

[Phase One Final]
Implementation Strategy for Puget Sound's
Shellfish Beds Recovery Target

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Note to readers / reviewers: Content addressing several key elements of this test-case Implementation Strategy is not yet developed, but an approach to do so throughout the fall of 2015 is in review. These elements include:

- Policy changes, actions, and approaches needed (including specific Near-Term Actions)
- Research needs (ongoing and desired scientific investigations)
- Monitoring needs
- Adaptive management processes, steps, and timing
- Estimating costs

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1.0 Introduction

Puget Sound recovery is governed by the Action Agenda for Puget Sound, the approved Comprehensive Conservation and Management Plan (CCMP) under the Federal Clean Water Act that outlines the regional strategies and specific actions needed to recover the largest estuary in the USA. One way to organize recovery efforts has been through tracking more than twenty Vital Signs, indicators with specific recovery targets that help the region measure progress.

Cleaning up the Puget Sound is a collaborative effort between state and federal agencies, tribal governments, local governments, business and environmental groups, and many others. Such a complex and huge undertaking demands thoughtful and evolving strategic approaches that align diverse efforts across the region and leverage limited resources to maximize gains.

Developing this implementation strategy is a test-case to determine if a more effective approach to reaching Vital Sign targets can be realized, in this case for shellfish beds.

Box 1.1: Purpose of an Implementation Strategy

- **Summarize the recovery strategy for a given Vital Sign / target:** What is the rationale for selected approaches to recovery, and the intent of actions intended to achieve the target?
- **Provide a shared roadmap for those involved in Puget Sound recovery:** Implementation partners include; practitioners, sponsors, policy makers, legislators, scientists, managers, tribal and community members, and participating citizens.
- **Orient action toward the shared measurements of recovery:** Define the path to achieve our 2020 Puget Sound Vital Sign targets.
- **Support Aligned Actions:** Highlight the most important work and how policy should enable recovery, how actions should address pressures, how research should reduce key uncertainties, and how monitoring should assess both effectiveness and trends.
- **Help to mobilize funding:** Clear demonstration of the most important work to achieve the 2020 targets will aid in making the case for necessary resources.
- **Advance needed policy:** Definition of the path to the targets will highlight policy opportunities and barriers to recovery work that partners can then develop actions to address.
- **Facilitate recovery by educating key partners, improving communication, and strengthening coordination efforts** among all participants
- **Inform development of related work plans and documents:** Local Near-Term Actions, Action Agenda updates, Biennial Science Work Plans, State of the Sound reports, etc.
- **Function as the template for deliberate adaptive management**

1.1 What are Implementation Strategies in the context of Puget Sound recovery?

Implementation Strategies are intended to unite, guide, and integrate efforts to recover ecosystem components that have been selected as Puget Sound Vital Signs (among other roles: see Box 1.1). They are also intended to provide more focused content for the Action Agenda than has been included to date.

Implementation Strategies articulate long-term recovery pathways, prioritizing near-term actions most likely to achieve recovery target(s). They should provide perspective and direction for local recovery efforts to be better aligned with regional priorities (e.g., propose Near Term Actions for the Action Agenda that support recommended strategies).

Three Implementation Strategies are currently in development: this one for Shellfish Beds, another for Estuaries, and a third for Chinook salmon. In 2014, PSP and Department of Natural Resources (DNR) convened a diverse stakeholder group to prepare the “Puget Sound Eelgrass (*Zostera marina*) Recovery Strategy.” Taking lessons from that initial effort, Implementation Strategies for Shellfish Beds and estuaries were prepared in spring 2015 as test-cases to determine feasibility. Implementation Strategies are expected to be revised and to improve with each cycle of the adaptive management process.

Implementation Strategies are intended to serve the entire community of those with an interest and a part in recovery, in general, and in relation to the focal Vital Sign. This includes legislators and policy makers, local implementers, and funding agencies, as well as recovery practitioners and professionals. Implementation Strategies should ultimately increase the confidence and consensus of this entire community in the collective approaches for success.

1.2 How to use this document?

This Implementation Strategy is a guide with which practitioners, implementers, sponsors, and those making decisions about shellfish beds recovery can align ongoing and future actions within the context of regional priorities. It states the rationale for recovery, assumptions about how recovery might be achieved, and what the priorities should be. All are open to question and improvement. Please share your questions, comments, and feedback to help improve this strategy.

2.0 Why are shellfish important to the Puget Sound region?

Bivalve shellfish are of ecological, economic, cultural, recreational, and historical significance to Puget Sound. Shellfish have sustained people in the region for at least 5,000 years (Antczak et al. 2008). In the 1850s, tribes signed treaties with the U.S. government, reserving rights to fish and harvest shellfish in usual and accustomed areas (excepting staked or cultivated shellfish beds). Commercial shellfish harvesting began during the California Gold Rush era and continues to support livelihoods today.

Shellfish also provide biophysical services: they feed by filtering and ingesting minute particles – mostly microscopic algae – from seawater. This helps to maintain water quality and clarity, allowing sunlight to penetrate to depths at which eelgrass and macro algae (attached seaweed) use it for photosynthesis (Newell 2004). Shellfish pass on digested and undigested material that settles to form sediments, feeding benthic organisms. They also add structure to nearshore habitats, provide refuge and food for other species, and can help to remove nitrogen from the water (Newell 2004).

Washington State leads the country in production of farmed clams, oysters, and mussels with an annual value of over \$107 million. Across the state, shellfish growers directly and indirectly employ over 3,200 people and provide an estimated total economic contribution of \$270 million (Washington Shellfish Initiative 2011). In Mason County the commercial shellfish industry is the second largest private-sector employer. The Washington Shellfish Initiative (2011) estimates that 125,000 shellfish harvesting trips are made each year to Puget Sound beaches, providing a net economic value of \$5.4 million to the region.

3.0 What are the Shellfish Beds targets for recovery in Puget Sound? How are we doing?

3.1 2020 Shellfish Beds recovery goal

The shellfish beds recovery goal for Puget Sound is a net increase of 10,800 harvestable acres of shellfish beds between 2007 and 2020, including 7,000 acres where harvest had been prohibited. Success is largely dependent on water quality, as a shellfish bed's classification is determined based on whether national standards are being met (see call-out box). Additional detail about how that target was developed is provided in the next section.

3.2 How was the 2020 recovery goal derived?

In 2006, a multi-agency workgroup evaluated potential classification upgrades to commercial shellfish harvesting areas. A list of Restoration Projections is kept and updated annually by the Washington State Department of Health (WDOH) that details the current classification of each growing area, the current pollution identification and correction activities, the reasons for the classification restrictions (nonpoint source pollution, wastewater treatment plant outfall, marina, etc.), the estimated acreage upgraded, and a projected timeframe for the upgrade.

Based on findings in the initial Restoration Projections list, WDOH developed an ambitious "stretch-goal"¹ of upgrading the classification of 10,000 acres by 2020. This is a *net* gain, the sum of (positive) upgraded classification acreage and (negative) downgraded classification acreage, accounting only classification changes associated with pollution.

In 2011, the Puget Sound Partnership (PSP) adopted a similar goal as one measure, or Vital Sign, of the health of Puget Sound, targeting a net increase of 10,800 harvestable shellfish acres between 2007 and 2020, including 7,000 acres where harvest is currently prohibited. At that time, there were approximately 10,700 acres of Puget Sound shellfish growing areas where harvest was prohibited due to non-point source pollution. PSP resolved that

Shellfish Classification

Before shellfish from commercial and recreational harvest areas are considered safe to eat, pollution sources must be assessed, and marine water quality must meet national standards. The Washington State Department of Health has monitored water quality (bacterial levels) in Puget Sound for over 30 years under the National Shellfish Sanitation Program, with standards and regulations written in a Model Ordinance and adopted through Chapter 246-282 of the Washington Administrative Code. Today, this entails collecting and analyzing over 10,000 marine water samples each year, and inspecting numerous potential pollution sources that could impact marine water.

Based on monitoring results, commercial harvest areas are classified as Approved, Conditionally Approved, or Prohibited:

- **Approved** areas meet national standards for harvest, except during emergency pollution events, when they are closed.
- **Conditionally Approved** areas also meet standards, except during predictable polluted events such as measured rainfall, seasonal rainfall, or high river flows, when they are closed.
- **Prohibited** areas do not meet national standards and are closed to harvest at all times.
- **(NOTE: recreational areas are classified as open conditionally opened and closed)**

¹ A stretch-goal is an operational goal with an objective probability of attainment that may not be quantified, but considered to be ambitious, given current trends.

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Puget Sound Shellfish Beds Implementation Strategy Narrative
Phase One Final, Last Updated September 8, 2015

3.3 Current status of shellfish beds in Puget Sound

Over 800 miles of Puget Sound shoreline harvest areas are currently classified as either Approved, Conditionally Approved, or Prohibited. As of January 2015, this area represented 91 commercial shellfish growing areas covering approximately 190,000 acres (Table 1).

Of the 10,821 acres classified as Conditionally Approved, about 72% are affected by nonpoint pollution sources, such as farming (agricultural) activities, individual on-site sewage systems, and wildlife (Figure 1). Most of the remaining acres (25%) are affected by conditions at wastewater treatment plants. Marinas and areas where numerous boats are moored on a seasonal basis account for only about 3% of the Conditionally Approved acreage.

Of the 35,980 acres in Puget Sound classified as Prohibited, about 22,000 acres (63%) are affected by wastewater treatment plant outfalls, and 10,000 acres (26%) by nonpoint pollution sources such as farms, wildlife, and individual on-site sewage systems (Figure 2). The remaining 4,000 acres are closed due to marinas and chemical contamination.

Table 1 Puget Sound Classified Shellfish Acreage (January 1, 2015)	
Classification	Acres
Approved	142,243
Conditionally Approved	10,821
Prohibited	35,980
TOTAL	189,044

3.4 Progress to date towards the shellfish beds recovery goal

WDOH has tracked classification changes in shellfish growing areas since 1981 (Figure 3). A rash of classification downgrades in the late 1980s was offset by classification upgrades since the late 1990s. From 2007 through March 2015 the Puget Sound area has seen a net improvement of 2,851 acres.

Projections based on the WDOH Restoration Projections list as of April 2015 yielded an expectation that 8,966 acres could be added by 2020. Achieving this acreage improvement would meet the target, however, potential loss of acreage has not been estimated. In April 2011, a large section (4,000 acres) of the Samish Bay Shellfish Growing Area was downgraded due to extremely high bacteria levels in the Samish River. This classification change significantly reversed progress.

Figure 2. Sources of pollution for Conditionally Approved (left) and Prohibited (right) shellfish areas: nonpoint (red), wastewater treatment plant outfalls (blue), marinas (green), and other (yellow). Source: WDOH

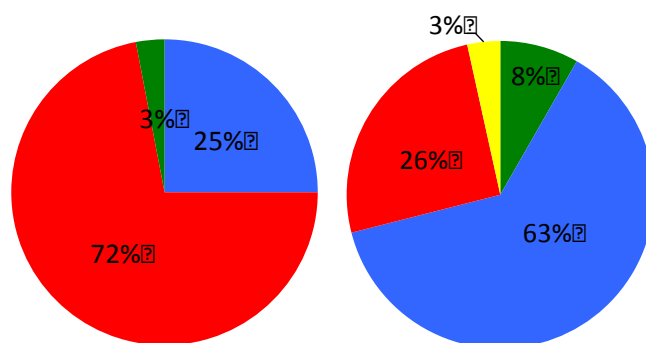
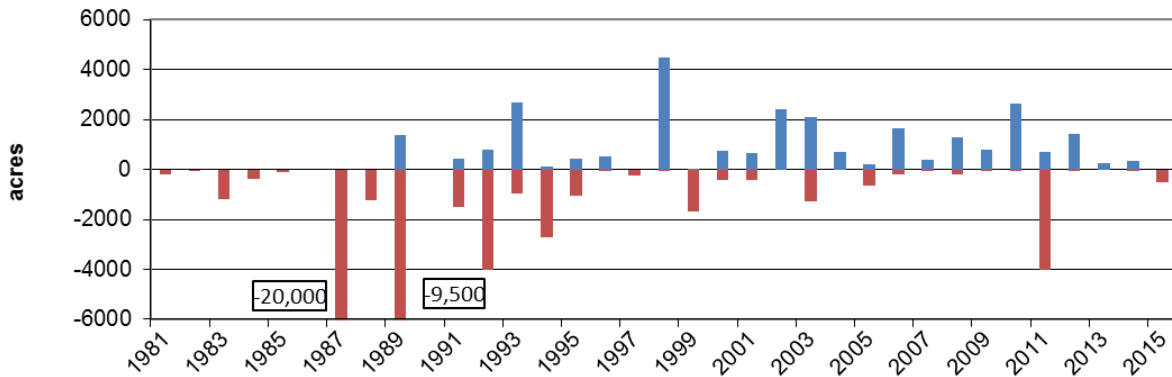


Figure 3. Area of shellfish beds changing classification by year in Puget Sound (blue = upgraded, red = downgraded)



The 2020 target will not be met if the Samish Bay area is not upgraded by 2020. Stakeholders have been working on nonpoint pollution issues in the Samish Bay watershed, including the following efforts:

- Over 360 site visits to area farms by Skagit County and the departments of Ecology and Agriculture.
- 178 Best Management Practices (BMPs) implemented.
- Skagit County has defined the area as a Marine Recovery Area, and 57% of the on-site sewage systems have up-to-date inspections.
- Approximately 144 on-site sewage system repairs have been completed.

Although not yet meeting the standard for a classification upgrade, water quality in the Samish River shows an improving trend since 2008 (Figure 4). Annual rainfall totals are shown by year at the top of each bar.

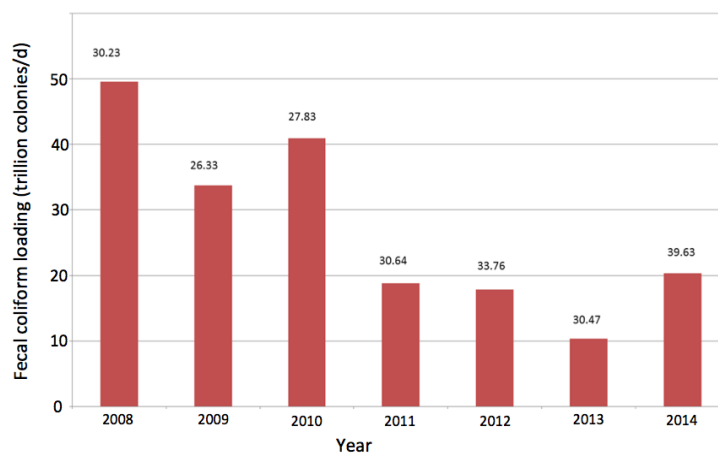


Figure 4. Recent trends in water quality in the Samish River with annual rainfall.

Steps in the Right Direction: Other progress and initiatives that have contributed to shellfish recovery include the following examples.

- **OSS Funding:** WDOH carried out a priority Near Term Action (NTA) to assess the viability of establishing (1) a regional, self-sustaining septic loan program to help property owners repair or replace septic systems, and (2) a dedicated fee to help local health jurisdictions (LHJs) work with property owners to ensure proper use and care of their septic systems. The agency is now working with the Department of Ecology and LHJs to establish the regional septic loan program. WDOH introduced legislation in 2015 to require a local septic fee in all Puget Sound counties. The bill failed and will be reintroduced in the 2016 session.
- **Shellfish Protection District Best Practices:** In 2013, WDOH organized a Shellfish Protection District (SPD) Workshop that resulted in an online “[SPD Best Practices Library](#)” to develop and supplement strategies in new and existing SPDs.
- **Pollution Identification and Correction (PIC) Forums:** WDOH brings experienced practitioners together with those new to PIC to share guidance and explore topics such as outreach methods, accessing private property, and using technical assistance, incentives, and enforcement. Addressing challenges that counties face when they respond to state water quality violations is an important aspect of this work.

4.0 Key pressures, challenges, and barriers to recovery progress

4.1 Pressures on Puget Sound harvestable shellfish beds

Pollutants affecting shellfish harvesting are mostly from humans, livestock, and pets or other warm-blooded animals. The principal contributors of pathogens are poorly functioning wastewater treatment plants, combined sewer overflows (following high rainfall events), failing on-site septic systems, and poor manure management practices on farmlands, which allow pathogens to enter streams and waterways. Effluent from vessels also contributes harmful bacteria, but in lesser quantities (Figure 2). Potential pathogens from these sources are measured using fecal coliform as the indicator bacteria. While they may not affect shellfish viability, they can accumulate in shellfish to the point where they become unsafe for humans to eat and often indicate the presence of additional viruses. When this occurs too frequently, shellfish beds are downgraded. The Vital Sign tracks changes in this classification status.

Oil spills can also affect water quality, but this is typically non-pathogenic, and generally only temporarily affect the harvest of shellfish beds. In addition, some microscopic algae produce bio-toxins that can cause sickness or even death if contaminated shellfish are consumed by humans. When pollutants and toxins in harvestable shellfish beds exceed pre-defined thresholds, shellfish beds are temporarily closed for harvest. Bio-toxins and or oil spills do not lead to classification changes.

4.2 Challenges and barriers to recovery success

Despite significant efforts to recover shellfish bed acreage, potential improvements are limited by the following five challenges and barriers – as outlined in the Results Washington Action Plan.

1. **Lack of effective and sustainable local nonpoint pollution programs.** Protection of shellfish growing areas requires that local programs monitor water quality, so that sources can be identified and corrected quickly. Puget Sound counties vary in their capacity to identify and correct pollution problems and most are supported substantially by grants.
2. **Insufficient farm waste management in some counties.** Shellfish growing areas impacted by improper farm and manure management have been difficult to protect and restore. Management of polluted runoff is regulated on dairies under the Dairy Nutrient Management Act. The Department of Ecology regulates non-dairy livestock operations. A challenge for doing this regulatory work is that it is limited to where access is voluntarily granted or discharges are documentable from public access. Department of Ecology recently developed a guidance document to provide information on livestock-related water quality impacts to help landowners and producers make informed management decisions to protect water quality.

While there are many tools and technical assistance programs available, the challenge is often encouraging their use. For example, local conservation districts have developed web-based risk management tools that can help producers evaluate field conditions and weather forecasts prior to making land applications of manure.

3. **Limited control of boaters' waste.** Sewage discharges, even by a small number of vessels in small quantities can cause pollution that can be a problem of particular concern over or near shellfish beds. Just over 3,300 acres are impacted by marinas or other boating activities based on the potential for wastewater discharge. Control of boaters' waste could result in classification upgrades within portions of these areas.
4. **Difficulty implementing on-site sewage system management and repair programs.** Local programs to manage and repair OSS have been underfunded. Many local health jurisdictions rely on grants to support this work. Routine maintenance can cost landowners hundreds and repairs can cost thousands or tens of thousands. Affordable funding is needed to help landowners repair or replace failing systems.
5. **Wastewater treatment plant outfalls to Puget Sound close shellfish beds.** Wastewater treatment plants are the largest impact to shellfish growing areas in Puget Sound, yet very little guidance is provided by the Puget Sound Action Agenda on how to reduce impacts. Alternatives can be very expensive and there are few incentives or disincentives for owners of smaller plants to seek alternatives. Commitment and a multi-agency coordinated strategy are needed to address this source.

An additional challenge identified while developing this Implementation Strategy was the ongoing need for outreach and education to support water quality improvements. Working with landowners to manage pollution requires consistent, ongoing effort. Counties are in various stages of developing the infrastructure needed for monitoring pollution, utilizing data management systems to inventory sources on private property, requiring and tracking regular inspections, and managing a coordinated, multi-

agency response needed for corrective action. Effective and consistent outreach and education programs backed by technical and financial assistance and enforcement are essential to support landowner compliance.

4.3 Other Puget Sound Vital Signs related to Shellfish Beds recovery

In 2010, the Puget Sound Partnership engaged regional experts and the public in identifying the key ecosystem indicators and pressures that would help identify whether progress is being made in restoring the Sound. This suite of indicators is referred to as the Puget Sound Vital Signs. In 2011, the Leadership Council adopted 2020 targets for most of the 21 Vital Signs, including Shellfish Beds. (See www.psp.wa.gov/vitalsigns/ for more information.)

As indicated in the recovery schematic (see Section 6 and Appendix B), two Vital Signs are identified as directly contributing to shellfish beds recovery: On-Site Sewage Systems and Freshwater Quality.

- Failing on-site sewage (septic) systems comprise one of three principal sources of fecal pathogens in Puget Sound. As of March 2013, in Skagit County, of 4,253 septic systems assessed, 95% were found to be operating soundly while 3% needed repairs and 2% were found to be failing (www.psp.wa.gov/effectiveaction.php). Another Vital Sign, related to human wellbeing, would similarly benefit from reductions in non-point pollution: Swimming Beaches. Beach closures, like shellfish beds, are based on monitored levels of bacterial contamination in marine waters.
- Freshwater quality is also an important consideration, as much of the fecal coliform that is transported into shellfish growing areas arrives via ditches, streams, and rivers that flow into Puget Sound.

In addition, during strategy development partners noted that ocean acidification is a key factor affecting water quality and shellfish beds, and the topic is addressed as Goal 2 in the Washington State Shellfish Initiative (see Section 6.1). The Marine Resource Advisory Council is implementing priority actions from the Blue Ribbon Panel on Ocean Acidification (Washington State Blue Ribbon Panel on Ocean Acidification 2012) that may accelerate progress towards the Shellfish Beds Vital Sign targets. However, as in the case of oil spills, the pH of marine water does not directly affect the classification status of shellfish beds, and is thus outside the scope of this Implementation Strategy.

As noted earlier, as additional Vital Sign Implementation Strategies are developed, the hope is that they can be integrated: common pressures can be addressed, synergies identified, solutions crafted, and conflicts reconciled.

5.0 What efforts are underway to improve water quality and recover shellfish beds?

WDOH monitors shellfish harvesting areas and informs stakeholders of water quality issues. Partnerships with local, state and federal agencies, tribes, shellfish harvesters, and concerned citizens help protect and improve water quality in impacted areas. As described below, protection and restoration programs have evolved over time, in response to changing needs and conditions.

5.1 Water Quality Restoration Program

Following large-scale downgrades in classification of shellfish growing areas in the late 1980s, a water quality restoration program for Puget Sound was created at WDOH. This program is focused on working with stakeholders to resolve pollution issues, particularly in downgraded growing areas. The program also emphasizes protection, or *maintaining* the classification of Approved growing areas by continuing to assess water quality in Approved areas, and implementing coordinated responses when pollution recurs. Continued vigilance is vital, even in Approved areas.

5.2 Early Warning System

In 1997, WDOH developed an early warning system to identify shellfish areas susceptible to a downgrade. The purpose of the program is to avert a downgrade by addressing pollution problems in areas at risk. Each year, harvest areas where water quality is found to approach acceptable limits for harvest, or if pollution sources have the potential to adversely impact, are listed as “Threatened with a classification downgrade”. Since the implementation of the program, 42 of the 91 Puget Sound shellfish harvest areas have been listed as “Threatened” at least once. When “Threatened” areas are identified, WDOH works with stakeholders to coordinate pollution identification and correction projects. The number of “Threatened” areas in Puget Sound declined after 2005, but has been increasing in the last few years (Figure 5).

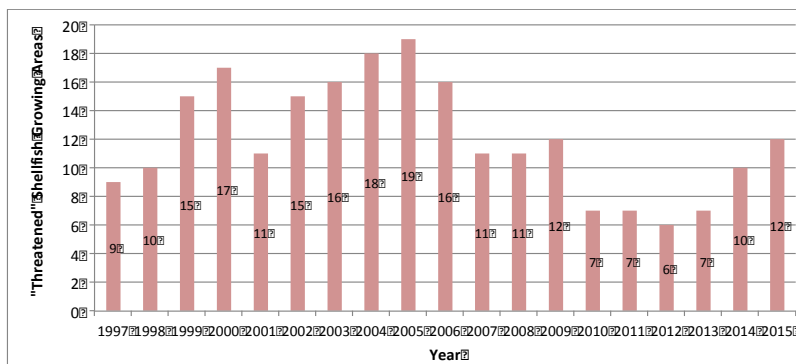


Figure 5. Number of “Threatened” shellfish areas in Puget Sound, by year.

5.3 Shellfish Protection Districts

Shellfish Protection Districts (RCW 90.72) were created to prevent further closures of recreational and commercial shellfish harvesting areas and to restore water quality to allow reopening of impacted harvest areas. In 1992, it was amended to require counties to form shellfish protection districts (SPD) and prepare a protection plan after a classification downgrade due to nonpoint pollution sources. The plan must be implemented within 60 days of the formation of the SPD. SPDs allow a local governing body to collect fees to fund the program.

Currently, there are 16 SPDs in the Puget Sound region (Figure 6). Fourteen districts have been created based on classification downgrades, and two created voluntarily.

5.4 Management of on-site sewage systems

The 2005 state on-site sewage regulation (chapter 246-272A WAC) required the 12 Puget Sound counties to adopt management plans to ensure better use and care of the region's estimated 600,000 on-site sewage systems.

Legislation the following year required these same counties to designate Marine Recovery Areas (MRAs) and carry out enhanced work in areas where septic systems impact shellfish beds and other marine waters (chapter 70.118A RCW).

While the local septic management programs share common program elements, they are all uniquely designed and implemented. As seed money, the state has put about \$7 million into the local programs since 2005, and over \$5 million of federal funding since 2010 via the National Estuary Program. Local dedicated funding for the management programs is limited and uneven, with needs estimated at over \$20 million annually. Remedying this with a sustainable revenue stream is a priority need. A companion priority need is to avail more funding to system owners to incentivize better maintenance and to help finance the high cost of repairing and replacing systems.

The Puget Sound Vital Sign for septic systems tracks inspection status of systems located inside the region's MRAs (Figure 7). By 2015, the indicator was trending up at 42% of systems with up-to-date inspections. Efforts to actively engage homeowners in such work are challenging and costly, yet are key

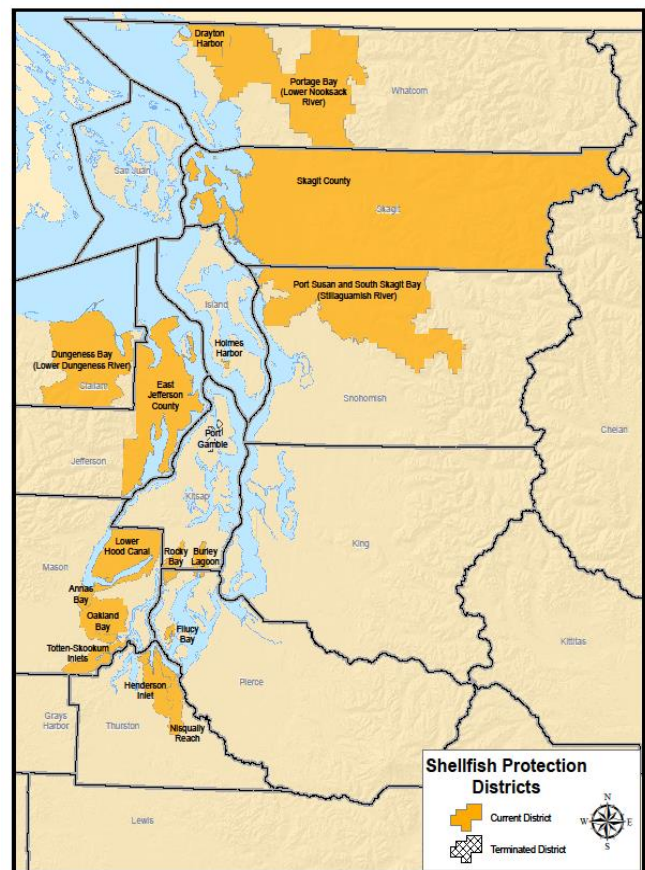


Figure 6. Shellfish Protection

to safeguarding water quality and system performance. The MRAs currently encompass just over 10% of the region's estimated number of septic systems.

5.5 Pollution Identification and Correction programs

Pollution Identification and Correction programs (PIC) can be an effective way to clean up pollution from on-site sewage systems and livestock. PIC programs monitor watersheds for fecal coliform bacteria and can trigger intensive community outreach and property surveys to identify and correct sources. Effective programs work with property owners to correct problems using multiple approaches such as outreach, technical assistance, incentives and, if necessary, enforcement. WDOH has provided National Estuary Program funds and other support for the following activities:

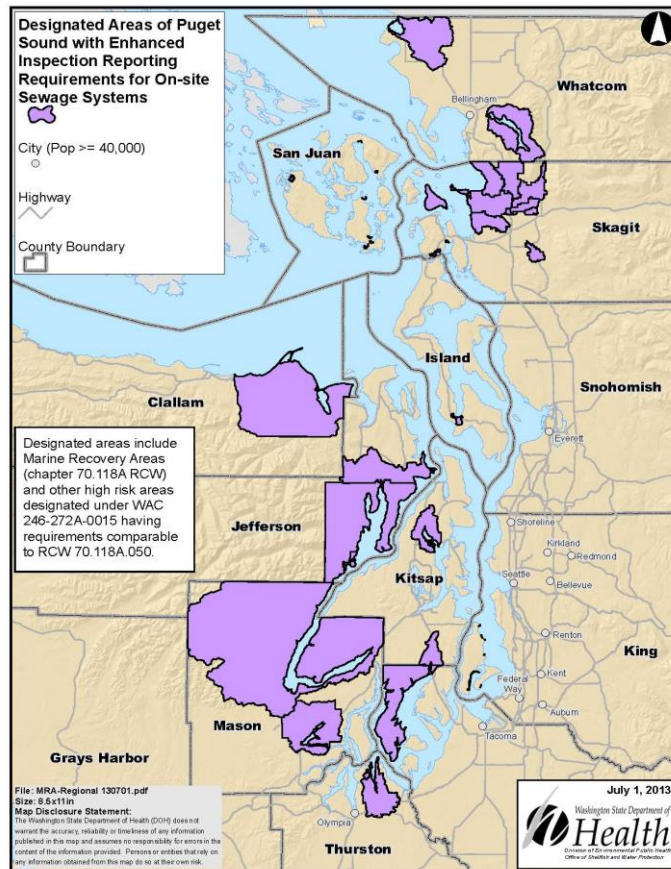


Figure 7. Designated Marine Recovery / High Risk Areas

- \$7.5 million to Puget Sound counties for PIC programs to protect and restore shellfish growing areas in Puget Sound.
- Four PIC and SPD forums to share topics and resources.
- A SPD/PIC best practices library on the WDOH website.
- Trials of PIC tools such as sewage sniffing dogs and chemical tracers to help identify bacteria sources.
- Increased technical assistance and inspections of dairies in Whatcom, Skagit, and Snohomish counties by the Washington State Department of Agriculture's Dairy Nutrient Management Program. In addition, they are conducting surveillance and providing technical assistance for manure exchanges.
- Ecology inspectors are working with Whatcom and Skagit counties and landowners to correct pollution from farms. Ecology also provides a regulatory backstop for counties with active PIC programs.
- Coordination of the multi-agency Whatcom Clean Water Program in the Nooksack River and Drayton Harbor watersheds.
- Over \$400,000 to implement agricultural BMPs in counties with active PIC programs.

In the draft work plan of the Washington Shellfish Initiative (Phase 2, April 2015), the State seeks to develop and implement effective water clean-up plans (Total Maximum Daily Loads, TMDLs) or Straight to Implementation (STI) plans for fecal coliform bacteria in watersheds with shellfish growing areas. In Puget Sound, Ecology plans to revisit existing TMDLs in the watersheds like the Lower Nooksack River and Samish and update existing implementation plans based on new information and data.

6.0 Shellfish Beds Recovery Strategy

This section describes how shellfish beds recovery strategies were identified, combined, prioritized, and depicted through two key tools: a results chain and more condensed recovery schematic.

6.1 Overview of existing strategies, ongoing programs, and areas of focus

Descriptions of ongoing programs intended to recover shellfish beds were gathered from three sources:

- **The Washington State Shellfish Initiative** (42 actions). Announced on December 9, 2011 (and updated on February 19, 2015, available at <http://pcsga.org/wprs/wp-content/uploads/2013/04/Washington-Shellfish-Initiative.pdf>), the WSI recognizes the economic significance of the shellfish industry, and is intended to protect and enhance a resource that supports jobs, communities and cultural values. The WSI reflects a convergence of the National Oceanic and Atmospheric Administration's (NOAA's) National Shellfish Initiative and the state's interest in promoting a critical clean water industry. The NOAA policy establishes a framework to allow sustainable domestic aquaculture to contribute to the U.S. seafood supply, support coastal communities and important commercial and recreational fisheries, and help to restore species and habitat. NOAA sees aquaculture as a critical component to meeting increasing global demand for seafood and maintaining healthy ecosystems. As envisioned, the initiative will protect and enhance a resource that is important for jobs, industry, citizens, and tribes.
- **The 2014 Action Agenda Update for Puget Sound** in which 18 sub-strategies and 22 NTAs (Near Term Actions) are associated with recovering shellfish beds (Puget Sound Partnership 2014).
- **The Governor's Results Washington initiative** (10 shellfish actions).
- Other **ongoing programs** and efforts have been included in the "key actions" lists in Section 6.4.

A cross-tabulation of recovery actions from these three sources was prepared to inform development of the results chain and schematic.

6.2 Depicting the shellfish beds recovery strategy in results chain format

The results chain diagram (see Appendix A) depicts the content described above into chains of cause and desired effect converging on shellfish beds recovery. In this results chain diagram, all actions are represented by a yellow oval attached to the relevant Action Agenda sub-strategy (yellow hexagon), or

intermediate result (blue rectangle; within *Miradi* software, text describing a given object in the results chain diagram can be viewed in a window that pops up when the cursor is hovered over the relevant polygon). This version of the results chain therefore represents a full depiction of the shellfish beds recovery strategy, inclusive of all relevant sub-strategies and all ongoing programs, that had been proposed to recover shellfish beds as of May 2015.

**Please contact kari.stiles@psp.wa.gov for a copy of the Miradi project file containing the results chains*

6.3 Key elements of the shellfish beds recovery strategy

A condensed version of the results chain, referred to as the schematic (see Appendix B), was developed to communicate the key elements of the strategy to recovery practitioners when soliciting their input about completeness, relevance, and priorities. The schematic featured only the salient components of the full strategy, with truncated causal pathways represented by descriptors of approaches, intended pressure reductions, and desired outcomes. The version that emerged after several rounds of input from participants featured four principal themes (appearing as white text in grey rectangles in the schematic). The substance of the schematic is described as follows.

The goal of increasing and maintaining harvestable shellfish acres (goal at bottom right of figure) is approached via two converging pathways, both intending to improve water quality. The first aims to **reduce bacterial and viral pathogens** that enter marine waters from three main sources – farmed lands, developed lands, and vessels – using measures that (as described above) are known to work. Measures for agricultural areas include promoting awareness about and propagating practices for better manure management—that are designed to meet water quality standards—on fields and in livestock facilities. In developed lands, the primary interventions are detecting and repairing failing on-site sewage systems (OSS; itself a ‘Vital Sign’ indicator for which an Implementation Strategy will be prepared), and modifying wastewater treatment systems and outflows. Measures that apply to both farmed and developed lands include reducing stormwater inputs, and expanding Pollution Identification and Correction (PIC) programs. An essential element of the pathogen reduction approach is to **protect upgraded areas**, that is, to prevent them from being downgraded by continued monitoring of pathogen levels and, where necessary, applying PIC programs in ‘at risk’ areas (as described above in 5.2). Pathogen inputs from vessels can be reduced by establishing a ‘no-discharge zone’ in all or parts of Puget Sound, and by constructing and repairing pump-out stations at strategic locations.

Two indirect pathways to improve marine water quality for shellfish beds tackle other (non-bacterial) types of pollution, for instance by reducing risk of oil spills, and mitigating effects of ocean acidification.

Additional less-direct measures that feature in the shellfish beds recovery strategy include methods for **improving shellfish culture**, increasing shellfish use for recreation, and restoring native shellfish, specifically pinto abalone and Olympia oysters.

Approaches to recover shellfish beds described above rely on addressing and intervening in biophysical systems that affect shellfish beds. However, practitioners highlighted in their feedback an additional and under-represented element in the recovery strategy for shellfish beds, relating to the role of communities. Successful management of OSS systems and of manure will require active support for restoration, and participation in stewardship among rural and farming communities. Accordingly, approaches were added (lower left of the schematic) intended to raise awareness; describe and

propagate the use of BMPs; increase enforcement and compliance with regulations, laws, and permits; and provide loans for OSS repair.

6.4 Priority strategies to guide work plan development

In both Implementation Strategy meetings with regional shellfish experts and partners, the schematic was used to solicit suggestions as to what the shellfish beds strategy should focus on, and which approaches and actions should be prioritized in the near term, in order to maximize progress towards the target. The following summary of responses reflects general (but not necessarily unanimous) consensus.

Based on evaluation of the water quality restoration potential of classified shellfish harvesting areas, the greatest gains within the next five years lie within areas impacted by nonpoint pollution sources. Addressing nonpoint pollution deriving from failing OSS in developed lands, and especially from livestock manure in farmed lands (an approach/result referred to as sustainable farming on the recovery schematic, and meant to encompass manure management strategies), offers more achievable solutions in the short term. Maintaining the status of upgraded areas (in actuality, all growing areas) is also a priority. The remedial approaches and pressure reduction outcomes recommended as priorities are marked in the schematic by larger text, and linked by thicker arrows. In addition, successful strategies will need to minimize adverse effects on human wellbeing and the agricultural economy, while meeting the obligation to meet and protect Tribal Treaty rights.

The draft Phase 2 work plan of the Washington Shellfish Initiative focuses on five ways to advance efforts to ensure manure land-application practices do not negatively impact water quality:

- Develop and advance options to minimize or eliminate unplanned and improper application of manure to agricultural lands (Washington State Department of Agriculture, Washington State Conservation Commission, Ecology).
- Develop increased economic opportunities for dairies and other livestock owners to manage manure as a commodity (WSDA).
- Issue an updated Concentrated Animal Feeding Operation permit by December 2015 to provide better water quality protection and expedite the permit process (ECY).
- Coordinate state agency efforts to enhance the ability of operators and applicators to get real-time weather information (WSCC and Conservation Districts).
- Develop a targeted, coordinated, education and outreach program for small-acreage livestock property owners with ongoing follow-up (WSCC).

While outfalls from wastewater treatment plants and combined sewer overflows prohibit the largest amount of shellfish bed acreage the ability to upgrade portions of these areas is not practical during this short time frame. Longer term planning should take outfall removal and extension into consideration. Note that although implementation of such approaches is not feasible by 2020, they could have a considerable influence on the target in the longer term – the schematic portrays this relationship as a medium thick line.

Looking forward, the key actions (or approaches) to address each major barrier identified in Section 4.2 have been identified in the Results Washington, Shellfish Initiative and Shellfish Coordination Group work plans, and include:

6.4.1 *Barrier: Lack of effective and sustainable local nonpoint pollution programs*

Key actions

- Continue to distribute state and federal funds to support PIC programs.
- Convene PIC workshops to communicate successful strategies to local programs.
- Identify effective coordination, best practices, sources of sustainable and supplemental funding, and barriers that reduce the effectiveness of local and multi-agency efforts.

Key outcomes and objectives

- Improved capacity and locally-driven, sustainable programs.
- Effective and efficient locally-driven programs.
- Meeting water quality standards.

6.4.2 *Barrier: Insufficient farm waste management in some counties*

Key actions

- Use data (shellfish growing area classification information and other partner-provided data) to define/identify impacted marine areas.
- Continue to use the Results Washington Shellfish Coordination Group process to advance local efforts to improve water quality in Samish and Portage bays.
- Advocate for legislation requiring sufficient farm waste management protective of water quality.

Key outcomes and objectives

- Identification of agriculturally impacted shellfish harvesting areas.
- Identification of root causes and potential solutions to correct water quality issues in key areas.
- Development of, advancement of, and consensus-building regarding agricultural BMPs to minimize or eliminate unplanned and improper applications of manure to agricultural lands.

6.4.3 *Barrier: Limited control of boaters' waste.*

Key action

- Continue to evaluate and make recommendations for the establishment of a No Discharge Zone in all or parts of Puget Sound.

Key outcomes and objectives

- Reduction of direct inputs of sewage from small boats and commercial vessels that could impact shellfish harvesting areas, marine protected areas, and public beaches.
- Improvement in water quality and reduction in pollution inputs.

6.4.4 *Barrier: Difficulty implementing on-site sewage system management and repair programs.*

Key actions

- Pursue legislation to provide a sustainable funding source for local on-site sewage system management programs.
- Pursue legislation to create a regional, low-interest loan program to help system owners repair and replace failing systems.
- Continue to distribute state and federal funds to support local on-site sewage system management programs.
- Strengthen and standardize local on-site sewage system management programs.

Key outcome and objective

- Sustainable locally-driven on-site sewage system management programs.

6.4.5 *Barrier: Wastewater treatment plant outfalls.*

Key actions

- DNR, in collaboration with Ecology, WDOH and PSP, will develop and implement an outfall and effluent reduction strategy designed to reduce impacts to state-owned aquatic lands and associated resources from sewer and stormwater discharges. The strategy will focus on greater participation in the National Pollution Discharge Elimination System (NPDES) process by DNR, identification and prioritization of impacts to sediments and natural resources such as aquatic vegetation and shellfish, and alternatives to discharging wastewater and stormwater to improve water quality. DNR has developed an internal policy that allows for further collaboration with Ecology, WDOH, and Washington Department of Fish and Wildlife (WDFW) in reviewing the impact that outfalls may be having on state-owned aquatic land and natural resources of concern.
- Coordinate with tribes in the development and implementation of efforts to address wastewater treatment plant outfalls.

Key outcomes and objectives

- As outlined in the Governor's Results Washington Action Plan, developing this strategy by June 2016 will seek to mitigate loading and impacts from existing and future sewer and stormwater outfalls in Puget Sound.

It is important to affirm that recovery measures judged not to be immediate priorities are nonetheless important for shellfish bed recovery. Awareness about shellfish use, culture, and restoration should be promoted. It is intended that by specifying priorities decision-making at regional and local levels will be facilitated, and the chance of attaining narrowly construed recovery goals in the near term increased.

6.5 Social pressures, approaches, and human wellbeing

Many human behaviors lie at the root of reducing pressures, bacterial and viral pathogens, which limit the total acreage of harvestable shellfish beds. We have represented a variety of approaches on the schematic to convey the need for effective strategies to reduce cumulative negative impacts on shellfish beds from the following sources:

- On-site septic systems.
- Agricultural livestock and pet sources.
- Wastewater treatment plant and combined sewer overflow impacts.
- Boating waste.

Our approaches represent a range of possible solutions including:

- Traditional community outreach and education programs.
- Social marketing that focuses on specific behavior changes for certain segments of the population.
- Expanding and implementing Pollution Identification and Correction programs (PIC).

Social approaches within the context of gaining a net increase of harvestable shellfish acres also have corresponding desired outcomes and results. These are represented within the schematic in part by the light green Human Wellbeing Outcome (HWO) “rectangles.” Outcomes include risks reduced to public health (which also links directly to the Swimming Beaches Vital Sign), increased opportunities for recreational shellfish harvest, increased ability to continue traditional and cultural practices linked to shellfish, and minimize unintended consequences and potential negative impacts to the shellfish and agricultural economic productivity and livelihoods. There is an effort currently underway, simultaneous to the development of this Implementation Strategy, to update the Puget Sound Human Health and Quality of Life Vital Signs with an expanded portfolio of human wellbeing indicators.

This section is expected to be more fully developed in the next stage of IS development through a process directed by the Strategic Initiative Transition Team for Shellfish.

6.6 Process used to determine priority strategies

Developing and validating priority recovery strategies for shellfish beds was broken into two phases, involving many partners and perspectives during each.

6.6.1 Phase 1

During the first phase of this process, WDOH and PSP worked with key experts to compile existing shellfish beds recovery strategies, information, and recommendations relevant to Puget Sound. After cross-referencing these resources to ensure that the necessary information was captured and gaps identified, PSP and WDOH worked together to develop:

- A **results chain** (see Section 6.2) that depicts causal linkages between a recovery approach, associated actions and desired results, and a desired ecosystem recovery outcome.
- A **recovery schematic** (see Section 6.3) that simplifies the results chain to emphasize primary recovery approaches and depicts the anticipated “bang for the buck” that implementing an approach could yield in terms of recovery.

In April 2015, PSP and WDOH convened a core group of diverse partners, selected for their expertise in shellfish, to review the initial results chain and recovery schematic at a workshop (see Appendix C for the workshop summary and participants). During the workshop, participants refined and validated

working drafts of both documents. Their input was used to refine the documents for the second phase, and workshop participants were asked to recommend additional partners to help further refine the documents.

6.6.2 Phase 2

In May 2015, after updating the results chain and recovery schematic based on Phase 1 input, PSP and WDOH convened a Phase 2 workshop to expand the conversation (see Appendix C for the workshop summary and participants). An invitation to participate was more broadly circulated than during Phase 1, including distribution lists provided by the Northwest Indian Fisheries Commission, the Salmon Recovery Council, and other key groups.

The purpose of the workshop was to further refine and validate the results chain and recovery schematic with a broader audience. Participants were asked to provide feedback during and after the meeting to inform the revision process (see Appendix C for a summary of feedback). PSP then translated the results of the process into the Implementation Strategy package, including this narrative and the current versions of the schematic and results chain.

7.0 Conclusions

Note: Content addressing the elements below has not yet been fully developed, but Puget Sound Partnership is developing an approach to do so throughout the fall of 2015, which is in review.

7.1 Priority areas of focus, and key changes in strategy

Placeholder

7.2 Key uncertainties and research needs

Placeholder

We anticipate that further IS development, as directed by Strategic Initiative Transition Teams, will identify specific areas where additional research and monitoring (related to Section 7.2) may be needed, and address Sections 7.3 and 7.4 below.

7.3 Cost Estimates and potential sources of support

Placeholder

7.4 Adaptively managing the plan

Placeholder

7.5 Lessons learned

Some of the lessons learned (so far) in developing Implementation Strategies are listed below.

1. **Foundational information exists.** For these test cases, the essential information needed to begin building an IS was found to exist, in documented form or in the judgment of experts and experienced practitioners. In each case, developing the IS involved compiling and drawing out the relevant information as efficiently as possible. All participants contributed constructively, patiently, and effectively.
2. **The schematic is a useful tool for collaboration and consensus building.** Summarizing the results chain in schematic format proved successful in communicating, selecting and refining key elements and pathways of the recovery strategy. It was important to present the initial product as a 'straw' version for improvement and approval by a wider group of practitioners. Input from participants improved the schematic, and the final versions were products of general, if not unanimous, consensus.
3. **The perspectives and participation of affected communities are essential.** Awareness about the issues (and tradeoffs) among affected communities, and their active participation in stewardship, emerged as vital to success. The same is likely true for other Vital Signs.
4. **Simple, focused strategies relied on complex, comprehensive context.** The relative simplicity of the final strategies, which emphasize a few pathways to recovery, probably could not have been achieved without the existing recovery strategy being diverse and complex. In other words, it seems unlikely that a simple strategy could be defined, at least not with confidence, without first building a complex strategy.
5. **Strategic, 'high-level' elements are straightforward.** It was relatively straightforward to capture 'high-level' elements of a given IS. The products of this process (results chain, schematic and narrative text) should allow a wide readership to understand the rationale and principal components of the recovery strategy for a given Vital Sign.
6. **More detailed actions and approaches to achieve strategies are harder to identify.** However, it became progressively harder to acquire on-the-ground details, which tend to be site-specific. This raises the questions: How detailed should an IS document be for it to be effective? Is it necessary to repeat the process at local levels?

7.6 Next steps

Placeholder

Acknowledgments

To be completed.

References

- Antczak, A., and R. Cipriani, eds. 2008. *Early Human Impact on Megamolluscs*. Archaeopress.
- Newell, R. 2004. Ecosystem influences of natural and cultivated populations of suspension-feeding bivalve molluscs: a review. *Journal of Shellfish Research* 23.1: 51-62.
- Puget Sound Partnership. 2010. Performance Management Action Item 2: Recovery Targets for Shellfish Beds Restored. Unpublished Leadership Council memo.
- Puget Sound Partnership. 2014. Action Agenda for Puget Sound. Unpublished report available from http://www.psp.wa.gov/2014_action_agenda_download.php.
- Washington State Blue Ribbon Panel on Ocean Acidification. 2012. Ocean Acidification: From Knowledge to Action, Washington State's Strategic Response. H. Adelsman and L. Whitely Binder (eds). Publication no. 12-01-015. Washington Department of Ecology, Olympia, WA.

Appendices

- A. Recovery schematics
- B. Results chains
- C. Stakeholder process
 - Workshop summaries: Phase 1 (April 27) and Phase 2 (May 19)
 - Comment response summary table