature, conductivity, dissolved oxygen, and in-situ fluorescence are measured every 0.5 meter of a depth profile. Water samples are collected at 0, 10, and 30 meters for analysis of nutrient concentrations and chlorophyll-a. Krembs (2012) describes how resulting data is processed to develop the 3 physical variables, 5 chemical variables, 3 nutrient ratios, and 1 biological variable used to calculate index scores.

The Eutrophication Index portion of the score communicates changes in conditions that imply a progression in eutrophication. Since ocean water that enters Puget Sound on incoming tides is the largest single source of nitrogen loading, the remaining portion of the score accounts for the influence of physical conditions and oceanic drivers that affect oxygen availability and

circulation of water in Puget Sound. The index reports on a scale of +50 to -50. A score of zero indicates conditions are unchanged relative to the 1999-2008 reference period. Positive (favorable) or negative (unfavorable) scores indicate that monthly measured variables averaged over a year fall above or below the expected conditions. Scores ranged from +18 to -23 between 2009 and 2019 (PSP 2020).

Key takeaways from PSP (2020) reporting on the Marine Water Condition Index were:

- Scores have generally declined over the last 20 years. This means that some symptoms of eutrophication were progressing.
- Scores in Georgia Basin, Bellingham Bay, and Whidbey Basin have declined continuously from 1999 to 2019 relative to the reference period. Scores in the other 9 regions have decreased, but not as consistently.
- Unfavorable ocean conditions have contributed to the apparent decline across all regions.

1.1.2 DISSOLVED OXYGEN IN MARINE WATERS

The dissolved oxygen indicator provided a recovery target for the Marine Water Quality Vital Sign (PSP 2019). The target, set in 2011, was:

By 2020, human-related contributions of nitrogen do not result in more than 0.2 mg/L reductions in DO levels anywhere in Puget Sound.

PSP's indicator target is related to Ecology's Water Quality Standards for DO.³ Due to the complex dynamics of nutrient concentrations in tidal waters, Ecology relies on surrogates to determine if nutrient enrichment is occurring (Ecology 2018a). These surrogates include DO concentrations, pH, algal mats, and chlorophyll levels. However, noncompliance with numeric criteria for DO is Ecology's principal mechanism for regulating nutrient inputs into Puget Sound.

Numeric criteria for DO are 1-day minimum values that range from 7 mg/L in waters designated "extraordinary" to 4 mg/L in "fair" waters. Since portions of Puget Sound cannot always meet these criteria due to "natural conditions" (e.g., intrusions of upwelled, low-oxygen waters), Ecology's DO criteria include an "anthropogenic allowance" of 0.2 mg/L. When DO concentrations in a waterbody are naturally lower than the numeric criteria, human actions considered cumulatively can cause the DO concentration to decrease by up to an additional 0.2 mg/L without causing a violation of Water Quality Standards. See caveat in Box 2.

³ Additional information about Ecology's authority under the federal Clean Water Act and the state Water Pollution Control Act; Water Quality Standards relevant to nutrients; and Puget Sound impairments is provided in Section 11 of the Marine Water Quality Implementation Strategy Starter Package (Roberts et al. 2018).

The anthropogenic allowance was the source for PSP's 0.2 mg/L target, but its application differs in two significant ways. First, the Vital Sign indicator target is broader than the Water Quality Standard because Ecology's anthropogenic allowance applies only if numeric criteria are not met. Second, PSP's 0.2 mg/L target is means to understand ecosystem condition and a non-regulatory goal for Puget Sound recovery as opposed to an enforceable legal standard.

Box 2. EPA Disapproval of the Natural Condition Provisions

In November 2021, EPA disapproved the natural condition provision in Washington's Surface Water Quality Standards for dissolved oxygen in marine waters because it allows for a less stringent condition to supersede otherwise applicable EPA-approved numeric criteria.⁴

Ecology initiated rulemaking in September 2022 to develop more narrowly tailored natural condition provisions that will meet EPA's expectations. A final rule was adopted in 2024 and was awaiting EPA approval at the time of writing.

DO concentrations exhibit a high degree of variability, with measured values changing throughout the day, by depth in the water column, and over relatively small spatial scales. The Salish Sea Model (Khangaonkar et al. 2012) is used by Ecology to guide management actions needed to protect water quality and by PSP for dissolved oxygen indicator reporting. The Salish Sea Model (SSM) is three-dimensional computer tool developed over the past decade to simulate how water, sediments, and nutrients enter and circulate throughout Puget Sound and other portions of the Salish Sea. The SSM is able to run scenarios, or virtual experiments, that evaluate the relative effect of current, anthropogenic, and potential future nutrient loads on dissolved oxygen (Ecology 2022a).⁵

The 2020 target for DO in marine waters was not met. Model results relevant to the indicator were reported by PSP (2019):

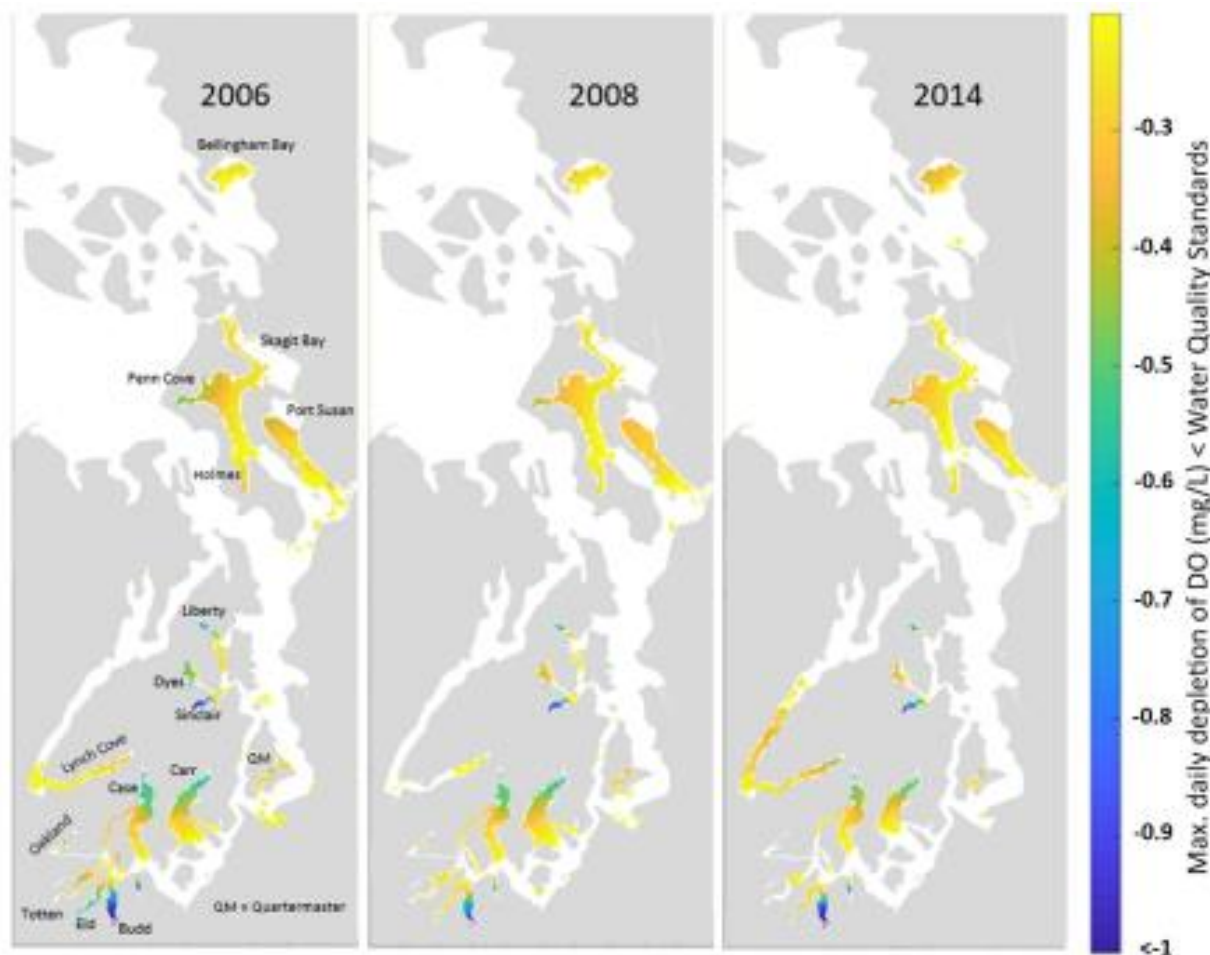
- DO concentrations have decreased by more than 0.2 mg/L at multiple locations due to anthropogenic nutrient inputs. Figure 1 shows where DO is depleted below the water quality standard, with areas in green showing the highest level of predicted DO depletion resulting from anthropogenic contributions of nitrogen.
- In several areas, human-related oxygen depletion persists for three months or more.
- Human sources of nutrients have a significant impact on DO in multiple embayments.

⁴ November 19, 2021. Letter from Daniel Opalski, Director, Water Division, U.S. EPA Region 10 to Vince McGowan, Water Quality Program Manager, Washington State Department of Ecology re: EPA's Action on Revisions to the Washington State of Ecology's Surface Water Quality. Standards for Natural Conditions Provisions. <https://www.epa.gov/system/files/documents/2022-01/wawqs-action-letter-11-19-2021.pdf>

⁵ Regulatory applications of the SSM are discussed in Section 1.4 and Section 5.

- A combination of nutrient reductions from marine point sources (e.g., wastewater treatment plants) and watershed sources are needed to meet the indicator target.

Figure 1. Model results for the spatial distribution of the maximum daily dissolved oxygen depletion below the water quality standard in 2006, 2008, and 2014.



Source: Washington Department of Ecology, Environmental Assessment Program, Modeling and TMDL Unit. As presented in PSP (2019).

1.1.3 VITAL SIGN AND INDICATOR REVISIONS

The previous sections describe the Vital Sign and indicators in place during development of the Marine Water Quality Implementation Strategy. They were included to provide context for the planning effort that resulted in the strategies described throughout this document, even though they are now out-of-date. PSP is transitioning to new Vital Signs and indicators based on O'Neill et al. (2018) and McManus et al. (2020). The new Marine Water portfolio is now what appears on PSP's web portal and reporting on new indicators began in May 2022, though some new indicators and targets were still under development at the time of writing.

The [new Marine Water Vital Sign](#) combines the previous Marine Water Quality and Marine Sediment Quality Vital Signs. As part of this change, the existing Marine Water Quality indicators were revised to better reflect the effects of eutrophication beyond DO as well as emerging threats related to climate change.

- The Marine Water Condition Index indicator was replaced with new indicators for some of its individual parameters:
 - New nutrient balance in marine waters indicator – Will track the ratio of silicate to nitrogen via field measurements. This ratio is important because changes have potential to alter planktonic community composition (e.g., decreases in lipid-rich diatoms and increases in less nutritious flagellates) and affect food web dynamics (Krembs et al. 2014).
 - New marine water temperature indicator – Will use field measurements to track variation in temperature over time and space.
 - New ocean acidification indicator – Will track water carbonate chemistry measured as Omega-saturation and ability for biological calcification.
- The DO indicator was retained but revised to measure concentrations directly instead of via modeling.
- A new Marine Benthic Index was added to track infaunal community composition and condition. Krembs et al. (2014) observed significant changes in benthic macro-invertebrate total abundance and taxa richness in 6 regions of Puget Sound. These changes are not correlated with toxicity, so Krembs et al. (2014) hypothesized that increases in nitrogen concentrations and shifting nutrient ratios are potentially connected to changes in benthic food webs.
- A new primary production indicator was added.
- A new noise in marine water indicator was added.

1.2 IMPLEMENTATION STRATEGIES

Progress toward meeting 2020 Vital Sign indicator targets was mixed. Several indicators made gains relative to baseline conditions, but many others are not showing improvement (PSP 2019). EPA, as federal lead for NEP efforts in Puget Sound, identified a need to further focus regional recovery and protection priorities. The [Implementation Strategy](#) is a planning tool developed to provide this focus.

Implementation Strategies describe outcomes necessary to accelerate progress towards individual Vital Signs and their indicator targets. They are intended to serve as a road map for aligning opportunities across agencies and programs, provide priorities for the Action Agenda, and guide funding decisions. Implementation Strategies are developed collaboratively with local and regional input from experts and practitioners from multiple disciplines.

Implementation Strategy development follows a process designed by PSP (2017). A volunteer **Interdisciplinary Team** (IDT) recruited through a public process provides most of the technical input on what to include, focus on, and recommend as priorities within the Implementation Strategy. This occurs in facilitated workshops where *Open Standards for the Practice of Conservation* (Conservation Measures Partnership 2013) planning tools are used to structure group discussion and develop products.

A complete Implementation Strategy contains the following elements:

- A summary narrative that identifies and prioritizes approaches for achieving targets; describes strategies, actions, programs, and policy changes associated with each approach; delineates research and monitoring needs; identifies adaptive management opportunities; and estimates strategy costs.
- Three types of Open Standards for the Practice of Conservation logic models:
 - A **situation analysis** that documents participants' common understanding of the factors contributing to problems, barriers, and opportunities. This conceptual model is used to help decide where and how to intervene.
 - **Results chain** diagrams that describe the cause-effect changes necessary to make progress through selected intervention points. They are logic models that define the sequence of steps needed to achieve specific outcomes, and document group hypotheses about how approaches are expected to address identified barriers.⁶ Most Implementation Strategies have 4 or 5 strategies visualized with results chains.
 - A schematic overview figure depicting how the strategies selected by participants work together to drive progress towards indicator targets. Priority pathways or approaches are also identified for each strategy.
- Supporting technical reports/appendices including an analysis of ongoing programs for a Base Program Analysis (this document) and a State of Knowledge report synthesizing relevant scientific information.
 - Uncertainties identified by the IDT and other participants during the Implementation Strategy development process are catalogued by PSI. These technical appendices can identify, scope, or present results of **critical analyses** (studies to answer key questions) conducted by PSI and other NEP partners and/or added to [PSP's Science Workplan](#).

⁶ Conceptual models and results chains are developed and shared in software called Miradi. Results chain diagrams, descriptions, and recommended actions for all Implementation Strategies are available for viewing in the [Puget Sound Recovery](#) project on the on the Miradi Share website.

1.3 DEVELOPMENT OF THE MARINE WATER QUALITY IMPLEMENTATION STRATEGY

An Implementation Strategy for the Marine Water Quality Vital Sign has been under development since late 2018. The development process was led by the Department of Ecology's [Water Quality Program](#) with support from EPA, PSP, Puget Sound Institute, and Cascadia Consulting Group. The [Interdisciplinary Team](#) consisted of 25 subject matter experts representing several perspectives (state agency, local government, tribal government, federal agency, university, consulting, industry group) and disciplines (engineering, oceanography, ecology, agriculture/aquaculture, regulator).

The [Stormwater Strategic Initiative Lead](#), a partnership between Ecology, the Washington Department of Commerce (Commerce), and the Washington Stormwater Center completed the narrative. Regulatory components of the strategy will be executed by Ecology per the state Water Pollution Control Act and federal Clean Water Act (§303 and §402). Implementation of non-regulatory elements will be managed by the Stormwater Strategic Initiative Lead, who distributes EPA Puget Sound Program geographic and NEP funding (per Clean Water Act §320). Non-regulatory and regulatory elements of [Washington's Water Quality Management Plan to Control Nonpoint Sources of Pollution](#) and associated subawards (Clean Water Act §319) will also advance priorities identified in the Implementation Strategy.

The five strategies developed during the Implementation Strategy process are:

- (1) Reduce Wastewater Nutrient Loads (MWQ.RC1)⁷
- (2) Reduce Urban Stormwater and Agricultural Runoff Nutrient Loads (MWQ.RC2)
- (3) Restore Natural Nutrient Attenuation (MWQ.RC3)
- (4) Develop Anthropogenic Nutrient Load Allocations (MWQ.RC4)
- (5) Advance Marine Waters Monitoring and Research Programs (MWQ.RC5)

Sub-strategies and actions associated with these strategies are expected to improve the management of anthropogenic nitrogen inputs, with the intent of reducing the spatial/temporal extent of waters experiencing a >0.2 mg/L decrease in DO concentrations attributable to anthropogenic causes and stopping any progression in eutrophication.

Notably, the Interdisciplinary Team did not reach consensus about recommended strategies or even a problem definition. Some members questioned the validity of Ecology's DO standards; highlighted the relatively small amount of anthropogenic nitrogen compared to nitrogen entering the system with influx of low-DO ocean water; and raised concerns about sensitivity of the Salish Sea Model. Section 13 of the accompanying State of Knowledge appendix includes

⁷ These labels refer to the individual results chains available for viewing in the [Marine Water Quality project on Miradi Share](#).

discussion of uncertainties and data gaps compiled during the Implementation Strategy development process and identifies future analyses that could help close those gaps.

1.4 PUGET SOUND NUTRIENT REDUCTION PROJECT

Development of the Marine Water Quality Implementation Strategy occurred concurrent with Ecology water quality improvement studies and regulatory actions. The [Puget Sound Nutrient Reduction Project](#) is a related but separate effort taking place under Ecology's delegated authorities under Clean Water Act (§303 and §402).

Box 3. Clean Water Act Process and Jargon

States are required to monitor and assess water quality to determine the degree to which their Water Quality Standards are being met and submit a list, called the **303(d) list**, of waters too polluted or otherwise degraded to meet Water Quality Standards. These are called **impaired waters**.

Total Maximum Daily Load (TMDL) refers to both the planning process to identify actions needed to achieve target pollutant reductions in impaired waters and a quantitative assessment of the waterbody's **assimilative capacity** (the maximum load of pollutant(s) it can receive without causing or contributing to Water Quality Standard violations).

Wasteload Allocations (WLA) are the portion of the loading capacity apportioned to **point sources** (discrete, end-of-pipe discharges) via NPDES permits (Box 4). **Load Allocations (LA)** are the portion apportioned to **nonpoint sources** (diffuse, runoff and natural background loads).

As noted in previously, Ecology's principal mechanism for regulating nutrient inputs into Puget Sound is noncompliance with Water Quality Standards for DO. The Puget Sound Nutrient Reduction Project was initiated in 2018 after DO impairments resulted in 303(d) listings for 102 Puget Sound waterbody segments. As a result of these listings, Ecology is obligated to quantify needed pollutant reductions and identify management actions necessary to bring impaired waters back into compliance with Water Quality Standards (Box 3).

The Puget Sound Nutrient Reduction Project is the planning effort, similar to a TMDL, through which Ecology is accomplishing this work.⁸ Ecology released a [draft Nutrient Reduction Plan](#) in June 2025. This "Advanced Restoration Plan" allows for more flexibility than a TMDL to aggregate loads geographically or temporally. The [Puget Sound Nutrient Forum](#) is how Ecology is communicating about the project and receiving official public comment on Nutrient Reduction Project analyses and implementation planning.

⁸ See Monschein and Mann (2007) for a discussion of the use of alternatives when other pollution control requirements eliminate the need for a TMDL pursuant to 40 CFR §130.7(b)(1).

A large component of the Puget Sound Nutrient Reduction Project involves Salish Sea Model (SSM) assessments of waterbody segment response to different nutrient input scenarios. SSM outputs were used to develop total nitrogen loading targets for marine point source discharge and watersheds in each of Puget Sound's eight oceanographic basins. Those targets (MWQ.RC4, Section 5) and a control strategy were presented in the draft Nutrient Reduction Plan (Ecology 2025).⁹ Implementation will occur through the addition or revision of pollutant limits to National Pollutant Discharge Elimination System permits (MWQ.RC1, Section 2) and Nonpoint Pollution Program activities (MWQ.RC2, Section 3).

5. 1.5 SCOPE OF THIS REPORT

This report is one of several appendices to the Marine Water Quality Implementation Strategy Narrative. It provides a brief overview of the five strategies developed as part of the Implementation Strategy process, but its focus is analysis of existing programs that could support operationalization of the strategies. Additional information about the strategies, details about their development, and recommended actions is available in the narrative and other supporting appendices.

This report is consistent with EPA (1993) guidance on NEP base program analysis. It intentionally focuses on state, regional, and local tools since regional partners do not necessarily have an ability to drive changes or influence priorities for federal programs.

Sections 2 - 6 provide an overview of the five strategies and existing programs that could support their operationalization. Sub-sections correspond to priority approaches/sub-strategies identified on the strategy results chain and include review of supporting literature; discussion of key programs, barriers, opportunities, and innovative models that could be replicated; descriptions of potential critical analyses (studies to answer key questions raised during the strategy development process); and identification of implementation actions suitable for NEP partners.

The analysis provided in this document was influenced by contributions from the Interdisciplinary Team and other regional experts during the strategy development process as well as review of pertinent literature. Syntheses of results from previous Puget Sound NEP grants made through Lead Organizations¹⁰ between 2011 - 2016 were particularly informative:

⁹ Ecology has not ruled out future TMDLs in areas where Nutrient Management Plan efforts are not successful, or if formal WLA and LA are needed to achieve compliance with standards (Ecology 2021a). Northwest Environmental Advocates has challenged EPA's approval of Ecology's decision to pursue a TMDL alternative, arguing that EPA-approved WLAs for individual permittees are necessary to regulate discharges of nitrogen and ensure compliance with Water Quality Standards (Case 2:21-cv-01637).

¹⁰ Prior to 2016, Puget Sound NEP and geographic funding from EPA was disbursed via cooperative agreements with five [Lead Organization](#) collaborations amongst various state agencies. After 2016, they were replaced by three [Strategic Initiative Lead Teams](#) under a revised EPA [funding model](#).

- McCarthy’s (2019a and 2019b) syntheses of nutrient-related awards made by the Toxics and Nutrients Prevention, Reduction, and Control Lead Organization
- Wright’s (2020a) synthesis of awards made by the Watershed Protection and Restoration Lead Organization
- Roberts et al.’s (2024) synthesis of awards made by the Pathogens Prevention, Reduction, and Control Lead Organization

2. REDUCE WASTEWATER NUTRIENT LOADS

Wastewater treatment plants (WWTPs) are the largest anthropogenic source of nutrients to Puget Sound (Mohamedali et al. 2011) and were therefore an early focus of Ecology’s Nutrient Source Reduction Project. The objective of this strategy is for WWTPs to achieve the nitrogen effluent limits and load targets being developed by Ecology. The IDT identified several regulatory, financial, and technological barriers to achieving WWTP load reductions. The Reduce Wastewater Nutrient Loads Strategy describes their ideas to address those barriers.

Results chain MWQRC1 identifies four sub-strategies that, when implemented together, are expected to support achievement of the strategy objective:

- Develop a regulatory framework for wastewater NPDES permits (MWQ.RC1.1)
- Develop a funding pathway for WWTPs to overcome financial barriers (MWQ.RC1.2)
- Implement and invest in developing or adapting nutrient reduction technology (MWQ.RC1.3)
- Develop a water quality trading strategy to achieve NPDES compliance (MWQ.RC1.4)

Box 4. NPDES Permits

The federal Clean Water Act requires **National Pollutant Discharge Elimination System (NPDES)** permits for the discharge of pollutants from point sources into surface waters.

NPDES permits contain limits on the amount of pollutant(s) allowed in the discharge (Box 5), monitoring and reporting requirements, and other provisions to ensure that the discharge does not degrade water quality.

On-site sewage systems (OSS) are a nonpoint source of nutrient pollution not regulated via NPDES permits, so they were intentionally excluded from this strategy. However, the [Shellfish Beds Implementation Strategy](#) includes a strategy focused on strengthening local OSS management and repair programs.

2.1 DEVELOP A PERMIT FRAMEWORK

Reducing wastewater nutrient loads requires development of numeric effluent limits (Box 5) for nitrogen and their inclusion in NPDES permits for WWTP discharges. These actions are part of Ecology’s regulatory responsibilities, and therefore largely out of the purview of Puget Sound NEP and Interdisciplinary Team recommendations.

The Puget Sound Nutrient Reduction Project includes extensive water quality modeling that will ultimately establish numeric water-quality based effluent limits (WQBELs) to be included in future NPDES permits.

However, given concerns about existing DO impairments getting larger in area or longer in duration while WQBELs are being developed, Ecology decided to develop a NPDES general permit to limit interim increases in nutrient loading.¹¹

Ecology issued a final [Puget Sound Nutrient General Permit](#) (PSNGP) in December 2021. This permit established narrative effluent limits because numeric effluent limits are not feasible until additional modeling occurs. Numeric WQBELs will be added during future PSNGP cycles once additional modeling is completed.

The PSNGP covered 58 WWTPs discharging into Puget Sound marine waters. These facilities provide wastewater treatment for 101 municipalities, local sewer districts, and state/federal facilities.

Box 5. Effluent Limitations

Effluent limits are restrictions on quantities, rates, and concentrations of pollutants discharged to a receiving water. They are the primary mechanism used in NPDES permits to control discharges.

Numeric effluent limits are upper bounds of the amount of a pollutant that may be discharged. For most pollutants, they are mass-based or concentration-based values.

Narrative effluent limits identify best management practices (BMPs) or other requirements to control pollutants. They are required¹² when numeric limits are infeasible but can also be added to supplement numeric limits.

Technology-based effluent limits (TBELs) are based on the capability of a treatment method to reduce the pollutant to a certain concentration at a reasonable cost. TBELs are developed independently of a discharge’s potential impact on a receiving water.

Water quality-based effluent limits (WQBELs) are used when TBELs are not stringent enough to prevent water quality standard violations in a receiving water. If WQBELs can’t be met, alternative disposal methods or locations must be found.

¹¹ This sub-strategy was developed with the Interdisciplinary Team before the decision to develop the PSNGP.

¹² 40 CFR §122.44(k)(2)

Before the PSNGP, LOTT Clean Water Alliance's Budd Inlet Treatment Plant was the only WWTP discharging into Puget Sound with a NPDES effluent limit for nitrogen.

The PSNGP placed WWTPs into three categories based on breakpoints in loading data:

- Dominant – 7 plants that discharge 80% of the cumulative TIN point source load
- Moderate – 20 plants that discharge 19% of the load
- Small – 31 plants that discharge <1% of the load

The permit established “action levels” for each WWTP based on current annual average total inorganic nitrogen (TIN) loads. Dominant and moderate dischargers are required to optimize treatment processes to prevent TIN loads from increasing and, if action levels are exceeded, they are required to identify and implement corrective actions that will decrease loads during the permit term. Since major facility upgrades will likely be necessary to meet future effluent limits expected in upcoming permit cycles, covered facilities are also required to begin long-term planning for capital upgrades. Target effluent limits provided in the PSNGP for planning purposes were: (1) seasonal 3 mg/L TIN limit (April-October) and (2) AKART analysis (Box 6) to determine a treatment level that can be achieved year-round (potentially ~8 mg/L).

The schedule included in Ecology (2025) shows that all marine source permits will be updated with WQBELs by 2031.

Box 6. All Known, Available, and Reasonable Methods of Treatment (AKART)

The legal basis for Ecology's Water Quality Program is the federal Clean Water and the state Water Pollution Control Act, which begins with the statement:

*It is declared to be the public policy of the state of Washington to maintain the highest possible standards to insure the purity of all waters of the state ... and to that end require the use of **all known available and reasonable methods** by industries and others to prevent and control the pollution of the waters of the state of Washington.¹³*

EPA's guidelines for water quality criteria are a minimum, and states are explicitly allowed to develop regulations more stringent than required by the Clean Water Act.¹⁴ Likewise, EPA established national guidelines and standards for effluent limits, but state law requires incorporation of permit conditions which require AKART to prevent and control pollution. AKART limits can be more stringent than those in federal TBEL guidelines. AKART is determined in a case-by-case basis and requires engineering and economic judgement.

¹³ RCW 90.48.010 (AKART provisions also appear in RCW 90.48.520 and RCW 90.52.040)

¹⁴ 40 CFR §131.4(a)

Other planning elements required by the permit were an environmental justice evaluation and an influent load reduction/source control evaluation that covers septage handling,¹⁵ pretreatment, and reducing nitrogen loads from new development (Box 7).

Box 7. Wastewater and Land Use Planning

Nutrient limits in the PSNGP have implications for planning required by Washington’s Growth Management Act (GMA).¹⁶ Nutrient loading from existing WWTP facilities increases as population size increases. PSNGP action levels were based on existing discharges, so they do not incorporate housing units in production (under construction or with approved/ pending permits). As a result, jurisdictions experiencing rapid development are more likely to trigger corrective actions during the first permit term.

Permit-required planning for interim and long-term capital upgrades will need to be consistent with GMA capital facilities planning to ensure wastewater infrastructure is able to accommodate anticipated growth. Adding new treatment streams may consume available WWTP footprint and limit opportunities for future capacity expansion to serve growing populations (e.g., Brown and Caldwell 2020). This type of planning integration may be more challenging where a GMA planning jurisdiction and the NPDES permittee are different entities and, for some jurisdictions, there may be a timing mismatch with GMA’s planning cycle.

The PSNGP’s requirement for evaluation of potential source control measures also has a nexus with land use planning and building codes. The intent is to encourage utilities to investigate approaches, other than centralized treatment, to reducing nitrogen loads. Provided examples included building-scale pretreatment, reuse, and/or urine diversion at new construction multi-family residential and commercial properties. The administrative complexity of implementing and ensuring public health outcomes for such building-scale facilities introduces another potential mismatch between the entities with authority to allow/encourage such approaches and NPDES permittees.

These examples illustrate potential opportunities for Puget Sound NEP partners to provide financial and/or technical support for planning integration. It is important to manage any actual or perceived tradeoffs between regional water quality improvement goals and the priority land development goal of directing growth into urban areas.

¹⁵ Septage is the waste removed from septic tanks and other systems used to store domestic sewage. In the past, WWTPs accepted septage for treatment. Today, many facilities are no longer accepting septage or can only accept a small amount due to capacity limitations and restrictions on nitrogen discharges (SCJ Alliance 2025). In 2024, a Washington State Legislature budget proviso directed Ecology to work with the Washington State Association of Local Public Health Officials to assess the current and future needs for managing septage. A statewide septage capacity assessment (SCJ Alliance 2025) and [report to the Legislature](#) were completed in July 2025.

¹⁶ RCW 36.70A.700 et seq. Requirements for capital facilities planning are in WAC 365-196-415.

LEGAL CHALLENGES TO THE PUGET SOUND NUTRIENT GENERAL PERMIT

Several parties filed appeals of the PSNGP to the [Pollution Control Hearings Board](#), including Puget Soundkeeper Alliance, King County, City of Tacoma, Washington Environmental Council and Suquamish Tribe, City of Everett, Birch Bay Water and Sewer District Case, City of Bremerton, Pierce County, and City of Edmonds.

Below is a timeline that provides a brief summary of how these legal challenges were resolved and the subsequent actions taken by Ecology to move forward with nitrogen limits.

- March 2022 – The Pollution Control Hearings Board issued a [partial stay](#) (i.e., some permit requirements/conditions were put on hold) of the PSNGP pending resolution of the appeals.
- September 2024 – The Supreme Court of the State of Washington [resolved an Administrative Procedure Act petition](#) made by several permittees that had delayed Pollution Control Hearings Board review of the appeals.
- February 2025 – The Pollution Control Hearings Board [invalidated](#) the Puget Sound Nutrient General Permit “insofar as it is mandatory for already-permitted dischargers” on the basis that general permits are issued “in lieu of” individual permits not “in addition to.”
- April 2025 – Ecology sent a [letter](#) to permittees offering the option to voluntarily continue coverage under the general permit or have nitrogen reduction requirements addressed in their individual permits.
- June 2025 – Ecology released a draft 2025 reissuance of the PSNGP; the comment period closes in August 2025. This [draft general permit](#) would allow facilities to opt in and apply for permit coverage. Individual permits would not be able to support “bubble” action levels (where permittees with multiple facilities can be considered in aggregate) or a nutrient credit trading mechanism (section 2.4).

2.2 DEVELOP A FUNDING PATHWAY FOR WWTP IMPROVEMENTS

Financial barriers associated with adding advanced nutrient removal technology to existing WWTPs are significant. Based on a preliminary state-wide economic evaluation of potential nutrient limits by Ecology and Tetra Tech (2011), aggregate capital costs to achieve nutrient removal objectives are likely to exceed \$2 billion (Table 1).¹⁷ These capital costs, as well as ongoing operating costs and facility footprint requirements, would increase steadily as the level of required nitrogen removal increases (Ecology and Tetra Tech 2011, Brown and Caldwell 2020).

Table 1. Order-of-magnitude estimates for capital upgrade cost associated with various potential nitrogen permit limits for Puget Sound WWTPs

	Year-round 8 mg/L TIN limit	Year-round 3 mg/L TIN limit	Seasonal 8 mg/L TIN limit	Seasonal 3 mg/L TIN limit
Ecology and Tetra Tech (2011) cost estimates	\$3.1 billion	\$3.5 billion	\$1.5 billion	\$1.7 billion
Escalated to 2023	\$5.0 billion	\$5.7 billion	\$2.4 billion	\$2.7 billion
Methods Row 1: Sum of WRIA 1 - WRIA 19 capital costs for Objectives A and B from Tables ES-4 and ES-5. Row 2: Cost inflation factor of 1.63 derived from March 2022 U.S. Army Corps of Engineers Civil Works Construction Cost Index System yearly composite index values for FY10 and FY23.				

More recent facility specific mid-range estimates of capital costs to upgrade just 3 major WWTPs in King County were \$2.83 - \$2.89 billion for year-round nitrogen removal and \$1.70 billion for seasonal nitrogen removal (Brown and Caldwell 2020). These estimates did not include potential near-term costs for interim corrective actions if actions levels are exceeded; the range for addition of side stream treatment was \$50 - \$500 million for these same facilities.

The intent of this sub-strategy is to encourage alignment of federal, state, and local funding sources in support of advanced treatment upgrades. Table 2 provides a summary of existing programs with potential to support implementation of this sub-strategy. It includes funding sources as well as programs that could provide technical assistance to help PSNGP permittees secure funding.

¹⁷ WWTPs generally need to be upgraded every few decades due to obsolescence and/or to handle population growth. The Ecology and Tetra Tech (2011) estimates were incremental capital costs associated with upgrading facilities that existed at the time of the analysis. Given that the timeline for capital facilities planning is generally on the order of 20+ years, PSNGP compliance deadlines may accelerate already-planned upgrades. In these cases, the marginal cost of adding nutrient control could be lower. However, we conservatively conclude that costs are likely to exceed \$2 billion for three reasons: (1) the seasonal 8 mg/L limit is less stringent than the planning target provided in the PSNGP; (2) 2020 facility-specific cost estimates from Brown and Caldwell are significantly higher than the 2011 estimates even after adjusting for inflation; and (3) rapidly accelerating inflation pressure.

Table 2. Programs with potential to support the Funding Pathway Sub-Strategy

Program	Implementers and/or funders	Description
Centennial Clean Water Grants ¹⁸	Department of Ecology (Water Quality Financial Assistance) and EPA	Grants for nonpoint activities, on-site sewage systems, and wastewater facilities for hardship-eligible small communities
Clean Water State Revolving Fund (CWSRF)	Department of Ecology (Water Quality Financial Assistance) and EPA	Provides low-interest loans for wastewater facilities, on-site sewage systems, some stormwater facilities, and nonpoint source pollution reduction activities. Infrastructure Investment and Jobs Act appropriations for water infrastructure will be disbursed via SFRs.
Community Development Block Grant General Purpose Grants (CDBG)	Department of Commerce and U.S. Department of Housing and Urban Development (HUD)	Grants for community and economic development projects, including sewer infrastructure design/construction and planning. HUD allocates annual appropriations via formula. Larger “metropolitan” cities and counties receive block grants directly from HUD, while smaller “non-entitlement” jurisdictions receive awards from Commerce.
Municipal Research and Services Center (MRSC)	Department of Commerce	Nonprofit that supports local governments by providing legal and policy guidance, training, and online resources.
Public Works Program	U.S. Department of Commerce Economic Development Administration	Provides grants to communities in economic decline ¹⁹ for upgrade of critical infrastructure, including wastewater facilities
Puget Sound Nutrient Reduction Grant Program	Department of Ecology (Water Quality Financial Assistance)	Washington’s Legislature appropriated \$10 million in the 2025-2027 biennial budget to provide financial support to entities subject to the PSNGP.
Rural Community Assistance Corporation	6 federal and 3 Washington agencies, among many other funders	Non-profit that provides training, technical assistance, and low interest loans to small, low-income communities in rural areas. Services include a Tribal Circuit Rider program.

¹⁸ Grants and loans from the Centennial Clean Water Grant program and the Clean Water State Revolving Fund program are awarded via Ecology’s [Water Quality Combined Funding Program](#). This program administers funding from 7 state and federal sources via one application and integrated ranking/selection process.

¹⁹ Areas that have an unemployment rate at least 1% higher than national average; per capita income 80% or less of the national average; or have experienced/about to experience a special need from severe unemployment or severe changes in economic conditions

Program	Implementers and/or funders	Description
Small Communities Initiative	Departments of Commerce, Health, and Ecology	Provides technical assistance to small, rural communities that must upgrade their drinking water or wastewater systems
Water and Infrastructure Finance Innovation Act (WIFIA)	EPA	Federal financing program administered directly by EPA. Available to communities for high-cost wastewater projects that are otherwise eligible for the Clean Water State Revolving Fund.
Water and Waste Disposal Loan and Grant Program	U.S. Department of Agriculture Rural Development	Helps very small rural communities finance acquisition, construction, or improvement of infrastructure including sanitary sewer and stormwater systems. Offers a predevelopment planning grant program to assist communities with initial planning and development of applications for their loan programs.
Washington Infrastructure Assistance Coordination Council (IACC)	6 state and 5 federal agencies, plus 15 associations, boards, and non-profits	Nonprofit whose purpose is to improve the delivery of infrastructure assistance, both financial and technical, to local governments and tribes in Washington State.
Washington Public Works Trust Fund	Department of Commerce	Provides loans for critical public infrastructure, training for local governments, and state project support staff. A revolving loan fund is managed by a board of local infrastructure representatives. A portion of American Rescue Plan Act state stimulus funding appropriated to Washington was placed in the Fund.

Given the magnitude of expected capital outlays, the Interdisciplinary Team indicated that new and expanded funding sources are needed to address financial barriers. Subsequently, one new state funding source was developed, and two large federal appropriations occurred.

- Washington’s Legislature created the Puget Sound Nutrient Reduction Grant Program to provide grants to entities subject to the PSNGP. The 2021-2023 biennial budget included \$9 million to support planning for future treatment facility upgrades and development/implementation of optimization strategies required by the permit. Ecology is administering the program. During this first phase of funding, permittees were eligible receive base awards of \$50,000 for each WWTP plus additional awards determined by three prioritization factors: cities with population <760,000 receive higher priority, older facilities receive higher priority, and facilities serving populations with lower Median Household Income (MHI) receive higher priority (Ecology 2021b). Total award amounts are expected to range from \$88,000 to \$334,300. Ecology set aside \$1 million to fund a regional implementation study to support smaller plants’ collective implementation of PSNGP requirements. A regional study may include guidance documents, technical assistance, and planning-level upgrade designs. The 2025-2027 biennial budget included \$10 million for this program.
- The federal American Rescue Plan Act (ARPA), signed into law in March 2021, provided stimulus funding that can be used to improve water and sewer systems. \$60 million of Washington’s State Recovery Fund allocation was placed in the Washington Public Works Trust Fund to be used as loans for infrastructure projects. Allocations from the Local Recovery Fund are being calculated and disbursed similar to Community Development Block Grants (CDBG). Metropolitan cities/counties make requests and receive funding directly from the federal Department of Treasury, while smaller non-entitlement local governments are served by the Department of Commerce.²⁰ ARPA recovery funds must be obligated by December 31, 2024 and spent by December 31, 2026.
- The federal Infrastructure Investment and Jobs Act (“Bipartisan Infrastructure Law” or BIL), signed into law November 2021, provided \$55 billion for water infrastructure programs. The majority of this funding will be distributed through Clean Water and Drinking Water State Revolving Funds (CWSRFs and DWSRFs).²¹ \$11.7 billion of supplemental funding was provided to Clean Water State Revolving Funds (Box 8) to disburse for upgrades of wastewater and stormwater infrastructure. In addition, \$1 billion of new funding was provided to CWSRFs to address emerging contaminants.

²⁰ Commerce’s CDBG web site provides a list of “non-entitlement” and “metropolitan” (population >250,000) jurisdictions at: <http://www.commerce.wa.gov/wp-content/uploads/2016/06/CDBG-2014-List-of-Local-Governments.pdf>

²¹ <https://www.epa.gov/infrastructure/explore-epas-bipartisan-infrastructure-law-funding-allocations> provides an interactive breakdown of BIL funding allocations to EPA for water infrastructure. EPA’s Puget Sound Geographic Program will receive \$89 million but this funding cannot be used for regulatory compliance.

Box 8. Clean Water State Revolving Fund (CWSRF)

The CWSRF is a federal-state program providing low-cost loans for public water infrastructure projects.²² It replaced EPA's Construction Grants Program in 1987. A "revolving fund" uses one-time or recurring grants to capitalize a managed fund used to make loans. The fund is replenished as loans are repaid, providing a self-sustaining source of funding for new loans and program administration.

EPA provides states with annual capitalization grants and states provide a match. States operate the revolving fund, define terms (e.g., interest rates, repayment schedules), and provide loans, grants, or principle forgiveness loans for the planning, design, and construction of wastewater facilities and other water infrastructure.

EPA (2022a) anticipated a \$31 million grant for Washington's CWSRF in FY2022, with an additional \$1.6 million earmarked for emerging contaminants. Ecology provided \$253.6 million in financial assistance from the CWSRF for FY2022 and expects to offer \$310.8 million in FY2023 (Ecology 2021c, Ecology 2022c).

The BIL's supplemental appropriations to CWSRFs came with some more favorable terms compared to base CWSRF grants. These include reduced state match requirements (10% versus 20%) through fiscal year 2023, and the ability to use ARPA State and Local Recovery Funds for non-federal match (EPA 2022a).

Congress also directed that 49% of the new funding be provided as **additional subsidization** in the form of grants or principal forgiveness loans (versus 30% for base CWSRF funds). Additional subsidization is to be provided to address affordability concerns and for specific types of projects.²³

EPA (2022a) instructed states to review, refine, and improve as necessary their CWSRF affordability criteria to ensure they are reflective of current affordability issues in the state.

Information about Washington's criteria and analysis of wastewater service affordability in the Puget Sound region is provided in Section 2.2.1.

²² [40 CFR part 35, subpart K](#)

²³ Prior to 2009, the most favorable financial terms a CWSRF could provide was 0% financing. The American Recovery and Reinvestment Act of 2009 enabled states to use a portion of their capitalization grants to provide additional subsidization. This authority was made permanent in 2014 amendments adding Section 603(i) to the Clean Water Act. Per [33 U.S.C. §1383\(i\)](#), states may provide additional subsidization: (1) to benefit a municipality that meets the state's affordability criteria; (2) to benefit a municipality that seeks to subsidize individual ratepayer in the residential user rate class or demonstrates that ratepayers will experience a significant hardship from the increase in rates necessary to finance a project; or (3) to implement a process, material, technique, or technology that addresses water or energy efficiency goals, mitigates stormwater runoff, or encourages sustainable project planning, design, and construction.

There is a limited window of opportunity for utilities to access BIL supplemental funding being dispersed via CWSRFs. States must make commitments (i.e., sign assistance agreements with eligible recipients) within one year of receipt of each capitalization grant from EPA and expend the funds within two years of receipt (EPA 2022a). This means the funding from final year of supplemental appropriations (FY 2026) must be **expended by FY 2028**. Given this aggressive schedule and a competitive application process that takes over a year to complete, new projects would need to be developed enough to enter the CWSRF project pipeline (i.e., make it into Ecology Intended Use Plans (IUP)) in the next few years to receive BIL funding.²⁴

This narrow timeline contributes to two barriers that may limit uptake of BIL supplemental CWSRF appropriations for funding PSNGP-required interim actions or long-term upgrades. First, as noted in Section 2.1, several parties appealed to the Pollution Control Hearings Board and a partial stay of the permit was ordered. If the permit is affirmed, there will have been years of delay in seeking funding assistance. Second, not all PSNGP permittees may be aware of the BIL window of opportunity and/or be inclined to apply for funding due to the administrative complexity of the process, relatively low assistance limit (\$43 million in FY 2022) compared to expected need, or an expectation that they would not qualify for hardship interest rates or additional subsidization.

Ecology provides educational resources and technical assistance to applicants of their Water Quality Combined Funding Program, including annual applicant trainings workshops. There may be an **opportunity for NEP partners to support Ecology efforts with additional outreach about BIL and ARPA funding and providing direct support to applicants**. Existing technical assistance resources and potential opportunities include:

- Several programs identified in Table 2 and nonprofit organizations could support CWSRF outreach efforts to utilities, including the Infrastructure Assistance Coordinating Council, the Municipal Resources and Services Center, the Small Communities Initiative, Association of Washington Cities, and the Washington Association of Sewer and Water Districts.
- In early 2022, Ecology was collecting data for EPA's 2022 Clean Water Needs Survey, which documents existing and projected (within 20 years) capital investment needs for publicly-owned facilities to meet Clean Water Act water quality goals. Survey results can be used to identify PSNGP permittees that have not identified permit-required upgrades. Proactive outreach to those permittees could facilitate the incorporation of upgrades into the CWSRF project pipeline. To date, PSNGP-required upgrades have not been identified in survey responses (E. Hanson, Ecology Clean Water Needs and Outcomes Coordinator, pers. comm.).
- The BIL included a provision allowing states to use up to 2% of their annual CWSRF capitalization grant for providing technical assistance to rural/small jurisdictions and tribal entities. States can use this funding to hire staff, nonprofit organizations, or regional entities that provide community outreach, technical evaluation of wastewater solutions, preparation

²⁴ A description of Ecology's annual funding cycle can be found in their [FY22 Intended Use Plan](#). Application submittal occurred in August - October 2020 for FY 2022 funding.

of applications, preliminary engineering reports, and financial documents necessary to receive CWSRF financial assistance (EPA 2022a). Information about the amount of funding allocated for this work and a description of activities must be included in the state's IUP.

The following three sections discuss IDT-identified uncertainties related to the wastewater funding sub-strategy suitable for “critical analyses” (defined in Section 1.2). Data collection and analysis for the affordability critical analysis is complete and summary results are provided below. The cost efficiency and cost-benefit analysis proposals have not been scoped nor have investigators been identified.

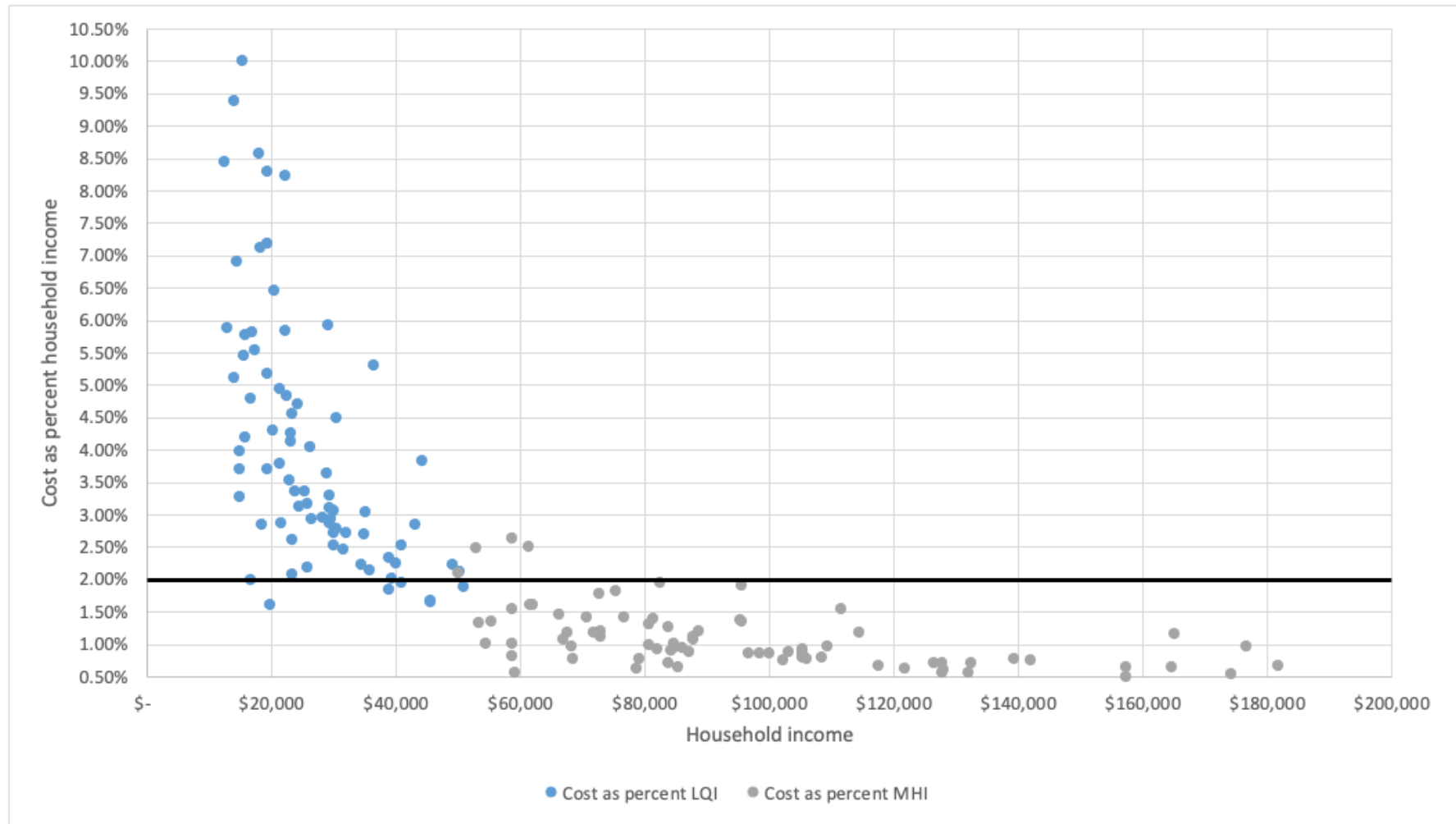
2.2.1 AFFORDABILITY

Despite the *millions* in new appropriations described above, there remains a significant gap between available funding and the *billions* of projected costs. And, unlike grants, funding support that comes in the form of loans would result in increase in sewer bills for ratepayers. Similar to a [PSNGP Advisory Committee](#) recommendation to lessen the financial burden of the permit on individual utilities, IDT members expressed concern about impacts of WWTP upgrade costs on local ratepayers.

A previous critical analysis on stormwater utility fees in the Puget Sound region (Evrard et al. 2022, Kinney et al. 2021, and Kinney et al. 2022) included an analysis of combined water utility service (drinking + sewer + stormwater) affordability in the City of Seattle. Results raised questions and concerns about the current affordability of water utility service in the region (i.e., before any PSNGP-required interim measures or long-term upgrades would raise rates) so a critical analysis was initiated in November 2021. The intent of this work was to conduct a broad survey of wastewater service costs across the region to inform implementation of the wastewater funding sub-strategy.

Barber et al. (2022) and Burke et al. (2023) compiled single family residential wastewater service rates for most of the 101 local sewer providers affected by the PSNGP. Appendix A provides a list of those providers with information about their status as a PSNGP permittee or as a wholesale customer of a permittee. State permittees, as well as federal and tribal wholesale customers, were excluded from this analysis. Service costs were calculated assuming monthly household water usage of 5.5 centum cubic feet (ccf) or 4,114 gallons to reflect winter quarter average (i.e., no outdoor irrigation). **In 2022, the average annual service cost was \$940.32 (range \$318.60 to \$1,934.52).** Then U.S. Census American Community Survey income by quintile data was obtained. Service areas for each local sewer provider were delineated and then associated with census tracts to calculate Lowest Quintile Income (LQI, the 20th percentile) and Median Household Income (MHI) for 80 wastewater service areas. Results are provided in Figure 2. Of the 80 wastewater service providers, 71 (89%) had annual service costs exceeding 2% of LQI and 4 (5%) had costs exceeding 2% of MHI.

Figure 2. Puget Sound wastewater service cost as a percent of household income



Data source: Barber et al. (2022)

Next Burke et al. (2023) estimated the potential impact of PSNGP-required upgrades. Ecology and Tetra Tech (2011) estimated monthly costs to ratepayers associated with four different potential regulatory requirements nutrient removal. Those estimates were escalated to 2022 dollars then the estimates for the least and most stringent nutrient limits were added to the existing service costs. The number of providers with service costs exceeding 2% of MHI increased from 4 to 8 (10%) with a seasonal 8 mg/L nitrogen discharge limit and 18 (23%) with a year-round 3mg/L nitrogen discharge limit. All providers had service costs exceeding 2% LQI for both PSNGP-adjusted scenarios.

The 2% benchmark featured on Figure 1 reflects EPA financial capability assessment guidelines used by utilities to determine the financial impact Clean Water Act compliance has on residents. Past EPA (1997, 2014) guidance suggested that wastewater costs exceeding 2% MHI have, at the utility level, a high impact on residents. **The results in Figure 1 are consistent with previous research concluding that use of 2% MHI as a utility-level benchmark understates impacts to low-income households** (Congressional Research Service 2017, Teodoro 2018). Newer EPA (2021, 2022a, 2022b) guidance incorporates LQI in a proposed indicator to better reflect affordability impacts at the household level.

It is clear from Figure 1 that an answer to the question of affordability differs markedly based on the income metric employed for the analysis. **This is significant because Washington uses cost as percent MHI to determine hardship for wastewater facility construction funded through CWSRF and Centennial Clean Water Grants.** Hardship determinations affect loan interest rates as well as eligibility for forgivable principal loans (Table 3). Yet these criteria understate the extent to which sewer service costs may constrain low-income households.

Table 3. Criteria for hardship interest rates and forgivable principal loans

Sewer fee divided by MHI is:	< 2% non hardship	2 - 3% moderate hardship	3 - 5% elevated hardship	> 5% severe hardship
1 - 5 year loan term	30% of market rate	20% of market rate	10% of market rate	0.0%
6 - 20 year loan term	60% of market rate	40% of market rate	20% of market rate	0.0%
21 - 30 year loan term	80% of market rate	60% of market rate	40% of market rate	20% of market rate
Forgivable principal loan eligibility	Not eligible	50% up to \$5 million	75% up to \$5 million	100% up to \$5 million

Hardship interest rates determined per [WAC 173-98-300 4\(b\)](#), forgivable principle eligibility determined per [WAC 173-98-320](#), and \$5 million limit from [WAC 173-98-520 3\(b\)](#).

For the purposes of defining affordability for additional subsidization, Ecology (2021c) also considers population trends and uses unemployment data as a tiebreaker. Ecology does not award additional subsidization in the form of grants (Ecology 2021c). Per [WAC 173-95-500 2\(b\)](#), three types of projects are eligible for additional subsidization: (1) wastewater and stormwater facility preconstruction (planning and design) projects in *hardship* communities where the

projects involve sustainable planning or design; (2) wastewater facility construction projects in communities that meet *affordability* criteria; and (3) Green Project Reserve²⁵ eligible projects.

EPA (2022a) instructed states to review, refine, and improve as necessary their CWSRF affordability criteria to ensure the criteria are reflective of current affordability issues in the state. This is an opportunity to incorporate newer thinking regarding use of MHI versus LQI in decision-making about loan terms and perhaps influence how BIL funding for additional subsidization gets distributed.

In 2024, Ecology released financial capability assessment guidance to support PSNGP permittees in conducting an economic evaluation of reasonable treatment options. This includes completion of an affordability assessment to identify an economically reasonable level of treatment in the context of AKART. The guidance is largely similar to previous guidance, with the exception of a new Lowest Quintile Poverty Indicator that defines disadvantaged households within a community (Ecology 2024).

New focus on customer assistance programs associated with COVID-19 relief packages may also inform financial capability assessments. Two new programs of note include:

- ARPA provided funding to the U.S. Department of Health and Human Services (HHS) for a new water/sewer bill emergency assistance program modeled after the Low-Income Home Energy Assistance Program (LIHEAP) established in 1981. The program's priority is households pending disconnection for non-payment. HHS developed the **Low Income Household Water Assistance Program** (LIHWAP) then disbursed the special appropriations as allotments to states in the form of grants. Commerce administers Washington's LIHWAP via the same network of community action organizations that provide assistance for LIHEAP. Those local organizations determine eligibility and how much assistance a household can receive, then send payment(s) directly to the water utility on the households' behalf.²⁶
- BIL directed EPA to conduct a national needs assessment for rural and low-income water/sewer bill assistance, and authorized EPA to develop a **Rural and Low-Income Water Assistance Pilot Program** that could provide direct financial assistance, lifeline rates, bill discounting, special hardship provisions, percentage-of-income payment plans, or debt relief.²⁷ However, no funding for this pilot program was appropriated in the BIL (EPA 2022a).

²⁵ Green Project Reserve are projects or project components that focus on green infrastructure, water efficiency, energy efficiency, or environmentally innovative activities ([WAC 173-98-030\(42\)](#)).

²⁶ Other states have sent these funds directly to water utilities. [RCW 57.46.010](#) provides authority for Commerce to allow the third parties who disperse federal energy program assistance funding to also distribute voluntary contributions collected by water-sewer districts to assist low-income residential customers. MRSC's [Utility Discounts and Financial Assistance Programs Web Page](#) provides additional context.

²⁷ Sections of 50108 and 50109 of the [Infrastructure and Investment Jobs Act](#).

Additional research on the effectiveness of customer assistance programs, as well as legal or administrative constraints related to such programs in Washington, is warranted. Previous research is limited and indicates that enrollment levels tend to be low compared to eligible populations. Pierce et al. (2021) and Teodoro (2021) describe multiple challenges to administering these programs, such as imprecise eligibility rules; extensive time and effort required for customers to apply; and a lack of trust to share income information. Best practices should be identified before widespread adoption is proposed as a solution to affordability challenges. Progress has been made since the original draft of this report was completed in 2022. During the 2024 session of the Washington State Legislature, funding for a [water rate study](#) that will examine the need for a statewide low-income assistance program to offset household drinking water and sewer costs was added to the state's 2023-2025 operating budget.

The Environmental Justice Review required by the PSNGP puts the burden on individual permittees to identify measures to prevent adverse impacts on communities that could be disproportionately impacted by rate increases. A regional review is a necessary complement to such evaluations. Utility fees are regressive (i.e., they take a larger share of a low-income household's budget) and a form of structural inequity (Beecher 2020). Resolving large-scale structural inequities related to Washington's overall tax and funding structure at the local level is not possible. Additionally, minimizing displacement risk due to decreasing affordability is a regional issue not a local one (Box 9).

Box 9. Nexus with the Land Cover and Development Implementation Strategy

Strategy #1 from the 2022-2026 Action Agenda was derived from the Land Cover and Development Implementation Strategy:

Advance smart development and protect intact habitats and processes by channeling population growth into attractive, transit-oriented centers with easy access to natural spaces.

The high cost of living in urban centers, relative to rural communities, has been identified as a barrier to this regional goal. Funding clean water services primarily with utility fees could contribute to this housing affordability gap. This is because rural areas may not be subject to certain regulations (e.g., PSNGP, municipal stormwater general permits, and consent decrees for combined sewer overflows) that require urban geographies to make costly upgrades.

Additionally, in areas with high housing costs income may not accurately reflect the ability to pay for water utilities (Beecher 2020). It is important to explore trade-offs among regional recovery strategies to identify ways to minimize unintended adverse consequences.

2.2.2 COST EFFICIENCY

The IDT recommended that ways to reduce the cost of WWTP upgrades be explored. Potential options for consideration include development of a water quality credit trading program (discussed in Section 2.4), regionalization, privatization, and public-private partnerships.

Regionalization of wastewater services involves structural and non-structural methods to capture economies of scale and improve operational performance (Environmental Financial Advisory Board 2019). It can range from a simple shared service agreement for administrative and operational tasks to full system consolidation, where one entity assumes management of another.²⁸ Regionalization can reduce the administrative burden of operating numerous small systems and may have the added benefit of decreasing the impact of capital upgrades on ratepayers by spreading the costs across a larger customer base. A recent example of consolidation in the Puget Sound region is the City of Shoreline's 2021 assumption of the Ronald Wastewater District, which was established more than 40 years before Shoreline became a city.

A large number of wastewater systems complicates existing challenges like aging infrastructure, compliance with new regulatory requirements, and workforce development. (Environmental Financial Advisory Board 2019). The presence of multiple small systems managed by special purpose districts or public utility districts may also complicate capital facilities planning under the Growth Management Act. Regionalization tends to be more effective when jurisdictions are closer together, more densely populated, and systems contribute to a common regional problem (Ecology 2009). **Historically, watershed-level compliance challenges and TMDLs have been a catalyst for regionalization.** Ecology (2009) provided several examples of regulatory requirements driving regionalization of facilities and services, including two Puget Sound case studies:

- In 1956, there were 22 sewer districts operating in the metropolitan Seattle area and most had a service area of <2 square miles. Degradation of water quality in Lake Washington led to creation of a centralized regional wastewater system in the early 1960s. Metro closed 28 small treatment plants and eliminated 46 wastewater discharge points into Lake Washington and Lake Sammamish. Today, King County's regional wastewater treatment system has a 420-square-mile service area and involves sewage disposal agreements with 34 local sewer agencies (Appendix A).
- A 1999 TMDL for dissolved oxygen in the lower Snohomish River led to an agreement to construct, operate, and maintain a joint deep-water outfall used by the City of Everett, Kimberly-Clark Everett Mill Plant, and the City of Marysville.

²⁸ In this context regionalization does *not* involve centralization of physical facilities. Since Special Purpose Districts and Public Utility Districts do not have authority for land use planning, assumption by a local government could potentially advance decentralized treatment options.

Decision-makers for smaller utilities may lack objective information about the sustainability of their current systems and their options for transitioning to a different governance model (Environmental Financial Advisory Board 2019). Local entities may also lack resources to negotiate and develop partnership agreements (Ecology 2009). **NEP partners could potentially support Ecology and Commerce in identifying opportunities for consolidation, disseminating information about the process, and providing technical assistance.**

EPA (2022a) recommended that states encourage regionalization, partnerships, and non-physical consolidation via CWSRF incentives. **The size of grant and loan limits have been identified as a potential disincentive to consolidation efforts.** Regional systems may receive less financial support relative to smaller individual facilities. **Ecology (2009) recommended that loan limits be based on a “per local government” basis instead of a “per project” basis so that regionalized and non-regionalized applicants compete on a level playing field.**

Privatization and Public-Private Partnerships have been suggested as a potential way to access private capital for capital upgrades. **Privatization** is when publicly owned facilities become privately owned. Full privatization of wastewater facilities is generally not encouraged in Washington, per [WAC 173-240-104](#), and nor elsewhere without assurance that the public partner can reacquire assets on preferential terms at the end of a contract (GAO 2010). **Public-Private Partnerships (P3s)** involve cooperation between public and private sectors to finance, design, construct, or operate wastewater facilities. Private financing is not “free money” because it must be repaid to investors seeking a return (GAO 2010). P3s can provide an alternative source of financing (though it generally costs more than public financing), result in faster delivery of new facilities or upgrades compared to traditional public procurement, and allow small systems improved to access human capital.

2.2.3 COST-BENEFIT ANALYSIS

Another type of evaluation recommended by the IDT for this strategy is a regional cost-benefit analysis. Some IDT members questioned whether the benefits of PSNGP implementation will be proportional to the costs, particularly in light of competing water infrastructure investment needs for stormwater management and combined sewer overflow correction. Others suggested that additional economic analysis was necessary to support regional prioritization of specific strategies and actions.

Northern Economics (2019) recommended several economic analyses to support the Marine Water Quality Implementation Strategy:

- A contingent valuation study of Puget Sound residents’ willingness to pay for water quality improvements.
- A formal cost and cost effectiveness (e.g., cost per pound of nitrogen removed) analysis for both point and nonpoint nutrient reduction strategies. Conducting this analysis by sub-basin or watershed could support identification of differences in implementation costs. Cost

effectiveness analysis of specific nonpoint BMPs could support development of watershed modeling and decision support tools (as described in Section 5.2).

- An analysis of tradeoffs between economic efficiency and distributional equity (i.e., who pays and who benefits from nitrogen reduction?).

The last bullet relates to how the costs of nutrient reduction are distributed. Compliance costs are likely to vary for point versus nonpoint sources, by geography and land use, and extent of financial support for implementation. Benefits of wastewater upgrades would be enjoyed by all Puget Sound residents—not only those who are ratepayers within sewer service areas subject to the PSNGP—so distributional equity outcomes for the wastewater strategy may be improved by sharing the cost of upgrades more widely. In Maryland, addition of nutrient removal technologies to WWTPs for compliance with the Chesapeake Bay TMDL was funded by regional fees levied on households served by both sewer and septic (NRC 2011). Future appropriations to the Puget Sound Nutrient Reduction Grant Program could support WWTP capital upgrades construction in a way that spreads costs among beneficiaries beyond ratepayers.

2.3 DEVELOP AND ADAPT NUTRIENT REDUCTION TECHNOLOGIES

The intent of this sub-strategy is to support pilot testing, evaluation, and optimization of wastewater treatment technologies; evaluate co-benefits of wastewater nutrient removal; and explore opportunities to reduce nitrogen upstream of WWTPs. The accompanying State of Knowledge report provides some information about promising technologies for WWTPs and approaches for upstream reduction.

This sub-strategy is largely regulatory in nature because treatment decisions are subject to Ecology’s approval. However, **co-benefits of nutrient reduction strategies to other Puget Sound Vital Signs are potentially significant and opportunities to support selection of technologies that maximize those benefits should be supported with EPA Puget Sound funding to the extent possible.**

Some operational changes employed for optimization required by the PSNGP and advanced nutrient removal treatment technologies may reduce contaminants of emerging concern (CECs) in wastewater effluent (Ecology 2021d). Many CECs are not regulated due to a lack of water quality standards, but they can be present in the marine environment at levels that may be harmful to fish, wildlife, and humans (Stormwater Strategic Initiative 2021). Limiting nitrogen discharged from WWTPs may indirectly benefit the [Toxics in Aquatic Life Vital Sign](#).

Likewise, reducing nitrogen upstream of WWTPs may involve distributed treatment systems that reclaim wastewater via injection wells to groundwater or incentives for greywater reuse. These approaches are relevant to other NEP planning efforts (refer back to Box 7) and could potentially benefit the [Summer Low Flows in Streams and Rivers indicator](#) of the Streams and Floodplains Vital Sign.

Some WWTPs are located in low-lying areas that may be vulnerable to future flooding from sea level rise and extreme weather events induced by climate change. The facility planning required for major capital upgrades provides an opportunity to incorporate measures to mitigate new hazards that may appear in the next 50 years. Such planning is consistent with recommendations to improve long-term strategic planning in the [Shoreline Armoring Implementation Strategy](#) (Habitat Strategic Initiative 2021).

The development of King County's [Clean Water Plan](#) is an example of the type of integrated planning that could maximize co-benefits of nutrient removal. Technical documents prepared to support the plan include toxics reduction, groundwater recharge, and sea level rise as implementation considerations. (King County 2021).

2.4 DEVELOP A WATER QUALITY TRADING STRATEGY

Water quality trading is market-based mechanism that takes advantage of differentials in the cost of control measures for various pollutant sources to increase the economic efficiency of Clean Water Act compliance on a watershed basis (EPA 2003). However, nutrient trading programs are not a panacea for reaching nutrient goals at a lower cost given the number of potential barriers involving institutional obstacles, supply/demand problems, and geographic mismatches (NRC 2011).

This sub-strategy aims to reduce barriers associated with development of a Puget Sound nutrient water quality trading program. The intent of a trading program would be to provide regulated parties with more flexible and cost-effective alternatives to achieve NPDES effluent limits for nitrogen.

Generally, trades can occur between point sources (e.g., one WWTP is able to reduce loading at lower cost than others) or between point sources and nonpoint sources to allow point sources to meet limits without incurring expensive upgrades. Point to nonpoint trading is the most common type of trading program in the U.S. (Morgan and Wolverton 2008). In the case of the PSNGP, the magnitude of WWTP reductions expected in future permits is high enough that it is unlikely to be “traded away” exclusively via reductions in nonpoint loadings (Ecology 2021e). During efforts to develop a trading program for a Spokane River dissolved oxygen TMDL, it was found that purchase of credits was unlikely to a solution for full compliance with permit limits but was an option for obtaining the last few increments of reduction.

Another potential barrier to point-nonpoint trades is policy around trading baselines. EPA's original Water Quality Trading Policy required that the baseline for nonpoint trading is the level of pollutant load associated with compliance with applicable standards (EPA 2003). This means that watershed sources would have to achieve load reduction targets prescribed by an approved TMDL before being allowed to generate and sell any nutrient reduction credits. A subsequent memo acknowledged baseline requirements are often a barrier to entry into a market-based program and encouraged flexibility in implementing baseline concepts (EPA 2019a). Several comment letters on Ecology's draft trading framework by those involved in the

Spokane River dissolved oxygen TMDL seem to support the idea that baseline policy could affect participation in a trading program (Ecology 2018). Later in 2019, EPA requested public comment on various policy options regarding nonpoint source baselines for water quality trading in areas with a TMDL (EPA 2019b). Options included an incremental baseline approach; compliance schedules; Water Quality Standard variance; disaggregation of load allocations by geography, sector, or reduction practice; and in-lieu fee programs. Another EPA memo with additional changes or clarifications on trading baseline policy is likely forthcoming.

Some trading programs in other states allow trading only to address growth in effluent loads (e.g., due to increases in population) and only after all available onsite point controls have been implemented (Stephenson and Shabman 2017). This could take the form of one-time offset agreements, where the funding of a project or set of projects is negotiated to permanently offset an increase in discharges associated with expansion of a new point source in the watershed (Morgan and Wolverton 2008).

Ecology's (2018) Draft Water Quality Trading/Offset Framework identified the steps that would need to be followed to establish a trading program. First, proponents develop a trading/offset study proposal and submit it to Ecology for review. At this conceptual stage, proponents would have a scoping consultation with Ecology to confirm feasibility and identify next steps. Ecology responses to comment letters on the PSNGP indicate tribal consultation is appropriate at this stage (Ecology 2021e). Next, a Quality Assurance Project Plan (QAPP) must be prepared and approved by Ecology prior to any data collection needed to support studies conducted to address Ecology comments identified during the scoping consultation.

Some potential actions that could support and inform a proposal and/or regulatory discussions about water quality trading include research activities may be suitable for critical analyses by NEP partners or others are:

- A synthesis of information about nutrient trading programs in other large estuaries (e.g., Chesapeake Bay, Long Island Sound, San Francisco Bay). This could include compilation and evaluation of:
 - Market structure characteristics — types of trades allowed, credit allocation mechanisms, trading ratios and/or attenuation factors, mechanisms for determining and ensuring compliance; and
 - Program outcomes — number of trades, costs incurred, cost savings, achievement of water quality goals.
- Investigation of potential supply of and demand for nitrogen credits in individual watersheds or sub-basins. As recommended in Washington State Conservation Commission's (SCC) report to the Legislature on development of a water quality trading program (SCC 2018), any interviews with potential buyers and sellers should involve discussions about previously identified concerns related to certainty for point sources and lack of authority for point-source dischargers.

- Development of effectiveness monitoring and modeling capacity as described in Section 5.2 and approved in a QAPP. Attention would need to be paid to the spatial distribution of benefits and impacts; quantification of nitrogen removal (magnitude and level of certainty); load quantification certainty, temporal matching, additionality, and leakage (NRC 2011, Stephenson and Shabman 2017).

Progress has been made since the original draft of this report was completed. In 2022, Ecology received funding via a budget proviso to investigate and provide recommendations on draft structures for nutrient credit trading to achieve reductions for point source dischargers covered under the PSNGP. A second budget proviso in 2024 is supported implementation of the recommendations from PG Environmental (2023) and Ecology (2023).

The Draft Puget Sound Nutrient Reduction Plan indicated that Ecology is continuing to explore establishment of a nutrient credit trading program for the domestic WWTPs discharging into Puget Sound. Their next step is to conduct a market feasibility analysis. Ecology (2025) noted that a trading program may be a temporary measure to incentive early adoption and allow permittees to upgrade facilities.

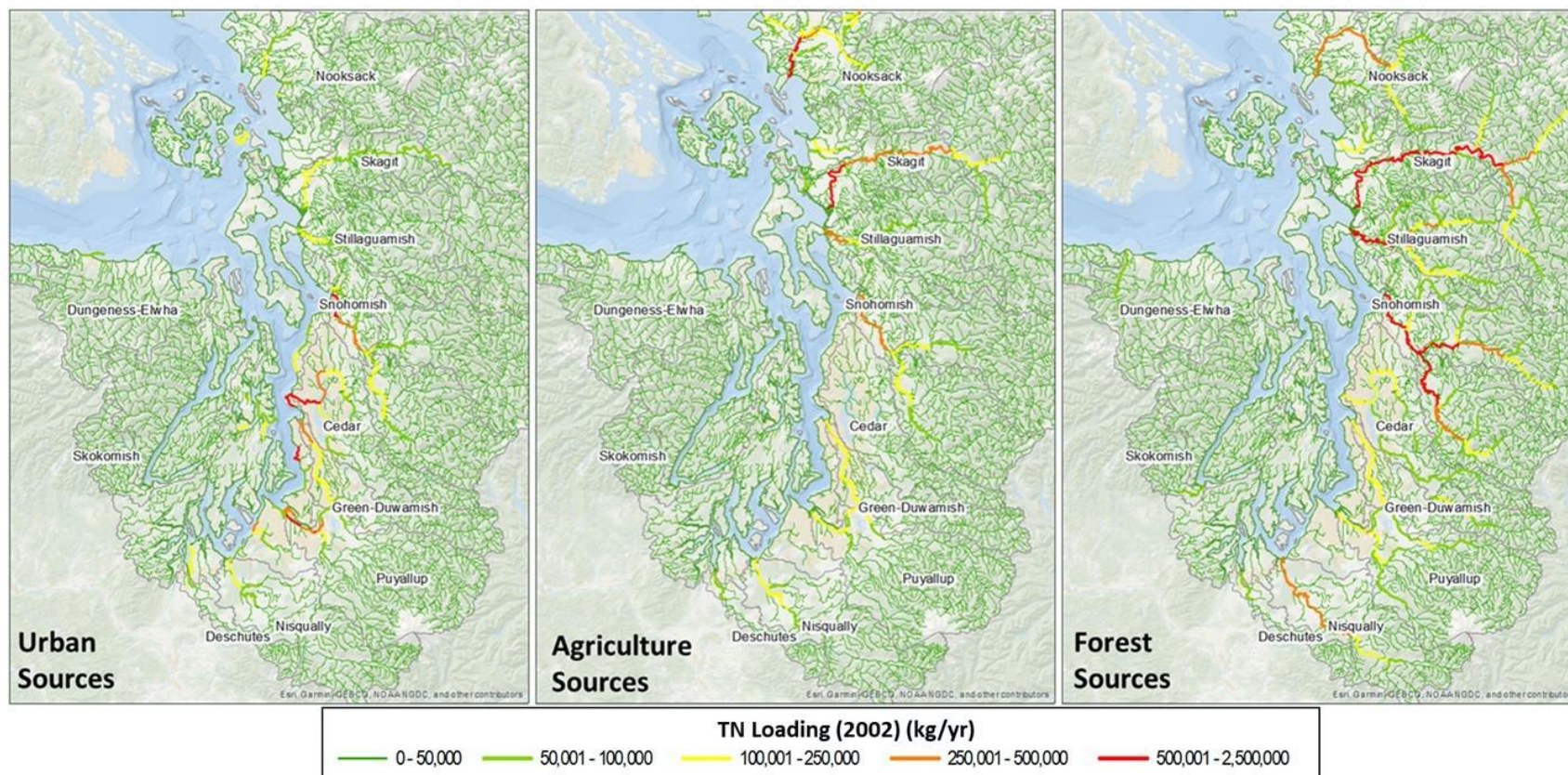
3. REDUCE URBAN STORMWATER AND AGRICULTURAL RUNOFF NUTRIENT LOADS

Urban stormwater and agricultural runoff can affect anthropogenic nutrient loads in waterways, resulting in excessive nitrogen and phosphorous loads. This strategy aims to reduce nutrient loads urban stormwater and agricultural runoff. Results chain MWQ.RC.2 identifies four sub-strategies expected to support achievement of the strategy objective:

- Implement agricultural management practices proven to reduce nutrient loads (MWQ.RC2.1)
- Implement actions to reduce nutrient runoff in stormwater (MWQ.RC2.2)
- Increase and stabilize funding that supports actions, incentives, and local capacity to implement nutrient load reduction actions and programs (MWQ.RC2.3)
- Create a behavior change campaign that supports the development and distribution of locally relevant outreach resources to improve the public's knowledge of their nutrient impacts on marine water quality (MWQ.RC2.4)

Figure 3 compares nitrogen loading from urban sources (stormwater, wastewater discharges into rivers, and on-site sewage systems), agricultural sources (livestock and fertilizer), and forests. McCarthy (2019b) summarized relative contributions of total nitrogen loading from various sources into Puget Sound from rivers, streams, and nearshore watersheds based on SPARROW model results for 2002. About half (46.9%) of the overall load was from urban sources, about a quarter was from forests (25.5%), and the remainder was from agricultural sources (16.6%) and atmospheric deposition (9.8%). The State of Knowledge appendix provides more information about sources of nonpoint pollution and the effectiveness of best management practices (BMPs) used to control those sources.

Figure 3. Estimates of Total Nitrogen loading from urban, agriculture, and forest sources



Source: SPARROW outputs for model year 2022. From McCarthy 2019(b).

The following sections of this report describe existing federal, state, and local programs that can support watershed nutrient reduction efforts.

NONPOINT POLLUTION PROGRAM

Ecology's [Nonpoint Pollution Program](#) is a key program for implementation of the Reduce Urban Stormwater and Agricultural Runoff Nutrient Loads Strategy. This program addresses pollution from agricultural, forestry, and residential sources through non-regulatory and regulatory methods. It was developed under Section 319 of the Clean Water Act, which created a grant program that provides states and Tribes funding to develop and implement nonpoint source pollution management programs. States are required to develop assessment reports that describe nonpoint source pollution problems and management measures being taken to address those problems. Ecology is currently updating the state's Nonpoint Plan. A draft of [Washington's Water Quality Management Plan to Control Nonpoint Sources of Pollution](#) was released for public comment in May 2025.

The Nonpoint Pollution Program supports local water quality assessments and watershed-scale water quality planning efforts; provides financial assistance for the voluntary implementation of water quality improvement projects at the site scale; and takes enforcement actions when necessary. Ecology works with other state agencies (e.g., Agriculture, Health, Natural Resources) and local partners (e.g., conservation districts, city and county governments, non-profit watershed groups) to support administration of, and provide a regulatory backstop for, programs addressing nonpoint source pollution. In addition to authorities associated with Ecology's Water Quality Program, other state regulations integrated into the Nonpoint Plan include (but are not limited to) the Growth Management Act ([Chapter 36.70A RCW](#)), Shoreline Management Act ([Chapter 36.70A RCW](#)), Hydraulic Code ([Chapter 77.55 RCW](#)), Dairy Nutrient Management Act ([Chapter 90.64 RCW](#)), Forest Practices Rules ([Title 222 WAC](#)), and on-site sewage system regulations ([Chapter 246-272A WAC](#)).

Ecology is developing [Voluntary Clean Water Guidance for Agriculture](#) (discussed further in section 3.1.2) alongside the Nonpoint Plan update. This technical resource for agricultural producers is intended to reduce uncertainty around what Best Management Practices (BMPs) are adequate (i.e., presumed to be in compliance with state water quality law) to address nonpoint pollution from a site.

3.1 IMPLEMENT AGRICULTURAL BMPs TO REDUCE NUTRIENT LOADS

Agricultural practices contribute to excessive nutrient loads in surface waters — particularly nitrogen and phosphorous. Agricultural activities directly adjacent to surface waters and the lack of functioning riparian areas create the potential for nutrient discharges to surface waters. Agricultural practices that are considered a source of nonpoint pollution include “excess fertilizers, herbicides, and insecticides...salt from irrigation practices ...[and] bacteria and nutrients from livestock (e.g. manure), pet wastes, and faulty septic systems” (Wong 2014).

Nitrogen loading from nonpoint sources can be corrected using pollution control measures such as agricultural BMPs (Box 10), but challenges to implementing voluntary programs, achieving expected load reductions, and enforcement are common barriers to the effective use of such measures.

Box 10. Agricultural Best Management Practices (BMPs)

BMPs are physical, structural, and/or managerial practices approved by Ecology that, when used singularly or in combination, prevent or reduce pollutant discharges.²⁹ They help to reduce nonpoint loading from both agricultural and urban sources to a level compatible with water quality goals.

There are several existing federal and state programs to help commercial and non-commercial agricultural producers design, fund, and implement BMPs and practices that protect water quality (including Ecology's Voluntary Clean Water Guidance for Agriculture). Examples include cover crops, conservation tillage, fencing, manure management, and riparian buffers.

This sub-strategy is cross-cutting with the [Shellfish Beds Implementation Strategy](#) "Provide and maintain sufficient farm waste management" strategy, which recognizes that regulatory and incentive-based programs are necessary to effectively address fecal pollution from pastures, manure storage facilities, and land application of manure.

3.1.1 COMPLIANCE, ENFORCEMENT AND GUIDANCE

[WAC 173-201-510\(3\)\(c\)](#) states that "the primary means to be used for requiring compliance with the [Clean Water Act] standards shall be through BMPs...that shall be applied so that when all appropriate combinations of individual best management practices are utilized, violation of water quality criteria shall be prevented." Furthermore "when applicable BMPs are not being implemented, the department may conclude individual activities are causing pollution in violation of [RCW 90.48.080](#). For example, [RCW 90.64.023](#) established a dairy farm inspection program for the purpose of "survey[ing] for evidence of [Clean Water Act] violations", "identify corrective actions", monitor dairy management plans and "identify producers who would benefit from technical assistance programs." [RCW 90.64.170](#) established a livestock nutrient management program implemented by Ecology.

Measuring of nonpoint source pollutants is challenging because impaired water bodies may have multiple causes including what is upstream of violations. Violators are expensive to identify, measure, and monitor and nutrient runoff may be originating from a variety of sources

²⁹ [WAC 173-201A-020](#)

including urban lands, forestry practices, mining practices and atmospheric deposition (in addition to agriculture). Efforts like the NRCS' Conservation Effects Assessment Project (CEAP) may help better understand trends in conservation practices and associated outcomes over time. The [CEAP survey](#) is a joint effort between USDA's Natural Resources Conservation Service (NRCS) and National Agricultural Statistics Service (NASS) to survey thousands of eligible farmer/operators nationally to estimate conservation practices and associated management and environmental outcomes "across the nation's cultivated cropland" (NRCS 2024). The first of three surveys will begin in 2024. Information from the surveys will be combined with field data and other information to determine trends and outcomes. The information analyzed by NRCS will be available in aggregate, to ensure compliance with federal confidentiality and privacy requirements are met for individual operators. Data provided by these surveys may provide additional information on the use of, and effectiveness of, conservation/best management practices that address and support nutrient reduction through non-point sources like agriculture.

3.1.2 VOLUNTARY CLEAN WATER GUIDANCE FOR AGRICULTURE

Ecology released the first set of thirteen chapters of its [Voluntary Clean Water Guidance for Agriculture](#) in March 2022. The guidance documents are a "technical resource for agricultural producers that describes Ecology's recommended BMPs". Ecology states that as long as "an operation uses suites of [BMPs] consistent with the recommendations in this guidance...Ecology will presume that water quality is being adequately protected by [a farm/livestock] operation". Ecology worked with an [advisory group](#) to evaluate BMP effectiveness, develop BMP recommendations, and outline implementation considerations.

At the time of writing, five chapters have been reviewed and supported by EPA: *Cropping Methods: Tillage and Residue Management*; *Livestock Management — Pasture and Rangeland Grazing*; *Sediment Control: Soil Stabilization and Sediment Capture (Structural)*; and *Riparian Areas and Surface Water Protection*; and *Livestock Management — Animal Confinement, Manure Handling, and Storage*.

The remaining eight chapters will be included in Ecology's 2025 update to the [state's Nonpoint Pollution Plan](#). At the time of writing, drafts are available of three chapters: *Runoff Control from Agricultural Facilities*; *Vegetative Sediment Control*; and *Irrigation Management*. The five remaining chapters are: *Cropping Methods: Crop System*; *Nutrient Management*; *Pesticide Management*; *Water Management: Field Drainage and Drain Tile Management*; and *Suites of Recommended Practices*.

Within the guidance document Ecology acknowledges that despite the presumption that water quality should be protected by an operation following its BMP recommendations, if "there is a documented discharge of pollution to state waters that has a significant impact...Ecology may take additional action [which could include] working with a producer to implement additional practices or to improve execution of existing practices."

The first chapter of Ecology’s [Voluntary Clean Water Guidance for Agriculture](#) covers cropping methods: tillage and residue management to protect water quality. In this chapter Ecology covers conservation-based tillage and residue management to reduce soil erosion. The document recommends several practices regarding tillage and recommends working with the regional NRCS office and local Conservation Districts. The document includes success stories of adoption conservation tillage, resources for cost-share and technical assistance programs (including the EQIP program – see section 3.1.4 for details) and compares specific tillage practices including no-till, strip till, direct seed, ridge till, mulch till, and conventional tillage.

The following BMPs are recommended to be used in conjunction by Ecology and will be detailed in subsequent chapters of the Voluntary Clean Water Guidance for Agriculture:

- Riparian buffers (to control and reduce risk of nitrogen or other nutrients from transport offsite and offers surface water protection)
- Nutrient management — application of “fertilizer at agronomic rates and at times when risk of runoff is low
- Livestock and pest management — to reduce nitrogen in runoff; technical assistance and PIC programs, proper manure storage and handling

The next sections of this document provide details on the types, efficacy, and challenges of reducing nonpoint source nutrient loading through agricultural BMPs. These sections detail the cost-share and technical assistance programs in Puget Sound that support, fund and help to implement agricultural BMPs.

3.1.3 RIPARIAN BUFFER BMPS – LITERATURE AND ANALYSIS

BACKGROUND TO RIPARIAN BUFFERS IN PUGET SOUND

Riparian buffers are one type of BMP that voluntary programs provide cost-share assistance to install. A brief literature review of riparian buffer BMPs in Puget Sound is provided prior to details on individual programs that support the installation of riparian buffers. Additional information can be found in the accompanying State of Knowledge appendix.

According to Washington Department of Fish and Wildlife’s (WDFW) “Riparian Ecosystems, Volume 1: Science Synthesis and Management Implications” report, the “pollutant removal function of riparian areas has been studied for at least 40 years [but]...despite the large quantity of research...no widely accepted recommendations have emerged on minimum buffer widths needed to protect water quality” (Quinn et al. 2020). Quantification of pollutant removal occurs through a measure known as removal efficacy (or removal efficiency).

WDFW’s meta-analysis of published data found that to achieve 90 percent removal efficacy buffers required, at minimum, widths ranging anywhere from 33, 39, 75 and 170 ft. In a

separate study, 90 percent removal efficacy was predicted with buffer widths of 80 ft. — while another found 436 ft. to yield a similar efficacy. Furthermore, another study found that buffer width alone (barring other factors) yielded 44 percent “of the variance in nitrogen removal results”, while another found that “buffer width explained only 9 percent” (Quinn et al. 2020).

WDFW’s report states that while “management decisions...should be made by science...determining the “right” buffer width for pollutant removal cannot be purely scientific.” It is instead a “social choice” that requires “factual information” (for instance, best available science), “understanding stakeholder’s preferences” and a “process for using science and values to explore tradeoffs amongst policy options” like a decision support tool, or similar stakeholder-informed policy decision tool (Quinn et al. 2020).

Additional literature suggests that increasing buffer width may not yield clear ecological benefits as varying stakeholders, tribes and agencies support fixed-width buffers versus variable width buffers. Proponents of each claim differing results for their ability to support ecological restoration, such as improving water quality and salmon habitat while supporting agricultural landowners’ preferences (Quinn et al. 2020).

According to the Washington State Conservation Commission (SCC), which implements the Conservation Reserve Enhancement Program for the installation of riparian buffers (see section 3.1.4 for details on this program), beginning with a minimum buffer width (in this case 50 feet) for a voluntary program can assist with implementation. This is because landowners may then be in favor of increasing the buffer width after meeting and speaking with technicians and after seeing successful results of the program, according to the SCC’s *CREP Effectiveness Monitoring Report*.³⁰ The average buffer width for the CREP program is 142 feet.

KING COUNTY’S BUFFER TASK FORCE

King County’s Fish, Farm, Flood Advisory Committee’s Buffer Task Force provided recommendations on the “dimensions and locations of voluntary riparian buffer plantings on private property as well as estimate[s] the potential acreage of farmland that could be converted to riparian buffers [in King County]” (King County 2020). The Task Force constructed logic models for each type of watercourse and evaluated what riparian functions were most critical for types of streams or reaches. The technical team used the synthesis to propose a set of variable width buffer recommendations that were then adjusted by the Task Force members to come to a final set of recommendations supported by fish and agricultural interests (Kubo et al. 2019).

Regarding participation, King County (2020) found that **“further incentivization would be important for a landowner to participate in voluntary riparian planting.”** Members of the

³⁰ [2013 Implementation and Effectiveness Monitoring Results for the Washington Conservation Reserve Enhancement Program \(CREP\): Buffer Performance and Buffer Width Analysis;](#)

Buffer Task Force expressed that **payments would likely be needed to make up for lost production potential on active farms.**

Regulatory implications were also noted – in particular it was recognized that once trees get to a 4” diameter at breast height within 165’ of the watercourse they become part of the Critical Area in King County. This results that riparian area being no longer being farmable. The Buffer Task Force recommended that the “implementation workgroup...discuss the potential for minimum buffers in order to ensure that plantings funded by public dollars are providing a legitimate ecological benefit and work on identifying incentives that help accelerating plantings” (King County 2020).

An appendix to the Buffer Task Force report includes a decision flow chart that can assist in determining voluntary riparian buffer widths for plantings based on type of watercourse type, features of the waterway (such as banks, tree canopy shade, etc.).

MINIMUM BUFFER WIDTH REQUIREMENTS FOR ECOLOGY FINANCIAL ASSISTANCE

Projects in agricultural landscapes funded through Ecology’s Water Quality Combined Funding Program (Section 319 grants, Centennial Clean Water Fund grants or loans, CWSRF loans) are required to meet National Marine Fisheries Service (NMFS) buffer width recommendations.³¹ The 2012 NMFS buffer table sets minimum widths based on the type of stream (constructed, fish bearing, confined/unconfined, intertidal, adjacent land use, etc.). Ecology’s most recent interpretation of the NMFS guidelines for applicants specifies: 35 foot minimum for constructed ditches/intermittent streams; 50 foot minimum for perennials waters not identified as being accessed and were historically not accessed by anadromous or listed fish species; 100 foot minimum for streams that are or were accessed by anadromous or ESA listed fish species; 75 foot minimum for intertidal and estuarine streams and channels that are identified as being accessed or were historically accessed by anadromous or ESA listed fish species.³²

RIPARIAN BUFFER LEGISLATION

In December 2021, Gov. Jay Inslee proposed legislation to award \$187 million in new salmon recovery actions³³. Several aspects of this proposed legislation involved expanding riparian buffer protection programs including:

- \$17.3 million to fund the establishment of a ‘riparian protection zone’ and a ‘statewide riparian plant propagation program’ as well as “providing technical support and enforcement

³¹ [Interim Riparian Buffer Recommendations for Streams in Puget Sound Agricultural Landscapes](#)

³² [FY24 Funding Guidelines for the Water Quality Combined Funding Program](#)

³³ Inslee salmon recovery brief 2021

capacity to local jurisdictions to incorporate salmon recovery into GMA and SMP regulations”³⁴

- \$100 million to create a new Riparian Habitat Conservation Grant at the Recreation and Conservation Office
- \$5.264 million to implement “new tools and incentives to advance and accelerate riparian buffer implementation” through Ecology’s [Centennial Clean Water Program](#) grants

In January 2022, the Governor’s Office and Senators Rolfes (Kitsap County), Dhingra (Skagit County), among others, introduced [Senate Bill 5727](#) (known as [HB 1838](#) in the House), also known as the Lorraine Loomis Act, to protect, restore, and maintain habitat for salmon recovery³⁵. SB 5727 would amend and adds new sections to several RCWs, including [RCW 77.85](#) on salmon recovery, [RCW 36.70A](#) on growth management planning, and [RCW 90.58](#) on the Shoreline Management Act.

The Act would have required a “riparian management zone” for areas that must be “protected and restored” and apply the “statewide standard to state and local land use planning, permitting and incentive programs, water quality protection, enforcement of regulatory programs, and financial and technical assistance programs.” Riparian management zones are those defined by the WDFW’s riparian guidance documentation.

Additional requirements of the Act included the development of a publicly available GIS “map that illustrates the riparian management zone...for each watershed”. Additionally, the Act included a “statewide riparian habitat conservation grant program” once the maps are complete to cover the costs of implementing riparian buffers. The cost-share program would cover at least 70 percent of a “landowners’ cost to establish and maintain” and up to 90 percent. If a landowner is found to violate the rules, they may be subject to a penalty of up to “\$10,000 a day for each violation”. This is in addition to enforcement activities from Ecology “who may also take actions to enforce any water quality standard violation” that may result from landowners’ activities.

Significant push-back from landowners and agricultural groups, including the Washington State Dairy Federation, led lawmakers to reject the bill in favor of increased funding for voluntary conservation programs as of April 2022. New funding proposed by the legislature includes increased allocation for VSP, CREP and a new, un-named buffer incentive program, as well as the convening of a riparian habitat work group.³⁶

³⁴ *ibid*

³⁵ <https://app.leg.wa.gov/billsummary?BillNumber=5727&Year=2021&Initiative=false>

³⁶ https://www.capitalpress.com/ag_sectors/water/washington-lawmakers-nix-forced-buffers-embrace-conservation

3.1.4 COST-SHARE AND TECHNICAL ASSISTANCE PROGRAMS

The United State Department of Agriculture’s Natural Resource Conservation Service (NRCS) provides financial and technical assistance to landowners, groups, organizations, tribes, and local and state government through voluntary conservation programs for the purpose of conserving and managing soil, water, and natural resources. Several of these programs are relevant for the Marine Water Quality IS.

BACKGROUND OF THE NRCS

The NRCS was created as the Soil Conservation Service and in 1994 changed its name to the National Resource Conservation Service to reflect the breadth of the organization’s activities. NRCS implements several programs in the conservation component of the Agricultural Improvement Act of 2018 and 2014 (also known as the 2014 and 2018 Farm Bills). The NRCS administers conservation programs including the Environmental Quality Incentives Program (EQIP), Agricultural Conservation Easement Program, Regional Conservation Partnership Program (RCPP), Conservation Stewardship Program, the Conservation Innovation Grant Program (a sub-program of EQIP), the Healthy Forests Reserve Program (a sub-program of RCPP) and provides Conservation Technical Assistance (CTA).

In 2018 NRCS received \$5.2 billion in funding, which decreased to \$4.953 billion in 2020³⁷. Overall spending for USDA conservation programs is projected to decrease slightly from 2020 through 2023.

Figure 4 indicates the portion of funding each program has historically been allotted and is projected to receive through 2023. According to the USDA’s Economic Research Service, “funding will increase for the Agricultural Conservation Easements Program (from \$250 million to \$450 million annually) and the Regional Conservation Partnership Program (\$100 million to \$300 million annually).”³⁸ Figure 5 shows how this spending was allocated among major USDA conservation programs.³⁹

³⁷ <https://www.usda.gov/our-agency/about-usda/budget>

³⁸ <https://www.ers.usda.gov/publications/pub-details/?pubid=93025>

³⁹ <https://www.ers.usda.gov/webdocs/charts/60997/2018farmactspending.png?v=127.6>

Figure 4. Annual Spending for Major USDA Conservation Programs 1996 to 2023

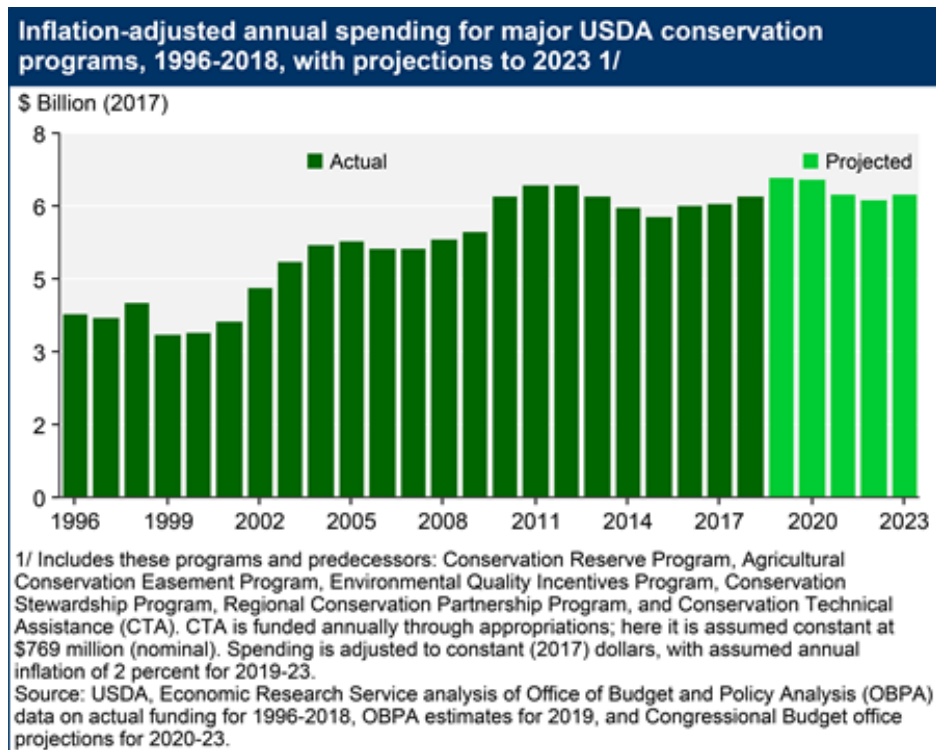
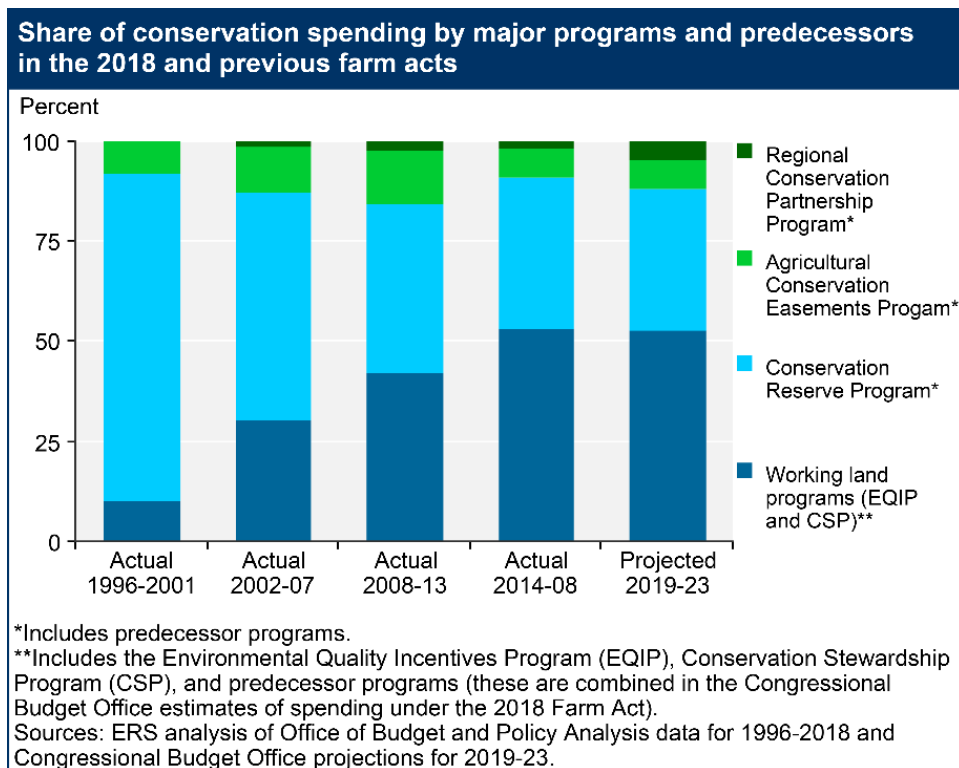


Figure 5. Allocation of Spending by Major USDA Conservation Program



CONSERVATION RESERVE ENHANCEMENT PROGRAM

Conservation Reserve Enhancement Program (CREP) is a joint federal and Washington State-funded program that provides financial assistance to landowners to voluntarily establish and maintain riparian buffers in agriculture⁴⁰ with a contract period running 10 to 15 years. The SCC provides technical support and resources to local conservation districts with the USDA Farm Service Agency administering the program on the federal level. Specific landowner measures funded by CREP include the installation of riparian buffers that seek to decrease water temperature in the “decade following riparian restoration”⁴¹ through increasing shade and canopy cover, implementing a variety of BMPs (such as grass filter strip) and enhancing wetlands. SCC reports annually on the “statewide implementation and efficacy of CREP”.

The SCC reports that Washington has over 1,067 CREP projects that cover 11,426 acres along approximately 634 miles of streams as of 2020. Since program inception, CREP has restored approximately 850 miles (425 miles of stream length). CREP currently has approximately 9,600 miles in the program⁴² with 59 new CREP projects implemented beginning in 2019.⁴³ According to the SCC, approximately 6,336 miles that need to be restored are on private agricultural land. Wetland enhancement acreage numbers nearly 309 acres with nearly 9 acres of grass filter strip implemented in 2019. According to the SCC, projects that are “five to ten years old are already averaging 72 percent canopy cover along small streams”. 93 CREP contracts were re-enrolled in 2019⁴⁴. Based on observations conducted by SCC in 2019, stream canopy cover on large streams at all sites was 71 percent and 78 percent on small streams. Although CREP measures restoration in miles and acres, literature suggests that acres and miles of stream-side restoration may not directly equate with nitrogen reduction outcomes (Bernhardt et al. 2005).

A summary of individual Puget Sound Conservation District Participation in CREP is provided in Table 4.

⁴⁰ <https://kingcd.org/programs/better-water/conservation-reserve-enhancement-program/?highlight=crep>

⁴¹ *ibid*

⁴² B. Cochrane, personal communication, August 2020

⁴³ <https://scc.wa.gov/crep/>

⁴⁴ *ibid*

Table 4. Individual Puget Sound Conservation District Participation in CREP⁴⁵

Conservation District	Projects	Miles	Acres	New 2019 Projects	Re-enrolled Projects	Notes
King	4	1.25	8.51	N/A	N/A	2015-2018
King	No data available	634.4	11,426	7 ⁺	3	Since all time. *SCC data combines Snohomish and 'North King County' as one entry.
Pierce	No projects since 2017	No data available	N/A	None	None	N/A
Thurston	6	3.2	47.03	1 ⁺	None	2015-2018
Lewis	82 ⁺	48	818 - 907	4 ⁺	3	
Snohomish	31 new CREP projects (plus 6 re-enrollments)	98,341 linear feet of stream planted (18.6 miles)	206.47 acres planted	7 ⁺	3	2015-2020 *SCC data combines Snohomish and 'North King County' as one entry.
Skagit	No projects since at least 2015			1 ⁺	2	
Whatcom	438	220	2,942	22 ⁺	16	
Washington State Totals	845 (since project inception)	425 miles of stream length	13704.85 (cumulative) 645 (new in 2019)	59	93	

⁴⁵ The data presented in this table was provided by representatives from each Conservation District. According to the SCC's "Implementation, Effectiveness Monitoring, and Financial Report for the Washington Conservation Reserve Enhancement Program (CREP) for Federal Fiscal Year 2019", which used data from the FSA, slight discrepancies in the number of projects and acreage have been reported. Based on input from the SCC, the data provided by the conservation districts is reported here unless it was unavailable. In that case, the data is from the SCC report, indicated by a ⁺.

Success of CREP in Washington

A 2013 report stated that Washington's CREP "has demonstrated success at the landowner level to improve riparian conditions for salmon and water quality" by installing riparian buffers.⁴⁶ According to the SCC, CREP projects in Washington have varying buffer widths spanning a minimum of 35 feet to a maximum of 180 with an average of 142 feet. From 2000 to 2018 the mandated buffer width was 35 feet. Since 2018 the minimum width increased to 50 feet as mandated by the NRCS to "promote greater function with respect to shade and stream bank stability".⁴⁷

Future of CREP in Washington

A 2019 SCC analysis suggests that the CREP program should "increase financial incentives to increase participation" and "target contiguous landowners within a watershed". BMPs, like riparian buffers, implemented through CREP are parcel-based. However, to achieve a watershed-scale effect CREP coverage needs to increase to "60-80% coverage [in a watershed] to get past the biological threshold in order to see how stream function has improved"⁴⁸. The current CREP budget for the 2018-2020 biennium is \$3.7 million. SCC is requesting \$6.8 million in new funding for the 2021-2023 biennium.

ENVIRONMENTAL QUALITY INCENTIVES PROGRAM

Through the Environmental Quality Incentives Program (EQIP), USDA's NRCS provides financial and technical assistance incentives to plan and implement voluntary conservation practices. Conservation practices include water, soil, air quality improvement, enhancing wildlife habitat, improving the resiliency and productivity of agricultural lands, and helping producers in meeting sustainability measures. Nationally, the EQIP budget in 2019 was \$1.75 billion. Based on the 2018 Farm Bill, EQIP is projected to increase to \$2.025 billion by fiscal year 2023⁴⁹. In 2019, Washington State had a \$15 million EQIP budget with the Puget Sound region apportioned \$1.5 million.

EQIP is a cost-share program that covers 75 to 90 percent of the costs associated with implementing conservation measures. The rates of allocation/distribution are established by NRCS economists based on cost of labor, supplies (cost of equipment, for example) and other economic factors to implement the practices required by EQIP.

Eligible landowners include agricultural producers, nonindustrial private forestland (NIPF) owners and tribes. Eligible land includes cropland, rangeland, pastureland, nonindustrial private

⁴⁶ [2013 Implementation and Effectiveness Monitoring Results for the Washington Conservation Reserve Enhancement Program \(CREP\): Buffer Performance and Buffer Width Analysis](#);

⁴⁷ B. Cochrane, personal communication, May 2020

⁴⁸ B. Cochrane, personal communication, May 2020

⁴⁹ <https://www.nacdnet.org/2019/01/08/2018-farm-bill-breakdown-eqip/>

forestland and other farm or ranch lands.⁵⁰ EQIP applicants can receive technical assistance services, covered by NRCS, for on-site assessments, site-specific management plans, engineering assistance for designs including irrigation upgrades, practices to upgrade manure management, irrigation, forest management, erosion control/buffers, planting, etc. Certain groups of landowners (termed historically underserved producers) may qualify for additional assistance (up to 90 percent) including increased payment rate and opportunity to receive advance payment of up to 50 percent for the purchase of qualifying materials and services needed. Historically underserved producers include:

- Socially disadvantaged farmers (of or belonging to racial or ethnic groups that have been prejudiced against as according to the 2008 Farm Bill⁵¹ and further clarified in the 2018 Farm Bill⁵²)
- Beginning and limited resource farmers (landowners with less than 10 years of experience)
- Indian tribes and veterans (who are beginning farmers)

NRCS offers a ‘limited resource farmer/rancher’ tool to determine qualification status based on income and region.⁵³

EQIP has several sub-programs with different criteria. A discontinued program, the [National Water Quality Initiative](#), assisted producers in implementing conservation and management practices through a systems approach to control and trap nutrient and manure runoff. Funding for the program was allocated only to certain eligible watersheds in 2016, the last year the program was offered. Eligible watersheds were listed as impaired according to CWA section 303(d).⁵⁴

The **Puget Sound EQIP local working group**, one of three state-wide working groups, meets annually to “discuss natural resource issues, opportunities, and priorities” and provide recommendations to help develop local NRCS conservation programs. The Puget Sound working group covers the same counties as the NRCS Puget Sound regional office: Thurston, Kitsap, Mason, Pierce, and King.⁵⁵ The local working group competitively ranks applications according to national, state and local priorities to “achieve the greatest conservation benefits in coordination with EQIP statutory priorities” (established by the NRCS National Office and

⁵⁰ <https://www.nnrg.org/resources/eqip/>

⁵¹ http://www.nrcs.usda.gov/programs/farmbill/2008/pdfs/sdrbf_at_a_glance_062608final.pdf

⁵² <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/people/outreach/slbfr/>

⁵³ <https://lrftool.sc.egov.usda.gov/determinationtool.aspx?fyyear=2020>

⁵⁴ [https://www.nrcs.usda.gov/wps/portal/nrcs/detail/null/?cid=nrcs144p2_031016#:~:text=The%20EQIP%20National%20Water%20Quality,Environmental%20Protection%20Agency%20\(EPA\)](https://www.nrcs.usda.gov/wps/portal/nrcs/detail/null/?cid=nrcs144p2_031016#:~:text=The%20EQIP%20National%20Water%20Quality,Environmental%20Protection%20Agency%20(EPA))

⁵⁵ <https://www.nnrg.org/resources/eqip/>

incorporated in individual state priorities).⁵⁶ Funding is distributed to Washington’s 10 local groups and one tribal work group.

Additional information on the EQIP program can be found in the Land Development and Cover BPA (Wright 2020b).

REGIONAL CONSERVATION PARTNERSHIP PROGRAM

The NRCS’s Regional Conservation Partnership Program (RCPP) was authorized by the 2014 Farm Bill and funds several program components throughout the country. Through RCPP, NRCS partners with state and local agencies and non-governmental organizations to provide financial and technical assistance to landowners to “design and implement conservation solutions”.⁵⁷

Unlike other NRCS programs, landowners do not apply directly to NRCS for funding for projects, but NRCS selects proposals from partner organizations like land trusts, conservation commissions and other entities. According to Washington Farmland Trust, RCPP is a unique program because it “offers a more coordinated approach with different partners” and offers “more security than programs like ACEP because ACEP requires competition between different projects [to determine what projects are awarded funding]”. In Washington, the Puget Sound RCPP is a partnership with the NRCS and the SCC with a goal of making coordinated investments that fund conservation practices within specific watersheds in Puget Sound, like the Puyallup River watershed (see details in table below). Landowners within a specific watershed can request cost-share assistance to complete customized best management practices (BMPs) for improving water quality and salmon habitat.

Funding

Nationally, of the total funding allocated to conservation programs by the USDA from 1996 to 2023, RCPP’s portion increased from 0 percent through 2001 to 1.7 percent through 2007 to 4.7 percent in 2019 projected through 2023. RCPP was allocated \$100 million fiscal year 2019 which is projected to increase to \$300 million annually by fiscal year 2023, as authorized through the 2018 Farm Bill. Before the 2018 Farm Bill, RCPP was funded with a mixed of “dedicated funding and a percentage of funds from donor programs (like EQIP, ACEP and CSP)”⁵⁸ Through the 2018 Farm Bill, NRCS now operates RCPP as an independent program with its own designated funding.⁵⁹

The Puget Sound region, through the SCC, has been awarded \$9 million in RCPP funding over a period of five years beginning in 2015. That funding enables SCC to make “coordinated

⁵⁶ <https://www.federalregister.gov/documents/2019/12/17/2019-26872/environmental-quality-incentives-program>

⁵⁷ <https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/financial/rcpp/?cid=nrcseprd1459034>

⁵⁸ <https://www.nacdnet.org/2019/01/10/2018-farm-bill-breakdown-rcpp/>

⁵⁹ <https://www.ers.usda.gov/topics/natural-resources-environment/conservation-programs/>

investments that fund several conservation practices within a specific watershed or portion of a watershed.⁶⁰ Through SCC and project partners, in-kind matching contributions can be made between when a project is selected and when a “formal partnership agreement is signed with NRCS” which allows money to be promised to landowners immediately upon project selection rather than waiting for a project to start or be under-way.

Puget Sound Focus

In fiscal year 2020, Washington State was awarded a total of \$1.4 million. In 2020, 30,934 acres were receiving RCPP conservation practices⁶¹, an increase from 28,463 in 2019 and 23,410 in 2018. A total of 795 “counts” (individual practices, which may be applied in conjunction with practices on the same land) were recorded in 2020. Practices include Cropland Soil Quality, Cropland Soil Health, Fish & Wildlife Habitat, Forest Land Conservation, Grazing Land Conservation, Irrigation Efficiency, Water Quality, and Wetlands. Approximately 19% of land unit acres receiving conservation under the RCPP program was for nutrient management.⁶² In Puget Sound, SCC administers projects in the five selected areas of restoration. The areas were selected in part through the Nature Conservancy’s 2016 map and webpage, *Opportunity Assessment for Targeted BMPs in Puget Sound* (detailed in Section 3.1.7), for the RCPP steering committee “to direct funding and inform decisions”.⁶³ According to the SCC, “priority areas” for Puget Sound RCPP projects are organized by watershed. Results in Table 5 are from the SCC’s final report for the RCPP-funded “Precision Conservation for Salmon and Water Quality in Puget Sound ” project (Joy 2021).

⁶⁰ <https://scc.wa.gov/pugetsound-rcpp/>

⁶¹ https://www.nrcs.usda.gov/Internet/NRCS_RCA/maps/cp_rcpp_maps.html

⁶² https://www.nrcs.usda.gov/Internet/NRCS_RCA/reports/srpt_cp_rcpp.html#wq

⁶³ https://scc.wa.gov/wp-content/uploads/2016/06/TechReport_Opportunity-Assessment-for-Targeted-BMPs-in-Puget-Sound_2016.pdf

Table 5. Puget Sound Priority Project Areas, Activities and Accomplishments Funded by RCPP 2015 to 2021⁶⁴

Project Area (Watershed)	Project Description	Activities	Accomplishments	Partners
Newaukum Creek (Snoqualmie)	Improve water quality for salmon	Completed streamside restoration projects that lower stream temperature and help reduce nutrients and fecal coliform entering the stream	Established 2.3 acres of vegetated riparian buffers Implemented 3 waste storage facilities Installed 2,384 ft. of fencing Contracted wide variety of nutrient management project with producers for practice installations *Note: data demonstrating water quality improvements is not yet available	King County, American Farmland Trust , King Conservation District , SCC, Ecology, NRCS, National Fish and Wildlife Foundation (NFWF)
Nookachamps Basin	Improve water quality and salmon habitat	Lower stream temperature, install bank stabilizing large woody debris (LWD) to improve fish habitat and reduce bank erosion, install livestock exclusion fencing, install small-scale structural BMPs for manure storage	Established 3 riparian forest buffers, installed 2 livestock exclusion fences, 1 pumping plant and 1 roof runoff structure Additional projects completed with RCPP funds include advanced waste treatment practices project such as: installation of 4 waste separation facilities, 3 irrigation pipelines, 8 waste storage facilities (new or upgrades), 4 waste facility closures, 2 pond sealing/lining with compacted soil treatment, 5 pumping plants, 8 waste transfer projects, 2 underground outlets, 1 roof and covers, 1 structure for water control, and 1 vegetated treatment area; additionally, partner contributions funds were utilized to assist 21 producers to implement nutrient management practices on dairies	Skagit County Public Works, Skagit Fisheries Enhancement Group, Skagit Conservation District, PIC program of Skagit County
Snohomish / Skykomish Rivers	Improve water quality and fish habitat for ESA-listed salmonids	Reduce nutrient loading through improved nutrient management, remove in-stream fish barriers	Installed 8 riparian forest buffers, 4 livestock exclusion fences, 2 watering facilities, 1 stream crossing, and 1 aquatic organism passage to improve fish habitat and water quality in addition to 2 waste separation (nutrient management) practices, 5 waste transfer (nutrient management) practices, 4 pumping plants, 2 roof runoff structures, 1 underground outlets, 2 heavy use areas, 1 sprinkler system, 1 waste storage facilities, 1 sediment basin, and 1 composting facility to protect and improve water quality from nutrient run-off	Snohomish Conservation District , Tulalip Tribes, City of Monroe, Local producers, Qualco Energy, Adopt-a-Stream Foundation, Ecology, Puget Sound Natural Resource Alliance, Sustainable Land Strategy

⁶⁴ Washington State Conservation Commission (WCCC) Precision Conservation for Salmon and Water Quality in Puget Sound Final Report, 2021. Request Access.

Stillaguamish Watershed / Skagit Bay Drainage	Improve water quality, soil health, and fish passage projects for ESA-listed salmonids	Remove in-stream fish barriers, improve soil health through increased organic matter and carbon sequestration, reduce nutrient loading through improved nutrient management through the Soil Health, Nutrient and Fish Passage Management Systems Project	Nutrient management projects completed include working with one dairy farm and one beef facility. Projects on the dairy farm included: 1 waste facility (manure lagoon) closure, pond lining for a 2nd lagoon and waste transfer for field application of solid manure. At the beef facility projects included: 1 sprinkler system, buried waste transfer line, and nutrient management practices to facilitate proper storage and application of nutrients. Additional nutrient management practices included: 3 waste transfers, 1 heavy use area, and 1 roof and covers project. To improve salmonid habitat work completed included: an aquatic organism passage practice – a bridge for improved salmonid habitat access and stream crossing with one producer, 2 stream crossings and a stream habitat improvement and management practice were also completed, 365.5 acres of cover crops implemented with 4 producers to improve soil health and water quality, and 9 riparian forest buffers installed	Snohomish Conservation District, Stillaguamish Watershed Council, Stillaguamish Clean Water District, Local producers, SCC, NRCS, Stillaguamish Tribe of Indians
Thomas Creek (Skagit)	Reduce fecal coliform pollution impacting shellfish harvest areas in Samish Bay	Working with livestock landowners to implement BMPs for manure management, preserve farmland through conservation easements, and restore stream-side areas	Five landowners are utilizing RCPP financial assistance funds to complete livestock nutrient management and salmonid habitat enhancement practices to protect water quality including: 3 heavy use protection areas (.93 acres), 17 waste transfer projects, 3 waste separation facilities, 8 pumping plants, 4 roofs and covers, 2 roof runoff structures, 6 nutrient management projects covering 1,125 acres, 479 feet of hedgerow planted, 2 tree/shrub site prep and 1 tree/shrub establishment, 11.8 acres of riparian forest buffer installed, 3 waste storage facilities, 1 sprinkler system, 3 waste recycling projects, 1,723 feet of fence installed, 1 new livestock pipeline, 1 watering facility installed, 1 underground outlet, 1 waste facility closure, 1 access control, 51.1 acres of cover cropping, and 3 prescribed grazing projects. 36 additional nutrient management practices were completed utilizing partner contributions funds only including: 4 waste storage facilities, 1 roofs and covers, 1 fence, 2 cover crops, 1 riparian forest buffer, 1 pumping plant, 9 roof runoff structures, 4 heavy use protection areas, 2 subsurface drains, 2 watering facilities, 2 underground outlets, 1 waste separation facility, and 3 waste transfers	Skagit Conservation District, Skagit County, Samish Tribe, NRCS, Skagitians to Preserve Farmland

LESSONS LEARNED FROM NRCS PROGRAMS

As part of the final close-out report for the RCPP grant-funded “Precision Conservation for Salmon and Water Quality in Puget Sound” project, SCC included a ‘lessons learned’ section based on interviews with project leaders (Joy 2021). Highlights of the report include:

- Project selection was aided by existing Clean Water Act initiatives and outreach rather than brand-new projects – which were harder to establish and implement
- Rules surrounding EQIP, particularly the Comprehensive Nutrient Management Plan (CNMP) for EQIP enrollment funding requirements, created “confusion” that was exasperated by a lack of clarity around NRCS’ role and a lack of NRCS staff capacity; this was additionally made more challenging due to the strictness of EQIP funding and whether it was applicable to certain types of “precision conservation” projects. These included projects to install riparian buffers which were only cost-shared at “a third or maybe a quarter of the cost” according to project leader interviews. This could be remedied through “increas[ing] NRCS capacity and engagement for RCPP” to engage “from the start to finish” of projects, the report stated
- **Matching funds requirements in general were challenging** – they had different rules for different types of projects (e.g. buffer projects), multiple applications, invoices, pay rates, coordination and the additional challenge of project leaders not wanting to “line up a landowner [for a project] and then cancel because you didn’t get a state match” stated one organization representative
- Effective outreach and recruiting included “door-to-door efforts”, using conservation districts’ tried and true conservation outreach methods (newsletters, tours, targeted mailings, workshop with landowners, etc.)
- **A lack of common and consistent monitoring and measuring frameworks** including a lack of a “common way of measuring” – for example, measuring of BMPs implemented varied between “plant survival, miles of buffers planted, feet of fencing, fish passages built. Number of landowners enrolled and number of BMPs implemented were also cited as measurements.”

VOLUNTARY STEWARDSHIP PROGRAM

The Voluntary Stewardship Program (VSP) was established in 2011 through the recommendations of the Ruckelshaus Center report as described in [RCW 36.70A.700](#) and through the legislature enacting Engrossed Substitute House Bill (ESHB) 1886. VSP is an alternative to critical area regulations on lands where agricultural activities occur and is unique to Washington State. VSP was developed following several legal challenges to critical area ordinance regulations that directed farmers to remove land from production in order to meet riparian buffer requirements, which would reduce the economic viability of agricultural operations.

The Voluntary Stewardship Program promotes development of locally-directed watershed-scale plans to balance GMA’s environmental and economic goals⁶⁵ and “includes goals and measurable benchmarks to protect the functions and values of critical areas and promote agricultural viability along with supporting the voluntary enhancement of critical areas”⁶⁶. The SCC administers funding to counties to engage agricultural landowners to develop and then implement watershed work plans. 27 of 39 Washington Counties opted-in to VSP including five Puget Sound counties: Mason, Lewis, San Juan, Skagit, and Thurston. Within each county, VSP provides opportunities designed to support individual landowners, such as funding to implement specific voluntary conservation practices “directed at certain types of critical area functions” to, at a minimum, maintain the level of critical area functions and values that were in place under GMA as of the baseline time for VSP (i.e. July 2011) as well as to encourage restoration efforts. The VSP program differs from other conservation programs because it is an opt-in program designed and administered at the individual county level, rather than state-wide.

Five-year status reports are provided by each participating county to SCC. In those reports, each county must assert whether it is making sufficient progress towards meeting the goals and benchmarks outlined in their work plan. These goals and benchmarks require monitoring and implementation must demonstrate the effectiveness of maintaining critical areas protections at a watershed-scale, rather than at the parcel-scale, which is the requirement under GMA. As each county’s goals and benchmarks vary, each county must have “appropriate monitoring sufficient to maintain 2011 functions”. However, as VSP is a new program with varying levels of implementation and monitoring, “data used to calculate what has occurred” is challenging.⁶⁷

According to a November 2021 press release from SCC, all counties enrolled in the program are “on track to meet their VSP work plan goals”⁶⁸ based on progress reports evaluated by the commission, “a state technical panel and an advisory committee. Additional information on VSP can be found in PSI’s Land Development and Cover BPA.

CONSERVATION DISTRICT PROGRAMS

Puget Sound Conservation Districts provide a variety of support for agriculture and forest landowners. Local conservation districts provide technical and financial assistance to producers, individuals and organizations to:

- Support applicants to NRCS’s program such as the Conservation Reserve Enhancement Program (CREP)

⁶⁵ [RCW 36.70a.700](#).

⁶⁶ <https://Sccwagov.App.Box.Com/S/Wy07h3i3rmsb6jhcfmh7rk07g84aintr/File/502420588771>

⁶⁷ Mason County VSP 2 Year Report, <https://app.box.com/s/a0jw23gkcmnegpg97p4l3wj3g2q3b9jz/file/502423312030>

⁶⁸ <https://www.scc.wa.gov/news/vsp-milestone-11082>

- Provide access to free workshops, trainings and certifications
- Assist in land steward recognition
- Provide access to expert advice including landowner consultations

Puget Sound Conservation Districts have been awarded technical assistance funds from NRCS through the National Association of Conservation Districts (NACD), which provides funding and technical/administrative assistance, promotes soil health, work to conserve forestland, provides resources for managing water quality/quantity and engages with over 300 conservation districts nationally. Conservation districts have received funding from National Estuary Program funding. Conservation districts are an integral part of county planning, including outreach, adoption and implementation of Individual Stewardship Plans supporting counties' VSPs.

STATE CONSERVATION COMMISSION'S NATURAL RESOURCE INVESTMENTS PROGRAM

Conservation districts use Natural Resource Investments Program funding to cover a portion of the cost of BMPs as an incentive for landowners to implement them on their properties. In 2019, \$3.4 million was allocated to Puget Sound Conservation Districts.⁶⁹ In 2019, 235 BMPs were installed, and 49,471 feet of stream protected. An updated 2022 report for this program from SCC is forthcoming.⁷⁰

LESSONS LEARNED FROM CONSERVATION DISTRICTS

From 2014 to 2015, the SCC, Washington State University Extension (WSU) and the Pierce, Kitsap, and Mason Conservation Districts conducted a collaborative outreach project in the targeted watersheds of Burley Lagoon, Rocky Bay, Vaughn Bay, and Hood Canal with a focus on BMPs that reduce fecal coliform pollution. The project focused on increasing knowledge of BMPs with landowners. Landowners' parcels were targeted if they were located on or within 250 feet of marine or freshwater shorelines. A total of 1,494 landowners were contacted with 62 signing up for a site visit. Landowners who were contacted via an offer letter, postcards or door knocking showed a significant knowledge change:

- 43 percent of the 62 landowners found the BMP education materials useful
- 74 percent of the landowners "specified that they would install plants to absorb and filter water"
- Around 38 percent noted a 'significant increase' in knowledge change regarding buffer use and function, 22 percent noted a 'significant increase' in knowledge change regarding septic system recommendations and nearly 40 percent noted a 'significant increase' in "water

⁶⁹ https://uploads-ssl.webflow.com/5faf8a950cdaa250571edad5/5faf8a950cdaa271ca1edb4a_NRI_FINAL_011420.pdf

⁷⁰ S. Joy, personal communication, April 2022

quality impacts due to homeowner activities” when landowners were surveyed following site visits by the conservation districts

Overall, SCC and their conservation district partners found that “ninety-seven percent of those landowners that participated in site visits would recommend it to a friend or neighbor”⁷¹ suggesting that ‘door knocking’ and in-person site visits, coupled with targeted outreach like mailers may improve conservation districts’ relationships with landowners and future installation of BMPs.

3.1.5 AGRICULTURAL BMP-FOCUSED GRANT PROGRAMS IN PUGET SOUND

The below grants are a selection of agricultural BMP-focused grant programs from a variety of organizations.

ECOLOGY’S WATER QUALITY COMBINED FINANCIAL ASSISTANCE GRANTS

Ecology’s [Water Quality Combined Funding Program](#) combines multiple funding sources including:

- The Washington State Water Pollution Control Revolving Fund Program; commonly referred to as the Clean Water State Revolving Fund (CWSRF). CWSRF offers low interest and forgivable principal loans
- The Stormwater Financial Assistance Program (SFAP) is a state-funded grant program
- The Centennial Clean Water Program (Centennial) is a state-funded grant program
- The Clean Water Act Section 319 Nonpoint Source Grant Program (Section 319) is a federal-funded grant program

Table 6 shows WQCFP grants currently active, or closed, from fiscal years 2017 to 2022. This list is filtered by theme to only show projects in the Puget Sound region that a) are specifically targeted to reduce impairment from nonpoint sources and b) include the implementation of agricultural BMPs, restoration, monitoring and/or maintenance, or land acquisition activities (which may include riparian enhancement activities) and the funding of Pollution Identification and Correction programs.⁷² One key agricultural project in Lewis County is also included.

Details on related grants prior to fiscal year 2017 can be found at the Ecology Grants and Loans map [website](#) and filtering on the appropriate descriptions (year, theme, sub-theme). Fiscal year 2023 funding agreements are currently in negotiation and are not yet active and are thus not included in this table. Descriptions of the final offer list can be on the [Water Quality Combined Funding Program website](#) and the [FY 2023 Final Offer List](#).

⁷¹ Focused Watershed Outreach and Shore Stewards Joint Final Report

⁷² <https://apps.ecology.wa.gov/publications/documents/2210001.pdf>

Table 6. Ecology's Water Quality Combined Financial Assistance Grants Fiscal Year 2017 to 2022

Agreement Name	Description	Total Cost	Ecology Share	Total Disbursed as of 08/22	Effective Date	Expiration Date	Recipient Organization
Kitsap County 4A and 4B Listed Stream Restoration Project	Project goal: enable Kitsap County watersheds to meet or exceed water quality standards, resulting in improved public health and restoration of shellfish beds in associated closures zones.	\$300,000	\$300,000	\$295,307	3/1/2017	4/30/2020	Kitsap Public Health District
Direct Seed Implementation - Sediment Reduction in the Upper Chehalis	Project goal: improve water quality and soil health in the Chehalis Basin by providing local farmers affordable access to direct seed equipment, technical assistance, and outreach and education. The objectives are to: eliminate tillage practices by using a no-till drill on a minimum of 1500 acres which will reduce sediment runoff to local rivers and streams; and educate at least 500 people about agricultural best management practices that improve water quality.	\$60,260	\$45,195	\$42,521	7/1/2019	6/30/2022	Lewis County Conservation District
North Creek Riparian Restoration Project	Project goal: improve water quality and fish habitat in the North Creek watershed through re-forestation. Re-forestation will increase riparian vegetation cover to the stream, which will improve water temperatures and dissolved oxygen levels. It will also restore the hydrology of the wetlands adjacent to North Creek, improve water storage and groundwater re-charge, and reduce downstream flooding.	\$202,800	\$152,129	\$93,062	3/1/2019	2/28/2022	Snohomish Conservation District

Mashel River and Ohop Creek Water-Quality Protection	Project goals: a) prevent degradation of water quality from potential increases in sediment delivery and decreases in forest age in the upper Mashel River/Busy Wild Creek and upper Ohop Creek/25-Mile Creek sub-basins of the Nisqually River Watershed by acquiring sensitive properties under immediate threat of clear-cut logging and b) acquire for restoration recently logged properties in these sub-basins in need of erosion reduction, riparian enhancement treatments, and of increased forest age (>40 years, to improve summer low flows).	\$14.2 M	\$14,243,752	\$60,602	4/1/2020	3/31/2023	Nisqually Indian Tribe
Sequim Bay-Dungeness Watershed Pollution Identification and Correction	Project goal: protect human health and increase access to recreational and commercial shellfish harvest areas in Puget Sound. Specifically, activities should lead to the upgrade of shellfish growing areas within Dungeness Bay near Sequim (Bay), Washington. The Bay has historically suffered from bacterial pollution that has produced both seasonal and year-round closures of shellfish growing areas. Dungeness Bay is situated within the East Straits growing area. This activity is aligned with the overall effort to clean up Puget Sound. The upgrade of shellfish growing areas remains a Vital Sign Target" of Puget Sound recovery."	\$240,000	\$180,000	\$109,369	12/01/2019	11/30/2022	Clallam County - Health and Human Services
Allen - Grace Confluence: A Riparian Reforestation Project (Snohomish County)	Project goal: establish a 4.2 acre native riparian buffer and install large woody debris at the confluence of Allen and Grace Creeks to improve water quality.	\$180,700	\$135,521	\$86,048	7/1/2019	6/30/2022	Adopt A Stream Foundation

Pilchuck River Tributary Buffer Enhancement Partnership; Coon Creek (Snohomish County)	Project goal: improve water quality in the Pilchuck River by restoring 15.0 acres of riparian forest canopy along 4,200 linear feet of tributary to the Pilchuck River, Coon Creek. The forested buffer will be self-sustaining and provide a multitude of important ecological benefits including shade, temperature reduction, increased dissolved oxygen and large woody debris habitat.	\$152,380	\$114,285	\$17,915	1/1/2021	12/31/2023	Adopt A Stream Foundation
False Bay Creek Livestock Exclusion and Riparian Planting BMPs - Phase I	Project goal: improve water quality in lower False Bay Creek in order to remove it from the state 303(d) list for bacteria. This project will exclude livestock from and restore riparian habitat along 1,900 feet of the creek. This project is Phase I of a two-phase project. Phase II will continue similar restoration work on San Juan Preservation Trust property along 7,300 feet of nearby San Juan Valley Creek.	\$186,227	\$113,420	\$48,953	7/1/2020	6/30/2023	San Juan County - Public Works Department
Poop Smart Clark Pollution Identification and Correction Program (Phase 1)	Project goal: improve water quality within the middle and lower portions of the EFLR watershed by prioritizing properties within 200 feet of a creek in the four prioritized sub-watersheds: Jenny, Brezee, and McCormick Creeks and Rock Creek North through targeted outreach to landowners.	\$740,405	\$500,000	\$144,148	10/01/2021	9/30/2024	Clark Conservation District
Snoqualmie Stewardship Riparian Restoration and Maintenance	Project goal: improve water quality in the Snoqualmie River and its tributaries by working with agricultural landowners to restore and maintain existing riparian buffers.	\$332,460	\$249,345	0	7/1/2021	6/30/2024	Stewardship Partners

Strait Priority Areas	Project goal: protect human health from risks of waterborne pathogens, keep shellfish beds open, and ensure water safety for recreational use by addressing 35 miles of coastline, four streams, Discovery Bay, Protection Island Reserve, and the Port Townsend shellfish growing areas which are listed as impaired for dissolved oxygen and bacteria.	\$429,273	\$321,955	\$321,955	3/1/2017	6/30/2020	Jefferson County Public Health
Central Hood Canal Pollution Identification and Correction	Project goal: protect human health from risks of waterborne pathogens, keep shellfish beds open, and ensure water safety for recreational use. The project will address 20 miles of coastline including two rivers and six streams entering Hood Canal, and marine waters impaired for bacteria.	\$385,166	\$288,874	\$288,874	3/1/2017	6/30/2020	Jefferson County Public Health
Northern Hood Canal Pollution Identification and Correction	Project goal: protect human health from risks of waterborne pathogens, keep shellfish beds open, and keep waters safe for recreation. The project will quantify and correct non-point source pollution and work towards removing waterbodies from the impaired list through PIC methodology.	\$485,406	\$364,055	\$362,250	9/1/2018	3/31/2022	Jefferson County Public Health
Oak Bay - Mats Mats Pollution Identification and Correction	Project goal: protect human health from risks of waterborne pathogens, keep shellfish beds open and waters safe for recreational use, as well as to learn what types of contaminants of emerging concern are present.	\$347,137	\$260,352	\$259,987	9/1/2018	3/31/2022	Jefferson County Public Health

Maddox Creek Culvert Removal and Stream Enhancement	Project goal: improve water quality while restoring fish passage in Maddox Creek. This project will reduce sediment loading, bank erosion, and stream temperature through removal of 9,700 cubic yards of fill within the channel, removal of 1 derelict, perched culvert; replanting 0.3 acres with native vegetation at a buffer width of at least 100 feet on each side; opening access to over 1.2 miles of fish habitat	\$600,862	\$450,647	\$443,906	7/1/2018	6/30/2021	Skagit County Public Works Department
Segelsen Stillaguamish Riparian Restoration	Project goal: establish a 10 acre native riparian buffer along Segelsen Creek and Stillaguamish River to improve water quality.	\$220,112	\$165,084	\$123,416	10/1/2019	9/30/2022	Sound Salmon Solutions
Jefferson County Foundational Monitoring & Pollution Identification and Correction	The goal of the Foundational Monitoring & PIC project is to provide a base-level of monitoring for the entire Jefferson County Clean Water District that will be sustained through future local funds and add programmatic support district-wide for Pollution Identification and Correction activities.	\$499,077	\$374,307	\$287,102	1/1/2020	12/31/2022	Jefferson County Public Health
Anderson Creek Water Quality Improvements	The goals of this project are to address water quality impairments and habitat conditions in Anderson Creek to benefit Anderson Creek, native cutthroat trout and kokanee populations, and support Lake Whatcom management efforts.	\$613,866	\$460,399	\$460,399	3/1/2019	2/28/2022	City of Bellingham Public Works Department

STATE RECREATION AND CONSERVATION OFFICE GRANTS

The Washington State Recreation and Conservation Office (RCO) currently manages several grant programs administered by the RCO's funding arm, the Recreation and Conservation Funding Board (RCFB). RCO is a state agency that supports outdoor recreation programs, salmon recovery (including restoration and fish barrier removal activities) and trails and land and water conservation. It supports the protection of ecologically important lands as well as supporting working lands.

RCO's 2019 to 2021 capital budget⁷³ was a total of \$327 million in a combination of federal and state grants. Relevant programs to the Marine Water Quality IS include:

- \$85 million to the Washington Wildlife and Recreation Program (including the Habitat Conservation Account, Farm and Forest Account and Outdoor Recreation Account) and approximately \$18.1 million dedicated to Riparian Protection
- \$925,000 to a community forest pilot program in Puget Sound
- \$12 million to the Washington Coastal Restoration Initiative
- \$49.5 million to projects related to Puget Sound Acquisition and Restoration program

A breakdown of grant programs relevant to the Marine Water Quality Implementation Strategy is provided in Table 7, and 2019-2021 allocations for riparian projects in Puget Sound is provided in Table 8.

Table 7. Allocation of RCO Funding per Grant Area

Account	Allocation of Total	Allocation Breakdown Between Category
Habitat Conservation Account	45 percent	35 percent Critical Habitat 25 percent Natural Areas 15 percent Riparian Protection 10 percent (or \$3 million, whichever is less) state lands restoration/enhancement 15 percent Urban wildlife habitat
Outdoor Recreation Account	45 percent	45 percent in total distributed between local, state parks, trails, and water access
Farm and Forest Account	10 percent	90 percent Farmland Preservation Category 10 percent Forestland Preservation Category

⁷³ As of September 2020, a capital budget submitted for the 2021-2023 biennium includes \$22 million for community forest projects, pending OFM approval.

Table 8. Active Riparian RCO Grant Projects in Puget Sound*

Program	Description	Active Grants in Puget Sound		
		Grant	Amount	Recipient
Washington Wildlife and Recreation Program – Riparian Protection Category • Habitat grants focused primarily on riparian protection to improve water quality		Davis Creek Wildlife Area	\$1,600,000	Washington Department of Fish and Wildlife
		Skookum Creek Acquisition	\$1,962,260	Whatcom Land Trust
		Lake Kapowsin Riparian Phase 1	\$1,712,375	Forterra
		Conserving the Hoko River Watershed	\$566,020	North Olympic Land Trust
		Chehalis Floodplain	\$200,000	Washington Department of Fish and Wildlife
		Dabob Bay Natural Area	\$3,017,883	Washington Department of Natural Resources
		West Foster Creek Riparian Restoration	\$119,100	Washington Department of Fish and Wildlife

*Further details on these and additional RCO grants can be found in PSI's [Land Development and Cover Base Program Analysis](#)

PATHOGENS PREVENTION, REDUCTION AND CONTROL LEAD ORGANIZATIONS

From 2011 to 2019, the Washington Department of Health (DOH) administered \$21.5 million in NEP funds as the Pathogens Prevention, Reduction and Control Lead Organization (LO). The primary objective of the Pathogen LO was to improve water quality in order to restore shellfish growing areas and to avoid shellfish closures. They also supported monitoring and reporting on current conditions to protect people from disease.

The Pathogens LO supported implementation and monitoring of agricultural BMPs in select counties. Information about these sub-awards, excerpted from Roberts et al. (2024), is provided in Table 9. The following projects were funded from two funds: the “Agricultural BMP Fund” which awarded \$750,000 to select projects from the Pathogens LO grant and a related \$150,000 grant for monitoring activities.

The Pathogens LO also funded several projects related to on-site sewage system (OSS) management and repair programs. We do not discuss these projects here because the [Shellfish Beds Implementation Strategy](#) includes an OSS-focused strategy. The Washington State Department of Health and local public entities regulate OSS, so the Shellfish Strategic Initiative Lead is the primary NEP partner for OSS-related strategies while the Stormwater Initiative Lead is a supporting partner.

Table 9. Pathogens Lead Organization Agricultural BMP-Focused Grants

Grant Name	Grantee	Summary
Kitsap County Agricultural BMPs	Kitsap County Health District	Kitsap County Health District and Kitsap Conservation District provided educational materials and technical assistance to landowners to site, design, and construct agricultural BMPs. They also conducted initial follow-up site visits to ensure proper installation, use and maintenance. This work resulted in the installation of five agricultural BMPs, preventing fecal coliform pollution properties entering surface waters.
Mason County Agricultural BMPs	Mason County Public Health	Mason County Public Health conducted outreach activities to landowners and stakeholders and provided technical assistance to site, design and construct agricultural BMPs. Mason Conservation District established a manure trailer rental reimbursement program to promote their Manure Exchange Program. They also worked with 10 landowners whose operations directly impact Oakland Bay, identifying 85 BMPs.
Pierce County Agricultural BMPs	Pierce Conservation District	In coordination with the Pierce County's Key Peninsula Pollution Identification and Correction (PIC) program, Pierce Conservation District conducted outreach to landowners and stakeholders and completed 14 agricultural BMP projects. Shellfish Partners and the Washington State Conservation Commission were partner organizations.
San Juan County Agricultural BMPs	San Juan County Health and Community Services	San Juan County Health and Community Services conducted outreach activities to landowners and stakeholders and provided technical assistance to site, design and construct agricultural BMPs. In collaboration with the San Juan Islands Conservation District identified 35 livestock pollution problems and installed resolving solutions for 18 of them.
King County Agricultural BMPs	Seattle-King County Health Department	Seattle-King County Health Department conducted outreach activities to landowners and stakeholders and provided technical assistance to site, design and construct agricultural BMPs. Partner organizations included King Conservation District, Vashon-Maury Island Community Council, Department of Ecology, and The Beachcomber newspaper.
Skagit County Agricultural BMPs	Skagit County Public Health and Community Services	Skagit County Public Health and Community Services conducted outreach activities to landowners and stakeholders and provided technical assistance to site, design and construct agricultural BMPs. In collaboration with Skagit County Public Works and Skagit Conservation District, they identified and corrected 66 livestock problems in the Samish Watershed and identified 38 livestock problems in Padilla Bay Watershed, one of which was corrected by the end of the grant period.
Snohomish County Agricultural BMPs	Snohomish County Public Works	Snohomish County coordinated with Snohomish Conservation District and the Department of Ecology to conduct outreach to landowners and provided technical assistance to site, design and construct agricultural BMPs on several adjacent parcels in the Stillaguamish Watershed. The BMPs implemented included disposing of a ~5,000 cubic yard horse stable waste pile that had accumulated over a 20-30 year period. Other collaborators included Snohomish Health District, City of Stanwood, Stillaguamish Flood Control District, Stillaguamish Tribe, and Washington Department of Agriculture – Dairy Nutrient Management Program.

Thurston County Agricultural BMPs	Thurston County Public Health and Social Services	Thurston County Public Health and Social Services, in collaboration with Thurston Conservation District, implemented best management practices such as restoring riparian conditions and excluding livestock from surface waters. Technical and financial assistance was provided and compliance actions were taken when necessary.
Dairy Waste Management on Berry Farms	Washington Department of Agriculture	WA DOA extended its Dairy Nutrient Management Program (DNMP) to include a focus on manure use during berry planting and as mulch on berry farms. The DNMP will work with berry farmers to reduce negative impacts associated with manure use, especially in Whatcom and Skagit counties.
Dairy Nutrient Management Program	Washington State Department of Agriculture	Washington State Department of Agriculture (WSDA) manages a Dairy Nutrient Management Program, which helps dairies achieve water quality compliance related to livestock activities. WSDA used this grant to hire one staff member to provide capacity to conduct technical assistance, compliance inspection, and water quality sampling to protect water quality and shellfish beds in Whatcom, Skagit, and Snohomish counties. The new staff inspected 65 dairies, made 24 improvements and 3 changes on non-dairy properties to reduce water pollution from farms.
Progressive Manure Applications Risk Management System	Whatcom Conservation District	The Whatcom Conservation District in partnership with dairy farmers and others developed a Manure Application Risk Management system. By evaluating pollution risks and improving manure application procedures, the system was designed to reduce agricultural runoff containing harmful pollution from reaching groundwater, surface water, salmon bearing rivers and shellfish beds.

More recently, the Shellfish Strategic Initiative (the Pathogen LO's successor) funded a project ([NTA 2016-0394](#)) that monitored manure management practices, such as covering and controlling manure runoff to protect water quality. American Farmland Trust, King Conservation District, and Whatcom Conservation District's Washington [Discovery Farms program](#) collaborated on the project at two sites in the Enumclaw area to assess and promote on-farm dry manure storage. Data from the project indicates that covered manure piles stored on a concrete slab resulted in less leaching of nutrients into run-off.⁷⁴

TOXICS AND NUTRIENTS LEAD ORGANIZATION

Ecology administered the Toxics and Nutrients Prevention, Reduction, and Control LO. During this time, Ecology chaired the NEP Toxics and Nutrients Core Team, a committee that distributed \$21 million of grant funds to toxics and nutrients projects from 2011 to 2019.

The goal of the Toxics and Nutrients LO was to improve both human and environmental health by preventing, reducing, and controlling toxics and nutrients from entering Puget Sound. NEP grant funding was split between toxics and nutrients projects. A portion of the funding was directed towards agricultural BMP projects implementation. This resulted in installing 60 BMP projects on 30 properties (McCarthy 2019a).

In particular, the Nutrients grant funded the completion of the following projects:

- San Juan Conservation District completed the installation of six BMP projects
- A Rocha, a nonprofit organization in Whatcom County, completed one BMP project
- Snohomish Conservation District completed one BMP project

In total, the Nutrients grant program provided over \$773,000 to agricultural BMP implementation to conservation districts.⁷⁵

Additional agricultural BMP projects included:

- Installation of agricultural BMPs within Kitsap County's Pollution and Identification Control program in Murden Cove through the Nutrients LO grant for \$256,000⁷⁶
- Penrose Pollution and Identification Control project from the City of Tacoma's Department of Health which included installation of manure bins, manure removal, etc. other BMP projects in Mayo Cove and surrounding watersheds near Tacoma

⁷⁴ <https://farmlandinfo.org/publications/evaluating-dry-manure-storage-options-for-water-quality-protection/>

⁷⁵ https://www.govlink.org/sc-puget-sound-action-area/docs/2013-01-07_04A_LO_FundedProjectsToDateAll.pdf

Both the Pathogens LO and the Nutrients LO supported the development of local Pollution Identification and Control (PIC) Programs and hiring of nonpoint specialists at Ecology able to identify and resolve watershed sources of pollution. The [Lower Stillaguamish River Pollution Identification and Correction \(PIC\) Program](#) in Snohomish County is one example.

The Nutrient Synthesis report stated that several of the projects funded were unable to be assessed for effectiveness because of lack of “quantitative data describing nutrient reductions” (McCarthy 2019a). Additional recommendations focused on the challenges that grant administrators faced. These recommendations included:

- The importance of working with local partners to “ensure the study design coordinates with the on-the-ground activities” and “when identifying site-specific details within a watershed.”
- Using local web resources to upload, organize and track data digitally.

WATERSHED LEAD ORGANIZATION

A Watershed LO administered by Ecology and Commerce supported local governments in carrying out projects that incorporate environmental needs into land use planning, urban development, climate adaptation planning and critical areas development. Between 2011 and 2016, they distributed NEP funds to support 85 projects implementing recovery priorities identified by the Action Agenda. Wright (2020a) analyzed the results of a selection of Watershed Lead Organization grant-funded riparian restoration, acquisition and floodplain reconnection projects. Lessons learned from these efforts could support nutrient management efforts.

3.1.6 SELECTED LITERATURE REVIEW AND CASE STUDIES OF AGRICULTURAL BMPS

Agricultural nonpoint source pollution is the leading cause of water quality impairments on EPA-surveyed rivers and streams, the third-largest cause for lakes, the second-largest for wetlands, and a major contributor to contamination of estuaries and groundwater (EPA 2017, Ribaud et al.).

The following literature review on agricultural BMPs describes some of the challenges of implementing agricultural BMPs to reduce nutrient impairment from nonpoint sources. Additional literature reviewed are available in the accompanying State of Knowledge report.

LITERATURE – EXAMPLES FROM THE CHESAPEAKE BAY

The Chesapeake Bay Agreement, first signed in 1983, was drafted to address nutrient impairment in the Chesapeake Bay. A second and third agreement (signed in 1987 and 2000, respectively) codified nutrient goals and strategies to guide restoration efforts. In 2009, President Obama issued an [executive order](#) (EO 13508) that called on the federal government to renew the effort to protect and restore the watershed.

In 2010, the EPA established a [Chesapeake Bay TMDL](#) that required a 25 percent reduction in nutrients and a 20 percent reduction in sediments delivered to the Bay. The TMDL led to the creation of a multi-state [Watershed Improvement Program](#) (now in its third phase).

Choi et al. (2019) compared the region's Watershed Improvement Program with a pilot targeted restoration approach, termed the 'Smart Strategy Scenario'. This scenario uses GIS to select "the most cost-effective BMPs and place them on soils where they have the highest potential for generating pollutant reduction. The Smart Strategy Scenario, according to the authors, essentially means "placing the right practices in the right places within watersheds to minimize the costs of achieving the Chesapeake Bay goals." BMPs in use in the Chesapeake Bay include nutrient management plans, vegetated buffers, conservation tillage programs and others. Funding comes from the following NRCS programs including the [Wetlands Reserve Program](#), Conservation Reserve Program, and RCO grants (NRC 2011).

According to Choi et al. (2019), **"in all cases, the cost of implementing BMP scenarios is far less than the benefits"** with "the 'Smart Strategy Scenarios' [approach] **out-performing the traditional [placement of BMPs]** in the Watershed Improvement Program." Additionally, directly downstream of BMP implementation in target watersheds the benefits of "water quality [improvements] exceeds the costs of the BMP scenarios by a wide margin", although this is diluted the further downstream from the BMP sites.

The study also found that households that live closest to the target watersheds experience the largest improvement in water quality based on the study's weighted distance measurements of water quality improvement using a stated preference study (Choi et al. 2019).

This pilot targeted restoration approach has played a role in the development of the [Chesapeake Assessment Scenario Tool](#), which is described in further detail in section 5.2. The Chesapeake Assessment Scenario Tool includes open watershed spatial data to develop scenarios for reduction of nutrient loads through implementation of various BMPs.

LITERATURE - EXAMPLES FROM DENMARK

Sommer and Knudsen (2021) and De Clercq and Sinabell (2001) provide a succinct overview of Denmark's well-known nutrient reduction quota regulations and analyze the effectiveness of the country's legislation.

Denmark's legislation was "enacted in the 1980s as part of the European Union's Environmental Action Plan and Water Framework Directive" (De Clercq et al. 2011). Denmark's nitrogen quota regulations, managed by the Ministry of Agriculture and Environment (with input from the SEGES, Denmark's agriculture extension service agency) require farmers to a) use crop rotation and plant catch crops (under-sown grass, wheat, and chicory, for example) with high nitrogen uptake during autumn and b) maintain a 9-month storage capacity for animal manure. Catch crops "catch" excess nitrogen while manure storage reduces the amount of manure on fields come springtime when significant melting occurs.

The amount of manure that may be applied to farmers' fields is calculated by the Ministry and SEGES. Farmers have the option to deal with excess nitrogen amounts by exporting of manure to biogas plants or trading to fellow farmers (similar to water quality credit trading as described in Section 2.4).

Sommer and Knudsen (2021) found that although agriculture contributed 70 percent of nitrogen to Danish coastal waterways from 2007 to 2011, nitrogen concentration in water leaching in general decreased from 1990 to 2018 (Sommer et al. 2021) and agricultural ammonia emissions from agriculture were reduced from 2005 to 2018 by 15 percent because of the legislation.⁷⁷

Sommer and Knudsen state that regulations that required "buffer zones, the use of catch crops that cover soil in autumn and winter and suboptimal nitrogen [allowed] quotas" initially resulted in farmer opposition. However, in 2014, an increase of nitrogen quotas to "an economically optimal level (a 25 percent increase from prior regulations)", the elimination of buffer strips, and increased subsidization of catch crops resulted in more farmer approval and thus greater adoption of the program.

Nonetheless, the authors maintain, nitrogen "quotas have resulted in loss of income" for farmers and "under-fertilization", which has led to sub-optimal crop yields and a decline in the quality of crops over several years. Additionally, the complexity of regulations has made it harder to farmers to navigate the regulatory system. The added complexity of the program has required more staff to administer the regulations and assist farmers on an individual level with the operations' requirements. Overall, the authors suggest that the most effective regulations have been the "ban on direct discharge of manure" and "ban of application of manure in the autumn" (Sommer et al. 2021).

LITERATURE - EXAMPLES FROM THE MISSISSIPPI RIVER DELTA

Point and non-point pollution sources play a significant role in the Mississippi/Atchafalaya River Basin (MARB), a 796-million-acre basin spread across 31 states and two Canadian provinces. The basin empties into northern Gulf of Mexico and since 1997 has been under joint federal, tribal and state agency to reduce hypoxic conditions present in its waterways. The Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (also known as the Hypoxia Task Force) leads collaborative efforts to reduce nutrient loads in the broader MARB watersheds (EPA's Mississippi River/Gulf of Mexico Watershed Nutrient Task Force 2023 Report to Congress). The Hypoxia Task Force's goal is to reduce the "5-year average areal extent of the hypoxic zone" to less than 5,000 kilometers by 2035 (EPA 2023). An interim target is to reduce total nitrogen (TN) and total phosphorous (TP) loads by 20 percent by 2025. Based on the Nutrient Task Force's prior report, published in 2021, TN loads have been reduced by 20 percent but TP loads have increased. The Bipartisan Infrastructure Law has provided EPA with

⁷⁷ Similar reductions have not occurred for phosphorous, which declined prior to 2006 and then increased.

\$60 million from fiscal years 2022 to 2026 to support nutrient reduction in the MARB. This funding provides support to the 12 Hypoxia Task Force member states, funding for partnering Tribes, and an additional \$19.5 million nationally to support USDA efforts in nutrient reduction activities (including point and non-point source). These efforts are further supported by Farm Bill funding, the Clean Water Act, the Water Resources Development Act and other authorities and partner programs (EPA 2021).

To measure nutrient loading from the MARB waterways into the Gulf of Mexico, two metrics are utilized: 1) a 5-year moving average load which takes the average of the load in the current year and the preceding four years for any given year; and 2) a normalization method that uses the USGS [Weighted Regressions on Time, Discharge, and Season](#) model (Hirsch et al. 2010, 2015; Lee et al. 2017). These models measure current 2021 loads against the baseline period from 1980 to 1996 to determine changes in TN and TP. According to the literature, models showed a decrease in TN and an increase in TP. These changes were attributed to both changes in the watershed as well as changes in streamflow (2019 and 2020 were particularly high streamflow years) which contributed to “higher 5-year moving phosphorous loads” (EPA 2023). Additional findings from the Hypoxia Task Force found that the “rate of increase of nitrogen has slowed in recent decades” although still increasing overall, as compared to total phosphorous. The Workgroup recommends “align[ing] nutrient management with crop needs [to ensure] success in controlling nutrients at the source” (EPA 2023).

Additional literature suggests (Sinha et al. 2017, Coffey et al. 2019) that nitrogen loads could increase in the Upper Mississippi River Basin due to climate change with increases ranging from 28 to 38 percent from 2031 to 2060 and increases of 50 to 81 percent in the years beyond. Potential increases in the Lower Mississippi River Basin range from 19 to 24 percent by 2060 and up to 33 percent by the year 2100. TP loads are projected to increase although this is more uncertain (Coffey et al. 2019). Some additional literature suggests that TN and TP could decrease depending on certain climate change scenarios, but results will be dictated by precipitation, temperature, and landscape changes (including types of use and land management) over time (EPA 2023). Hypoxic conditions may also increase due to an increase in freshwater discharge (thus decreasing salinity) from precipitation events, or water temperature increases in the Gulf and connecting waterways.

To address non-point pollution sources, the Hypoxia Task Force has undertaken various activities to promote education and understanding of nutrient reduction methods. These include publishing a [tool reference document](#) that catalogs available technologies to track agricultural practices. These tools span from remote sensing/imagery-based tools to conservation practice effectiveness tools. A sample of tools available include USDA’s Cropland Data Layers (CDL), the Landsat Satellite Imager Program, the National Agricultural Imagery Program (NAIP), and NOAA’s Coastal Change Analysis Program (C-CAP). Additionally, the Hypoxia Task Force commissioned American Farmland Trust to produce a tool assessment document to “quantify environmental, social and economic outcomes associated with farm conservation practices” (EPA 2023).

Lastly, producer/farmer surveys administered by USDA can help the Hypoxia Task Force to identify conservation practices (or the lack thereof) that may be contributing to changes in nutrient loading. The Task Force plans to use these surveys across the region as a method to “track progress of conservation adoption [measures] and highlight areas where additional conservation will have the largest nutrient reduction impact” (EPA 2023).

3.1.7 OPPORTUNITIES AND CHALLENGES FOR IMPLEMENTATION OF BMPS

Ribaudo and Shortle (2019) and Shortle and Uetake (2015) outline steps to improve the uptake and efficacy of agricultural BMPs, noting, however, that a “voluntary approach has generally not led to sufficient aggregation of conservation efforts in impaired watersheds to produce needed improvements in water quality” (Shortle and Uetake 2015).

Recommendations from the literature include employing targeting mechanisms and connecting policy instruments to measurable performance goals e.g., pay-for-performance.

TARGETING MECHANISMS

Improving targeting mechanisms attempts to address “high-priority problems in high-priority places” (Ribaudo et al. 2019). Choi et al. calls this “placing the right practices in the right places” (Choi 2019). Section 5.2 of this report describes the “Develop watershed modeling capacity” sub-strategy intended to support optimization of management actions. This work could be informed by modeling tools used in other regions to identify areas where placement of agricultural BMPs would result in larger reductions of nutrients to surface waters:

- USDA Agricultural Research Service’s [Soil and Water Assessment Tool](#) (SWAT) models the quality and quantity of surface and ground water to predict impacts of land management practices, land use impacts, pollution control and soil erosion. Pyo et al. (2017) explore using the SWAT tool by developing a multi-objective decision support system that couples the SWAT tool alongside BMP familiarity surveys amongst stakeholders to identify effectiveness and cost of certain BMPs. Pyo et al. found that mostly single BMPs or at most two BMPs resulted in highest reduction of total phosphorous from certain hydrologic units and “higher acceptability to stakeholders” with a range in costs.
- The [Agricultural Policy/Environmental Extender Model](#) from [Texas A & M Agrilife](#) can simulate nonpoint-source pollution impacts from cultivated cropland and assess the impacts of different management scenarios.
- The [Agricultural Conservation Planning Framework](#) (ACPF) is an ArcGIS tool developed by USDA’s Agricultural Research Service in partnership with USDA Natural Resources Conservation Service and produced by Iowa State University and other regional partners. ACPF identifies target areas for conservation practices through the production of output maps that enable producers to see where conservation practices may be adopted. ACPF output maps, based on HUC-12 watersheds, can delineate landscape types including wetlands, critical zones, drainage areas and vegetation. Currently the ACPF only exists in Iowa, Indiana, Illinois, Michigan, Wisconsin and other Midwest states.

In the Puget Sound region, the Nature Conservancy and SCC published the [Opportunity Assessment for Targeted BMPs](#), a GIS map that shows “priority geographic areas of the Puget Sound basin denoted by the blue and dark blue areas on the Opportunity Assessment Map. Projects located in the priority areas will be a higher priority for funding.” The Opportunity Assessment is a “corner stone of the precision conservation approach at the heart of the State Conservation Commission's Puget Sound RCPP.”⁷⁸ As noted in the RCPP and EQIP section of this Base Program Analysis, this map helped direct funding to certain high priority projects.

Targeting of BMPs has likewise gained traction nationally with an April 2022 EPA memo called *Accelerating Nutrient Pollution Reductions in the Nation's Water*.⁷⁹ According to the memo, the agency will assist the “USDA, utilities and local partners in targeting investments” by “promoting and facilitating broader use of watershed assessments” with a goal to “increase the proportion of USDA resources that are tied to watershed plans or other prioritization mechanisms, such as [NRCS' EQIP sub-program] the [National Water Quality Initiative](#)”.⁸⁰

McCarthy et al.'s (2019a) Puget Sound Nutrient Synthesis Report, a review of grant projects funded by the Toxics and Nutrients LO, recommends that agencies track “information regarding the location, type, and nutrient reductions from best management practices (BMPs) and associated BMP effectiveness data.”

CHALLENGES AND OPPORTUNITIES WITH TARGETING MECHANISMS

Efforts in the Chesapeake region continue to explore targeted mechanisms, specifically geo-referenced data according to the National Research Council's evaluation of the Chesapeake Bay program (NRC 2011). **Geo-referencing enables managers and modelers to identify the parcel-level location of BMPs, which would aid in inspecting, tracking, and assigning proper delivery ratios and BMP efficiencies, thereby improving the accuracy of the modeled estimates of nutrient and sediment loads.** However, tracking implementation and effectiveness of BMPs is lacking in Chesapeake Bay due to “limited resources, complex and rapidly changing data reporting mechanisms, **data privacy constraints**, and quality assurance/quality control needs. Verifying the continued functioning and effectiveness of historical activities presents a significant challenge” on staffing and resources the NRC states (NRC 2011).

The NRC suggests that “additional opportunities to access aggregated data that do not violate the confidentiality provision of the 2008 Farm Bill (Section 1619) could be used...[including reporting] of nutrient management plans reported in such a way that jurisdiction administrators would at least know how many agricultural acres in each watershed county were

⁷⁸ <http://allianceforpugetsound.org/rcpp>

⁷⁹ <https://www.epa.gov/newsreleases/epa-announces-strategy-protect-water-quality-accelerating-nutrient-pollution>

⁸⁰ Fox, Radhika. EPA, April 2022. Memorandum. Accelerating Nutrient Pollution Reductions in the Nation's Waters.

being managed under an NRCS-developed or NRCS-approved nutrient management plan”⁸¹ instead of individual’s proprietary information.

Subsequent actions to targeted implementation of BMPs, though, requires agencies to track the progresses of those BMPs. Identifying individual polluters and implemented BMPs is challenging because certain programs are, according to Ribaud et al., are “forbidden from geographic targeting” as “targeting has raised equity issues”.⁸² Identification of individual polluters is further hampered by stipulations in Section 1619 of the 2008 Farm Bill.

This regulation prevents the disclosure of Personally Identifiable Information (PII) related to USDA program participants. Critics have decried this as allowing polluters (such as large feed-lot operations) to avoid pollution control or fines related to nutrient management.

According to the North American Bird Conservation Initiative (NABCI)’s *Field Guide to Fish and Wildlife Conservation in the Farm Bill, 2018-2023 Edition*, “PII includes geospatial information and information about the agricultural land or its owner, such as conservation plans, wetland and highly erodible land determinations, and landowner name, address, and contact information. In order for USDA partners to access this information and provide conservation related services or perform monitoring, assessment, and evaluation of conservation benefits, third parties such as conservation districts, state agencies, and NGOs can enter into Conservation Cooperator Agreements (CCA).

CCA allow conservation cooperators and their staff, contractors, and representatives to handle and access PII on a need-to-know basis provided that they follow the requirements of Section 1619. For example, when landowners hire conservation districts or contractors to design or implement conservation practices, the landowner gives the PII directly to the contractor⁸³ rendering the 1619 unnecessary. State resource agencies and wildlife NGOs often enter into “**1619 Memoranda of Understanding**” (MOU) so that they can work more closely with NRCS to deliver financial and technical assistance, coordinate outreach efforts, and enhance conservation monitoring.

Several examples of MOU or waivers for individual owner/operators are in place nationally. Example include MOU signed between conservation districts in the Chesapeake Bay region which included an NRCS and USGS data sharing project that allowed USGS to receive point location data then aggregate these data at a watershed scale. Additional data-sharing waivers have been launched in Sauk County, Wisconsin.⁸⁴ Waivers offered to individual owner/operators are available in Vermont through the Vermont Agency of Agriculture, Food

⁸¹ *ibid*

⁸² *ibid*

⁸³ <https://wildlifemanagement.institute/brief/june-2021/nabci-releases-farm-bill-field-guide>

⁸⁴ https://sauk.granicus.com/metaviewer.php?view_id=2&clip_id=873&meta_id=78202

and Markets⁸⁵ and the Dupage and Kane Counties of Illinois⁸⁶, among others. **Waivers allow for agriculture owner/operators to “authorize the release of the designated information” related to agricultural operations to the NRCS, conservation districts and NGOs for the “purpose of tracking conservation practices”.**⁸⁷

These waivers allow the NRCS and conservation districts to gather aggregate information on operations in order to “report nutrient reductions from agriculture towards meeting TMDLs” while upholding Section 1619’s provision that PII is “protected from disclosure to others [outside of the agreement]”. Nonetheless, **spatial accuracy is reduced because BMP data is often aggregated and released at the county level** (NRC 2011). One solution to this is to use field verification to determine whether BMPs are still existing or no longer functioning. NRC states that, however, “field verification is costly, and several states have questioned its value given the resource constraints that limit BMP implementation” (NRC 2011). Remote sensing data may assist in this effort.

An additional related pollution prevention measure for individual producers is the Ecology-issued [Concentrated Animal Feeding Operation General Permit](#) (CAFO). The CAFO permit is issued to large commercial and/or industrial producers of livestock or poultry in a small area. The permit is intended to support the implementation of “specific pollution prevention practices of facilities, such as collecting runoff and storing manure, land applying nutrients according to crop budgets, and adapting practices based on soil test results to protect water quality.” In the summer of 2022 a public comment period was issued based on proposed changes to the permit. The proposed changes to the permit were based on the outcome of a Court of Appeals case in 2021: “Washington State Dairy Federation vs. the Washington State Pollution Control Hearings Board ([case no. P17-016c](#))”. Ecology is currently reviewing comments received and plans to “make a permit reissuance decision by the end of 2022”.

PAY-FOR-PERFORMANCE AND CHALLENGES TO LANDOWNER PARTICIPATION

According to the USDA’s “[Rewarding Farm Practices versus Environmental Performance](#)” report (2006) performance-based policy “provides incentives based on the amount of environmental performance achieved.” Implementing pay-for-performance “based on actual or expected improvements in water quality” (Shortle and Uetake 2019) can be useful and involves switching from paying polluters “to implement pollution-reducing farming practices to one in which payments are received for actual or expected improvements in water quality (pay-for-performance)”.

⁸⁵

https://agriculture.vermont.gov/sites/agriculture/files/documents/water_quality/farm_waiver_qapp%28july2019%29.pdf

⁸⁶ <https://www.kanedupageswcd.org/Forms/USDAwetlandmapform.pdf>

⁸⁷https://agriculture.vermont.gov/sites/agriculture/files/documents/Water_Quality/VAAFM_Partner_Database_QAPP%28July2019%29.pdf

Pay-for performance has been used in government contracts for decades and has been shown to be “more cost-effective than basing payments on practices costs” (Ribaudo 2020) in agriculture based on the Ribaudo et al.’s research in the Chesapeake Bay Watershed. Additional aspects of pay-for-performance include Water Quality Trading (see section 2.4 for more information). WQT also has the potential to “substitute low-cost nonpoint pollution controls for expensive point source controls” e.g. “pollution trading with agricultural sources”.

Chapman et al. (2019) note that pay-for performance “may be necessary in contexts where farmers have low or even negative profit margins.” However, they stress that **“purely financial instruments...or economic motivations alone do not explain participation”** and that **attitudes, values and culture play a large role in adoption of stewardship practices**. Chapman et al.’s survey of farmers in Snohomish County and Skagit County discussing motivations to enroll in the CREP program revealed that the farmers held a variety of normative values. These ranged from aesthetics to a “rebuking of farmer’s local and experiential knowledge by urbanities and regulators” that turned off farmers from enrolling or maintaining riparian buffers funded by the CREP program (Chapman 2019).

Additional findings from the landowner survey revealed that “no-touch restrictions” (e.g. landowners may not work on their buffers) can conflict with an ethic of active land management and that one-size-fits-all rules for buffers don’t allow integration of farmers’ experiential knowledge. Chapman et al. (2019) state that “value alignment is key” and that program success can be improved by validating the “knowledge and skills of the farmer [because] when programs ignore this expertise, farmers can feel slighted.”

Much like Chapman et al.’s study, Diamond et al.’s (2021) study on rural identity informs ways to gain rural buy-in for incentive programs. Namely, that **locals may resent top-down federal policies and that a lack of flexibility and autonomy (and recognition of farmers’ local knowledge) can prevent increasing participation**.

In addition to the findings above, literature on incentive program up-take, such as those from Chapman et al. (2019) and Diamond et al. (2021) broadly point to **the importance of designing programs that align with the normative values, intangible preferences, and non-financial motivations of landowners**. Only when program design incorporates these elements will higher participation be achieved – this is especially true for riparian buffer incentives where strict width requirements may decrease uptake.

3.2 IMPLEMENT ACTIONS TO REDUCE STORMWATER NUTRIENT LOADS

Nutrient loading from developed areas can be high as a result of vehicle emissions, use of fertilizers on residential or commercial properties, on-site septic systems, and improper or illegal sewer connections. This sub-strategy focuses on mitigating and managing stormwater-associated nutrient loads from developed areas.

Ecology regulates stormwater runoff via NPDES stormwater general permits that apply to different types of land use and activities. Runoff from developed areas not covered under one of the stormwater general permits is addressed through the Nonpoint Pollution Program (Section 319) described in Ecology (2015) and Section 3.1.

- Two [Municipal Stormwater General Permits](#) cover separate storm sewer systems (MS4s). The Phase I permit applies to the two largest cities and three largest counties in the Puget Sound region, and the Phase II permit covers smaller urban areas. Additional secondary permittees covered by the Phase I and II permits include school districts, irrigation districts, and other special purpose public entities that own and operate MS4s.
- A [Construction Stormwater General Permit](#) covers construction operations that disturb one or more acres.
- An [Industrial Stormwater General Permit](#) covers most industrial sites, although industry-specific permits apply to boatyards and sand/gravel facilities.

These stormwater general permits require permittees to develop stormwater management programs and implement stormwater BMPs (Box 11). Detailed implementation guidance is provided in stormwater manuals developed by Ecology, or [equivalent](#) manuals developed by a permittee and then approved by Ecology.

Box 11. Stormwater Best Management Practices (BMPs)

Stormwater BMPs are activities, prohibitions of practices, maintenance procedures, managerial practices, or structural devices that reduce volume of stormwater flows, prevent pollution from potential sources, and treat runoff to remove sediment, oils, and other pollutants.

Ecology's [Stormwater Management Manual for Western Washington](#) (SWMMWW) provides technical requirements for measures necessary to control the quality and quantity of stormwater. The most recent version, which went into effect in 2019, includes treatment technologies verified to minimize phosphorous concentrations. Future manuals could highlight BMPs most effective for nitrogen removal. This would require the addition of nitrogen performance goals into the SWMMWW and certification of technologies by the [Washington State Technology Assessment Protocol Program](#) (TAPE).

Most TAPE-certified systems were not designed for removing nitrogen, though it could occur incidental to phosphorus removal. In 2018, the TAPE Program added a requirement for manufacturers to collect data on nitrogen parameters for technologies that enter the program (C. Milesi, pers. comm.). This data would help Ecology understand the extent of removal to

inform development of feasible performance goals for addition to the SWMMWW. Once added to the manual, TAPE could certify nitrogen removal technologies for use.

Ecology's [Stormwater Action Monitoring Program](#) (SAM) currently monitors effectiveness of BMPs for removing phosphorous, so there is an opportunity to expand monitoring of nitrogen parameters under this program as well. Notably, nutrient treatment systems installed and monitored using Toxics and Nutrients Lead Organization funding had lower-than-expected performance (McCarthy 2019a).

Additional monitoring could also help identify non-structural stormwater BMPs that may have a large impact on nitrogen loads. Existing monitoring data suggest some potentially promising areas of focus. Hobbs et al. (2015) found that runoff from residential lands contained the highest dissolved nutrient concentrations, and that higher concentrations and mass loads were observed during the dry season. They recommended investigating pollution reduction approaches targeting low-density residential areas and increasing the frequency of street sweeping during the summer. Some other states have passed laws restricting residential fertilizer applications in areas where eutrophication is a problem (NRC 2011), but behavior change campaigns (MWQ.RC2.4, Section 3.3) are a potential alternative.

Expanded enforcement of existing stormwater permit requirements was recommended as another action under this sub-strategy. Since a large proportion of the nutrient load can be bound to suspended sediments, enforcement of construction BMPs may be especially important (K. Dinicola, pers. comm.). Additional focus on local Illicit Discharge Detection and Elimination (IDDE) programs required under the MS4 permits may also be beneficial in this context.

Several existing technical assistance and education/outreach programs could potentially support urban stormwater focused nutrient reduction efforts. The [Washington Stormwater Center](#) educates stormwater practitioners and conducts research on effectiveness of BMPs. The [Stormwater Outreach for Regional Municipalities](#) (STORM) coalition provides assistance and outreach materials to MS4 permittees required by the permits to educate residents and businesses about stormwater pollution. STORM facilitates the [Puget Sound Starts Here](#) initiative, detailed below in Section 3.4.

3.3 INCREASE AND STABILIZE FUNDING FOR NUTRIENT REDUCTION PROGRAMS

The Interdisciplinary Team emphasized that current funding sources for nonpoint nutrient reduction programs are not likely to be sufficient for reducing nutrient loads to the extent needed to achieve expected watershed targets. This sub-strategy is intended to support the development of new state and/or local sources of revenue that provide stable and dedicated funding for program operations.

Stormwater utility fees provide funding for management of urban runoff, and most local governments in the region subject to Municipal General Stormwater Permits do charge these

fees (Evrard et al. 2022, Kinney et al. 2021, and Kinney et al. 2022). Smaller cities and rural areas not subject to the requirements of the MS4 permits often do not raise revenue in this way. Some jurisdictions may receive funding for clean water programs from revenue raised by special purpose districts (e.g., shellfish protection districts, flood control districts) or county department budgets, though many resort to intermittent sources like grants (Ross Strategic 2021).

Several sources of grant funding have been detailed in this document, but grants are generally intended to be short-term support rather than an ongoing source of basic program funding. Additionally, reliance on grant funding can cause administrative challenges. Time dedicated to finding, applying for, and managing grants reduces the effort spent on program delivery, and can make staff retention difficult given longer-term budget uncertainty (Ross Strategic 2021).

This strategy is cross-cutting with two [Shellfish Beds Implementation Strategy](#) priorities: (1) Establish and support sustainable local pollution identification and correction (PIC) programs; and (2) Implement and support on-site sewage system (OSS) management and repair programs. Both emphasize the need for sustainable funding to support local programs that engage property owners to identify and correct sources of pollution.

EPA Puget Sound funding disbursed through the Watersheds LO and the Pathogens LO were instrumental in supporting the development of local Pollution Identification and Control (PIC) Programs and hiring of nonpoint specialists at Ecology able to identify and resolve watershed sources of pollution (McCarthy 2019a). Two of these grantees have subsequently been successful in developing new local funding mechanisms to continue this work:

- In May 2021, the Mason County Board of County Commissioners passed an ordinance creating a unified [Clean Water District](#) with a dedicated funding mechanism. Most parcels with a surface water drainage connection to in-County marine waters are now assessed an annual fee of \$5.06 via property tax statements.
- In August 2021, Clallam County's Board of Health passed an ordinance creating a dedicated funding mechanism for implementation of their OSS Management Plan. An amended fee schedule includes a new operations and maintenance fee for every septic system in the County. The \$13 annual fee is assessed via property tax statements.

NEP partners could encourage other jurisdictions to develop similar funding mechanisms, by taking actions such as providing analysis of existing funding gaps, communicating this success story to other jurisdictions, or developing model ordinances. Such work would help advance Institutional Strategy A from the [2022-2026 Action Agenda](#): Explore and utilize new sources of funding, enhance existing sources of funding, and increase overall funding for Puget Sound recovery.

3.4 DEVELOP A BEHAVIOR CHANGE CAMPAIGN

This sub-strategy recommends the development and distribution of locally relevant outreach resources to improve the public's knowledge of their nutrient impacts, as well as applying social marketing tools to develop a behavior change campaign.⁸⁸ **EPA Puget Sound funding could potentially support regional coordination, sharing of materials/resources, and dissemination of social marketing best practices.**

A variety of programs and organizations supported by EPA Puget Sound funding have focused on nutrient-related community outreach, education, and behavior change (McCarthy 2019a). Some of these programs are geared towards urban landowners, such as the Snohomish County LakeWise Program and South Sound Natural Lawn Care Program, while others are focused on agricultural landowners (such as the [Conservation Stewardship Program](#) or other programs supported by conservation districts such as the Direct Seed Loan Program). These programs and organizations are detailed below.

SNOHOMISH COUNTY LAKEWISE PROGRAM

Snohomish County's LakeWise program "works to reduce nutrients by building awareness of water quality impacts that residents have on their lakes and aims to influence behavioral changes through incentives, education, and technical assistance (McCarthy 2019a). The Lakewise program is run by Public Works with the intention to reduce property runoff (particular fertilizer and lawn care products) into adjacent lakes.

Specific BMPs adopted by landowners during the grant period for this program included BMPs for septic system care, fertilizer use, infiltration of stormwater runoff, pet waste management, and bare soil and erosion control. Shoreline landowners also planted shoreline buffers. From 2015 to 2017 the LakeWise program received \$296,000 in NEP grants through the Toxic and Nutrients grant.

According to the Puget Sound Nutrient Synthesis Report, between 2015 to 2017

- 320 households participated with 139 home site visits with the program
- 16 workshops and community events were held
- 61 LakeWise certifications were issued
- Approximately 2,271 feet of shoreline habitat was restored and 1.2 acres of shoreline buffer plants were planted at 35 shoreline households. According to Ecology's adapted nutrient

⁸⁸ Social marketing applies traditional marketing principles to influence behavior change in target audiences. It is a rigorous, evidence-based approach that has been used for decades to improve public health. Social marketing differs from traditional community outreach and education programs in that it focuses on identifying and addressing specific barriers to action, as compared to simply providing materials to inform an audience (PSP 2015).

model (M. Roberts, 2013) the restoration activities undertaken during the grant period will result in 2,624 pounds of nitrogen removal annually and 147 pounds of phosphorus removal

- As of early 2019, 542 households had participated in the LakeWise program by attending a septic system care or natural lawn care workshop
- 206 properties have had a LakeWise site visit and are working on completing the LakeWise checklist
- 84 properties have completed the checklist and become LakeWise certified
- According to Ecology's Nutrient LO synthesis (McCarthy 2019a), homeowners that attended a workshop or participated in a site visit demonstrated increased awareness of BMPs. The report states that "financial incentives are a motivator for many activities, including septic system inspections, workshop participation, site visits, and shoreline restoration."

The LakeWise program continues to offer free septic and lawn care workshops, site inspections and offers a "LakeWise Certified" sign for homeowners who become certified. The LakeWise program is funded through Snohomish County's Surface Water Management fund through Public Works.

SOUTH SOUND NATURAL LAWN CARE PROGRAM

The [City of Olympia's South Sound Natural Lawn Care Program](#) was created to reduce nutrient and pesticide loading into Budd Inlet⁸⁹ and Puget Sound and target high-priority neighborhoods within the Deschutes watershed through technical assistance and incentives that included a free soil test, two educational home visits by a lawn care professional, and demonstration workshops.

From 2014 to 2015 the South Sound Lawn Care program received \$219,000 in NEP funds through the Toxics and Nutrient grant. The program resulted in:

- 220 participants households
- 385 home site visits
- 220 soil samples taken

⁸⁹ Budd Inlet is an important location in terms of water quality because it does not meet Ecology's water quality standards for dissolved oxygen. Ecology has a TMDL clean-up plan that is designed to address water quality issues in Budd Inlet. Public comment on Ecology's TMDL recently closed in the summer of 2022 and a long-term management solution has been identified to restore Capitol Lake to an estuary. Additional information on the Budd Inlet TMDL report can be found [here](#). The City of Olympia's South Sound Natural Lawn Care Program additionally supports efforts to reduce nutrient loading in the watershed alongside the TMDL.

Expected nitrogen reductions from the South Sound Natural Lawn Care projects are 1.55 pounds per 1,000 square feet of lawn, reduced from 3.36 pounds to 1.81 pounds of nitrogen per 1,000 square feet. This represents a 46% reduction in expected nitrogen use.

Based on follow-up surveys sent to participants, “the largest behavior changes were associated with lawn care practices and incentives supported by demonstration and site visit....nearly 98 percent of respondents indicated their use of natural lawn care practices increased” (McCarthy 2019a).

Outreach associated with the program continues through the City of Olympia website and is supported by the City’s Storm and Surface Water Utility funds.

CHALLENGES AND BARRIERS TO EFFECTIVENESS OF BEHAVIOR CHANGE CAMPAIGNS

Brent et al. (2020) examined the distributional effects of voluntary green stormwater infrastructure program (GSI) incentives on private residential property owners’ participation. GSI programs analyzed included the [RainWise](#) rain garden program in Seattle and King County. The RainWise program has spent more than \$7.6 million on GSI and has reduced stormwater by over 22 million gallons. Brent et al. state that:

- Homes within RainWise eligible areas are more expensive (likely due to proximity to water bodies)
- Homeowners with the least and most expensive homes have lower participation rates in the program
- Participation is highest in the upper middle income deciles of homes eligible
- Participations is higher in neighborhoods where more neighbors have already adopted RainWise, thus influencing their neighbors to adopt
- Private GSI installations, particularly those that are mandatory, did not have any proximity effect
- Peer effects create the opportunity to “strategically expand eligibility areas while implementing targeted campaigns” (Brent 2020).

Additional information on behavior change is described in the [B-IBI Base Program Analysis](#). Kinney and Roberts (2020) identify factors essential to the successful implementation of behavior change and outreach campaigns. Financial incentives are key because project cost is generally a significant barrier. Direct and focused engagement, face-to-face interactions, and trusted messengers are similarly important.

The B-IBI BPA also lists the 2017 to 2019 Near-Term Actions funded by the Stormwater Strategic Initiative that focused on behavior change and outreach-oriented programs. These include including “Strengthening STORM”, also known as [Stormwater Outreach for Regional](#)

[Municipalities](#), Commerce’s [Building Green Cities](#) (also discussed in PSI’s [Land Development and Cover Base Program Analysis](#)), the [Puget Sound Starts Here](#) program.

Kinney and Roberts (2020) identify other local examples of the successful application of social marketing techniques to encourage residential property owners to undertake costly stewardship projects, including the [Shore Friendly](#) and [Building Green Cities](#).

4. RESTORE NATURAL NUTRIENT ATTENUATION

Natural nutrient attenuation (NNA), also known as in-situ nitrogen reduction or nutrient assimilation services, involves the removal of nitrogen and phosphorus after they have entered a waterbody. Restoration of nutrient assimilation services typically occurs by creating or enhancing habitats to support ecological process that transform, store, or remove nutrients from ambient waters (e.g., aquatic plants, complex stream habitat, wetlands, shellfish). Restoration of natural nutrient attenuation is a compliment to, not a substitute for, source control efforts (Stephenson and Shabman 2017, Rose et al 2021).

This strategy seeks to implement projects that restore or maintain NNA functions in watersheds and estuaries via 2 sub-strategies:

- Leverage existing funding from other restoration programs by encouraging them to consider nitrogen reduction benefits when designing and selecting projects (MWQ.RC3.1)
- Improve understanding of where NNA functions can be protected or restored to create significant load reductions (MWQ.RC3.2)

This strategy is cross-cutting with the [Floodplains and Estuaries Implementation Strategy](#) (River-Basin Scale Integrated Planning and Project Implementation Strategy), the [Freshwater Quality \(B-IBI\) Implementation Strategy](#) (Watershed Planning Strategy, Education and Incentives Strategy), and the [Land Cover and Development Implementation Strategy](#) (Protect and Restore Ecologically Important Lands Strategy)

As a result, **NEP partners are well-suited to support the analysis, planning, and coordination elements of identified on the NNA results chain.** Additional information about habitat acquisition and restoration programs, as well as regulatory protections for critical habitats, is provided in base program analysis and synthesis reports associated with the Implementation Strategies mentioned above (Wright 2021, Wright 2020, Kinney and Roberts 2020).

4.1 LEVERAGE EXISTING FUNDING PROGRAMS

The purpose of this sub-strategy is to promote implementation of multi-benefit restoration projects that would help reduce nutrient loads by leveraging existing salmon, estuary, and floodplain funding programs. Table 10 identifies the programs with potential to support implementation of this sub-strategy.

Specific actions identified by the IDT to advance this sub-strategy were:

- Promotion of research to improve design and construction of salmon, estuary, and floodplain restoration projects so that they increase NNA benefits for water quality.
- Coordination with the salmon recovery partners (Governor's Salmon Recovery Office, Tribes, local Lead Entities, etc.) and the Floodplains by Design Program to explore the potential for designing and funding projects with multiple benefits, including NNA restoration to improve water quality.

Operationalizing this strategy would require coordinated investment in pre- and post-construction water quality monitoring upstream and downstream of different types of restoration projects to measure associated reductions in nitrogen concentrations. This would require extensive coordination among multiple programs and a rigorous study design able to distinguish project characteristics associated with enhanced nitrogen removal. Once key design elements influencing nutrient attenuation are known, they can be communicated to program managers for incorporation into project guidance and selection criteria.

Past modeling work in the region can provide insights into the types of project features that may increase nutrient attenuation potential. Sheibley et al. (2015) indicated that increasing the travel time of water through a river or stream reach by restoring woody debris, pool-riffle morphologies, riparian zones, and floodplain connectivity may improve efficiency of attenuation function. Ecology (2012) demonstrated the possible role estuary restoration can play in attenuating nutrients at the mouths of freshwater tributaries. This TMDL study examined the impact that restoration the Deschutes estuary via removal of the dam that created Capitol Lake would have on water quality in Budd Inlet. Dissolved oxygen levels in Budd Inlet were predicted to be significantly lower under modeled scenarios where the estuary was restored.

Shellfish aquaculture and kelp harvest may also provide natural nutrient assimilation services. The literature suggests that in situ NNA can be implemented through a payment for nitrogen reduction or in the form of a credit trading program. These programs are more effective if they offer an additionality benefit over and above the status quo of current amount of shellfish placement benefits. Rose et al. (2021) note that, however, "in situ approaches [do not stop] upstream damages [that] are still occurring" and that in situ treatments must be consider "part of a suite of nitrogen removal options".

Table 10. Protection and restoration programs with potential to support the Natural Nutrient Attenuation Strategy

Program	Implementers and/or funders	Description
Estuary and Salmon Restoration Program (ESRP)	Department of Fish and Wildlife and Recreation and Conservation Office ⁹⁰	Provides funding from multiple sources and technical assistance for process-based habitat protection and restoration. Project solicitations occur every other year. All project phases (property acquisition, feasibility, design, restoration, and monitoring) are eligible. Proposals are evaluated by a multi-disciplinary technical review team composed of members from multiple agencies and organizations.
Floodplains by Design ⁹¹	Department of Ecology, The Nature Conservancy	Public-private partnership that strives to “develop and disseminate the principles of IFM” while strengthening “local community engagement in IFM” (Wright 2021) throughout Washington State. Supports capital restoration projects and convenes a network of integrated floodplain management practitioners to coordinate and support a collective vision of floodplain management in Washington. Ecology funds the competitive grant program of FbD. Since 2013, the Washington State legislature has appropriated \$215.9 million to fund Floodplains by Design.

⁹⁰ Washington State’s Recreation and Conservation Office (RCO) provides fiscal and contract management support to other state agencies implementing several restoration and acquisition programs. These programs distribute a mix of state and federal funding. RCO administers federal funds from a variety of sources as well as the state funds used to meet grant match requirements.

⁹¹ Additional information be found in the [Floodplains and Estuaries Implementation Strategy 2021 Narrative Update](#). PSI’s [Synthesis of Integrated Floodplain Management in Selected Puget Sound River Deltas](#) (Wright 2021) describes existing integrated floodplain management groups, approaches and processes that seek to reconnect and restore floodplains in Puget Sound.

Program	Implementers and/or funders	Description
Forest Riparian Easement Program (FREP)	Department of Natural Resources	Riparian easements on forestland may assist in natural nutrient attenuation. <u>RCW 76.13.130</u> established FREP in 2002 and re-authorized it in 2012 through <u>WAC 222-21-005</u> to allow the state to acquire “easements primarily along riparian and other sensitive aquatic areas from qualifying small forestland owners willing to sell or donate easements to the state”. ⁹² DNR administers FREP and authorizes the state to pay landowners in exchange for putting a 50- year conservation easement on their trees in the required riparian buffers. The amount of the compensation is based on the value of the trees left in the riparian buffer. The program is available to a qualifying landowner as defined in <u>WAC 222-21-010</u> .
Puget Sound Acquisition and Restoration Fund (PSAR)	Puget Sound Partnership, Salmon Recovery Funding Board	State capital funding for large habitat restoration and acquisition projects. Provides state match for several federal grant programs. Project solicitations occur every other year. Project sponsors submit proposals to local Lead Entities who review and select up to 3 projects to submit for further consideration. Projects are then reviewed and ranked by the Salmon Recovery Funding Board, PSP, and Puget Sound Salmon Recovery Council before going to the Office of Financial Management, Governor’s office, and legislature as part of a biennial budget request.
Regional Fisheries Enhancement Groups	Washington Department of Fish and Wildlife, 7 non-profit regional groups	Nonprofit organizations that implement restoration projects and lead community-based stewardship activities. Supported by fishing license fees administered by WDFW.

⁹² https://www.dnr.wa.gov/publications/fp_rules_ch222-21wac.pdf?ddapwu

Program	Implementers and/or funders	Description
Rivers and Habitat Open Space Program		Available for qualifying landowners wishing to sell permanent easements for some channel migration zones and critical habitat for state listed threatened or endangered species. Although not directly intended to support natural nutrient attenuation, habitat improvements may yield nutrient reduction in adjacent waterways.
Salmon Recovery Funding Board	Washington Recreation and Conservation Office, Salmon Recovery Funding Board, National Oceanographic and Atmospheric Administration	Grants for projects to restore damaged habitat, fix fish migration barriers, and preserve pristine habitat. Some of the funding for this program comes from the federal (NOAA) Pacific Coastal Salmon Recovery Fund.
Washington Wildlife and Recreation Program - Habitat Conservation Account	Washington Recreation and Conservation Office	Provides funding for acquisition, restoration, and recreational facility development in categories including critical habitat, natural areas, riparian protection, state park lands, and urban wildlife habitat.

Siting considerations must also be considered. Literature suggests using GIS (as suggested by the Chesapeake Bay program above) to “aid in the identification of appropriate sites that minimize user conflict” and “have no bacteria-based water quality restrictions”. This is to ensure that oyster harvest in areas of high bacterial abundance is prohibited as these oysters are not safe for human consumption. As is often the case areas of high nitrogen impairments may be in areas with high bacterial (e.g. fecal coliform, *e. coli*) abundance.

The Chesapeake Bay program (as described above) “include site-specific measurements of denitrification” for aquaculture. Using regional watershed modeling tools, suggested by MWQ.RC4.2 may aid in site-specific in-situ natural nitrogen attenuation practices.

4.2 IMPROVE UNDERSTANDING TO IDENTIFY PRIORITY WATERSHED AREAS

This sub-strategy seeks to improve understanding of where NNA functions can be protected or restored to create significant load reductions. IDT members recommended watershed analysis as a tool to identify specific areas that need nutrient load reductions, as well as existing wetlands providing NNA services that could be prioritized for regulatory protections via critical area ordinances.

Ecology’s [Watershed Characterization Model](#) is a decision support tool, developed with funding from the Watershed Lead Organization, that could potentially be used to advance this sub-strategy. It is a set of spatially explicit water flow/water quality and habitat assessments that compare different areas within a watershed for restoration and protection value. Nutrients are one water quality parameter included in the model. The main products of this model are color-coded maps that show the relative value of small watersheds throughout the Puget Sound Basin. The colors reflect a matrix which describes management recommendations (high/medium/ low protect or restore) based on the watershed’s level of importance versus level of degradation).

Other decision tools could be employed to evaluate the cost-effectiveness of NNA alternatives. This work would be closely related to the watershed model capacity sub-strategy (MWQ.RC4.2, Section 5.2).

5. DEVELOP ANTHROPOGENIC NUTRIENT LOAD REDUCTION TARGETS

The objective of this strategy is to quantify the nutrient reductions needed to achieve marine dissolved oxygen water quality standards, then identify an optimal combination of point source and watershed reductions that would be protective of sensitive inlets and bays. Ecology’s Water Quality Program is implementing this strategy via the Puget Sound Nutrient Reduction Project. There are two sub-strategies associated with results chain MWQ.RC4:

- Use the Salish Sea Model to quantify point source and watershed nutrient targets for attainment of marine DO water quality standards (MWQ.RC4.1)

- Develop or adapt watershed model capacity to identify sources of anthropogenic loading and reduction options in individual watersheds (MWQ.RC4.2)

5.1 DEVELOP NUTRIENT LOAD REDUCTION TARGETS USING THE SALISH SEA MODEL

Since the IDT developed this strategy, Ecology used the Salish Sea Model (SSM) to determine the assimilative capacity of Puget Sound basins and evaluate different nutrient reduction scenarios to identify those that result in the most improvement. Ecology (2025) established load reduction targets for marine point sources and watershed inflows (i.e., the sum of anthropogenic nutrient inputs, both point and nonpoint, discharged into Puget Sound via rivers and streams). The marine point source targets will be used to develop numeric water quality-based effluent limits (WQBELs) for nitrogen discharged directly into Puget Sound via WWTPs. Recall from section 1.4 that the PSNGP used narrative criteria and action levels based on existing WWTP performance in the first permit cycle because this information was not yet available.

The IDT identified some modeling uncertainties suitable for critical analysis, as well as opportunities to communicate Salish Sea Model results. This input is documented in the accompanying State of Knowledge report (James et al. 2022).

Modeling results will support regulatory actions requiring reductions from anthropogenic nutrient sources using NPDES permits and the state's Nonpoint Pollution Program. Several of the Marine Water Quality strategies described in this document and the associated narrative will support implementation of the Ecology (2025) Nutrient Reduction Plan. They include: MWQ.RC1 reduce wastewater nutrient loads (section 2), MWQ.RC2.1 reduce agricultural nutrient loads (section 3.1), MWQ.RC2.2 reduce urban stormwater nutrient loads (section 3.2), and MWQ.RC3 restore natural nutrient attenuation (section 4).

5.2 DEVELOP WATERSHED MODELING CAPACITY

Watershed nutrient inputs are associated with a range of anthropogenic sources, such as municipal stormwater, WWTPs that discharge to rivers, agriculture, forestry, and atmospheric deposition, so load reductions could be achieved in a number of ways. The SSM was used to establish watershed loading targets (Ecology 2025); future phases of modeling will quantify contributions from different sources within each watershed and specify reductions for each source. Results chain path MWQ.RC4.2 describes remaining steps necessary to develop a regional watershed model that could identify optimal management actions.

Since the IDT developed this strategy, Ecology partnered with the U.S. Geological Service to develop a version of the SPARROW model to estimate nutrient loads and sources from watersheds discharging into Puget Sound (Ecology 2025). At the time of the release of the draft Nutrient Reduction Plan, Ecology indicated they were evaluating the model as a potential tool to prioritize and develop individual watershed clean-up plans.

The IDT identified acquisition of data inputs to feed a regional watershed model as a priority. **NEP partners are well suited to support this non-regulatory strategy element. Coordination and consistency among watersheds and different monitoring organizations was identified as a potential barrier to successful implementation.** Two [Puget Sound Ecosystem Monitoring Program](#) (PSEMP) Work Groups, Freshwater and Modeling, could help facilitate robust data collection and curation as part of the model development process.⁹³

Key data needs include baseline nutrient concentrations in rivers/streams, point source discharges, verification of land use source loading assumptions, and nitrogen removal effectiveness of BMPs. An analysis of gaps in the spatial distribution of Ecology's Ambient Freshwater Monitoring Network may be helpful in prioritizing additional monitoring needs. The IDT also identified information barriers related to human dimensions and suggested that optimizing watershed load reductions will require evaluation of the cost effectiveness and feasibility of BMP installation.

As described in Section 3 and Section 6, **several existing programs could be leveraged to provide relevant data** on existing conditions, trends, pollution sources, BMP implementation, and effectiveness of pollution control measures. With the exception of Ecology Environmental Assessment Program [effectiveness monitoring](#) of TMDL waterbodies, most of these programs collect data on one type of nonpoint pollution and associated BMPs (e.g., [Voluntary Clean Water Guidance for Agriculture](#), [Stormwater Action Monitoring](#) (SAM), [Forest Practices Adaptive Management Program](#)). And relevant nutrient parameters may not be included in monitoring protocols for all programs.

Development of the type of planning tool envisioned by the IDT would require a synthesis of all available data on control measures appropriate for different sources of pollution, and focused data collection to fill existing gaps, to enable translation of watershed goals into specific BMPs. The [Chesapeake Assessment Scenario Tool](#) is an example that could be emulated. The watershed plan development support provided by this group of models provides recommendations for BMPs to achieve numeric nitrogen, phosphorus, and sediment goals that also reduce implementation costs and prioritize co-benefits. Northern Economics (2019) includes some preliminary compilations of data from other regions, including Chesapeake Bay.

Development of watershed modeling capacity for Puget Sound lags behind the Salish Sea Model. Ecology prioritized development of tools to evaluate WWTP discharges since that source accounts for 69% of anthropogenic nitrogen loading compared to 31% from watershed sources (Ecology 2019). Some IDT members and other participants in the implementation strategy development process raised concerns that this lag in watershed modeling capacity may result in economically inefficient outcomes by driving implementation of expensive capital

⁹³ When the IDT was developing this strategy, both of these Work Groups were active. However, by late 2024 they were both inactive.

upgrades to WWTPs in lieu of potentially more cost-effective watershed nitrogen reduction solutions (e.g., opportunities to develop a water quality trading program could be lost).

Participants in the Implementation Strategy development process also noted concerns about marine dischargers being required to “take up the slack” (i.e., be responsible for a disproportionate share of nitrogen load reductions) due to delay in identification of watershed source loading targets.

This issue relates to broader point source discharger concerns about “reasonable assurances” (Box 12) for nonpoint source pollution control activities (Brown and Caldwell 2014, Ecology 2015b).⁹⁴

Box 12. Reasonable Assurances

A fundamental principle of TMDLs is that the sum of all WLAs and all LAs must not exceed the waterbody’s assimilative capacity. Under the federal Clean Water Act, the only federally enforceable pollutant controls are those for point sources permitted under the NPDES program.

In order to allocate loads among both point (WLA) and nonpoint (LA) sources, the state must provide must be **reasonable assurances** that expected nonpoint load reductions will actually be achieved. Assurances may include application of local ordinances, grant conditions, or other enforcement authorities.

Where there are not reasonable assurances, the entire load reduction must be assigned to point sources.

Source: EPA 1991

Urban and agricultural BMPs can be voluntary and therefore more challenging to implement and enforce. Effectiveness is also more uncertain than point source controls due to recognized factors such as BMP design, site-specific conditions, maintenance intensity, scale of implementation, and lag times between implementation and full performance (NRC 2011, Fisher et al. 2021). If one or more TMDLs result from the Puget Sound Nutrient Reduction Project, these factors could ultimately undermine reasonable assurance conclusions and result in a larger regulatory burden and increased costs for point source dischargers.

⁹⁴ This concern is not unique to Washington’s Nonpoint Pollution Program (State-EPA Nutrient Innovations Task Group 2009). Some of these issues may be addressed with the additional specificity about suites of BMPs that would reduce loadings from significant source categories (e.g., as provided in the Voluntary Clean Water Guidance for Agriculture), per terms of a 2021 [settlement agreement](#) resulting from a 2016 complaint by Northwest Environmental Advocates (Case 2:16-cv-01866).

6. ADVANCE MARINE WATERS MONITORING AND RESEARCH PROGRAMS

This strategy aims to improve understanding of physical, biological, and biogeochemical impacts of excess anthropogenic nitrogen in marine waters by maintaining/expanding existing monitoring networks and improving collaboration amongst programs. Results chain MWQRC5 includes three sub-strategies:

- Improve understanding of biological responses to nutrient stress (MWQRC5.1)
- Advance observations of receiving waters (MWQRC5.2)
- Improve utilization of nutrient utilization pathways (MWQRC5.3)

The accompanying State of Knowledge appendix captures input from the IDT about specific priorities, such as the connection between nutrient enrichment and biological integrity; impacts of low dissolved oxygen on Puget Sound species; data on marine biogeochemistry, primary productivity, and nutrient utilization pathways to improve model calibration/validation; and development of detectable indicators of change for future effectiveness monitoring. Several critical analyses to address some of these data gaps and are proposed in the State of Knowledge report.

Table 11 provides a compilation of existing programs that have potential to support this sub-strategy. **EPA Puget Sound funding, and existing NEP programs/tools like the Puget Sound Ecosystem Monitoring Program (PSEMP) and PSP's Science Work Plan, are well-positioned to directly support identified priorities and coordinate the multiple organizations needed to carry out this complex research agenda.**

Table 11. Programs with potential to support the Marine Waters Monitoring and Research Strategy

Program	Implementers and/or funders	Description
Acidification Nearshore Monitoring Network (ANeMoNe)	Department of Natural Resources (Aquatic Assessment and Monitoring Team)	Monitoring of water quality, shellfish spat settlement, eelgrass density/morphology, and bird use via partnerships with local universities, WDFW, NOAA, Puget Sound Restoration Fund, and local volunteers.
Beach Environmental Assessment, Communication, and Health (BEACH) Program	Department of Ecology	Monitoring for fecal bacteria at marine beaches.
Biotoxins and Illness Protection Program	Department of Health (Shellfish Program)	Routine testing for biotoxins in recreational and commercial shellfish harvest areas.
Crab Abundance Monitoring Program	Swinomish Tribe	Abundance monitoring of larval and juvenile Dungeness crab.
Coordinated Tribal Water Quality Program	Northwest Indian Fisheries Commission and EPA	Partnership with member tribes providing technical support for water quality monitoring, data storage/management, and data exchange.
Fish Management Division	Department of Fish and Wildlife (Fishery and Hatchery Science and Management)	Research and management of marine fishes, including recurring Puget Sound bottom trawl surveys, forage fish monitoring, Toxics Biological Observation System (TBIOS), and rockfish surveys.
Long Term Marine Waters Monitoring Program	Department of Ecology (Environmental Assessment Program)	Monthly collection of water column samples from 29 core and 45 rotating stations in the Salish Sea, and assessment of data for multiple parameters including dissolved nutrients and nutrient ratios. High resolution aerial photos captured during “Eyes Over Puget Sound” seaplane sampling trips track jellyfish and algal blooms.
Marine Sediment Quality Monitoring Program	Department of Ecology (Environmental Assessment Program)	Long-term monitoring of benthic macrofauna abundance and species richness, sediment chemistry, and toxicity bioassays.

Program	Implementers and/or funders	Description
Northwest Association of Networked Ocean Observing Systems (NANOOS)	University of Washington, NOAA, and a large number of member organizations	Operates oceanographic monitoring stations and provides data aggregator services
Ocean Acidification Monitoring	NOAA	Coordinates research and monitoring to improve understanding of how ocean chemistry is changing and impacts on marine life. Partners with Northwest Fisheries Science Center, University of Washington, and NANOOS.
Pacific Northwest Crab Research Group	Network of researchers, resource managers, crabbers, and community members coordinated by the Puget Sound Restoration Fund	Prioritizes research questions, develops collaborative projects, and facilitates knowledge sharing to promote and support sustainable Dungeness crab populations.
Padilla Bay National Estuarine Research Reserve (NERR)	Department of Ecology and NOAA	Regular monitoring of water quality parameters, including nutrients and chlorophyll, occurs as part of NOAA's NERR System-wide Monitoring Program.
PRISM Marine Modeling Program	University of Washington, with multiple federal, state, and local funders	Water quality and bio-chemical monitoring via bi-annual research cruises, a network of Oceanic Remote Chemical Analyzer (ORCA) buoys, and gliders.
Puget Sound Ecosystem Monitoring Program (PSEMP)	Puget Sound Partnership	Collaborative network of researchers who study and communicate about Puget Sound ecosystem status and trends and effectiveness of recovery actions.
Puget Sound Marine Monitoring Program	King County	Offshore water column monitoring with a large number of stations within a concentrated area and targeted near wastewater treatment plant discharges. Zooplankton monitoring in collaboration with UW.
Puget Sound Zooplankton Monitoring Program	Department of Fish and Wildlife with multiple regional partners	Previously a pilot program of Long Live the Kings transitioned to a long-term home at WDFW in 2018 to ensure coordinated zooplankton monitoring continues uninterrupted.
Salish Sea Modeling Center	University of Washington, with multiple federal, state, and local funders	Provides computational and modeler support for applications of regional hydrology, hydrodynamic, water quality, and ecosystem models on a single platform.

Program	Implementers and/or funders	Description
SoundToxins	Sea Grant and Department of Health, with multiple sampling partners	Weekly or bi-weekly phytoplankton and environmental condition monitoring for early detection of harmful algae bloom events
Stormwater Action Monitoring	Department of Ecology and 90+ municipal stormwater permittees in western WA	Regional collaboration to satisfy monitor monitoring needs under the Western Washington municipal stormwater general permits. Funds stormwater management effectiveness studies, status and trends monitoring, and source identification. Projects are designed to produce regionally transferable findings.
Submerged Vegetation Monitoring Program	Department of Natural Resources (Nearshore Monitoring and Aquatic Assessment)	Distribution and abundance monitoring of seagrasses in greater Puget Sound.
Washington Ocean Acidification Center	University of Washington, with multiple federal, state, tribal and commercial funders	Water quality monitoring, including at shellfish hatchery and rearing areas. Biological monitoring of phytoplankton, microplankton, mesoplankton, pteropods, and foraminifera.
Watershed Health Monitoring	Department of Ecology (Environmental Assessment Program)	Status and trends monitoring of streams and rivers to assess overall watershed condition. Biological, chemical, and physical habitat parameters measured at reference sites plus randomly selected sites on a rotating basis by region.

7. SUMMARY OF RECOMMENDATIONS

We offer the following summary of recommendations for NEP partners to advance implementation of these strategies in support of Ecology regulatory actions:

- Support Ecology efforts to inform permittees about the Water Quality Combined Funding Program application cycle with additional outreach about the more favorable terms and short timeline associated with federal stimulus funding (e.g., larger share eligible for additional subsidization, ability to use American Rescue Plan block grants to meet non-federal match requirements). If needed, direct assistance putting together materials needed for applications could be provided to smaller under-resourced permittees.
- Support Ecology and Commerce in identifying opportunities for wastewater service regionalization/consolidation to increase cost efficiency. This could involve disseminating information about options for different governance models and the consolidation process.
- Provide financial and/or technical support for integration of planning required for long-term capital upgrades and under the Growth Management Act to ensure wastewater infrastructure is able to accommodate anticipated population growth. Attention can be focused where the land use planning jurisdiction and the wastewater treatment provider are different entities.
- Develop an agricultural riparian buffer incentive program similar to the Washington Department of Natural Resources' Forest Riparian Easement Program to provide additional incentive for agricultural producers to install large riparian buffers on their land. This program compensates qualifying forest landowners for the market value of timber in the required riparian buffer in exchange for a 50-year conservation easement. Reducing nutrients in agricultural run-off can also involve relatively simple manure management practices like using tarps.
- Provide support to develop coordinated geo-referenced implementation tracking and effectiveness monitoring of all agricultural incentive programs operating in the region. Formal data sharing agreements, or MOU, like examples provided from other states, may be necessary due to rules prohibiting disclosure of personal information about Farm Bill program participants.
- Encourage local jurisdictions to develop funding mechanisms for PIC and OSS programs by providing analysis of existing funding gaps, communicating about recent examples of new clean water property assessments, and/or developing model ordinances.
- Support development and expansion of programs that improve the public's knowledge of nutrient impacts and incentives for behavior change through funding of pilot programs, sharing of materials/resources, and dissemination of social marketing best practices.
- Leverage the Puget Sound Ecosystem Monitoring Program and PSP's Science Work Plan to support the analysis, planning, and coordination of monitoring elements associated with the Natural Nutrient Attenuation Strategy and Advance Marine Waters Monitoring and Research Programs Strategy.

- Conduct a cost-benefit analysis, building on NEP-supported work by Northern Economics, to support regional prioritization of specific strategies and actions. This could involve a formal cost effectiveness (e.g., cost per pound of nitrogen removed) for point and nonpoint reduction strategies by subbasin, as well as an evaluation of distributional equity (e.g., who pays and who benefits from permit requirements)

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APPENDIX A. LOCAL SEWER AGENCIES AFFECTED BY THE PSNGP

Local Sewer Agency Affected by the PSNGP	County	PSNGP permittee (# of facilities)	Wholesale customer	Wholesale ⁹⁵ provider
City of Port Angeles	Clallam	yes	no	n/a
City of Sequim	Clallam	yes	no	n/a
Clallam County (Clallam Bay + Sekiu)	Clallam	yes (2)	no	n/a
City of Langley	Island	yes	no	n/a
City of Oak Harbor	Island	yes	no	n/a
Town of Coupeville	Island	yes	no	n/a
City of Port Townsend	Jefferson	yes	no	n/a
Cedar River Water and Sewer District	King	no	yes	King County
City of Algona	King	no	yes	King County
City of Auburn	King	no	yes	King County
City of Black Diamond	King	no	yes	King County
City of Carnation	King	no	yes	King County
City of Issaquah	King	no	yes	King County
City of Kirkland	King	no	yes	King County
City of Mercer Island	King	no	yes	King County
City of Redmond	King	no	yes	King County
City of Renton	King	no	yes	King County
City of Seattle	King	no	yes	King County
Coal Creek Utility District	King	no	yes	King County
Highlands Sewer District	King	no	yes	King County
Lakehaven Water and Sewer District	King	yes (2)	no	n/a
Midway Sewer District	King	yes	no	n/a
Northshore Utility District	King	no	yes	King County
Sammamish Plateau Water and Sewer District	King	no	yes	King County
Skyway Water and Sewer District	King	no	yes	King County
Soos Creek Water and Sewer District	King	no	yes	King County
Southwest Suburban Sewer District	King	yes (2)	yes	King County
Valley View Sewer District	King	no	yes	King County
Vashon Sewer District	King	no	yes	King County
Woodinville Water District	King	no	yes	King County
City of Bellevue	King	no	yes	King County
City of Kent	King	no	yes	King County
City of Pacific	King	no	yes	King County
City of Tukwila	King	no	yes	King County

⁹⁵ **Wastewater wholesaler and retailer roles explained** – Some local sewer agencies that operate wastewater treatment plants have agreements to provide treatment services to neighboring local sewer agencies. These wholesaler providers charge their wholesale customers a uniform rate to cover treatment costs (capital, operation, maintenance) based on the number of users the other agency serves. The wholesale customer then acts as a retailer and bills their customers for the wholesaler's services plus their costs to convey wastewater to the wholesaler's system. This is the reason the number of local sewer agencies affected by the PSNGP is larger than the number of permittees.

Local Sewer Agency Affected by the PSNGP	County	PSNGP permittee (# of facilities)	Wholesale customer	Wholesale provider
King County	King	yes (4)	no	n/a
Northeast Sammamish Sewer and Water District	King	no	yes	King County
Alderwood Sewer and Water District	King/Snoh	yes	yes	King County
City of Shoreline	King/Snoh	no	yes	King County
City of Bainbridge Island	Kitsap	yes	yes	Kitsap County
City of Bremerton	Kitsap	yes	no	n/a
City of Port Orchard (West Sound Utility District)	Kitsap	yes	no	n/a
City of Poulsbo	Kitsap	no	yes	Kitsap County
Kitsap County	Kitsap	yes (3)	no	n/a
Kitsap County Sewer District #7	Kitsap	yes	no	n/a
City of Shelton	Mason	yes	no	n/a
Mason County	Mason	yes	no	n/a
City of Dupont	Pierce	no	yes	Pierce County
City of Fife	Pierce	no	yes	Tacoma
City of Fircrest	Pierce	no	yes	Tacoma
City of Gig Harbor	Pierce	yes	no	n/a
City of Lakewood	Pierce	no	yes	Pierce County
City of Milton	Pierce	no	yes	Tacoma
City of Ruston	Pierce	no	yes	Tacoma
City of Steilacoom	Pierce	no	yes	Pierce County
City of Tacoma	Pierce	yes (2)	no	n/a
City of University Place	Pierce	no	yes	Pierce County
Pierce County	Pierce	yes	no	n/a
East Sound Sewer and Water District	San Juan	yes (2)	no	n/a
Fisherman Bay Sewer District	San Juan	yes	no	n/a
Town of Friday Harbor	San Juan	yes	no	n/a
City of Anacortes	Skagit	yes	no	n/a
City of Mount Vernon	Skagit	yes	no	n/a
Town of La Conner	Skagit	yes	no	n/a
City of Bothell	Snohomish	no	yes	King County
City of Brier	Snohomish	no	yes	King County
City of Edmonds	Snohomish	yes	no	n/a
City of Everett	Snohomish	yes	no	n/a
City of Lake Forest Park	Snohomish	no	yes	King County
City of Lynwood	Snohomish	yes	yes	Edmonds
City of Marysville	Snohomish	yes	no	n/a
City of Mountlake Terrace	Snohomish	no	yes	Edmonds
City of Snohomish	Snohomish	yes	no	n/a
City of Stanwood	Snohomish	yes	no	n/a
Cross Valley Water District	Snohomish	no	yes	King County
Lake Stevens Sewer District	Snohomish	yes	no	n/a
Mukilteo Water and Wastewater District	Snohomish	yes	no	n/a
Olympic View Water and Sewer District	Snohomish	no	yes	King County
Silver Lake Water District	Snohomish	no	yes	Everett
Town of Woodway	Snohomish	no	yes	Edmonds
City of Lacey	Thurston	no	yes	LOTT

Local Sewer Agency Affected by the PSNGP	County	PSNGP permittee (# of facilities)	Wholesale customer	Wholesale provider
City of Olympia	Thurston	no	yes	LOTT
City of Tumwater	Thurston	no	yes	LOTT
Thurston County (Boston Harbor + Tamoshan)	Thurston	yes (2)	yes	LOTT
Birch Bay Water and Sewer District	Whatcom	yes	no	n/a
City of Bellingham	Whatcom	yes	no	n/a
City of Blaine	Whatcom	yes	no	n/a
Lake Whatcom Water and Sewer District	Whatcom	no	yes	Bellingham