Programmatic Biological Assessment

Shellfish Activities in Washington State Inland Marine Waters
U.S. Army Corps of Engineers Regulatory Program

October 2015

US Army Corps
of Engineers ®
Seattle District

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Abbreviations

BA	Biological Assessment
BiOp	Biological Opinion
CFR	Code of Federal Regulations
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
DA	Department of the Army
dB	decibel
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FLUPSY	floating upwelling system
FR	Federal Register
HCP	Habitat Conservation Plan
JARPA	Joint Aquatic Resources Permit Application
MPG	major population groups
MHHW	mean higher high water
MLLW	mean lower low water
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NMFS	National Marine Fisheries Service
NWP	Nationwide Permit
NPDES	National Pollutant Discharge Elimination System
PBA	Programmatic Biological Assessment
PCE	Primary Constituent Elements
PCN	pre-construction notification
PCSGA	Pacific Coast Shellfish Growers Association
PSP	Puget Sound Partnership
PSSTRT	Puget Sound Steelhead Technical Recovery Team
PSTRT	Puget Sound Technical Recovery Team
PVC	polyvinyl chloride
RHA	Rivers and Harbors Act

SLOPES	standard local operating procedures for endangered species
SPIF	specific project information form
WAC	Washington Administrative Code
WDNR	Washington Department of Natural Resources
WDFW	Washington Department of Fish and Wildlife
WDOH	Washington Department of Health
USFWS	U.S. Fish and Wildlife Service

1. Introduction

The Seattle District of the U.S. Army Corps of Engineers (Corps) is responsible for regulating shellfish related activities in the state of Washington under Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act (RHA) of 1899. The issuance of permits under the Regulatory Program authorizing shellfish related activities constitutes a Federal action that requires compliance with the Endangered Species Act (ESA).

Section 7(a)(2) of the ESA requires Federal agencies to complete consultation with the National Marine Fisheries Service (NMFS) and/or U.S. Fish and Wildlife (USFWS) on any Federal action that may affect an ESA listed species or designated critical habitat (50 CFR 402). Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996, requires Federal agencies to complete consultation with NMFS on any Federal action that may adversely affect essential fish habitat (EFH) (50 CFR 600). ESA listed species and EFH exist in Washington State where the Corps would permit shellfish related activities.

The Corps has developed this Programmatic Biological Assessment (PBA) to comply with the requirements of ESA Section 7(a) and MSA Section 305(b) and to initiate consultation with NMFS and USFWS (the Services) for the Regulatory Program authorization of inland marine shellfish activities. The Corps and the Services have worked together to develop the PBA and proposed action which has resulted in Standard Local Operating Procedures for Endangered Species (SLOPES) to facilitate Corps regulation of shellfish activities in Washington State.

2. Background

2.1. Regulatory Program Authority

Pursuant to Section 404 of the CWA and Section 10 of the RHA of 1899, the Secretary of the Army, acting through the Corps, is responsible for administering a Regulatory Program that requires permits for certain activities in waters of the United States (33 Code of Federal Regulations (CFR) 320-331). Under Section 404, the Corps regulates the discharge of dredged or fill material into waters of the United States. Under Section 10, the Corps regulates structures and/or work in or affecting the course, condition, or capacity of navigable waters of the United States.

2.2. Program Implementation

The Corps implements the Regulatory Program and regulates activities through the issuance of Department of Army (DA) permits. This can take the form of individual project specific permits or general permits. Project specific permits are typically referred to as standard or individual permits. Activities requiring Corps authorization that are similar in nature and have minimal individual and cumulative environmental impacts may qualify for authorization by a general permit, such as a regional general permit or a nationwide permit (NWP). The Corps issues letters of verification for activities that qualify for an NWP. The complete set of NWPs is re-issued every five years. General and specific conditions are developed in concert with the NWPs. The Corps last issued the NWPs on February 21, 2012 (the “2012 NWPs”). On March 18, 2012, the Corps Seattle District issued regional conditions for the 2012 NWPs.

Project applicants must submit a permit application in order for the Corps to evaluate regulatory compliance. In Washington State, the Joint Aquatic Resources Permit Application (JARPA) serves as the application. This application is required in all cases for individual permits. For verification under NWPs the need for an application is determined by specific conditions associated with the NWPs. NWP National General Condition 18 (from the 2012 version of the NWPs) requires an application to be submitted if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat. This application must be submitted prior to work occurring, and is therefore commonly known as a ‘pre construction notification’ or ‘PCN’. Due to the number and distribution of threatened or endangered species throughout Washington State inland marine waters, the application/PCN requirement is triggered in all cases where work is proposed in Washington State inland marine waters.

2.3. Consultation History

In 2007, the Corps issued a new NWP (NWP 48 - Existing Commercial Shellfish Aquaculture Activities) with the 2007 version of the NWPs. The purpose of NWP 48 was to regulate existing commercial shellfish aquaculture activities. The Corps (Portland District) submitted a PBA evaluating effects of implementing NWP 48 in Washington State to the Services later in 2007 to meet requirements of the ESA and MSA (Jones and Stokes 2007). An addendum to the PBA was completed in 2008 (ENVIRON 2008). Separate Biological Opinions were completed by NMFS and USFWS in 2009 (NMFS 2009; USFWS 2009). In 2010, consultation with the Services was reinitiated with the submittal of an addendum to the PBA that addressed a change in the action and new species listings (Anchor 2010). The Services issued letters of concurrence in 2011 concluding the consultation.

In March of 2012, a new set of NWPs was issued by the Corps which superseded the 2007 version of the NWPs. The 2012 NWP 48 expanded the scope of commercial aquaculture activities covered under the NWP to include expansion activities and new activities in addition to covering existing activities. Since the prior ESA consultation was based on the 2007 NWP 48, the ESA coverage it provided was limited to those commercial shellfish aquaculture activities conducted under the 2007 NWP 48 and did not extend to activities conducted under the 2012 NWP 48. Updated ESA consultation to address activities conducted under the 2012 NWP 48 is therefore required to comply with the ESA and MSA.

At the national level, the Corps initiated formal consultation with NMFS on the 2012 version of the NWPs. NMFS issued a final BiOp in November 2014 with the conclusion that the program is not likely to jeopardize the continued existence of any listed or proposed endangered or threatened species under the jurisdiction of NMFS and is not likely to destroy or adversely modify any designated critical habitat or critical habitat proposed for designation (NMFS 2014). The BiOp acknowledged a two step process that the NWP program follows to ensure ESA compliance. The first step is the issuance of the NWPs themselves which formed the basis of the national consultation. The second step is regional or local ESA consultation.

In 2014, the Seattle District Corps prepared a new PBA for a range of shellfish activities that could be authorized in Washington State by various types of permits. The PBA was submitted to the Services in September 2014. The PBA was broader in scope than the previous NWP 48 consultation completed in 2011 which was only for shellfish activities that could be authorized by the 2007 version of NWP 48. Subsequent review and discussion between the Corps and Services resulted in revision of the document and an updated PBA that was resubmitted in December 2014. Continued coordination with the Services and other parties resulted in additional revisions which are represented in the current updated PBA dated October 2015.

A limited number of individual shellfish projects in Washington State have also been authorized by the Corps with individual ESA consultations.

2.4. Purpose and Development of the PBA

The Corps regulates a range of shellfish activities including activities conducted for commercial aquaculture, recreation, restoration, and wild harvest. A range of permit types could be used to authorize these shellfish activities. For example, certain aquaculture activities could be authorized under NWP 48 (*Commercial Shellfish Aquaculture Activities*) while a native shellfish restoration project could be authorized under NWP 27 (*Aquatic Habitat Restoration, Establishment, and Enhancement Activities*). Individual permits could also be issued for any type of shellfish activity. Despite the different permit types and underlying purposes of these shellfish activities, the shellfish activities themselves along with their effects on the environment and ESA listed species may be quite similar. For example, the same methods could be employed to grow shellfish for an aquaculture purpose as for a restoration project. The emphasis of the PBA is therefore on the specific shellfish activities and not on any particular permit type (e.g., NWP 48 vs. individual permit) or activity purpose (e.g., aquaculture vs. restoration). This is an important distinction between this PBA and the prior consultation for NWP 48 that was initiated in 2007. The prior consultation included only one permit (NWP 48) under the proposed action.

The PBA has been developed in coordination with the Services with the objective of achieving ESA and MSA compliance in an efficient and programmatic manner for shellfish activities authorized by the Corps Regulatory Program. The intent is to comprehensively address as much of the expected shellfish activity permitting as possible within the framework of the PBA. For those shellfish activities that are not included within the PBA proposed action and thus not comprehensively addressed by the consultation, the PBA is expected to be used as reference BA. The purpose of the reference BA is to streamline any follow-on consultation that may be necessary to achieve ESA compliance for those shellfish activities not completely covered by the PBA consultation. The procedures for how the PBA would be used as a reference document are detailed in Section 3.1.

A series of Conservation Measures are included within the proposed action. These Conservation Measures, which have been coordinated with the Services during the consultation process, must be adhered to in order for an activity to be authorized by the Corps under the PBA consultation.

The PBA does not include every possible shellfish activity that could be authorized by the Corps. The activities included in the PBA are those that are the most common, frequently conducted, or considered standard practice. Those activities that are novel, infrequent or unknown, or that result in potential impacts beyond the thresholds established for the PBA, would require further consultation under ESA. For example, installation of new floating rafts for shellfish culture are uncommon in the action area and the Corps does not expect to authorize many, if any, new such rafts over the duration of the PBA. These structures could potentially be authorized under NWP 48, but this activity is not included within the PBA proposed action.

The PBA emphasis on shellfish activities allows the resulting consultation to cover a timeframe that is not encumbered by the timeframes associated with specific Corps permits. The PBA proposed action is intended to extend beyond the expiration of the 2012 NWPs on 18 March 2017 and beyond the typical 3 to10 year authorization period for an individual permit. Although, the PBA consultation would not have a predetermined expiration date, the proposed action is based on an anticipated 20 year timeframe. Its period of applicability would instead be tied to specific acreage limits. The geographic area for the proposed action has been divided into five regions. Acreage limits for authorized shellfish activities have been developed for each of the regions. If and when these acreages are reached, and if warranted, an addendum to the PBA may be prepared to increase the amount of acreage. The acreage limits were developed based on a 20 year time horizon.

3. Proposed Action

3.1. Permitting Actions

The Federal action is the issuance of individual permits and the issuance of verification letters (or verifications) under general permits such as a NWP authorizing shellfish related activities within the inland marine waters of the State of Washington. Permit applications are required for all activities proposed in this PBA whether they could be authorized by an individual permit or a NWP. This means that written approval from the Corps is required before work commences in all cases.

Shellfish activities authorized by the Corps could be conducted for a variety of purposes including, but not necessarily limited to, culture and/or farming of shellfish for human or animal consumption (i.e., aquaculture), commercial harvest of naturally occurring shellfish populations, activities to support recreational shellfish harvest (e.g., seeding, grow out, etc.), and ecological restoration (e.g., improving water quality, restoring native shellfish populations).

Prior to authorizing any activity, the Corps would review applications in accordance with the regulations found at 33 CFR 320-332. For all actions this may include avoiding or minimizing impacts or requiring compensatory mitigation for impacts that cannot be avoided or minimized. Any compensatory mitigation required will comply with the regulations found in 33 CFR 332 and 40 CFR 230. Mitigation requirements include consideration of impacts to special aquatic sites (40 CFR 230 SubPart E), ensuring that adverse impacts are minimized (40 CFR 230 Subpart H), determining appropriate compensatory mitigation if necessary (40 CFR 230 Subpart J), and determining consistency with the PBA and its Conservation Measures. When evaluating a permit application under the NWP process, the Corps assures compliance with the mitigation regulations through NWP General Condition 23 (*Mitigation*). Other important considerations involved in the review of any permit application include tribal trust responsibilities the Federal Government has to Native American Tribes. For individual permits, the review would also include a public interest review (33 CFR 320.4). For purposes of the PBA action and effects analysis, it is assumed that no additional avoidance, minimization, or compensatory mitigation measures will be implemented beyond those measures described in Section 3.5 under Conservation Measures. This is a conservative assumption but is necessary because, 1) the outcome of any required avoidance, minimization or compensatory mitigation under the Regulatory Program is uncertain and may vary from project to project, and (2) the avoidance, minimization, and compensatory mitigation would be focused on addressing impacts associated with the CWA and RHA, and not necessarily address impacts to ESA listed species or designated critical habitat.

The Corps anticipates the majority of permitting actions (but not necessarily the majority of acreage) under the PBA would be verifications authorizing shellfish activities under NWP 48 (*Commercial Shellfish Aquaculture Activities*). However, shellfish activities may also be authorized under other NWPs including but not necessarily limited to NWP 4 (*Fish and Wildlife Harvesting, Enhancement, and Attraction Devices*), and NWP 27 (*Aquatic Habitat Restoration, Establishment, and Enhancement Activities*). Finally, the Corps could authorize shellfish activities with an individual permit.

The specific activities that are included within the proposed action are described according to shellfish species in Section 3.3. For each shellfish species, a suite of activities are described that constitute the 'PBA covered activities'.

In order for an applicant's proposed shellfish activities to comply with the ESA using this PBA, the activities must 1) fall within the scope of activities described in Section 3 of the PBA, 2) incorporate the relevant Conservation Measures (Section 3.5), and 3) occur within the geographic area considered by the

PBA (Figure 3-1). For permit applicants that describe shellfish activities that do not meet these conditions, further ESA consultation may be necessary prior to the issuance of a Corps permit or verification.

3.1.1. Activity Reauthorization

Individual permits are usually issued for a period of 3 to 10 years. Upon the expiration of an individual permit, a project applicant must reapply for a new permit in order to continue the activity. NWPs are reissued every five years. All previously issued verifications expire upon the issuance of a new set of NWPs. Applicants that wish to continue an activity must be reauthorized by the Corps. The majority of permitting actions conducted under this PBA are expected to be for reauthorizing ongoing activities. It is possible that over the expected 20 year timeframe of the PBA that an individual activity within the same footprint could be authorized as many as three or four times.

3.1.2. Continuing versus New Activities

For the subset of commercial shellfish aquaculture activities described in this PBA that would be authorized under NWP 48, there is a distinction made between aquaculture activities that have been in place and continuing for some period of time and activities that are new. This classification is necessary due to the regulatory history of NWP 48. For purposes of this PBA, each commercial aquaculture activity is classified as either 'continuing' or 'new'. 'Continuing'[1] shellfish aquaculture activities are those activities that had been granted a permit, license, or lease from a state or local agency specifically authorizing commercial shellfish aquaculture activities and that were occurring within a defined geographic footprint prior to18 March 2007. The emphasis is on the specific geographic footprint on which the activity was/is occurring. These activities are on-going and continue to occur in the identified footprint as of the date of the PBA. Based on permit applications previously submitted to the Corps, the continuing activities and their geog raphic footprints have been identifi ed and recorded in a database that is maintained by the Corps. 'New' activities are those activities that were initiated after 18 March 2007 and essentially include all activities that do not qualify as continuing. Expansion of activities into a new geographic footprint that had not previously been in commercial aquaculture is treated as a new footprint for the purpose of this PBA. Continuing footprints and new footprints are also referred to as 'continuing activities and 'new activities' in this PBA. A new activity would not be reclassified as a continuing activity in the future but would remain classified as new.

Shellfish activities proposed for lands classified as continuing are managed differently by the Regulatory Program than activities proposed for lands classified as new. This is reflected both in the PBA Conservation Measures (see Section 3.5) and in elements of the proposed action related to structures. Continuing activities that include the use of certain currently serviceable structures (i.e., rafts, floats, and Floating Upwelling Systems (FLUPSYs)) that were in place and authorized to be operating for a commercial shellfish aquaculture activity prior to 18 March 2007 are included among the list of PBA covered activities. Permits or verifications for their continued use and operation can thus be issued using the PBA. Maintenance of 'continuing' structures is also considered a PBA covered activity. Installation

[1] The term *continuing* as used in this PBA has a different meaning than the term *existing* as defined by the 2012 NWP 48. A continuing activity area/acreage refers to the specific geographic *footprint* on which a shellfish activity is occurring. An existing activity area refers to a leased area or an ownership area that may or may not have an active shellfish activity occurring in some part of the leased or owned area. The existing activity area is also referred to as a *project area* in NWP 48 terminology. In some cases, a continuing activity area/footprint may be identical to an existing project area. In many cases a continuing activity footprint may be smaller than an existing project area. In no cases would a continuing activity footprint be larger than an existing project area. To avoid confusion, the terms *existing* and *project area* are not further used in this PBA. The emphasis is on the terms *continuing* and *footprint*.

and operation of 'new' structures or the expansion of 'continuing' structures are not PBA covered activities. Permit applicants proposing new structures or expansions will require further ESA consultation prior to the issuance of a Corps permit or verification.

In the 2007 version of NWP 48, there was reference to 'areas that are periodically allowed to lie fallow as part of normal operations' (reference from 72 FR 11092). Use of the term 'fallow area' was discontinued in the 2012 version of NWP 48. The term is used throughout the PBA in order to accurately describe these areas and characterize effects to ESA listed species and designated critical habitat. Based on previously submitted permit applications received under the 2007 version of NWP 48 and verifications issued by the Corps since 2012, all areas previously identified as fallow had not had active cultivation since at least 2007 or much longer in some cases. For the purpose of the PBA and determining effects, it is assumed that shellfish activities will occur in all areas currently identified as fallow. The CMs for continuing active cultivation will apply to these activities.

3.1.3. Additional Notification Requirements

As described previously in Section 2.2, project applicants must submit a permit application in order for the Corps to evaluate regulatory compliance before issuing a permit or verification. When a permittee desires to make certain changes to activities previously authorized by permit or verification, additional notification to the Corps is required before work is initiated to ensure regulatory compliance. Applicants would need to re-submit an application, providing notice as to the desired changes. Such applications are required in the following circumstances:

- If a permittee changes methods, materials, equipment, species cultured, or activity location.
- If a permittee cannot, or chooses not to, meet all permit conditions or Conservation Measures (e.g., work windows).

In general, the Corps would evaluate permit applications for compliance with the regulations found in 33 CFR 332 and 40 CFR 230 as discussed previously.

3.1.4. Review of NWP 48 Verifications Issued in 2012 and 2013

Between 19 March 2012 and February 2013, the Corps issued approximately 850 verifications under the 2012 version of NWP 48 using the ESA consultation completed in 2011. Subsequent discussion between the Corps, NMFS, and USFWS in February 2013 determined the 2011 consultation only covered activities tied to the 2007 version of NWP 48. Verifications issued under the 2012 version of NWP 48 were not covered. The Corps subsequently stopped verifying activities under NWP 48 unless a separate, individual ESA consultation had been completed for the activity. At the conclusion of this programmatic ESA consultation, the Corps will review the previously issued NWP 48 verifications and either 1) reauthorize the activity if it is consistent with the conditions of the new PBA/consultation, 2) provide opportunity for the applicant to modify activities to fit within the scope of the PBA and then reauthorize the activity, or 3) suspend the previous verification and pursue individual ESA consultation within the framework discussed below if the activity does not meet the conditions of the PBA consultation. These 850 verifications are included as an element of the PBA proposed action and effects analysis so the subsequent authorization could be covered under the PBA consultation.

3.1.5. Pending and Recently Authorized Activities

The Corps currently has a backlog of about 100 aquaculture applications for both continuing and new activities. The ESA compliance for these applications is currently being addressed on a case by case basis and if completed may be authorized by the Corps. As of July 2014, a total of 62 shellfish activity footprints had been authorized with individual ESA compliance. Depending on when the PBA consultation is completed, the ESA compliance for some of the pending applications may be addressed under the PBA. Those activities with completed ESA compliance are not included within the PBA proposed action. However, most or all of these recently authorized activities with completed ESA compliance are expected by the Corps to be reauthorized in the future once the recently issued permit or verification expires. Acreages for these activities are therefore included within the proposed action in anticipation of this future reauthorization so that the ESA compliance for the reauthorized activity can be addressed with the PBA consultation.

3.1.6. Use as Reference BA and Coordination with the Services

In order to ensure project applicant compliance with the ESA, the Corps has developed a draft specific project information form (SPIF) that must be filled out by project applicants. The SPIF is the mechanism by which the Corps receives detailed information about a specific project which is used to verify applicant compliance with the ESA. If the project is in compliance with the PBA consultation, then no further consultation with the Services would occur. If the applicant does not meet all of the requirements of the PBA consultation, then further consultation with the Services would be initiated. Depending on the nature of the proposed activities, the SPIF may be used as a reference BA or a separate BA may be written. In either case, the focus of the consultation would be limited to the subset of applicant activities that are outside of the PBA proposed action. It is possible that compensatory mitigation may be required for activities that are not consistent with the PBA. The PBA consultation would be used to address ESA compliance for the subset of activities consistent with the PBA. An acreage footprint would be assigned to each activity authorized with the PBA consultation and deducted against the total acreage developed for the PBA. The draft SPIF is attached as Appendix A. The SPIF will be finalized once the PBA consultation is completed.

The Corps would maintain a database of all authorized shellfish activities that would include details on whether individual applicant activities were authorized consistent with the PBA consultation or whether further consultation was conducted and the PBA used as a reference BA. The database will include a summary of how the PBA was used as a reference BA for the applicable permits or verifications. The Federal action includes the submission of an annual report by the Corps to the Services that summarizes the previous year's shellfish related permitting activities conducted under the PBA. The report would ostensibly be a summary of the previously mentioned database for the prior year. The report would include 1) an assessment of overall program activity, 2) the number and types of verifications or permits issued, 3) details for how the PBA was used as a reference BA, 4) detailed information for each authorized activity including the permittee(s) name, general location, type of culture, type of harvest method, map illustrating the specific footprint for each authorized activity with latitude and longitude (new activities would have latitude/longitude for all project corners; continuing activities would have latitude/longitude centroid), and 5) the identification of new activities authorized in areas in the vicinity of eelgrass or kelp. The Corps plans to submit the report by February 15 of each year and host an annual coordination meeting with the Services by March 31 of each year to discuss the annual report and any actions that could make the program more efficient or accountable. The annual review will also be used to make adjustments to the PBA acreages as necessary to ensure ESA compliance.

3.2. Geographic Extent

The objective of the PBA is to include all permitting actions for shellfish activities conducted within the inland marine waters of the State of Washington, excluding the Columbia River. For the purpose of the PBA, this geographic area is subdivided into five geographic regions which include Grays Harbor, Willapa Bay, Hood Canal, South Puget Sound, and North Puget Sound (Figure 3-1). The boundary lines for these geographic areas are based on Tidal Reference Areas defined by the State of Washington (WAC 220-110-240). Note that individual Tidal Reference Areas (there are a total of 17) have been combined for the purpose of the PBA. For the Grays Harbor region, the western boundary is defined by a line projected from the outermost end of the north jetty to the outermost end of the south jetty. The western boundary of the Willapa Bay region is defined by a line projected from Leadbetter Point to Cape Shoalwater Light. The western boundary of the North Puget Sound Region is not specifically defined in the WAC Tidal Reference Area system. For the purpose of the PBA that boundary line is drawn between Cape Flattery, Washington, and Carmanah Point (Vancouver Island), British Columbia. The North Puget Sound Region extends north to the Canadian border. Tidal reference area 14 which includes the outer coastal waters is not included within the geographic scope of the PBA.

Within this geographic area, activities would occur in waters shallower than elevation -70 ft MLLW[2] with a few possible exceptions for continuing floating structures such as mussel rafts which may occur in areas of deeper water.

The PBA action does not include shellfish activities within the following areas:

- all areas within 0.25 miles of snowy plover designated foraging or nesting critical habitat under ESA, including but not limited to Leadbetter Point in Pacific County and Copalis Spit in Grays Harbor County (Appendix H).
- all areas within 200 ft of any bird, land mammal, insect, or plant critical habitat either designated or proposed under the ESA (e.g., marbled murrelet, Taylor's checker-spot butterfly, streaked horn lark) (Appendix H).

The vast majority of shellfish activities would occur in areas designated by the Washington Department of Health (WDOH) as approved, conditionally approved, or restricted (for commercial growing areas) and open, or conditionally open beaches (for recreational areas). It is assumed that some areas currently classified by WDOH as prohibited may be upgraded in the future. The Puget Sound Partnership has targeted a net increase from 2007 to 2020 of 10,800 harvestable shellfish acres, which includes 7,000 acres where harvest is currently prohibited (PSP 2014). Shellfish activities conducted for restoration or water quality purposes could occur throughout the geographic area of the proposed action regardless of the WDOH classification. The WDOH classification does not directly affect the scope of the proposed action, but would likely affect decisions made by applicants on the scope and location of their proposed activities.

[2] All elevations in this document are relative to mean lower low water (MLLW)

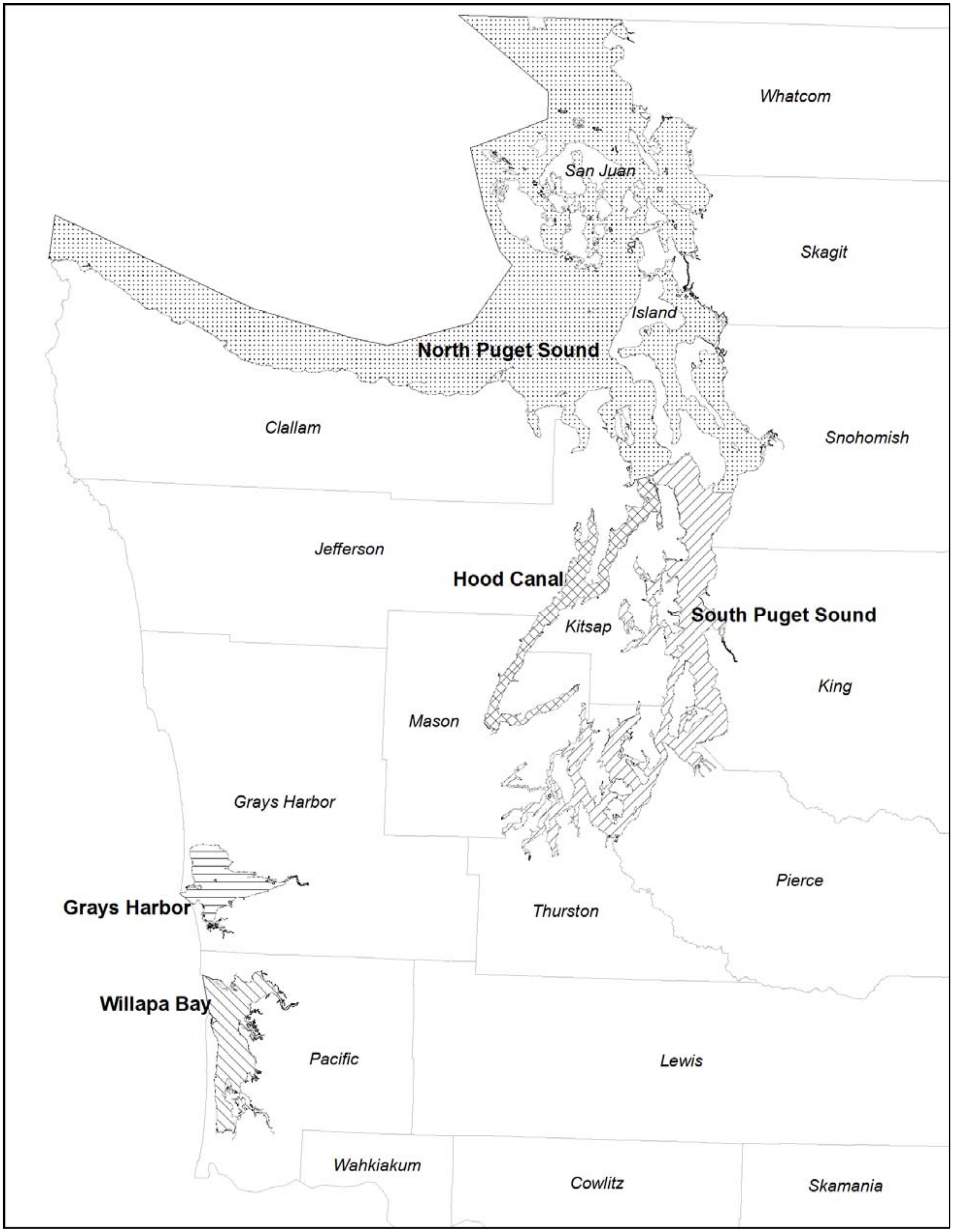

Figure 3-1. Washington inland marine waters included within the geographic scope of the PBA.

3.3. Description of Shellfish Activities

This section describes the suite of shellfish activities that are included within the proposed action of the PBA. These activities are collectively referred to as the 'PBA covered activities'. The descriptions are written from an aquaculture perspective because this represents the majority of shellfish activity that would be authorized under the proposed action and they encompass the range of shellfish activities that would likely be proposed by non-aquaculture permit applicants. The information was gathered from multiple sources including PCSGA (2011; 2013a; 2013b), WDNR (2008; 2013), Corps (2014a) and from knowledge of the professional Corps staff that have been involved in regulating shellfish activities. There is wide variation in the manner in which individual shellfish activities are conducted and the equipment/materials used. The descriptions below should be considered generally representative of the individual activities, but it is acknowledged that variability inherent within individual activities is not necessarily captured. This variability might result in some uncertainty when it comes to applying the PBA to a variation of a common activity that is covered by the PBA versus a novel activity that would not be covered. The Corps would use its discretion in applying the PBA in such a case. All permitted activities under the PBA, including for such gray area cases, would be coordinated with the Services, and reviewed as part of the annual PBA meeting. The PBA covered activities are summarized in Section 3.3.6. Section 3.4 describes specific acreages in each geographic region for the PBA covered activities. These two components (general description and acreage) together describe the work that would be authorized by the Corps under the proposed action.

3.3.1. Mussel Activities

There are two species of mussels cultured in Washington State marine waters. These include *Mytilus trossulus*, commonly known as the blue mussel and *Mytilus galloprovincialis*, commonly known as the Mediterranean or Gallo mussel. The blue mussel is native to Washington State. The mussel activities described below may be performed at any time of day and at any time of year. They are not dependent on season or tides.

3.3.1.1. Rafts, Floats, other Structures, and Surface Longlines

Mussels are typically grown suspended from rafts or surface longlines anchored in subtidal waters, but they can be grown from any structure (e.g., pier) where there is adequate water depth at low tide. A raft is considered an open-framed floating structure with cross beams. Raft platforms are constructed of lumber, aluminum, galvanized steel, and plywood with some form of flotation. Lines with attached mussels are suspended from the raft. There may be multiple rafts for one activity footprint (Figure 3-2).

A float is a floating platform structure, typically rectangular, that is either anchored or attached to a pier or dock. Floats are used as working platforms, storage or for mooring boats. A float can be towed into place for anchoring.

The proposed action includes the operation and maintenance of currently serviceable rafts and floats that qualify as continuing activities (pre-18 March 2007). New rafts and floats or the relocation or expansion of continuing rafts and floats are excluded from the PBA proposed action.

Other structures the Corps would permit under the proposed action are discharge and intake pipes associated with upland wet-storage tanks. These tanks are placed in upland areas and used for holding shellfish species for some period of time. Water is circulated through the tanks via pipes that extend from the tanks to the nearby marine waters. There would typically be pipes for both intake and discharge. The activity must be compliant with Section 402 of the Clean Water Act (National Pollutant Discharge Elimination System (NPDES)) and have an NPDES permit, if necessary, before the Corps would issue a permit or verification under the proposed action. The upland wet-storage tanks themselves and their associated discharge are not within the regulatory jurisdiction of the Corps so would not be permitted under the proposed action.

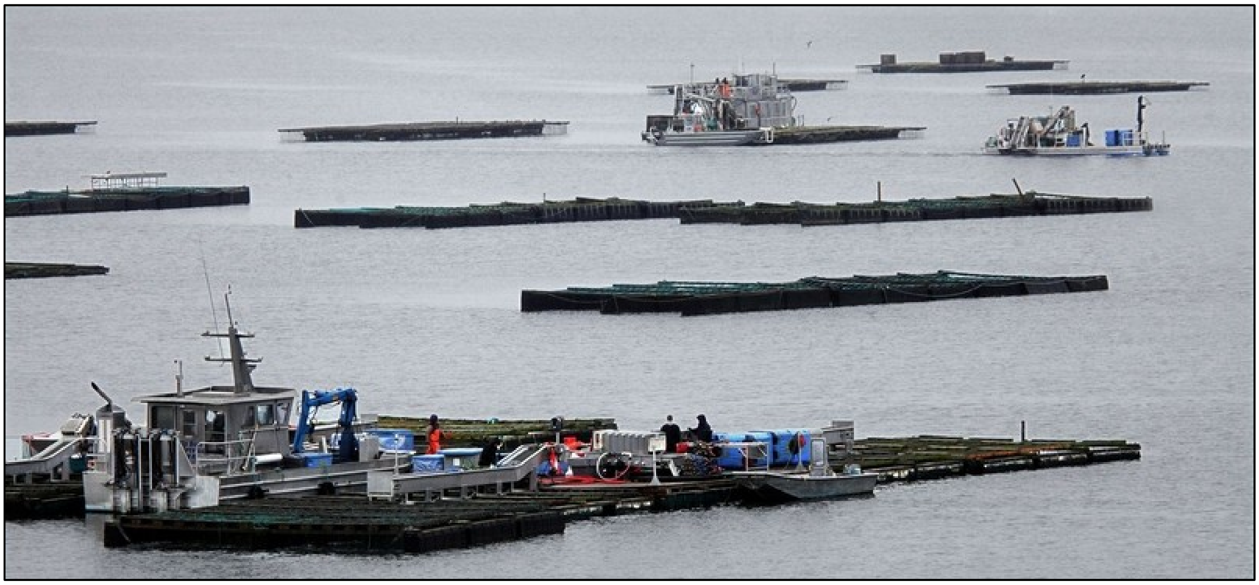

Figure 3-2. Penn Cove Shellfish mussel rafts and harvest barge (Everett Herald 2013)

Surface or floating longlines are typically made of heavy polypropylene or nylon rope suspended by floats or buoys or they could be suspended from a structure such as a pier. They can consist of a single buoy and rope with attached cultured species extending below the buoy and anchored to the substrate. They can consist of multiple buoys connected by rope extending horizontally across the water surface for hundreds of feet. Rope with cultured species would be hung at intervals along this horizontal line. Large anchors to the substrate may also be placed at intervals along the line and at each end.

Seeding and Planting

Naturally-spawned mussel seed are set on lines or metal screen frames in net cages that are suspended in the water during the late spring spawning season. Hatchery seed, when used, is already set on lines or screen frames at the nursery, and then transported to the mussel farm for planting. Once the seed reaches 6 to 12 millimeters long, which can take several months in winter or several weeks in summer, it is scraped from the frames or stripped from the lines and sluiced into polyethylene net sausage-like tubes, called “socks,” each with a strand of line threaded down the length of the sock for strength. A mussel disc may be inserted into the socks at intervals to support the weight of the mussels growing above it. Concrete weights with stainless steel wire hooks are hung on the bottom end of each mussel sock for tension. The socks are then attached to the raft or surface longline (Figure 3-3).

Maintenance and Grow-out

When the mussels reach about 1 inch in length, the weights are often removed from the socks and saved for reuse. Predator exclusion nets are hung around the perimeter of the rafts. Nets may be in place all year or may be used seasonally. If the predator exclusion nets become excessively fouled (e.g., with barnacles, algae, other aquatic vegetation or biological growth), they may be cleaned in place by hand or by mechanical methods. They may also be removed and then cleaned. Fouling organisms may also be removed from the raft structure itself.

Figure 3-3. Commercial mussel raft in south Puget Sound (Corps site visit 2013)

Harvest

When cultured mussels reach market size, about 12 to14 months of age, socks or lines of mussels are removed from the longline or raft for cleaning and grading. Biofouling is typically removed from mussels during harvest as the mussels are cleaned. The waste material is commonly returned to the water or put into a shell pile on shore. The mussels are stripped from the socks and bulk-bagged and tagged for transport to shore. Mussels that fall from the lines onto the predator nets or the bottom substrate may be harvested by hand or by suction dredge. Weights are reclaimed for re-use, and used socking and lines are recycled or disposed of at an appropriate waste facility. Harvesting occurs year round as mussels mature.

3.3.1.2. Mussel Bottom Culture

Mussel bottom culture entails growing mussels directly on the bottom substrate or in/on a container that is supported on the substrate. This may include growing mussels in bags or on trays supported on the substrate as described in the following sections for oyster and clams. Bottom culture could entail harvesting natural set mussels on stakes placed into the substrate or recruited to the substrate directly. The culture and harvest activities are similar to oyster stake and rack and bag culture methods. The reader is referred to the oyster stake and rack and bag sections for more detail on how this activity would be conducted.

3.3.2. Oyster Activities

Several species of oysters are cultured on the West Coast including the Pacific oyster (*Crassostrea gigas*), Kumamoto oyster (*Crassostrea sikamea*), Eastern oyster (also known as American oyster) (*Crassostrea virginica*), European flat oyster (*Ostrea edulis*), and the Olympia oyster (*Ostrea conchaphila*). Only the Olympia oyster is native to Washington State.

Oyster ground is often classified or referred to by its use, such as seed ground, grow-out ground, or fattening ground. There are four general strategies for oyster culture which depend on target markets, beach characteristics, and environmental conditions. These strategies include stake culture, rack-and-bag culture, bottom culture, and longline culture.

Many oyster activities are performed by workers on foot during low tides that expose the culture bed. The lowest tides occur for a period of several days each lunar month (29 days). During these low tides, workers may be present on the bed for 3 to 6 hours. In this document, work performed during these monthly low tides is described as occurring “during low tide.” Work can occur at any time of the year; although, traditionally, December through January has been a strong market for commercially harvested oysters. Oysters are typically harvested between 18 months and 4 years of age (Corps 2014a).

Oyster activities may also be performed at high tides or in the subtidal zone. These work activities would not be dependent on tides and could occur at any time of the year. Harvest activities may occur at any time.

The oyster activities discussed below all generally use oyster cultch as a basis for the culture. Oyster cultch is oyster shell with attached oyster seed (or spat). Cultch is prepared by bundling washed and aged Pacific oyster shells (“mother shells”) in plastic mesh bags which are then placed in the intertidal zone prior to spawning season. Up to thousands of cultch bags may be required for a single oyster operation. Naturalized seed then collects on the bags of shell which creates the oyster cultch. Stakes with attached shell or ‘hummocks’ of shell placed in intertidal areas may also be used to collect naturalized seed. Alternatively, seeding of the mother shells may occur in an upland hatchery. The cultch bags remain in the intertidal zone, either loose or on pallets, until the seed is large enough or “hard” enough (i.e., firmly cemented onto the mother shell and able to resist predation and desiccation) to withstand being moved onto the culture beds (Figure 3-4).

Figure 3-4. Oyster cultch shell with spat stacked on pallets (Corps site visit 2013)

3.3.2.1. Rafts, Floats, FLUPSYs, and other Structures

Oyster activities do not use structures to the same extent as mussel activities. Continuing rafts/floats may be used as work platforms while oyster activities are occurring at a site. These rafts/floats may be anchored to the substrate or attached to a vessel. Rafts and FLUPSY floats may also be used to grow-out seed. A FLUPSY is a type of float structure specifically used for growing out seed to a larger size (Figure 3-5). Because it requires a power connection, FLUPSYs may be placed in the intertidal zone adjacent to power sources, such as attached to a pier. The floating structure continuously draws seawater through the system. Juvenile shellfish, one to two millimeters in length, are transported to a FLUPSY from a shellfish hatchery. The seed is placed in bins with screened bottoms that are lowered into openings in a floating frame and suspended in the seawater. Several bins are placed in a row on either side of a central enclosed channel that ends at a paddlewheel or pump. The wheel or pump draws water out of the central channel creating an inflow of seawater through the bottom of the seed bins, continuously feeding the juvenile shellfish. The outflow from the bins is through a dropped section on one side of the bin facing the central channel. Typically, the FLUPSY platform is equipped with overhead hoists so the bins can be cleaned and moved. Once seed have reached a suitable size, they are removed from the FLUPSY and transplanted to a grow-out site

The proposed action includes reauthorization and maintenance of currently serviceable rafts, floats, and FLUPSYs that qualify as continuing activities (pre-18 March 2007). New rafts, floats, and FLUPSYs or the relocation or expansion of continuing rafts, floats, and FLUPSYs are excluded from the PBA proposed action.

Trays or bins elevated above the substrate may be used for additional seed grow-out or nursery seed boosting. Trays or bins are affixed to racks set on the substrate. Racks have typically been made of rebar, angle iron, and in rare cases, wood and or plywood. Trays are typically made of plastic. Racks may be deployed for a few months or longer. There may also be use of what are termed "stackable nester trays" for boosting seed. Tidal depths for elevated trays on racks vary from a +3 feet to -15 feet Mean Lower Low Water. Trays or bins may also be placed directly on the substrate (PCSGA 2013a).

Figure 3-5. A FLUPSY (Fisher Island Oysters 2007 in PCSGA 2011)

Upland wet-storage tanks, as described above for mussel activities, could also be used for oyster activities. The Corps would permit the pipes (for both discharge and intake) associated with these tanks under the proposed action.

3.3.2.2. Oyster Floating Culture

Oyster floating culture occurs using lantern nets, bags, trays, cages, or vertical ropes or wires suspended from surface longlines or rafts similar to that described above for mussels. Floating culture occurs in the subtidal zone. Surface longlines are heavy lines suspended by floats or buoys attached at intervals along the lines, anchored in place at each end. Lantern nets, adopted from Japanese shellfish culture, are stacks of round mesh-covered wire trays enclosed in tough plastic netting. The nets, bags, trays, cages, or vertical ropes or wires are hung from the surface longlines or rafts.

Seeding

Single set oyster seed is placed on the trays or in the bags and suspended in the water. Oyster cultch may be attached directly to the vertical ropes or wires.

Maintenance and Grow-out

Single oysters are regularly sorted and graded throughout the growth cycle. Every three or four months trays are pulled, the stacks taken apart, and oysters are put through a hand or mechanical grading process. The trays are then restocked, stacks rebuilt, de-fouled by removing species such as barnacles, algae and other aquatic vegetation, and returned to the water. Oysters grown directly on vertical lines are in clusters and receive little attention between seeding and harvesting.

Harvest

A vessel equipped with davits and winches works along the lines, and the trays, nets or bags are detached from the line one by one and lifted into the vessel. The gear is typically washed as it is pulled aboard. Oysters are removed and placed into tubs where they may be cleaned and sorted.

Oysters grown using floating culture may be transplanted to an intertidal bed for two to four weeks to “harden”. Hardening extends the shelf-life of floating cultured oysters by literally hardening the shell making it less prone to chipping, breakage, and mortality during transport and conditioning them to close their shells tightly when out of the water to retain body fluids. Oysters are re-harvested from the transplanted areas using bottom culture harvest methods. Alternatively, oysters grown by floating culture may be hung from docks at a tidal elevation that results in hardening them.

3.3.2.3. Oyster Bottom Culture

Bottom culture entails growing oysters directly on the substrate in intertidal or shallow subtidal areas (Figure 3-6).

Seeding and Planting

Prior to planting, oyster beds are prepared by removing debris such as driftwood, rocks, and predators (e.g., starfish, oyster drills) by hand or mechanically by dragging a chain or net bag. Any oysters that remain on site from the previous growing cycle may be removed or thinned. In some areas the substrate may occasionally be enhanced with crushed oyster shells often mixed with washed gravel to harden the ground (see discussion of graveling in Section 3.3.3).

Seeding occurs by spraying oyster cultch from the deck of a barge or casting it by hand. In some cases, farms rely solely on the natural set of oyster seed. Oyster hummocks may be created by mounds of oyster shell which provide a substrate more conducive to attracting natural seed (Figure 3-6).

Maintenance and Grow-out

Oysters may be transplanted from one site to another at some point during grow-out. For example, oysters may be moved from an initial growing area to “fattening” grounds with higher levels of nutrients allowing the oysters to grow more rapidly. Oysters may be removed for transplant either by hand or by dredge.

Oysters may sink into the mud in areas where the substrate is soft. When this happens, the oysters are harrowed to pull them up out of the mud. The harrow is a skidder with many tines, towed along the substrate by a boat. The harrow penetrates the substrate by a few inches, breaking up the oyster clusters, and moves the oysters back to the surface. This method is also referred to as "dragging". Dragging is typically performed during the second or third year of growth. Oyster dredge-harvest vessels are used for dragging by substituting the dredge baskets with drag tools which they hang on the outrigger cables. About five acres can typically be harrowed in one day (Corps 2014a).

Harvest

Harvest typically occurs either by hand during low tide or by dredge. During hand harvest, workers use hand tools or hand-pick oysters and place them into various sized containers placed on the bed (Figure 3-7). Larger containers may be equipped with ropes and buoys that can be lifted with a boom crane onto the deck of a barge at high tide. Smaller containers are sometimes placed or dumped on decks of scows for retrieval at high tide or are carried off the beach at low tide.

Mechanical or dredge harvest occurs by use of a harvest bag that is lowered from a barge or boat by boom crane or hydraulic winch at high tide and pulled along the bottom to scoop up or 'dredge' the oysters. The dredge bags have a leading edge (blade) consisting of a steel frame with teeth and a steel mesh collection bag attached to the frame. As the dredge bags are towed across the substrate, the oysters are loosened and guided into the bags. The bag is then hoisted onto the boat deck, emptied, and then redeployed. Two dredge bags may be towed simultaneously off each side of the boat. The boats, such as the one shown in Figure 3-8, can haul large volumes that can weigh over twenty tons. Dredge equipment can typically be adjusted so that the correct depth is dredged as tide levels change. A given area may be dredged twice in succession to ensure recovery of the maximum number of oysters (Corps 2014a). Harrowing may occur between the two successive dredge events in order to increase recovery of oysters. Alternatively, the area may be hand harvested at low tide after initial dredging to obtain any remaining oysters.

Figure 3-6. Oyster bottom culture (top) and hummocks (bottom), Willapa Bay (UW 2015)

Figure 3-7. Hand harvest of oysters, South Puget Sound (Taylor Shellfish 2013)

One crop of oysters is typically dredged twice before actually being harvested. In some case, oysters may be dredged at about one year and then transplanted to a grow-out bed. In other cases, the oysters may not be transplanted to a finishing (fattening) bed until they are closer to harvest size. Dredging can be accomplished at a rate of one acre harvested every two days depending on the time of year and density of oysters (Corps 2014a). In summary, an individual oyster bed may commonly be dredged a total of three times over the plant to harvest cycle.

Figure 3-8. Oyster dredge in Willapa Bay (Bay Center Farms 2015)

3.3.2.4. Oyster Longline Culture

In longline culture, oysters are grown in clusters on rope lines suspended off the bottom (typically 3 feet or less) between upright stakes made of PVC or metal pipe. This method keeps the oysters from sinking into soft substrates and minimizes their exposure to predators. Since the activity is supported by structures placed on the substrate, it is considered a ground-based culture method in this PBA to differentiate it from the floating or surface longlines discussed previously.

Seeding and Planting

Bed preparation activities are similar to those described above under bottom culture with the following additions. Residual oysters ("drop offs") dislodged from the lines during the previous growing cycle are typically harvested using bottom culture methods. The substrate may be leveled either manually or by mechanical means to address accumulations of sediment that have occurred since the previous planting cycle. If the PVC or metal stakes were removed after the previous harvest they are replaced by hand. When bed preparation is complete, long polypropylene or nylon lines with a piece of seeded oyster cultch attached approximately every foot are suspended above the ground between the stakes.

Maintenance and Grow-out

The oysters grow in clusters supported by the longlines over a period of 2 to 4 years (Figure 3-9). The longlines are checked periodically during low tides to ensure that they remain secured to the pipe and that the pipe remains in place. Periodic control of fouling organisms (e.g., mussels, barnacles, algae and other aquatic vegetation) and predator species may take place.

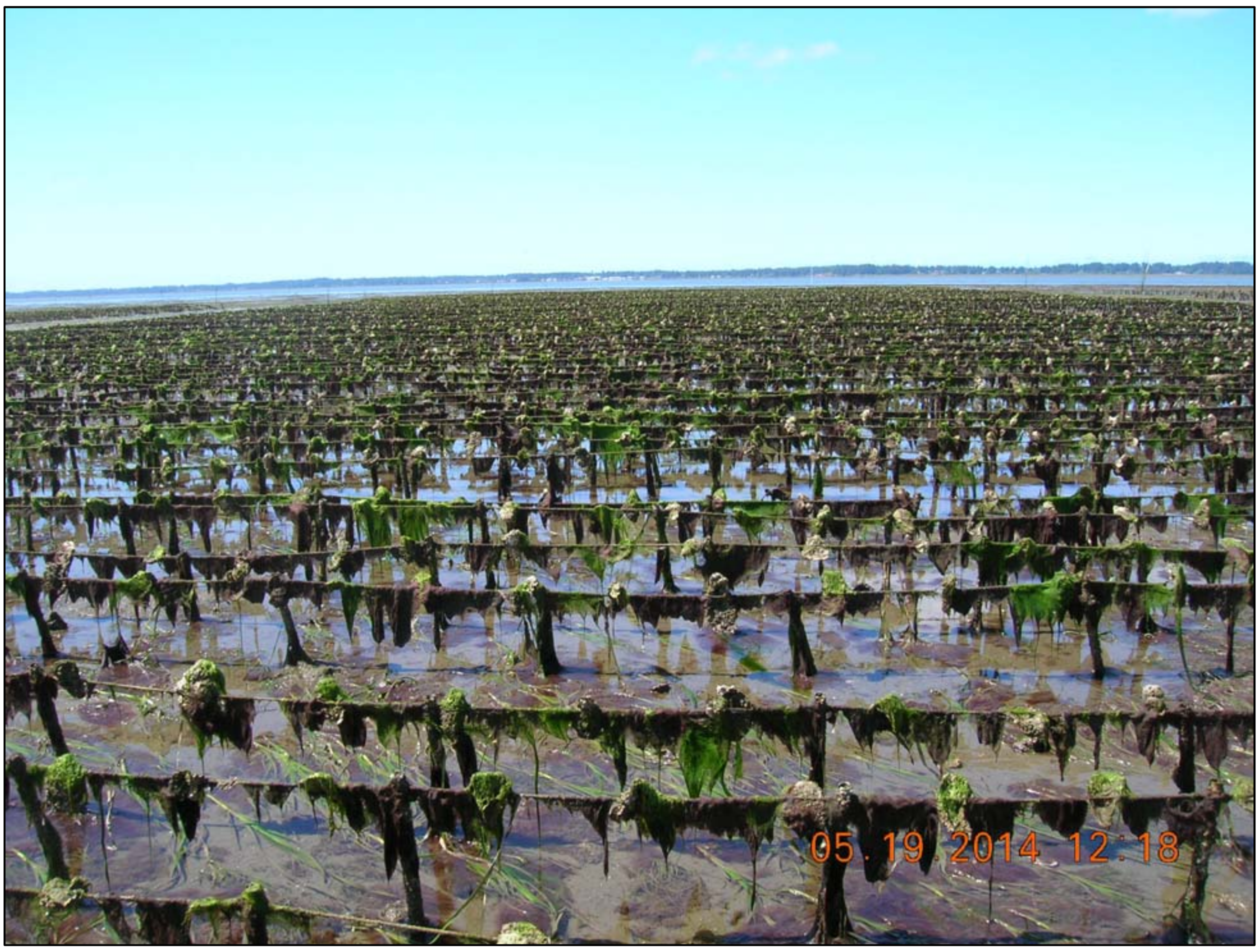

Figure 3-9. Oyster longline culture, Willapa Bay (Corps site visit 2014).

Harvest

Longline oysters may be harvested by hand or by machine. Hand harvest entails cutting oyster clusters off lines by hand at low tide and placing the clusters in harvest tubs equipped with buoys for retrieval by a vessel with a boom crane or hydraulic hoist at a higher tide. The oysters are then barged to shore. Some smaller operations carry the tubs off the beach by hand.

With mechanical harvesting, buoys are attached at intervals along the lines at low tide. During high tide the buoys are attached to a reel mounted on a vessel that pulls the lines off the stakes and reels them onto the boat. The oyster clusters are cut from the lines and then transported to processing plants or market. Some attached biological material (e.g., barnacles, algae) may incidentally fall off the lines during harvest. The oysters are removed from the lines at the processing facility and the line disposed of as waste material. Barnacles and mussels that remain on the lines are removed and may be re-used for their shell material.

About 5,000 to 7,500 sq. ft. (1/8 acre) can be harvested in one day (Corps 2014a). Pipes are often pulled after harvest and the area then harrowed and dredged to collect the remaining oysters. The ground could then be dragged with a chain or net bag to level it and remove debris before replacing stakes for the next cycle. Alternatively, stakes may remain in place depending on the environmental and substrate conditions.

3.3.2.5. Oyster Stake Culture

Oyster stake culture consists of metal or PVC stakes regularly spaced across the growing site with oysters attached directly to the stakes.

Seeding and Planting

Bed preparation methods are similar to those described above under bottom and longline culture. During low tides, stakes made of hard-surfaced material such as metal or PVC pipe are driven into the ground approximately two feet apart to allow water circulation and easy access at harvest. Stakes are limited to two feet in height to minimize obstruction to boaters.

Stakes can be seeded in upland hatchery setting tanks before being planted in the beds or transported to the site as bare stakes where there is a reliable natural seed set. Bare stakes might be planted during the prior winter to allow barnacles and other organisms to attach to the stakes, increasing the surface area available for setting oyster spat. An alternative method of seeding is to attach one to several pieces of seeded oyster cultch to each stake.

Maintenance and Grow-out

Stakes are left in place throughout a two to four year growing cycle. In areas where natural spawning occurs, multiple year classes of oysters grow on the stakes, with smaller, younger oysters growing on top of older oysters. The area is maintained by periodically checking stakes to ensure they remain upright and by removing fouling organisms (e.g., mussels, barnacles, algae and other aquatic vegetation) and predators. Stakes may be repositioned or replaced as needed. Some oysters may be periodically removed to relieve overcrowding. Oysters that fall from or are knocked off the stakes are harvested periodically by hand. They may be transplanted to firmer ground to improve their condition for harvest at a later time.

Harvest

Oysters are selectively hand harvested during low tide by prying clusters of market-sized oysters from the stakes or removing the stakes entirely. They are placed in containers and either hand carried off the beach or loaded on a boat for transport to shore. Undersized single oysters from the clusters may be transplanted to a special bed for grow-out since they cannot reattach to the stakes. They would then be harvested using bottom culture methods when they reach market size. Market-sized drop-offs that have not settled into the mud are harvested along with those pried from the stakes.

Fouling organisms would typically be dislodged during harvest. Stakes that are removed for reuse would be allowed to dry in an upland location to remove biofouling. Shell material may be stored for reuse.

3.3.2.6. Oyster Rack and/or Bag Culture

Rack and bag or bag culture entails growing oysters within plastic bags or other containers that are placed either directly on the substrate or on racks or lines that suspend the bags above the substrate.

Seeding and Planting

Bed preparation methods are similar to those described above for the other oyster culture methods. During low tide, longlines and PVC/metal stakes may be installed on the bed to secure the bags. Wood or metal racks could also be installed to keep the bags off the ground. Racks with legs may be placed directly on the substrate, or supports may be driven into the substrate. Single-set seed or oyster cultch is placed in reusable plastic net bags closed with plastic ties or galvanized metal rings. Bags are attached to the racks, stakes, or lines using reusable plastic or wire ties.

Figure 3-10. Oyster bag culture, south Puget Sound (NOAA Photo as reported in InsideBainbridge 2015)

In some cases, oysters are cultivated using a tumble bag system (Figure 3-11). Oyster tumbling involves attaching a buoy and securing the bags to a single horizontal stainless steel rod held in place by rebar stakes driven into the substrate. The oyster-seed filled bags pivot on the rod and float with the tide. The ebb and flow of the tide agitates the oysters or "tumbles" them.

Figure 3-11. Oyster rack and bag tumbling system, South Puget Sound (Corps site visit 2013)

Maintenance and Grow-out

Oysters are left to grow in the bags. The operation is checked periodically during low tides to ensure that the bags remain secure and to remove fouling organisms (e.g., mussels, barnacles, algae and other aquatic vegetation) and predators. Bags may be turned as often as every two weeks to control fouling organisms. Oysters may be periodically redistributed between bags to reduce densities. Oysters may be placed in progressively larger mesh size bags as the oysters grow.

Harvest

Oysters are harvested at low tide by removing the bags from their supports and transferring them to a boat, wheelbarrow, or vehicle for transport to shore. Bags may also be loaded on a boat at higher tides. Biofouling is common on the bags with barnacles and mussels the primary fouling organisms. To removal biofouling, bags are typically placed in upland areas where they are allowed to dry which allows for easier removal of fouling organisms prior to re-use. The activity to ‘dry’ bags typically occurs during the summer months.

3.3.3. Clam Activities

Several species of clams are cultured or harvested in Washington State including the littleneck clam (*Leukoma staminea*), Manila clam (*Venerupis philippinarum*), butter clam (*Saxidomus gigantea*), Eastern soft shell clam (*Mya arenaria*), horse clam (*Tresus nuttallii* and *Tresus capax*), razor clam (*Siliqua patula*), and the cockle (*Clinocardium nuttallii*). The most commonly cultured clam, the Manila clam, is not native to Washington State.

The following clam activities could occur any time of the year.

3.3.3.1. Rafts, Floats, FLUPSYs, and other Structures

Rafts, floats and FLUPSYs are used less in clam activities than they are in oyster and mussel activities. Their use for clam culture would be similar to that described above in the mussel and oyster sections. The proposed action includes reauthorization and maintenance of currently serviceable rafts, floats, and FLUPSYs that qualify as continuing activities (pre-18 March 2007). New rafts, floats, and FLUPSYs or the relocation or expansion of continuing rafts, floats, and FLUPSYs are excluded from the PBA proposed action.

Upland wet-storage tanks, as described above for mussel activities, could be used for clam activities. The Corps would permit the pipes (for both discharge and intake) associated with these tanks under the proposed action.

3.3.3.2. Clam Bottom Culture

Bottom culture entails growing clams directly on the substrate of intertidal areas.

Seeding and planting

Prior to planting clam seed on the tidelands, beds are prepared in a number of ways depending on the location. Bed preparation activities are similar to those described above for oyster bottom culture. The substrate may be prepared by removing aquatic vegetation, mussels, and other undesired species. Any shellfish present on site may be harvested to reduce competition. These activities could be conducted by hand or by mechanical means (e.g., water jet, harrowing).

Graveling (also called frosting) is a common activity employed for clam culture. This consists of adding gravel and/or shell when the tide is high enough to float a barge. Graveling by vessel often occurs during about a two hour window at slack tide. Applying at the slack tide allows for a more accurate placement of the graveling material. In a 1-2 hour period, about 1 acre can be graveled to a depth of up to 1 inch (Corps 2014a). Several thin layers of material may be placed over a period of days (Figure 3-13). To place a single 0.5-inch layer requires about 70 cubic yards of washed gravel or shell per acre. An individual site would not be graveled more frequently than once per year. Many sites are graveled annually whereas other may be graveled at a lesser frequency.

Clam seed is typically acquired from hatcheries and planted in the spring and early summer. Intertidal trays or bags may be used as nursery systems until seed is of sufficient size to plant. The trays are typically two-foot by two-foot with ¼ inch diameter openings that permit water to flow through. They are employed in stacks of six or seven, and placed in the lower intertidal areas secured with rebar or anchored with sand bags. Clam bags as described in the section on bag culture can also be used to hold clams in a nursery system. Natural spawning and setting of clams also occurs. Clam seed sizes and methods of seeding vary, depending on site-specific factors such as predation and weather conditions. Planting methods include hand-spreading seed at low tide upon bare, exposed substrate; hand-spreading seed on an incoming tide when the water is approximately four inches deep; hand-spreading seed on an outgoing tide when the water is approximately two to three feet deep; or spreading seed at high tide from a boat.

Figure 3-12. Adding gravel to a clam bed (i.e., graveling) (PCSGA 2011)

Immediately after seeding, cover nets may be placed over the seeded areas to protect clams from predators such as crabs and ducks. Cover nets are typically made from plastic such as polypropylene (Figure 3-13). The net edges are typically buried in a trench or weighed with a lead line and secured with rebar stakes. Predator cover netting typically remains on site until harvest.

Maintenance and Grow-out

After each growing season, surveys may be conducted during low tide to assess seed survival and distribution, and to estimate potential yield. Based on survey results, additional seeding activity may occur. Netting used to protect clams from predation can become fouled with barnacles, mussels, aquatic vegetation (e.g., algae, eelgrass) or other organisms. The nets usually remain on site throughout the growing period. Fouling organisms may be removed by hand or by mechanical means while the nets are in place. Depending on local conditions, net cleaning may occur as often as monthly or not at all. Biofouling occurs most frequently during the late spring and summer months.

Harvest

Before harvest begins, bed boundaries may be staked and any predator netting folded back during a low tide. Hand harvesters dig clams during low tides using a clam rake (Figure 3-14). Shovels or other hand operated tools may also be used. Market-size clams (typically about 3 years of age) are selectively harvested, placed in buckets, bagged, tagged, and removed. Undersized clams are returned to beds for future harvests. Since a given clam bed may contain multiple year classes of clams, it may be harvested on a regular schedule (such as annually) to harvest individual year classes of clams. Clams harvested for sale are generally left in net bags in wet storage. Clams are typically maintained in wet storage either directly in marine waters or in upland tanks filled with seawater for at least 24 hours in order to purge sand. Upland tanks are connected to the marine waters through intake and outfall structures (pipes) that are compliant with the NPDES.

Figure 3-13. Clam cover nets in South Puget Sound (Corps site visit 2014).

Harvesting of clams also occurs with mechanical equipment (Figure 3-15). This equipment is driven on the substrate when the tide is out and excavates the substrate to a depth of about 4-6 inches in order to extract the clams. Clams are harvested after 3 years. About 0.8 acres per day of clams can be mechanically harvested which results in about 12 to 15 days of work for each acre (Corps 2014a). The use of a 'hydraulic escalator harvester' equipment is not included among the PBA covered activities.

Figure 3-14. Hand harvest of Manila clams (top, Willapa Oysters 2007 in PCSGA 2011; bottom, South Puget Sound, Corps site visit 2013).

Figure 3-15. Mechanical harvest, low tide in North Puget Sound (GoogleEarth 2015; PSI 2015)

3.3.3.3. Clam Bag Culture

Clam bag culture is similar to the bag culture described previously for oysters. Clams are typically grown in plastic mesh bags placed directly on the substrate.

Seeding and Planting

Bed preparation activities are similar to those described above. Prior to setting bags on the tidelands, shallow (typically 2 to 4 inches) trenches may be dug during low tide with rakes or hoes to provide a more secure foundation for setting down the clam bags (Figure 3-14).

Clam seed (typically 5-8 millimeters) is placed in reusable plastic net bags closed with plastic ties or galvanized metal rings. Gravel and/or shell fragments may be added to the bags. Bags may be placed in shallow trenches during low tide and allowed to “silt-in” (i.e., become buried in the substrate). In high current or wind areas, bags may be held in place with 4 to 6 inch metal stakes.

Figure 3-16. Manila clam bags set into, on the substrate (Corps site visit 2013)

Maintenance and Grow-out

Bags are monitored during low tide throughout the grow-out cycle to make sure they remain secured. They may be turned occasionally to optimize growth. Fouling organisms (e.g., mussels, barnacles, algae and other aquatic vegetation) and predators may be periodically removed.

Harvest

When the clams reach market size, the bags are removed from the growing area. Harvesting may occur when there is one to two feet of water, so that sand and mud that accumulated in the bags during grow-out can be sieved from the bags in place. Bags are transported to a processing site where any added substrate is separated for later reuse.

3.3.4. Geoduck Activities

Geoduck (*Panopea abrupta*) is native to Washington State and is the largest known burrowing clam. Geoduck is a relatively new species for culture. Washington is the principal state in the United States actively farming geoducks. Cultivation under the proposed action would occur between elevation +7 ft to -4.5 ft MLLW. Naturally seeded or wild geoduck could occur from about +1 ft to deeper than -100 ft MLLW. Harvest of the wild population would occur no deeper than -70 ft MLLW under the PBA. This is the typical maximum depth for this activity (WDNR 2008).

3.3.4.1. Rafts, Floats, FLUPSYs, and other Structures

Continuing structures would include the use of floats, FLUPSYs, rafts and seed grow-out trays or racks. All of these types of structures have been described above in the mussel, oyster and clam sections. The proposed action includes reauthorization and maintenance of currently serviceable rafts, floats, and FLUPSYs that qualify as continuing activities (pre-18 March 2007). New rafts, floats, and FLUPSYs or the relocation or expansion of continuing rafts and floats are excluded from the PBA proposed action.

3.3.4.2. Geoduck Culture

Seeding and Planting

Bed preparation activities are similar to those described above. Bed preparation can also include a "pre-harvest" to remove all current shellfish on the bed including naturally seeded geoduck already present on the site. Undesired species such as sea stars and sand dollars (*Clypeasterioda*) may be removed by hand. Some growers may attempt to re-locate sand dollars to nearby suitable habitat; other growers remove them permanently from the marine environment.

The most common method of culture currently in use consists of placing a 6-inch diameter, 9-inch long PVC pipe (pipe sizes may vary among growers) by hand into the substrate during low tide, usually leaving the top section of pipe (also called a tube) exposed. Two to four seed clams (usually from hatcheries) are placed in each tube where they burrow into the substrate. Tubes are typically installed into the substrate at a density of about 1 tube per square foot or about 42,000 tubes per acre. The top of each pipe is covered with a plastic mesh net and secured with a rubber band to exclude predators (Figure 3-17). Additional cover netting may be placed over the tube field on beaches with heavy wind and wave action to guard against the tubes becoming dislodged in storms (Figure 3-18). Some growers do not use the individual pipe net covering but use the cover netting to cover the whole field of tubes. Some growers use flexible net tubes (Vexar®) instead of the PVC pipe, which eliminates the need for the additional cover netting. Intertidal geoduck culture typically ranges between the +5.0 and the -4.5 feet tidal elevation (MLLW). Geoduck seed can also be directly set into the substrate without the use of any structure.

Another method being used to exclude predators is net tunnels (Figure 3-19). The tunnels are made from 4-foot wide rolls of polyethylene net placed over a rebar frame to hold the net a couple of inches above the substrate with the net edges buried by the substrate. They are currently being used in the intertidal area. The mesh opening of the net is either 1/4-inch or 3/8-inch. A 24-inch wide net without a rebar frame may also be used.

Maintenance and Grow-out

Fouling organisms including mussels, cockle clams, and sand dollars often accumulate inside the tubes. Aquatic vegetation (e.g., algae and eelgrass) may also accumulate on or over the tubes. When this occurs, which could be throughout the year, these fouling organisms are removed.

Figure 3-17. Geoduck cultivation using individual tube nets for predator control, South Puget Sound (top, OPB 2012) and Discovery Bay (bottom, Kitsap Sun 2015)

Figure 3-18. Cover netting placed over geoduck tubes, South Puget Sound (Corps site visit 2014)

Figure 3-19. Geoduck tunnel net over rebar frame (Dewey 2013)

Tubes and netting are typically removed after 18 months to 2 years when the young clams have buried themselves to a depth sufficient to evade predators (about 14 inches). After tube removal, large area nets may be redeployed over the bed for several months. The tubes and nets are often taken to upland locations and allowed to dry in order to easily remove fouling organisms. They are then typically reused. As the clams grow, they may gradually dislodge the tubes from the substrate before they can be removed. The dislodged tubes could potentially be swept away from the site by the tides.

Harvest

Naturally produced geoducks can live for more than 100 years and may be harvested at any age or size. Cultivated geoducks are typically harvested 4 to 7 years after planting or when they reach about 2 pounds. A site seeded at 160,000 per acre might be expected to produce 32,000 to 40,000 marketable geoduck per acre. The geoducks are harvested in the intertidal zone at low tide (Figure 3-20) or by divers at high tide in the intertidal or subtidal zone. In either case, the geoducks are typically harvested using hand-operated water jet probes. For water jet harvest, the probe is a pipe about 18 to 24 inches long with a nozzle on the end that releases surface-supplied seawater from a 1-inch internal diameter hose at a pressure of about 40 pounds per square inch (about the same pressure as that from a standard garden hose) and a flow of up to 20 gallons per minute.

This harvest method allows the hand extraction of geoducks, which burrow as deep as 3 feet. The harvester inserts the probe in the substrate next to an exposed geoduck siphon or the hole left when the siphon is retracted. By discharging pressurized water around the geoduck, the sediment is loosened and the clam is removed by hand. For the dive harvester, this entire process takes 5 to 10 seconds (Figure 3-21). Each diver carries a mesh bag to collect the harvested geoducks. Divers periodically surface to unload their bags. One diver can harvest 500 to 1,000 geoducks per day. Multiple divers may work in an area at one time. Dive harvesters work no more than 3 to 4 hours per day.

Geoduck harvesting occurs year-round and is not limited by tidal height. However, dive harvesting tends to be the dominant method during winter months (November through February) due to the prevalence of high daytime tides, the absence of suitable low tides for daytime beach harvest, and generally favorable market conditions during that period. Both low-tide and dive harvests may occur on the same sites. It is estimated that the dive harvest is used about 75% of the time compared to the non-dive harvest method (Cheney 2007 referenced in Anchor 2010). Harvest occurs until all harvestable-sized geoduck are removed from the harvest area. Harvesters make several sweeps of a tract to ensure all harvestable-sized geoduck are removed. Because of differences in geoduck growth rates with a mix of harvest-sized and under-sized clams, only a portion of a project area may be harvested, with the remainder set aside for later dive or beach harvest. Additionally, a dive harvest is typically supplemented with beach harvest when clam densities are reduced in the project area. Harvest may also be constrained by tide and current conditions with slow or slack water conditions reducing or restricting the ability to effectively harvest with divers.

Figure 3-20. Harvesting geoduck at low tide (PCSGA 2011, CPPSH 2015)

Dive harvest is the typical method used for harvesting subtidal geoducks. Dive harvesters work within an approximate 100-foot range from the harvest vessel, or to the maximum lengths of their air and water lines. Intakes for supplying water to the onboard pumps are positioned several feet below the water surface. Intakes will be screened per Conservation Measure.

3.3.5. Vessel and Vehicle Support

Various types of vessels and vehicles could be used to support activities for all shellfish species. Vessels could include offshore rafts, small open crafts with outboard motors, and larger barges (Table 3-1). Land vehicles (e.g., trucks, ATV) could also be used to support the various activities. Use of support vessels would be within the immediate shellfish activity area or the immediate vicinity.

Vessels could be used to mechanically harvest, tow harrow, prepare or maintain the substrate (e.g., graveling). Vehicles may be used on the culture beds as a base of operations and to transport equipment and shellfish. Vehicles can also be used to mechanically harvest or prepare the substrate for harvest (Figure 3-15). This could include tractors harrowing/tilling the substrate.

Geoduck dive harvesters work from small surface vessels or dive platforms that contain machinery for surface-supplied diver air and water jets, diver communication equipment, and on-deck storage for harvested geoducks. Dive boats used to harvest cultivated geoduck may be anchored over the harvest sites and moved to deeper water during low tides. Dive boats used to harvest subtidal geoduck typically move over the harvest area as needed to adjust the divers' position relative to geoduck density.

Information on vessel sizes have has been provided by PCSGA which is expected to be representative of the range of support vessels that would be used for the various types of activities described above.

Figure 3-21. Geoduck dive harvest sequence (Anchor 2010)

Table 3-1. Types of support vessels and equipment used while implementing PBA covered activities and estimated in-air noise (PCSGA 2013b).

Equipment	Purpose	Estimated dBA
5hp motor with propeller	FLUPSY	65@100 yards
10hp engine	skiffs, water pumps, hatchery intake	65 @ 100 yards
40-330hp engine	boat inboard/outboard	65-90 @ 0.5 m
air compressor	diving	77-85 @ 7m
power washer (4000 psi)	nursery raft/FLUPSY	<100 @ operator ear (~3 feet)
electric hoist	lifting nursery raft/FLUPSY	75-85 @ 50 ft
crane	lifting nursery raft/FLUPSY	81 @ 50 ft
harvester (6 cylinder Chevy Vortec engine)	harvesting clams	60-90 @ 15 m

3.3.6. Summary of Covered Activities

The PBA covered activities are summarized below in Table 3-2. This summary may not necessarily list all the activities described in the previous sections.

Table 3-2. Summary of shellfish activities included within the proposed action of the PBA.

Species	PBA Covered Activities and Structures	
Mussel *Blue, Gallo*	Seeding/ Planting	• Raft, floats, and associated maintenance that are components of a ‘continuing’ activity • Set lines or metal screen frames in net cages suspended in water to naturally set seed. • Install socks weighted and lashed to rafts, lines, or stakes and suspended in water for hatchery-raised seed. • Place buoys or anchors used to mark and secure structures
	Maintenance/ Grow-out	• Placement/maintenance of predator exclusion nets • Replace and maintain stakes and lines • Remove biofouling and weights • Monitor growth
	Harvest/ Processing	• Strip mussels from the lines or socks • Bag mussels for transport • Intake or outfall structures (pipes) (discharge compliant with NPDES) to connect upland wet storage holding tanks
Oyster	Seeding/ Planting	• Raft, floats, and FLUPSYs and associated maintenance that are components of a ‘continuing’ activity

Species	PBA Covered Activities and Structures	
Pacific, Olympia, Kumamoto, Eastern, European flat		• Prepare substrate by removal of debris (rocks/large wood) • Remove/relocate undesired aquatic species • Apply up to 1-inch layer of gravel/shell annually to firm substrate (sprayed from vessel, or delivered with land vehicle and mechanically or hand deposited). Deposited material cannot be thicker than one inch even on a temporary basis. • Mechanically level substrate • Use of 'continuing' seed floats • Use of work floats • Use of racks/elevated trays or bins • Create oyster hummocks (oyster shell mounds) • Install bags of cultch material onto stakes, lines, racks, trays or secured directly onto substrate • Suspend lantern nets, bags, cages, vertical ropes or wires from surface longlines, or 'continuing' rafts
	Maintenance/ Grow-out	• Continued removal of debris/aquatic species, as necessary • Flip/turn bags • Re-position stakes • Remove excess biofouling • Harrow to lift excess mud or sand/re-level substrate • Pull and restack trays
	Harvest/ Processing	• Hand harvest into containers for transport • Mechanical shallow depth dredging from barges • Collection and transport of oysters to 'fattening' beds to harden (2nd harvest then occurs) • Wet storage (in-water) • Use of work platforms • Intake or outfall structures (pipes) (discharge compliant with NPDES) to connect upland wet storage holding tanks
Clam *Manila, littleneck, butter, eastern soft shell, horse, razor, cockle*	Seeding/ Planting	• Raft, floats, and FLUPSYs and associated maintenance that are components of a ‘continuing’ activity • Use of seed grow-out trays and bins • Prepare substrate by removal of debris (rocks/large wood) • Remove/re-locate other aquatic species (starfish, vegetation) • Apply up to 1 inch layer of gravel/shell annually to firm substrate (sprayed from vessel, or delivered with land vehicle and mechanically or hand deposited). Deposited material cannot be thicker than one inch even on a temporary basis.

Species	PBA Covered Activities and Structures	
		• Placing secured nets on the substrate • Applying seed from vessel/vehicle or from foot • Place secured or trenched-in net bags
	Maintenance/ Grow-out	• Continued removal of debris/aquatic species, as necessary • Repositioning/cleaning nets to remove debris/biofouling • Turning bags
	Harvest/ Processing	• Hand digging/bag removal • Mechanical harvest
Geoduck	Seeding/ Planting	• Raft, floats, and FLUPSYs and associated maintenance that are components of a 'continuing' activity • Use of seed grow-out trays and bins • Prepare substrate by removal of debris (rocks/large wood) • Remove/re-locate undesired aquatic species • Install PVC tubes with individual net covers or flexible net tubes • Install secured area net covers • Install secured net tunnels
	Maintenance/ Grow-out	• Clean tubes to remove debris/biofouling • Remove tubes/nets (area nets may be reset after tubes removed)
	Harvest/ Processing	• Harvest by hand (low tide, high tide, and subtidal by divers) • Use of pressured water to liquefy substrate
All species		• Use of work platforms • Vessel support (grounding/anchoring) • Land vehicle/foot support to and from uplands to transport equipment, material, shellfish, and people

3.3.7. Activities Specifically Excluded

Certain shellfish activities (Table 3-3) have been excluded from the proposed action for various reasons including:

- Activity results in uncertain or unknown impacts not appropriate for a programmatic consultation (e.g., new cultivation methods, new berms or dikes). Individual ESA consultation on a case by case basis is more appropriate in these cases.
- Activity is already covered under a programmatic or individual ESA consultation (e.g., mooring buoys, piers).

- Activity extends sufficiently beyond the jurisdiction of the Corps regulatory program and/or is regulated by another Federal agency (e.g., upland hatcheries, NPDES discharge, pesticide use).
- Any unauthorized activity (e.g., not permitted) is not included in the action of this PBA.

Table 3-3. List of shellfish activities not included as “PBA covered activities”

PBA Excluded Activities and Structures
Vertical fencing/vertical nets or drift fences (includes oyster corrals; does not apply to raft nets)
New berms or dikes or the expansion or maintenance of current, authorized berms or dikes
Use of a hopper-type barge or other method that results in material (i.e., gravel or shell) placed during graveling or frosting activities that is thicker than 1 inch in depth even for short periods of time.
Pile driving
Installation and maintenance of mooring buoys
Construction, maintenance, and operation of upland hatcheries
Cultivation of shellfish species not previously cultivated in the action area for the PBA
Construction, maintenance, and operation of attendant features, such as docks, piers, boat ramps, stockpiles, or staging areas
Deposition of shell material back into waters of the United States as waste
Dredging or creating channels (e.g., placing sand bags) so as to redirect fresh water flow
Installation of new rafts, floats, or FLUPSYs or the relocation or expansion of 'continuing' rafts, floats, or FLUPSYs.
Any form of chemical application to control undesired species (e.g., non-native eelgrass *Zostera japonica*, burrowing shrimp)
The use of materials that lack structural integrity in the marine environment (e.g. plastic children’s wading pools, unencapsulated Styrofoam®).
Unauthorized activities

3.4. Activity Acreage

In order to determine the scale of shellfish activity conducted under the proposed action, the Corps developed an estimate for the total acreage of shellfish activity that is expected to be authorized by Corps permits over the next 20 years. The acreages were developed based on activity purpose and then further subdivided by geographic region. The activity purposes include commercial aquaculture, subtidal geoduck harvest, recreation, and restoration. The commercial aquaculture activities were further subdivided as discussed in Section 3.4.1. Estimates for the amount of acreage that could be authorized under the proposed action are provided for each of these categories by geographic region.

The acreage estimates are based on many factors including historical Corps permit applications, estimates provided by commercial shellfish growers for future aquaculture production, estimates provided by the Washington Department of Fish and Wildlife (WDFW) for recreation related purposes, coordination with the Washington Department of Natural Resources (WDNR) and their potential shellfish activities, and the general knowledge and expertise of the Corps professional staff that have processed shellfish related permit applications.

Section 3.1 should be referenced for details on how these acreage amounts will be managed under the PBA.

3.4.1. Commercial Aquaculture

The majority of permitting actions authorizing shellfish activity using the PBA are expected to be for commercial aquaculture purposes. Commercial aquaculture activities are divided between activities that qualify as ‘continuing’ and those considered to be ‘new’. Section 3.1 should be referenced for the definitions of continuing and new activities. Continuing activities are further subdivided based on whether structures occur as part of the activity. The relevant structures are FLUPSYs, floats, and rafts. The continuing activities account for most of the expected shellfish aquaculture both by acreage and number of expected permitting actions. The Corps has previously received permit applications for all continuing activities and a number of applications for new activities. Many of these have been previously verified under NWP 48 or issued individual permits. For the purpose of categorizing acreages, the activities have been subdivided into floating culture (i.e., with floating lines or rafts) and ground-based culture which includes all other activities including oyster longline culture. Based on analysis of permit applications, there are a total of 934 shellfish activity footprints that qualify as continuing. Of these, a total of 927 include ground-based activities conducted in the intertidal or adjacent shallow subtidal areas. The remaining seven activity footprints are for floating culture with rafts exclusively. Five of the continuing activities include both raft and ground-based culture. There are also a limited number of floats and FLUPSYs that qualify as continuing. All of the continuing activities including the structures (rafts, floats, and FLUPSYs) could potentially be reauthorized using the PBA for ESA compliance. Details on the number of these activities and the associated acreage are summarized below.

Floats and FLUPSYs

Analysis of historical permit applications maintained by the Corps indicates there are a total of six shellfish activity footprints with continuing floats or FLUPSYs (Table 3-4). These are all located in the Willapa Bay (3 footprints) and South Puget Sound (3 footprints) regions. Only continuing floats or FLUPSYs and their maintenance would be authorized by the Corps under the proposed action.

Floating aquaculture

Analysis of historical permit applications indicates that floating aquaculture activities occur in Willapa Bay, Hood Canal, South Puget Sound and North Puget Sound. With respect to floating culture with rafts, only continuing floating activities and their maintenance would be authorized under the proposed action. New rafts would not be authorized under the PBA. There are a total of twelve continuing active footprints with rafts that cover 87 acres as detailed in Table 3-4. New surface or floating longlines would be authorized under the proposed action. There are a total of 22 continuing active and 32 continuing fallow acres with surface longlines (Table 3-4). The geographic locations for each of the floating culture continuing activities are illustrated in Appendix D. New floating acres are estimates based on coordination with the shellfish industry and Corps professional judgment.

Table 3-4. Summary of floating commercial aquaculture acreage

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound	Total
# footprints with floats/FLUPSYs	0	3	0	3	0	6
# Continuing footprints - rafts	0	0	2	8	2	12
Continuing active raft acres	0	0	12	13	62	87
Continuing fallow raft acres	NI	NI	NI	NI	NI	NI
# Continuing footprints - surface longlines	0	2	4	2	1	9
Continuing active surface longline acres	0	2	11	7	2	22
Continuing fallow surface longline acres	0	27	5	0	0	32
New floating acres -surface longlines	5	25	17	22	5	74
Total floating aquaculture acres	5	54	45	42	69	215

Note: Continuing fallow and new floating acres include surface longline culture methods only. Floating culture with rafts are included for continuing active acres only. NI = not included in proposed action.

Ground-based aquaculture

Ground-based commercial aquaculture encompasses all of the activities discussed in Section 3.3 except for the floating activities using rafts. The anticipated acreage for these activities includes both continuing and new activities (Table 3-5). The acreage for the continuing activities was collected from permit applications that are maintained by the Corps. The acreage and geographic footprints for this category of activities is expected to remain relatively constant over the period of the PBA. There may be some minor adjustments to the database based on updated information received from permit applicants. For example, a small percentage of the fallow acres were on permit applications with both floating and ground-based aquaculture. The PBA assumes these fallow areas would be for ground-based aquaculture in the future and so they are represented as such in Table 3-5. This could be shifted when more information is obtained from the applicant or a new permit application is submitted. The PBA annual review meetings will be used to adjust acreage totals for each category as necessary to ensure ESA compliance. The geographic locations for each of the continuing activity footprints are illustrated in Appendix D.

The total acreage for new activities is estimated based on projections provided to the Corps by the aquaculture industry, the historical rate of permit applications, and the experience of Corps professional staff.

Table 3-5. Summary of ground-based commercial aquaculture acreage

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound	Total
# Continuing ground-based footprints	28	251	207	371	70	927
Continuing *active* ground-based acres	1,145	16,395	926	2,331	1,290	22,087
Continuing *fallow* ground-based acres	1,820	9,441	397	780	2,333	14,771
Total continuing ground-based acres	2,965	25,836	1,323	3,111	3,623	36,858
New ground-based acres	95	75	421	426	310	1,327
Total ground-based commercial aquaculture acres	3,060	25,911	1,744	3,537	3,933	38,185

The vast majority of the ground-based commercial aquaculture and all new activities would occur at tidal elevations between - 4.5 ft and +7 ft MLLW. It is probable that some percentage of this total acreage would be authorized (or reauthorized) at subtidal elevations (i.e., deeper than - 4.5 ft MLLW). This would typically be shallow subtidal lands immediately adjacent to intertidal shellfish activity areas. Based on an analysis of historical permit applications, 22 acres of subtidal lands were previously authorized as continuing shellfish activities. Because permit applicants have not historically been required to delineate their project footprints by tidal elevation, this total likely underestimates the subtidal acreage of continuing shellfish activity. This conclusion is supported by Corps professional staff knowledge of many of the continuing shellfish activity areas. Analysis of aquatic parcel maps and the Corps geographic database also indicates that greater than 22 acres of subtidal lands have likely been previously authorized. WDNR has indicated all but 1,085 acres of marine bedlands (i.e., deeper than extreme low tide) in the State of Washington are owned by WDNR, and WDNR does not lease these lands for ground-based aquaculture currently and does not plan to lease them in the future at least within the expected timeframe of the PBA (WDNR 2013a). WDNR does lease subtidal lands for floating raft aquaculture activities. Because public subtidal lands would not be used for ground-based aquaculture, these 1,085 acres would be considered the maximum amount of subtidal acreage available for ground-based commercial aquaculture. This would constitute less than 3% of the total continuing commercial acreage. These unknown subtidal acres are included in the totals for ground-based activities in Table 3-5. They could either be continuing active or fallow acres.

Summary of commercial aquaculture acreage

Commercial aquaculture activities are summarized by floats/FLUPSYs, floating, and ground-based activities. The total potential commercial aquaculture acreage that would be authorized under the PBA by geographic region is illustrated in Table 3-6.

Table 3-6. Summary of commercial aquaculture activities and acreage

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound	Total
# footprints with floats/FLUPSYs	0	3	0	3	0	6
Total floating acres	5	54	45	42	69	215
Total ground-based acres	3,060	25,911	1,744	3,537	3,933	38,185
Total commercial aquaculture acres	3,065	25,965	1,789	3,578	4,002	38,400

The continuing commercial aquaculture activities have a different status than the new activities due to their historical and continued operation as discussed previously. Due to this status it is important to summarize this subset of activities separately (see Table 3-7).

Table 3-7. Summary of **continuing** (active and fallow) commercial aquaculture activities and acreage

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound	Total
Continuing footprints	28	251	209	375	71	934
Continuing footprints with floats/FLUPSYs	0	3	0	3	0	6
Continuing floating acres	0	29	28	20	64	141
Continuing ground-based acres	2,965	25,836	1,323	3,111	3,623	36,858
Total continuing acres	2,965	25,865	1,351	3,131	3,687	36,999

The vast majority of acreage for commercial aquaculture is for activities classified as continuing which includes both floating and ground-based activities. Since the continuing activities represent the majority of all shellfish activity potentially authorized under the proposed action, an evaluation of this information is useful for understanding the action and its effect on listed species and their critical habitat. It is anticipated that all of the continuing activities would be reauthorized by the Corps under the PBA. A detailed summary of the shellfish activities proposed by historical permit applicants can be found in Appendix B. A summary of the species cultivated by ground based methods can be found in Table 3-8. The table does not include a small amount of mussel bottom culture. The predominant species cultured varies by geographic region. On an acreage basis, the most commonly cultured species appears to be oyster followed by non-geoduck clams.

Table 3-8. Distribution of ground-based commercial aquaculture continuing footprints and acreage by species cultivated

Grays Harbor							
Total	Oyster Only	Clam Only	Geoduck Only	Oyster, Clam, & Geoduck	Oyster & Clam	Oyster & Geoduck	Clam & Geoduck
Continuing footprints	23	0	0	0	5	0	0
Continuing acres active	801	0	0	0	343	0	0
Continuing acres fallow	1,813	0	0	0	7	0	0
Total acres	2,614	0	0	0	350	0	0
Willapa Bay							
Total	Oyster Only	Clam Only	Geoduck Only	Oyster, Clam, & Geoduck	Oyster & Clam	Oyster & Geoduck	Clam & Geoduck
Continuing footprints	117	30	0	2	102	0	0
Continuing acres active	4,493	404	0	680	10,818	0	0
Continuing acres fallow	2,047	379	0	67	6,949	0	0
Total acres	6,540	782	0	747	17,767	0	0
Hood Canal							
Total	Oyster Only	Clam Only	Geoduck Only	Oyster, Clam, & Geoduck	Oyster & Clam	Oyster & Geoduck	Clam & Geoduck
Continuing footprints	14	0	3	9	179	1	0
Continuing acres active	24	0	8	444	440	1	0
Continuing acres fallow	8	0	2	108	279	0	0
Total acres	33	0	10	552	719	1	0
South Puget Sound							
Total	Oyster Only	Clam Only	Geoduck Only	Oyster, Clam, & Geoduck	Oyster & Clam	Oyster & Geoduck	Clam & Geoduck
Continuing footprints	3	18	142	56	89	15	34
Continuing acres active	46	36	121	635	1,310	34	140
Continuing acres fallow	2	8	45	454	222	5	14
Total acres	48	44	166	1,089	1,532	39	154
North Puget Sound							
Total	Oyster Only	Clam Only	Geoduck Only	Oyster, Clam, & Geoduck	Oyster & Clam	Oyster & Geoduck	Clam & Geoduck
Continuing footprints	12	7	0	7	40	2	2
Continuing acres active	51	43	0	323	834	16	30
Continuing acres fallow	74	29	0	2,107	122	1	0
Total acres	125	72	0	2,430	956	17	30

Oyster culture methods vary by region. The ground culture method is by far the dominant method used for clams in all regions. A summary of primary culture methods and an estimate for the relative distribution of species cultured by region is illustrated in Table 3-9. The estimate is based on the information in Appendix B and Table 3-8. This estimate is consistent with the PCSGA estimate of 300 acres currently used for geoduck culture in the Puget Sound and Hood Canal regions (PCSGA 2013a).

Table 3-9. Distribution of species cultivated and primary cultivation methods

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound
continuing active acres	1,145	16,397	949	2,351	1,354
cultured species distribution and methods	oyster dominant	oyster primary followed by clam, negligible geoduck	oyster most common followed closely by clam, less geoduck	relatively equal distribution of oyster, clam; slightly less geoduck	oyster and clam most common; less geoduck
oyster	95%	80-95%	40-60%	30-50%	50-60%
clam	1-5%	5-15%	20-40%	30-50%	30-40%
geoduck	0%	1%	10-20%	15-30%	1-10%
mussel	0%	1%	1%	1%	1%
oyster culture methods	bottom culture primary; longlines common	bottom culture primary; some longlines; limited rack & bag	bottom culture primary; some longlines; limited rack & bag	bottom culture dominant; limited rack & bag, longlines	bottom culture primary; longlines common; some rack & bag
clam culture methods	bottom	bottom	bottom	bottom	bottom
mussel culture methods	NA	surface longlines	rafts & surface longlines	rafts & surface longlines	rafts & surface longlines
continuing fallow acres	1,820	9,468	402	780	2,333
cultured species distribution and methods	same cultured species & methods as cont. active above	same cultured species & methods as cont. active above	same cultured species & methods as cont. active above	same cultured species & methods as cont. active above	same cultured species & methods as cont. active above
new acres	100	100	438	448	315
oyster & clam	95%	25%	78%	62%	79%
geoduck	0%	50%	18%	33%	19%
mussel	5%	25%	4%	5%	2%

Note: only new suspended lines for mussels would be authorized under the PBA (i.e., not rafts)

The Corps has also received a number of applications for shellfish activities that are classified as new. A summary of the species cultured and the methods employed for this subset of the new activities can be found in Appendix B. The Corps queried the PCSGA for estimates of future anticipated shellfish culture activities (PCSGA 2013a). The acreage provided is reflected in the tables above and in Table 3-9.

The PBA makes the following assumptions about future aquaculture activities for the purpose of determining effects of the action:

1) The future anticipated shellfish activities/species cultured on the *continuing active* acreage will remain largely the same relative to the activities that have been occurring over the recent history as described in Table 3-9.
2) The future anticipated shellfish activities/species cultured on the *continuing fallow* acreage will be consistent with that expressed in permit applications for each region. These activities closely mirror the activities on the continuing active acreage as illustrated in Table 3-9.
3) The future anticipated shellfish activities/species cultured on the *new* acreage is assumed to approximate the species cultured distribution estimates provided to the Corps from the shellfish industry as illustrated in Table 3-9 (PCSGA 2013a).

3.4.2. Subtidal Geoduck Harvest

In 2008, a Habitat Conservation Plan (HCP) was completed for geoduck harvest conducted by WDNR on WDNR lands. This geoduck harvest is for naturally occurring (not cultivated) geoduck. Under the PBA proposed action, the Corps anticipates authorizing activities described and carried out under the HCP. This includes a total annual harvest on a maximum of 6,000 acres of subtidal lands. Since the HCP represents a completed ESA consultation, the Corps would use the HCP consultation to address ESA compliance for these activities. The HCP activities are therefore not considered part of the proposed action in this PBA. The HCP activities and their effects are discussed in the context of cumulative effects and are included in the environmental baseline.

The Corps could also authorize subtidal geoduck harvest activities conducted outside the framework of the HCP. Acreage for these activities is included within the proposed action and discussed in the effects section of the PBA. The vast majority of this harvest is expected to occur on state owned subtidal lands within identified geoduck management tracts (see Appendix E). However it could also occur on non-state owned subtidal lands. WDNR indicates there is a total of 1,085 acres of non state-owned subtidal land in Washington State (WDNR 2013a). It is uncertain to what degree these lands contain geoduck for harvest. For the purpose of the PBA, it is assumed geoduck harvest would occur on these acres in the Hood Canal, North and South Puget Sound regions of the PBA where native geoduck occur. The non state-owned land acres for each region are estimates made by the Corps based on the WDNR aquatic parcel database (WDNR 2014a).

The acreage for this activity is separated into two categories, the total harvestable acreage and that acreage that is annually harvested (Table 3-10). The total harvestable acreage is the total acreage that could potentially be harvested over the 20 year period of the PBA. It includes the total acreage for the identified geoduck tracts described in the HCP updated to reflect more recent geoduck surveys (WDFW 2010a), plus the acreage for harvest on non state-owned lands. This acreage could increase in the future as additional geoduck harvest tracks are identified. The subset of non-state owned lands where this activity could occur are not specifically identified. It is possible that a percentage of this latter acreage overlaps with ground-based commercial aquaculture acreage described in Section 3.4.1. As described previously the aquaculture acreage includes some subtidal lands. The total harvestable acreage would not be harvested every year. The annually harvested acreage would typically be about 250 to 300 acres distributed geographically as illustrated in Table 3-10. These numbers are estimates based on the WDNR HCP (WDNR 2008) and Corps professional staff. The maximum acreage harvested in any one year would be about 6,050 acres on both state and non-state owned land that would be geographically distributed as illustrated in Table 3-10. This would be in addition to the 6,000 acres annually harvested under the framework of the HCP.

Table 3-10. Summary of subtidal acres for geoduck harvest

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound	Total
Total potentially harvestable acreage over 20 year PBA						
State lands	0	0	6,503	22,176	18,454	47,133
Non-state lands	0	0	200	500	300	1,000
Total	0	0	6,703	22,676	18,754	48,133
Annually harvested acreage under PBA						
State lands - typical year	0	0	62	137	54	253
State lands - maximum	0	0	1,500	3,000	3,000	6,000
Non-state lands	0	0	10	25	15	50
Total	0	0	1,510	3,025	3,015	6,050
Annually harvested acreage under WDNR HCP						
Typical year	0	0	62	137	54	253
Maximum	0	0	1,500	3,000	3,000	6,000
Cumulative annually harvested acreage (PBA & WDNR HCP)						
Typical year	0	0	135	300	123	558
Maximum	0	0	3,010	6,025	6,015	12,050

Notes:
1. The total maximum annual harvested acreage for all regions combined is less than the sum for the individual regions. This means that the maximum acreage for all regions combined would never be harvested during the same year.
2. Due to differences in boundary lines for geographic management regions in the PBA and HCP, actual region acreages may differ slightly from that illustrated in the table.

Most of the subtidal geoduck harvest would occur between -18 ft to -70 ft MLLW. A small percentage may occur in shallower subtidal areas particularly on the non-state owned lands. The only activity that would occur on this acreage is geoduck dive harvest as described in Section 3.3.4 and in the HCP (WDNR 2008). Harvest could occur at multiple locations simultaneously. For a given location, harvest could occur daily over a period of months at a time. The same location could also be harvested intermittently for several years in a row depending on the status of the remaining geoduck population. The Conservation Measures would be applied to subtidal geoduck harvest just as they would be applied to other activities covered by the PBA.

3.4.3. Recreation

Recreational shellfish activities could include various seeding, maintenance, and harvesting activities for all the PBA shellfish species (mussel, oyster, clam, and geoduck). The objective is to enhance populations sufficient to support regular recreational harvest (i.e., for personal use). In some cases the activities may resemble an aquaculture operation. Harvest could potentially occur on seeded or wild shellfish populations. Seeding and growing for purposes of shellfish related recreation would be limited to intertidal lands between +7 ft and - 4.5 ft MLLW. The acreages (Table 3-11) are based on information provided by WDFW (Brady 2014), historical Corps permitting, and the judgment of Corps professional staff regarding future permitting expectations.

Table 3-11. Recreation acres proposed for shellfish activity

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound	Total
Recreation acres	0	0	74	41	45	160

3.4.4. Restoration

Restoration activities included within the scope of the PBA include activities to seed and re-populate tidal or subtidal waters for purposes of habitat enhancement, ecological restoration, water quality improvement, or to increase the population size of native shellfish species. These activities could include seeding, planting, maintenance, and grow-out activities. Harvesting would generally not be considered a restoration activity except for purposes of scientific monitoring. Restoration activities are somewhat different than the other types of activities in that they are expected to occur only once as opposed to occurring on a regular (e.g., annually) basis like commercial aquaculture and recreation activities. The acreage estimates (Table 3-12) are based on the historical rate of Corps permitting for these types of activities.

Table 3-12. Restoration acres proposed for shellfish activity

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound	Total
Restoration acres	0	0	24	126	5	155

3.4.5. Summary Shellfish Activity Acreage

The proposed action includes authorization of permits for many different types of shellfish activity. These are broadly categorized as commercial aquaculture, subtidal geoduck harvest, recreation, and restoration. The total acreage potentially permitted under the PBA for each of these categories is summarized in Table 3-13.

Commercial aquaculture is typically an ongoing activity with continued activity within a given footprint every year. Shellfish activities conducted to support recreation may also occur on a regular basis within a given footprint. Subtidal geoduck harvest and restoration activities are most likely to be one time actions for a given geographic footprint that do not continue to occur every year.

Table 3-13. Summary of the total acreage potentially authorized for shellfish activity during the anticipated 20 year period of the PBA action

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound	Total
Commercial Aquaculture	3,065	25,965	1,789	3,578	4,002	38,400
Subtidal geoduck harvest	0	0	6,703	22,676	18,754	48,133
Recreation	0	0	74	41	45	160
Restoration	0	0	24	126	5	155

Note: Commercial aquaculture includes both floating and ground-based activities.

3.5. Conservation Measures

The following Conservation Measures are included as elements of the proposed action. The PBA covered activities would be conducted in a manner consistent with the Conservation Measures. All the Conservation Measures would apply to all shellfish activities regardless of purpose including commercial aquaculture, subtidal geoduck harvest, recreation, and restoration except for those commercial aquaculture activities that are classified as 'continuing' which would be excluded from the requirements for certain Measures. Subtidal geoduck harvest, recreation, and restoration related shellfish activities are all considered to be 'new' activities for the purpose of the Conservation Measures. The Conservation Measures will be Permit Conditions that are tied to individual permits or NWP verifications issued by the Corps authorizing shellfish activity.

1. Gravel and shell shall be washed prior to use for substrate enhancement (e.g., frosting, shellfish bed restoration) and applied in minimal amounts using methods which result in less than 1 inch depth on the substrate annually. Shell material shall be procured from clean sources that do not deplete the exiting supply of shell bottom. Shells shall be cleaned or left on dry land for a minimum of one month, or both, before placement in the marine environment. Shells from the local area shall be used whenever possible. Shell or gravel material shall not be placed so that it creates piles on the substrate. Use of a split-hull (e.g., hopper-type) barge to place material is prohibited.

2. The placement of gravel or shell directly into the water column (i.e., graveling or frosting) shall not be conducted between February 1 and March 15 in designated critical habitat for Hood Canal summer chum salmon.

3. For 'new' activities only, gravel or shell material shall not be applied to enhance substrate for shellfish activities where native eelgrass (*Zostera marina*) or kelp (rooted/attached brown algae in the order *Laminariales*) is present.

4. Turbidity resulting from oyster dredge harvest shall be minimized by adjusting dredge bags to "skim" the surface of the substrate during harvest.

5. Unsuitable material (e.g., trash, debris, car bodies, asphalt, tires) shall not be discharged or used as fill (e.g., used to secure nets, create nurseries, etc.).

6. For 'new' activities only, shellfish activities (e.g., racks, stakes, tubes, nets, bags, long-lines, on-bottom cultivation) shall not occur within 16 horizontal feet of native eelgrass (*Zostera marina*) or kelp (rooted/attached brown algae in the order *Laminariales*). If eelgrass is present in the vicinity of an area new to shellfish activities, the eelgrass shall be delineated and a map or sketch prepared and submitted to the Corps. Surveys to determine presence and location of eelgrass shall be done during times of peak above-ground biomass: June 1 – September 30. The following information must be included to scale: parcel boundaries, eelgrass locations and on-site dimensions, shellfish activity locations and dimensions.

7. For 'new' activities only, activities shall not occur above the tidal elevation of +7 feet (MLLW) if the area is listed as documented surf smelt (*Hypomesus pretiosus*) spawning habitat by WDFW. A map showing the location of documented surf smelt spawning habitat is available at the WDFW website.

8. For 'new' activities only, activities shall not occur above the tidal elevation of +5 feet (MLLW) if the area is documented as Pacific sand lance (*Ammodytes hexapterus*) spawning habitat by the WDFW. A map showing the location of documented Pacific sand lance spawning habitat is available at the WDFW website.

9. If conducting 1) mechanical dredge harvesting, 2) raking, 3) harrowing, 4) tilling, leveling or other bed preparation activities, 5) frosting or applying gravel or shell on beds, or 6) removing equipment or material (nets, tubes, bags) within a documented or potential spawning area for Pacific herring (*Clupea pallasi*) outside the approved work window (see Seattle District Corps website), the work area shall be surveyed for the presence of herring spawn prior to the activity occurring. Vegetation, substrate, and materials (nets, tubes, etc.) shall be inspected. If herring spawn is present, these activities are prohibited in the areas where spawning has occurred until such time as the eggs have hatched and herring spawn is no longer present. A record shall be maintained of spawn surveys including the date and time of surveys; the area, materials, and equipment surveyed; results of the survey, etc. The Corps and the Services shall be notified if spawn is detected during a survey. The record of spawn surveys shall be made available upon request to the Corps and the Services.

10. For 'new' activities only, activities occurring in or adjacent to potential spawning habitat for sand lance, or surf smelt shall have a spawn survey completed in the work area by an approved biologist[3] prior to undertaking bed preparation, maintenance, and harvest activities if work will occur outside approved work windows for these species. If eggs are present, these activities are prohibited in the areas where spawning has occurred until such time as the eggs have hatched and spawn is no longer present. A record shall be maintained of spawn surveys including the date and time of surveys; the area, materials, and equipment surveyed; results of the survey, etc. The Corps and the Services shall be notified if spawn is detected during a survey. The record of spawn surveys shall be made available upon request to the Corps and the Services.

[3] For information on how to become an "approved biologist" for forage fish surveys contact WDFW.

11. All shellfish gear (e.g., socks, bags, racks, marker stakes, rebar, nets, and tubes) that is not immediately needed or is not firmly secured to the substrate will be moved to a storage area landward of MHHW prior to the next high tide. Gear that is firmly secured to the substrate may remain on the tidelands for a consecutive period of time up to 7 days. Note: This is not meant to apply to the wet storage of harvested shellfish.

12. All pump intakes (e.g., for washing down gear) that use seawater shall be screened in accordance with NMFS and WDFW criteria. Note: This does not apply to work boat motor intakes (jet pumps) or through-hull intakes.

13. Land vehicles (e.g., all-terrain, trucks) shall be washed in an upland area such that wash water is not allowed to enter any stream, waterbody, or wetland. Wash water shall be disposed of upland in a location where all water is infiltrated into the ground (i.e., no flow into a waterbody or wetland).

14. Land vehicles shall be stored, fueled, and maintained in a vehicle staging area located 150 feet or more from any stream, waterbody, or wetland. Where this is not possible, documentation must be provided to the Corps as to why compliance is not possible, written approval from the Corps must be obtained, and the operators shall have a spill prevention plan and maintain a readily-available spill prevention and clean-up kit.

15. For boats and other gas-powered vehicles or power equipment that cannot be fueled in a staging area 150 feet away from a waterbody or at a fuel dock, fuels shall be transferred in Environmental Protection Agency (EPA)-compliant portable fuel containers 5 gallons or smaller at a time during refilling. A polypropylene pad or other appropriate spill protection and a funnel or spill-proof spout shall be used when refueling to prevent possible contamination of waters. A spill kit shall be available and used in the event of a spill. All spills shall be reported to the Washington Emergency Management Office at (800) 258-5990. All waste oil or other clean-up materials contaminated with petroleum products will be properly disposed of off-site.

16. All vehicles operated within 150 feet of any stream, waterbody, or wetland shall be inspected daily for fluid leaks before leaving the vehicle staging area. Any leaks detected shall be repaired in the vehicle staging area before the vehicle resumes operation and the leak and repair documented in a record that is available for review on request by the Corps and Services.

17. The direct or indirect contact of toxic compounds including creosote, wood preservatives, paint, etc. within the marine environment shall be prevented. *[This does not apply to boats]*

18. All tubes, mesh bags and area nets shall be clearly, indelibly, and permanently marked to identify the permittee name and contact information (e.g., telephone number, email address, mailing address). On the nets, identification markers shall be placed with a minimum of one identification marker for each 50 feet of net.

19. All equipment and gear including anti-predator nets, stakes, and tubes shall be tightly secured to prevent them from breaking free.

20. All foam material (whether used for floatation of for any other purpose) must be encapsulated within a shell that prevents breakup or loss of foam material into the water and is not readily subject to damage by ultraviolet radiation or abrasion. Un-encapsulated foam material used for current on-going activities shall be removed or replaced with the encapsulated type.

21. Tires shall not be used as part of above and below structures or where tires could potentially come in contact with the water (e.g., floatation, fenders, hinges). Tires used for floatation currently shall be replaced with inert or encapsulated materials, such as plastic or encased foam, during maintenance or repair of the structure.

22. At least once every three months, beaches in the project vicinity will be patrolled by crews who will retrieve debris (e.g., anti-predator nets, bags, stakes, disks, tubes) that escape from the project area. Within the project vicinity, locations will be identified where debris tends to accumulate due to wave, current, or wind action, and after weather events these locations shall be patrolled by crews who will remove and dispose of shellfish related debris appropriately. A record shall be maintained with the following information and the record will be made available upon request to the Corps, NMFS, and USFWS: date of patrol, location of areas patrolled, description of the type and amount of retrieved debris, other pertinent information.

23. When performing other activities on-site, the grower shall routinely inspect for and document any fish or wildlife found entangled in nets or other shellfish equipment. In the event that fish, bird, or mammal is found entangled, the grower shall: 1) provide immediate notice (within 24 hours) to WDFW (all species), Services (ESA listed species) or Marine Mammal Stranding Network (marine mammals), 2) attempt to release the individual(s) without harm, and 3) provide a written and photographic record of the event, including dates, species identification, number of individuals, and final disposition, to the Corps and Services. Contact the U.S. Fish and Wildlife Service Law Enforcement Office at (425) 883-8122 with any questions about the preservation of specimens.

24. Vehicles (e.g., ATVs, tractors) shall not be used within native eelgrass (*Zostera marina*). If there is no other alternative for site access, a plan will be developed describing specific measures and/or best management practices that will be undertaken to minimize negative effects to eelgrass from vehicle operation. The access plan shall include the following components: (a) frequency of access at each location, (b) use of only the minimum vehicles needed to conduct the work and a description of the minimum number of vehicles needed at each visit, and (c) consistency in anchoring/grounding in the same location and/or traveling on the same path to restrict eelgrass disturbance to a very small footprint.

25. Vessels shall not ground or anchor in native eelgrass (*Zostera marina*) or kelp (rooted/attached brown algae in the order *Laminariales*) and paths through native eelgrass or kelp shall not be established. If there is no other access to the site or the special condition cannot be met due to human safety considerations, a site-specific plan shall be developed describing specific measures and/or best management practices that will be undertaken to minimize negative effects to eelgrass and kelp from vessel operation and accessing the shellfish areas. The access plan shall include the following components: (a) frequency of access at each location, (b) use of only the minimum number of boats and/or crew members needed to conduct the work and a description of the minimum number of boats and crewmembers needed at each visit, and (c) consistency in

anchoring/grounding in the same location and/or walking on the same path to restrict eelgrass disturbance to a very small footprint.

26. Unless prohibited by substrate or other specific site conditions, floats and rafts shall use embedded anchors and midline floats to prevent dragging of anchors or lines. Floats and rafts that are not in compliance with this standard shall be updated to meet this standard during scheduled maintenance, repair, or replacement or before the end of the term of the next renewed authorization. [*Any alternative to using an embedded anchor must be approved by the NMFS*.]

27. Activities that are directly associated with shellfish activities (e.g., access roads, wet storage) shall not result in removal of native riparian vegetation extending landward 150 ft horizontally from MHHW (includes both wetland and upland vegetation) and disturbance shall be limited to the minimum necessary to access or engage in shellfish activities.

28. Native salt marsh vegetation shall not be removed and disturbance shall be limited to the minimum necessary to access or engage in shellfish activities.

3.6. Interrelated and Interdependent Actions

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02).

The proposed action consists of issuing various types of permits under Section 404 of the CWA and/or Section 10 of the RHA authorizing shellfish activities as described in Section 3.3. Under Section 404 of the CWA, the Corps authorizes the discharge of dredged or fill material into waters of the United States. Under Section 10 of the RHA, the Corps regulates structures and/or work in or affecting the course, condition, or capacity of navigable waters of the United States. The suite of PBA covered activities necessarily fall within these Corps regulatory authorities. There are several activities that would or could occur in support of the PBA covered activities but that would not be regulated by the Corps because they fall outside of the Corps regulatory authority. These are discussed below along with a determination of whether they are considered to be interdependent or interrelated.

3.6.1. Vessel and Vehicle Traffic

Vessel (boat/barge), vehicle (e.g., trucks, ATV), or foot traffic related to the transportation of people and materials to and from PBA covered activity areas is necessary to support the PBA covered activities in many, if not all, cases. Vessels could land on the shoreline and load or unload items to waiting vehicles or to individual persons who could then carry these items to an upland destination. Vehicle traffic could occur to and from shellfish activity areas directly along shorelines without any dock or pier. Vehicles could be traveling directly on the substrate (i.e., mudflats) to a proximate upland destination. The distinction between the interdependent vessel and vehicle traffic and the support activity described in Section 3.3.5 is the proximity to the shellfish activity area. The interdependent activity would be that traffic that occurs some distance from the activity area whereas the traffic described in Section 3.3.5 would occur in the immediate vicinity of the shellfish activity area.

The Corps does not regulate general marine or vehicle traffic to and from shellfish activity areas. Since these support activities are a necessary element of performing many of the PBA covered activities, they are considered an interdependent activity. Details on the types of vessels and vehicles that would be used are described above in Section 3.3.5.

In most cases, vessel traffic is anticipated to occur from the shellfish activity areas to a local pier, dock, or to the shoreline directly such as to a local beach. In some cases vessel traffic could occur from activity areas to a more distant destination (e.g., to deliver product to market). For the purpose of the PBA, this indirect effect is assumed to extend to the nearest navigation channel for vessels, or to an improved road surface for vehicles (assumed to be within several hundred feet of the shoreline).

3.6.2. Upland Storage Sites

Upland locations used for storing equipment, materials (e.g., shell), or maintaining live product in tanks (e.g., wet storage) could occur in close proximity to shellfish activity areas. These upland locations are in many cases interdependent with the shellfish activity area. The use and management of upland storage locations in close proximity to shellfish activity areas are considered to be interdependent with the proposed action. Disturbance (e.g., of native riparian vegetation) in such upland areas shall be minimized consistent with the Conservation Measures.

3.6.3. Shore Facilities

Shore facilities such as hatcheries and processing plants are typically used in coordination with the PBA covered shellfish activities but are not regulated by the Corps. They are operated independently of any of the PBA covered activities and do not depend on the covered activities except at a much larger scale or context than what would be considered an interdependent or interrelated activity. These types or facilities are not considered to be interdependent or interrelated with the proposed action.

3.7. Pesticide Application

The application of pesticides, including carbaryl to control burrowing shrimp species, is not regulated by the Corps but has historically been associated with some aquaculture activities. Pesticide use is not universal to activities covered by this PBA, but rather is elective depending on waterbody, species cultivated, growing conditions, and individual decision. Such pesticide application is regulated by the EPA and is generally governed under section 402 of the CWA as administered by the Washington State Department of Ecology. Permits for the application of pesticides, including carbaryl, along with any associated ESA section 7 consultation, are the responsibility of those wishing to use the pesticides. If a Corps permittee elects to use pesticides, the permittee must obtain the appropriate pesticide use permit and complete any relevant ESA consultation as detailed in the Corps issued permit or verification. The application of pesticides including carbaryl is not covered by this PBA.

3.8. Comparison with 2007 NWP 48 Consultation

In 2007, the Corps initiated ESA consultation for the implementation and administration of the 2007 version of NWP 48 for existing commercial aquaculture activities. The consultation was concluded in 2011. The 2007 version of NWP 48 has since expired making the prior ESA consultation obsolete. A new version of NWP 48 was issued in 2012 and includes a different set of aquaculture activities. The new set of NWP 48 activities have been combined with numerous other Corps permitting actions for non-aquaculture related shellfish activities to form the proposed action for the current PBA. The proposed action for the current PBA is therefore significantly different and more expansive in scope than for the 2007 ESA consultation. Furthermore, the Corps has significantly more information about the commercial aquaculture activities in the State of Washington today than it did in 2007. This resulted in several important changes to the commercial aquaculture component of the proposed action in the 2015 PBA compared to 2007 that is further discussed below. Finally, and most importantly, the structure of the 2015 PBA proposed action is fundamentally different than the action presented in the 2007 PBA. The emphasis is on the specific types and methods of the shellfish activities themselves and not on specific permits and their related authorization periods. This change in structure results in a proposed action that does not expire with the expiration of an individual or general permit which allows for more efficient administration of the Regulatory Program and compliance with ESA. The important differences between the two proposed actions are summarized below in Table 3-14.

Table 3-14. Summary of important differences in the proposed action between the 2007 ESA consultation for NWP 48 and the 2015 shellfish activity PBA

proposed action element	**2007 NWP 48 PBA consultation (concluded in 2011)**	**2015 PBA**
general description	Seattle District authorization of existing commercial shellfish aquaculture activities under Section 404 of the CWA and Section 10 of the RHA	Seattle District authorization of a suite of ongoing and new shellfish related activities under Section 404 of the CWA and Section 10 of the RHA
activity/project purposes	focus is on NWP 48 exclusively; included ongoing commercial aquaculture only	focus is on individual shellfish activities; includes ongoing and new commercial aquaculture; recreation related shellfish activities; restoration related shellfish activities; subtidal geoduck harvest; could include other purposes provided the individual activities are described in PBA
Corps permits included	2007 version of NWP 48 only	any and all types of permits potentially issued by the Corps provided it is for a shellfish related activity; includes individual permits and the 2012, 2017, 2022, & 2027 versions of NWP 4, 27, 48, or potentially other general permits
time period	2007 to 2012	expiration tied to authorized acreage limits; anticipated timeframe is 20 years extending from 2012 to 2032
geographic region	small, separate locations within Grays Harbor, Willapa Bay, and Puget Sound (including Hood Canal)	all inland marine waters of Washington State excluding the Columbia River
action area	the active and fallow areas for each individual aquaculture operation plus an area 5% larger than the individual operation footprints to account for drift of turbid waters	the entire embayments of Grays Harbor, Willapa Bay, Hood Canal, South Puget Sound and North Puget Sound to the Canadian border to account for unknown future locations for new shellfish activities and for effects of in-air noise associated with shellfish activity operations
total acreage	38,327 acres	86,813 acres
total commercial aquaculture acreage	38,327 acres	38,365 acres

proposed action element	2007 NWP 48 PBA consultation (concluded in 2011)	2015 PBA
fallow areas	All acreage identified as fallow by permit applicants assumed to be in active aquaculture 'as part of normal operations'.	It is assumed that shellfish activities will occur in all areas currently identified as fallow. This results in a conservative approach to the PBA effects analysis and determination.
previously identified fallow acreage included	amount of fallow acreage not separately quantified	14,796 acres
number of permit conditions/ conservation measures	16 (when consultation completed)	28
pesticide application	identified as interdependent activity	Not part of proposed action; not an interdependent activity. Pesticides are under the jurisdiction of EPA, a separate Federal agency with an existing ESA consultation for such activities.
upland hatcheries	element of proposed action	An interdependent activity; Corps does not regulate upland hatcheries as there is no CWA Section 404 or RHA Section 10 nexus

4. Action Area

The geographic area directly affected by activities authorized by the proposed action can be broadly described as the inland marine waters of Washington State between the tidal elevations of +7 ft and -70 ft MLLW in Grays Harbor, Willapa Bay, Hood Canal, Puget Sound, and the straits of Juan de Fuca and Georgia (Figure 3-1) with a few exceptions as described in section 3.2. This elevation band is illustrated throughout the action area in the Figures in Appendix D. For the purpose of the PBA, this area has been subdivided into five geographic regions identified as Grays Harbor, Willapa Bay, Hood Canal, south Puget Sound, and north Puget Sound. The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). For the purpose of this PBA, the action area includes the immediate area directly affected by the action as described above, the area extending beyond the directly affected area where interrelated and interdependent activities as described in Section 3.6 would occur, and a noise driven buffer extending out from the area encompassed by the interrelated and interdependent actions as discussed below.

Based on information provided by applicants on the type of equipment that could be used, the Corps has estimated noise buffers extending about 4,000 feet upland from MHHW (see Section 7.1.7). Due to the interrelated activity of vessel traffic, which could occur throughout the action area from the shoreline to navigation channels which are roughly in the center of each of the PBA regions, and the potential geographic locations for new activities including subtidal geoduck harvest, the entire inland marine area identified in Figure 3-1 is included within the action area.

The action area includes portions of the following counties in Washington State: Pacific, Grays Harbor, Clallam, Jefferson, Mason, Whatcom, San Juan, Skagit, Island, Snohomish, King, Pierce, Thurston, and Kitsap.

5. Status of the Species

Species listed under the ESA that occur in Washington State counties within the action area are summarized in Table 5-1. Because of specialized habitat requirements, lack of tolerance for human development, or both, some of these species would not be expected to occur in the action area, and/or there should be no effect on it/them from the proposed action. They will not be further considered in this document. Species that could potentially be affected by the proposed action are summarized in Table 5-2.

Table 5-1. ESA listed species occurring in the action area

Species (common name)	Pacific	Grays Harbor	Clallam	Jefferson	Mason	Whatcom	San Juan	Skagit	Island	Snohomish	King	Pierce	Thurston	Kitsap
Bull trout (*Salvelinus confluentus*), Coastal-Puget Sound DPS	x	x	x	x	x	x		x	x	x	x	x	x	x
Marbled murrelet (*Brachyramphus marmoratus*), California/Oregon/Washington DPS	x	x	x	x	x	x	x	x	x	x	x	x	x	
Northern spotted owl (*Strix occidentalis caurina*)	x	x	x	x	x	x		x		x	x	x	x	
Short-tailed albatross (*Phoebastria albatrus*)	x	x	x	x										
Western snowy plover (*Charadrius alexandrinus nivosus*), Pacific Coast DPS	x	x												
Streaked horned lark (*Eremophila alpestris strigata*)	x	x			x							x	x	
Yellow-billed cuckoo (*Coccyzus americanus*) - proposed														
Taylor's checkerspot butterfly (*Coccyzus americanus*)			x			x							x	
Oregon silverspot butterfly (*Speyeria zerene hippolyta*)	x	x												
Mazama pocket gopher (*Thomomys mazama pugetensis*, *T. m. glacialis*, *T. m. tumuli*, *T. m. yelmensis*)											x	x		
Canada lynx (*Felis lynx canadensis*)						x	x			x	x	x		
Gray wolf (*Canis lupus*)						x	x			x	x	x	x	
Grizzly bear (*Ursus arctos*)						x	x			x	x	x		

Species (common name)	Pacific	Grays Harbor	Clallam	Jefferson	Mason	Whatcom	San Juan	Skagit	Island	Snohomish	King	Pierce	Thurston	Kitsap
North American wolverine (*Gulo gulo luscus*) - proposed						x		x			x	x	x	
Oregon spotted frog (*Rana pretiosa*) - (proposed)						x		x		h	h	h	x	
Golden paintbrush (*Castilleja levisecta*)							x		x		h		x	
Marsh sandwort (*Arenaria paludicola*)												h		
Water howellia (*Howellia aquatilis*)												x	x	
Chinook salmon (*Oncorhynchus tshawytscha*), Puget Sound ESU			x	x	x	x	x	x	x	x	x	x	x	x
Steelhead (*Oncorhynchus mykiss*), Puget Sound DPS			x	x	x	x	x	x	x	x	x	x	x	x
Chum salmon (*Oncorhynchus keta*), Hood Canal Summer ESU			x	x	x				x					x
Chinook salmon (*Oncorhynchus tshawytscha*), Lower Columbia River ESU	x	x	x	x										
Chum salmon (*Oncorhynchus keta*), Columbia River ESU	x	x	x	x										
Bocaccio (*Sebastes paucispinus*), Georgia Basin DPS			x	x	x	x	x	x	x	x	x	x	x	x
Yelloweye rockfish (*Sebastes ruberrimus*), Georgia Basin DPS			x	x	x	x	x	x	x	x	x	x	x	x
Canary rockfish (*Sebastes pinniger*), Georgia Basin DPS			x	x	x	x	x	x	x	x	x	x	x	x
Green sturgeon (*Acipenser medirostris*), Southern DPS	x	x	x	x			x		x					
Pacific Eulachon (*Thaleichthys pacificus*)	x	x	x	x		x	x	x	x	x	x	x		x
Killer whale, Southern Resident DPS (*Orcinus orca*)	x	x	x	x		x	x	x	x	x	x	x	x	x
Humpback whale (*Megaptera novaeangliae*)	x	x	x	x		x	x	x	x	x	x	x	x	x

Note: h denotes historical range

Table 5-2 summarizes the ESA status of species potentially affected by the proposed action. General habitat requirements for these species can be found elsewhere including Jones and Stokes (2007), Anchor (2009), NMFS (2009), USFWS (2009) and referenced Federal Register notices and recovery plans. The emphasis in the below section is on the species occurrence and critical habitat within the action area.

Table 5-2. Summary of ESA listed species potentially affected by the proposed action that are further evaluated within the PBA.

Species	Classification	Critical Habitat	Recovery plan
Puget Sound Chinook salmon ESU	Threatened	Designated	Yes
Puget Sound Steelhead DPS	Threatened	Proposed	No
Hood Canal Summer Chum salmon ESU	Threatened	Designated	Yes
Lower Columbia River Chinook salmon ESU	Threatened	Designated	Yes
Columbia River Chum salmon ESU	Threatened	Designated	Yes
Green sturgeon, Southern DPS	Threatened	Designated	No
Bocaccio, Georgia Basin DPS	Endangered	Proposed	No
Yelloweye Rockfish DPS	Threatened	Proposed	No
Canary Rockfish DPS	Threatened	Proposed	No
Pacific eulachon, Southern DPS	Threatened	Designated	No
Killer whale, Southern Resident DPS	Endangered	Designated	Yes
Humpback whale	Endangered	None	Yes
Coastal-Puget Sound bull trout DPS	Threatened	Designated	Draft
Marbled murrelet, California/Oregon/Washington DPS	Threatened	Designated	Yes
Western snowy plover, Pacific Coast DPS	Threatened	Designated	Yes

5.1. Puget Sound Chinook Salmon

The Puget Sound Chinook salmon ESU was listed as threatened on June 28, 2005 (70 FR 37160). The ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound, including the Strait of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington, and 26 artificial propagation programs.

The recovery plan for Puget Sound Chinook is comprised of two documents: Puget Sound Chinook Recovery Plan (SSPS 2005) and Final Supplement to the Shared Strategy's Puget Sound Salmon Recovery Plan (NMFS 2006).

5.1.1. Status in the Action Area

Chinook salmon use the marine nearshore and offshore areas for juvenile rearing, migration, and adult foraging. Puget Sound Chinook salmon occur in the Hood Canal, north Puget Sound, and south Puget Sound regions as defined by the PBA. They are not known to occur in Willapa Bay or Grays Harbor. Juveniles would occur primarily in intertidal and shallow subtidal areas. Adults would occur primarily in deeper water and not in the intertidal zone.

5.1.2. Critical Habitat

On September 2, 2005, NMFS designated critical habitat for the Puget Sound Chinook salmon ESU (70 FR 52630). Specific areas proposed for designation include approximately 1,724 miles of streams and lakes and 2,182 miles of nearshore marine habitat. Designated critical habitat occurs in the action area.

NMFS described six principal biological or physical constituent elements (PCEs) to describe important elements of the designated critical habitat that are essential to the conservation of the species. These six primary constituent elements are:

PCE 1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.

PCE 2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

PCE 3. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

PCE 4. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh-and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

PCE 5. Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels. The focus on nearshore areas is in Puget Sound because of its unique and relatively sheltered fjord-like setting (as opposed to the more open coastlines of Washington and Oregon).

PCE 6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation. No specific areas have been designated based on this PCE.

5.2. Lower Columbia River Chinook Salmon

The Lower Columbia River Chinook salmon ESU was listed as threatened on June 28, 2005 (70 FR 37160). The ESU includes all naturally spawned populations of Chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River, and 17 artificial propagation programs.

The Lower Columbia Salmon and Steelhead Recovery Plan is based on three locally-developed plans, each of which covers a different portion of the species' range: Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead (ODFW 2010); ESA Recovery Plan for the White Salmon River Watershed (NMFS 2013a); and Washington Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan (LCFRB 2010).

5.2.1. Status in the Action Area

Chinook salmon use the marine nearshore and offshore areas of for juvenile rearing, migration, and adult foraging. Juvenile Lower Columbia River Chinook salmon have been found in the Strait of Juan de Fuca (Shaffer et al. 2012). It is presumed they may also occur in Willapa Bay and Grays Harbor based on their tendency to use the nearshore habitat (NMFS 2011). It is also possible that an occasional adult may enter Willapa Bay or Grays Harbor. They would not be expected to occur in the further inland waters of Puget Sound or in Hood Canal.

5.2.2. Designated Critical Habitat

On September 2, 2005, NMFS designated critical habitat for the Lower Columbia River Chinook ESU (70 FR 52630). The specific areas proposed for designation include approximately 1,344 miles of streams and lakes in Washington and Oregon. The downstream extent of the critical habitat is the mouth of the Columbia River at the Pacific Ocean. No critical habitat for this species occurs in the action area.

5.3. Hood Canal Summer Chum Salmon

The Hood Canal summer chum ESU was listed as threatened on June 28, 2005 (70 FR 37160). The ESU includes all naturally spawned populations of summer-run chum salmon in Hood Canal and its tributaries as well as populations in Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington. The ESU also includes some hatchery stocks. The recovery plan is comprised of two documents: Hood Canal and Eastern Strait of Juan de Fuca Summer Chum Salmon Recovery Plan (HCCC 2005) and the Final Supplement to the Hood Canal and Strait of Juan de Fuca Summer Chum Salmon Recovery Plan (NMFS 2007).

5.3.1. Status in the Action Area

Hood Canal summer chum occur in the Hood Canal and North Puget Sound regions as defined by the PBA. Juveniles would occur primarily in the intertidal zone during the late winter and early spring. Adults would occur in deeper water during the summer.

5.3.2. Designated Critical Habitat

On September 2, 2005, NMFS designated critical habitat for the Hood Canal summer-run chum salmon ESU (70 FR 52630). Designated critical habitat includes approximately 79 miles of streams and 377 miles of nearshore marine habitat. The PCEs listed above for Puget Sound Chinook salmon critical habitat also apply to critical habitat for Hood Canal summer chum salmon.

5.4. Columbia River Chum Salmon

The Columbia River chum ESU was listed as threatened on June 28, 2005 (70 FR 37160). The ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon and includes some hatchery stocks.

The Lower Columbia Salmon and Steelhead Recovery Plan is based on three locally-developed plans, each of which covers a different portion of the species' range: Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead (ODFW 2010); ESA Recovery Plan for the White Salmon River Watershed (NMFS 2013a); and Washington Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan (LCFRB 2010).

5.4.1. Status in the Action Area

Chum salmon use the marine nearshore and offshore areas of for juvenile rearing, migration, and adult foraging. Similar to the discussion above for lower Columbia River Chinook salmon, juvenile Lower Columbia River chum salmon have been found in the Strait of Juan de Fuca (Shaffer et al. 2012) and are presumed to occur in Willapa Bay and Grays Harbor based on their tendency to use the nearshore habitat (NMFS 2011). It is also possible that an occasional adult may enter Willapa Bay or Grays Harbor. They would not be expected to occur in the further inland waters of Puget Sound or in Hood Canal.

5.4.2. Critical Habitat

On September 2, 2005, NMFS designated critical habitat for Columbia River chum salmon (70 FR 52630). The specific areas proposed for designation include approximately 708 miles of freshwater and estuarine habitat in Oregon and Washington in the lower Columbia River and its tributaries. The downstream extent of the proposed critical habitat is the mouth of the Columbia River at the Pacific Ocean (latitude 46.2485, longitude -124.0782). No critical habitat for this species occurs within the action area.

5.5. Puget Sound Steelhead

The Puget Sound steelhead DPS was listed as threatened on May 11, 2007 (72 FR 26722). The DPS includes all naturally spawned anadromous winter-run and summer-run steelhead populations, in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), as well as two hatchery populations. NMFS is currently finalizing population structure and viability reports that will inform the development of a recovery plan.

5.5.1. Status in the Action Area

Steelhead would occur throughout the south Puget Sound, north Puget Sound, and Hood Canal regions as defined by the PBA. They would not be expected to occur in Willapa Bay or Grays Harbor. Juveniles would migrate to deeper waters soon after entering salt water and spend only minimal time in the intertidal zone. Adults likewise would occur primarily in deeper habitat and not in the intertidal zone.

5.5.2. Critical Habitat

On January 14, 2013, NMFS proposed to designate critical habitat for Puget Sound steelhead (78 FR 2726). The specific areas proposed for designation include approximately 1,880 miles of freshwater and estuarine habitat in Puget Sound, Washington. NMFS did not propose to designate the nearshore zone in Puget Sound as critical habitat because steelhead move rapidly out of freshwater into offshore marine areas which did not make it possible for NMFS to identify specific areas in the nearshore zone where essential features for steelhead are found (78 FR 2729). The PCEs listed above for Puget Sound Chinook salmon critical habitat also apply to proposed critical habitat for Puget Sound steelhead.

5.6. Coastal-Puget Sound Bull Trout

The Coastal-Puget Sound DPS was listed as threatened on November 1, 1999 (64 FR 58910). The DPS encompasses all Pacific coast drainages within the coterminous United States north of the Columbia River in Washington, including those flowing into Puget Sound. This population segment is geographically segregated from other subpopulations by the Pacific Ocean and the crest of the Cascade Mountain range. The population segment is significant to the species as a whole because it is thought to contain the only anadromous forms of bull trout in the coterminous United States (64 FR 58909).

In September 2015, USFWS released a final recovery plan for the Coastal-Puget Sound DPS (USFWS 2015).

5.6.1. Status in the Action Area

Bull trout occur in the action area as adults or subadults. Bull trout have been recorded in all parts of the action area from Grays Harbor north, through the Strait of Juan de Fuca, in Hood Canal, and in much of Puget Sound. Bull trout are not known to occur in Willapa Bay (WDFW 2004). Bull trout could occur in subtidal or intertidal waters as they forage for prey.

5.6.2. Designated Critical Habitat

On October 18, 2010, the USFWS designated critical habitat for bull trout throughout their United States range, including the Coastal-Puget Sound DPSs (75 FR 63898). The critical habitat was categorized into 32 critical habitat units within 6 recovery units (75 FR 63935). Only two of the critical habitat units occur within the action area: the Olympic Unit and Puget Sound Unit. Several waterbodies associated with tribal lands, habitat conservation plans, and Navy training areas have been excluded from the critical habitat designation (75 FR 63975-86).

The portion of the action area designated as critical habitat for the Puget Sound DPS includes most of the eastern waters of Puget Sound from the Nisqually Reach to the Canadian border, but does not include the San Juan Islands and does not include most of the action area in south Puget Sound. Designated critical habitat also includes most of Hood Canal, the east end of the Strait of Juan de Fuca, and Grays Harbor.

In freshwater areas, critical habitat includes the stream channels within the designated stream reaches and a lateral extent as defined by the bankfull elevation on one bank to the bankfull elevation on the opposite bank. If bankfull elevation is not evident on either bank, the ordinary high-water line determines the lateral extent of critical habitat. The lateral extent of critical habitat in lakes may initially be defined by the perimeter of the waterbody as mapped on standard 1:24,000 scale topographic maps. In marine nearshore areas, the inshore extent of critical habitat is the MHHW line, including the uppermost reach of the saltwater wedge within tidally influenced, freshwater heads of estuaries. Critical habitat extends offshore to the depth of 10 meters (33 feet) relative to the Mean Lower Low Water line (75 FR 63935).

USFWS developed the following PCEs for bull trout:

PCE 1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

PCE 2. Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

PCE 3. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

PCE 4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks, and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

PCE 5. Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

PCE 6. In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

PCE 7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

PCE 8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

PCE 9. Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

5.7. Green Sturgeon

NMFS published a final rule on April 7, 2006 listing the Southern DPS as threatened (71 FR 17757). A recovery plan for the Southern DPS green sturgeon is under development.

5.7.1. Status in the Action Area

During the late summer and early fall, subadult and nonspawning adult green sturgeon concentrate in Pacific coastal estuaries north of San Francisco Bay including Willapa Bay and Grays Harbor (Emmett et al. 1991; Moser and Lindley 2007; Israel et al. 2004), although the reason for this behavior remains unknown. Adult green sturgeon appear to be the most common sturgeon species in Willapa Bay, Washington (Emmett et al. 1991). However, no spawning is known to occur in this system, and the population of origin for these fish is unknown (Rien et al. 2000).

Adult and subadult green sturgeon in estuaries feed on crangonid shrimp, burrowing thalassinidean shrimp (primarily the burrowing ghost shrimp (*Neotrypaea californiensis*), amphipods, clams, juvenile Dungeness crab (*Cancer magister*), anchovies, sand lances (*Ammodytes hexapterus*), lingcod (*Ophiodon elongatus*), and other unidentified fish species (Moyle et al. 1995; Moser and Lindley 2007; Dumbauld et al. 2008). Burrowing ghost shrimp comprised approximately 50 percent of the stomach contents of green sturgeon in Willapa Bay (Dumbauld et al. 2008). Kelly et al. (2007) found adults and subadults within San Francisco Bay foraged in water less than 10 m in depth.

5.7.2. Designated Critical Habitat

Critical habitat for Southern DPS green sturgeon was designated on October 9, 2009 (74 FR 52300). The specific areas designated occur in California, Oregon, and Washington and include approximately 515 miles of freshwater riverine habitat, 897 square miles of estuarine habitat, 11,421 square miles of marine habitat, 487 miles of habitat in the Sacramento-San Joaquin Delta, and 135 square miles in the Yolo and Sutter bypasses of the Sacramento River. In Washington State, only estuarine and coastal marine areas were designated as critical habitat. Coastal United States marine waters within a 360-foot depth (relative to MLLW) from the Columbia River north to Cape Flattery, including the Strait of Juan de Fuca, to the United States border with Canada. All tidally influenced areas of Willapa Bay up to the elevation of mean higher high water, including, but not limited to, areas upstream to the head of tide endpoint in 14 tributaries. All tidally influenced areas of Grays Harbor up to the elevation of mean higher high water, including, but not limited to, areas upstream to the head of tide endpoint in 22 tributaries.

NMFS developed PCEs for green sturgeon in freshwater, estuarine, and coastal marine areas. Since the action area include estuarine and coastal marine critical habitat, PCEs for these areas are described below.

Green sturgeon Southern DPS estuarine area PCEs include:

PCE 1. Food resources. Abundant prey items within estuarine habitats and substrates for juvenile, subadult, and adult life stages. Prey species for juvenile, subadult, and adult green sturgeon within bays and estuaries primarily consist of benthic invertebrates and fishes, including crangonid shrimp, burrowing thalassinidean shrimp (particularly the burrowing ghost shrimp), amphipods, isopods, clams, annelid worms, crabs, sand lances, and anchovies.

PCE 2. Water flow. Within bays and estuaries adjacent to the Sacramento River (i.e., the Sacramento-San Joaquin Delta and the Suisun, San Pablo, and San Francisco bays), sufficient flow into the bay and estuary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds.

PCE 3. Water quality. Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages. Suitable water temperatures for juvenile green sturgeon should be below 24 °C. Suitable salinities range from brackish water (10 ppt) to salt water (33 ppt). Subadult and adult green sturgeon occupy a wide range of dissolved oxygen levels, but may need a minimum dissolved oxygen level of at least 6.54 mg

02/l (Kelly et al. 2007; Moser and Lindley 2007). Suitable water quality also includes water with acceptably low levels of contaminants (e.g., pesticides, PAHs, elevated levels of heavy metals) that may disrupt the normal development of juvenile life stages, or the growth, survival, or reproduction of subadult or adult stages.

PCE 4. Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within estuarine habitats and between estuarine and riverine or marine habitats. We define safe and timely passage to mean that human-induced impediments, either physical, chemical, or biological, do not alter the migratory behavior of the fish such that its survival or the overall viability of the species is compromised (e.g., an impediment that compromises the ability of fish to reach thermal refugia by the time they enter a particular life stage).

PCE 5. Water depth. A diversity of depths necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages. Subadult and adult green sturgeon occupy a diversity of depths within bays and estuaries for feeding and migration. Tagged adults and subadults within the San Francisco Bay estuary primarily occupied waters over shallow depths of less than 10 m, either swimming near the surface or foraging along the bottom (Kelly et al. 2007).

PCE 6. Sediment quality. Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages. This includes sediments free of elevated levels of contaminants (e.g., selenium, PAHs, and pesticides) that can cause adverse effects on all life stages of green sturgeon (see description of ‘‘Sediment quality’’ for riverine habitats above).

Green sturgeon Southern DPS coastal marine area PCEs include:

PCE 1. Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within marine and between estuarine and marine habitats. We define safe and timely passage to mean that human- induced impediments, either physical, chemical, or biological, do not alter the migratory behavior of the fish such that its survival or the overall viability of the species is compromised (e.g., an impediment that compromises the ability of fish to reach abundant prey resources during the summer months in Washington and Oregon estuaries).

PCE 2. Water quality. Coastal marine waters with adequate dissolved oxygen levels and acceptably low levels of contaminants (e.g., pesticides, PAHs, heavy metals that may disrupt the normal behavior, growth, and viability of subadult and adult green sturgeon). Based on studies of tagged subadult and adult green sturgeon in the San Francisco Bay estuary, CA, and Willapa Bay, WA, subadults and adults may need a minimum dissolved oxygen level of at least 6.54 mg O2/l (Kelly et al. 2007; Moser and Lindley 2007).

PCE 3. Food resources. Abundant prey items for subadults and adults, which may include benthic invertebrates and fish. Green sturgeon spend more than half their lives in coastal marine and estuarine waters, spending from 3–20 years at a time out at sea.

5.8. Canary Rockfish

The Georgia Basin canary rockfish was listed as threatened on April 28, 2010 (75FR 22276). The range of the DPS encompasses Puget Sound and the Georgia Basin in Washington (United States) and British Columbia (Canada) with the Victoria Sill as the likely western boundary of the DPS (74 FR 18527).

NMFS has appointed a Recovery Team to aide in the development of the recovery plan for listed rockfish. NMFS hopes to have a draft recovery plan prepared for internal review in early 2014.

5.8.1. Status in the Action Area

In North Sound (Strait of Georgia, San Juan Islands, and Strait of Juan de Fuca) recreational fisheries, canary rockfish constituted an average of 1.4 percent for the recreational catch from 1980 to 1986, but their frequency decreased to an average of 0.6 percent of the catch from 1996 to 2002 when their retention was prohibited (Palsson et al. 2009, cited in Drake et al. 2010). Washington REEF surveys between 1996 and 2013 suggest that canary rockfish are most consistently observed in northern waters of Puget Sound, the Strait of Juan de Fuca, and the outer coast (Table 5-3).

Table 5-3. Observations and Distribution of Canary Rockfish in Inland Washington Waters as reported in REEF Surveys Between January 1996 and July 2013 (REEF 2013).

Survey Area	Species Observations[1], (sighting frequency %)[2]	YOY Observations[1] (sighting frequency %)[2]
STRAIT OF GEORGIA (CANADA)	13, (0.5%)	-
WESTERN VANCOUVER ISLAND (CANADA)	121, (15.4%)	-
QUEEN CHARLOTTE STRAIT (CANADA)	4, (0.9%)	-
SAN JUAN ISLANDS	19 (1.5%)	-
Shaw Island	2, (3%)	-
HOOD CANAL	36, (1.6%)	-
Dabob Bay	23, (4.2%)	-
Quatsap Pt/Misery Pt – Potlatch State Park	13, (0.8%)	-
MT VERNON - EVERETT	3, (0.2%)	2, (0.2%)
Whidbey Island	3, (0.3%)	2, (0.2%)
SEATTLE - OLYMPIA	13, (0.3%)	5, (0.1%)
Vashon Island	3, (1.0%)	1, (0%)
West Seattle	4, (0.4%)	1, (0.1%)
Burien - Tacoma area	6, (0.2%)	-
OLYMPIC PENINSULA	74, (5.6%)	32, (2.4%)
Hood Head - Dungeness Bay	2, (0.7%)	-
Dungeness Bay to Kydaka Point	-	7, (2.8%)
Kydaka Point to Cape Flattery	72, (9.3%)	25, (3.2%)
KITSAP PENINSULA (EAST SIDE) AND SOUTH SOUND	1, (0.2%)	-

Survey Area	Species Observations[1], (sighting frequency %)[2]	YOY Observations[1] (sighting frequency %)[2]
Kitsap Peninsula (Port Gamble - Gig Harbor)	1, (0.3%)	-
CAPE FLATTERY - N COLUMBIA RIVER (PACIFIC COAST)	8, (11.4%)	8, (11.4%)

Notes: [1]Observations represent the number of surveys that observed individuals or YOY yelloweye rockfish. [2]Sighting frequency represents the percentage of surveys conducted that contained individuals or YOY yelloweye rockfish. Individual = adults and juveniles combined; YOY = young of year only.

Canary rockfish may occur throughout the Hood Canal, north Puget Sound, and south Puget Sound regions. Adults would typically be found in deep waters at or near the bottom often associated with hard bottom areas and along rocky shelves and pinnacles (NMFS 2013b). Juveniles would occur in shallow intertidal areas. They would not be expected to occur in Willapa Bay and Grays Harbor.

5.8.2. Critical Habitat

On November 13, 2014, NMFS designated critical habitat for the Georgia Basin canary rockfish DPS (79 FR 68042). The proposed critical habitat includes 590 square miles of nearshore habitat and 414 square miles of deepwater habitat of Puget Sound, Washington. The portion of the action area proposed as critical habitat includes parts of South Puget Sound, North Puget Sound, and Hood Canal.

In nearshore areas, the proposed critical habitat occurs from the shoreline from extreme high water out to a depth no greater than 30 meters (98 feet) relative to mean lower low water. In deepwater areas, the proposed critical habitat occurs from depths greater than 30 meters (98 feet). Essential features of the proposed critical habitat are described below.

In nearshore areas, juvenile settlement habitats located with substrates such as sand, rock and/or cobble compositions that also support kelp are essential for conservation because these features enable forage opportunities and refuge from predators and enable behavioral and physiological changes needed for juveniles to occupy deeper adult habitats. Several attributes of these sites determine the quality of the area including the quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities.

In deepwater areas, benthic habitats or sites deeper than 30 meters (98 feet) that possess or are adjacent to areas of complex bathymetry consisting of rock and or highly rugose habitat are essential to conservation because these features support growth, survival, reproduction, and feeding opportunities by providing the structure for adult bocaccio to avoid predation, seek food and persist for decades. Several attributes of these habitats or sites determine the quality of the area including: (1) quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; (2) water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities; and (3) the type and amount of structure and rugosity that supports feeding opportunities and predator avoidance.

5.9. Bocaccio

The Georgia Basin bocaccio (rockfish) DPS was listed as endangered on April 28, 2010 (75 FR 22276). The range of the DPS encompasses Puget Sound and the Georgia Basin in Washington (United States) and British Columbia (Canada) with the Victoria Sill as the likely western boundary of the DPS (74 FR 18527).

NMFS has appointed a Recovery Team to aide in the development of the recovery plan for listed rockfish. NMFS hopes to have a draft recovery plan prepared for internal review in early 2014.

5.9.1. Status in the Action Area

Larvae and pelagic juveniles tend to be found close to the surface, occasionally associated with drifting kelp mats (Love et al. 2002). They have been found as far as 480 kilometers (149 miles) offshore. Most bocaccio remain pelagic for 3.5 months before settling to shallow areas, although some may remain pelagic as long as 5.5 months. Larval rockfish (not identified to species) have been documented in each basin of the Puget Sound (NMFS 2013b).

Juveniles settle to shallow, algae-covered rocky areas or to eelgrass (*Zostera marina*) and sand (Love et al. 1991, cited in NMFS 2013b). They may school in these nearshore waters (MacCall and He 2002). Several weeks after settlement, fish move to deeper waters in the 18 to 30 meters (59 to 98 feet) range where they are found on rocky reefs (Love and Yoklavich 2008, cited in NMFS 2013b). Adults inhabit waters from 12 to 478 meters (39 to 1,600 feet) but are most common at depths of 50 to 250 meters (164 to 820 feet) (Love et al. 2002). Adults are generally associated with hard substrata, but do occupy mud flats, particularly those near structure such as boulders and crevices (Anderson and Yoklavich 2007, cited in NMFS 2013b).

Recreational catch data reported between the mid-1960s and the 1970s suggested that bocaccio were rare in Puget Sound proper (south of Admiralty Inlet) (Drake et al. 2010). However, throughout the late 1970s, the Washington State Department of Fish and Wildlife (WDFW) Washington State Sport Catch Reports documented that 8 to 9 percent of catches included bocaccio (Drake et al. 2010). These reports were primarily (66 percent) in punch card area 13 (south of the Tacoma Narrows Bridge). In 1980-1989, bocaccio were reported in 0.24 percent of the 8,430 rockfish identified (Palsson et al. 2009, cited in Drake et al. 2010). From 1996 to 2007, bocaccio were not observed out of the 2,238 rockfish identified in the dockside surveys of the recreational catches (Palsson et al. 2009, cited in Drake et al. 2010). REEF survey data for January 1996 through July 2013 indicate that bocaccio are identified in less than 0.02 percent of surveys with one observation each in the Seattle-Olympia area and the Hood Canal area (REEF 2013). The latest records of bocaccio sightings were in 2011 (Hood Canal) and in 2001 (Seattle-Olympia). In its review of available data, NMFS indicated bocaccio occupy each of the major regions of the Puget Sound/Georgia Basin. In North Puget Sound and the Strait of Georgia, records and observations of bocaccio are rare (COSEWIC 2002, cited in Drake et al. 2010).

5.9.2. Critical Habitat

On November 13, 2015, NMFS designated critical habitat for the Georgia Basin bocaccio DPS (79 FR 68042). The proposed critical habitat includes 590 square miles of nearshore habitat and 414 square miles of deepwater habitat of Puget Sound, Washington which is identical to critical habitat proposed for canary rockfish. The portion of the action area proposed as critical habitat includes parts of South Puget Sound, North Puget Sound and the Strait of Juan de Fuca, and Hood Canal. Essential features of the critical habitat identified by NMFS are also identical to those identified for canary rockfish as described above.

5.10. Yelloweye Rockfish

The Georgia Basin yelloweye rockfish DPS was listed as threatened on April 28, 2010 (75FR 22276). The range of the DPS encompasses Puget Sound and the Georgia Basin in Washington (United States) and British Columbia (Canada) with the Victoria Sill as the likely western boundary of the DPS (74 FR 18527).

NMFS has appointed a Recovery Team to aide in the development of the recovery plan for listed rockfish. NMFS hopes to have a draft recovery plan prepared for internal review in early 2014.

5.10.1. Status in the Action Area

In Puget Sound, the species is more frequently observed in north than in south Puget Sound (Miller and Borton 1980; Love et al. 2002; NMFS 2013b), which is likely due to the greater amount of rocky habitat in north Puget Sound. Palsson et al. (2009, cited in Drake et al. 2010) also found a relatively high frequency of yelloweye rockfish distribution in Hood Canal based on trawl surveys (1987-2005) and scuba surveys (1995-2006). Since the 1960s WDFW has recorded a progressive decline in yelloweye rockfish in recreational catch surveys. In the 1960s, yelloweye rockfish was 2.4 percent of the recreational harvest in North Sound (Strait of Georgia, San Juan Islands, and Strait of Juan de Fuca), it occurred in 2.1 percent of the harvest in the 1980s, but then decreased to an average of 1 percent after 1996 until the prohibition for landing the species in Puget Sound took effect in 2002 (Palsson et al. 2009, cited in Drake et al. 2010). Although the species is rare Puget Sound, based on a review of available data, NMFS indicates yelloweye rockfish occupy each of the major regions of the Puget Sound/Georgia Basin (NMFS 2013b).

In Puget Sound, yelloweye rockfish are believed to fertilize eggs during the winter to summer months and give birth in early spring to late summer (Washington et al. 1978, cited in NMFS 2013b). After parturition, yelloweye rockfish larvae remain pelagic for up to 2 months before settling (Moser 1996b, cited in NMFS 2013b). Larvae and pelagic juveniles tend to be found close to the surface, occasionally associated with drifting kelp mats (Love et al. 2002). Juvenile yelloweye rockfish do not typically occupy intertidal waters (Studebaker et al. 2009, cited in NMFS 2013b), but instead most settle in habitats along the shallow range of adult habitats in areas of complex bathymetry, rocky/boulder habitats, and cloud sponges in waters greater than 30 meters (98 feet) (Richards 1986, cited in NMFS 2013b).

5.10.2. Critical Habitat

On November 13, 2015, NMFS designated critical habitat for the Georgia Basin yelloweye rockfish DPS (79 FR 68042). The specific areas proposed for designation for yelloweye rockfish include 414 sq mi (1,488.6 sq km) of marine habitat in Puget Sound, Washington (78 FR 47635).

The portion of the action area proposed as critical habitat includes deeper waters of South Puget Sound, North Puget Sound and the Strait of Juan de Fuca, and Hood Canal, identical to that for the other two rockfish species described above. Essential features of the proposed deepwater habitat are also described above. No shallow water critical habitat was proposed for yelloweye rockfish.

5.11. Pacific Eulachon

The southern DPS of Pacific eulachon was listed as threatened on March 18, 2010 (75 FR 13012). The DPS encompasses eulachon populations spawning from the Skeena River in British Columbia (inclusive) and the Mad River in northern California (inclusive) (75 FR 13022).

On July 3, 2013, NMFS announced its intent to prepare a recovery plan for the species and requested information from the public (78 FR 40104).

5.11.1. Status in the Action Area

In Washington, most eulachon are found in the Columbia River basin; spawning runs also occur in some coastal rivers and tributaries to Puget Sound (Emmett et al. 1991; Willson et al. 2006). Southern DPS eulachon are not expected to occur in Puget Sound (Wydoski and Whitney 2003), but could occur in the Willapa Bay and Grays Harbor portions of the action area due to the proximity of these waterbodies to the Columbia River.

Table 5-4 details the known eulachon spawning areas in Washington based on the 2010 Eulachon Status Review (Gustafson et al. 2010). Eulachon are described as "common" in Grays Harbor and Willapa Bay (Emmett et al. 1991, cited in Gustafson et al. 2010; Monaco et al. 1990).

Table 5-4. Eulachon Spawning and Estuarine Areas in Washington(from Gustafson et al. 2010)

Eulachon Spawning Areas	Spawning Regularity	Estuary
Bear River	Occasional	Willapa Bay
Naselle River	Occasional	Willapa Bay
Nemah River	Unknown	Willapa Bay
Wynoochie River	Unknown	Grays Harbor
Elwha River	Occasional	Juan de Fuca
Puyallup River	Unknown	Puget Sound

Notes: Unknown, Irregular, Anecdotal, Occasional – sporadic, infrequent occurrence, does not occur every year and may not occur in most years, especially those rivers with a spawning regularity of "unknown."

Eulachon would rarely occur in Puget Sound (Wydoski and Whitney 2003; Penttila 2009), but could occur in Willapa Bay or Grays Harbor. Juvenile eulachon rear in marine nearshore areas and if present, would be expected in these portions of the action area.

5.11.2. Critical Habitat

On October 20, 2011, NMFS designated critical habitat for the southern DPS eulachon (76 FR 65324). The critical habitat includes 16 specific areas within the states of California, Oregon, and Washington. One of these areas, the Elwha River, occurs within the action area.

In estuarine areas, critical habitat includes tidally influenced areas as defined by the elevation of mean higher high water.

NMFS determined that the following physical or biological features are essential for conservation of the southern DPS of eulachon.

PCE 1. Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation.

PCE 2. Freshwater and estuarine migration corridors free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted.

PCE 3. Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival.

5.12. Southern Resident Killer Whale

NMFS listed the southern resident killer whale population as endangered on November 18, 2005 (70 FR 69903) and published a recovery plan for species in January 2008 (NMFS 2008).

5.12.1. Status in the Action Area

The southern resident killer whale population consists of three pods, identified as J, K, and L pods, that reside for part of the year in the inland waterways of the Strait of Georgia, Strait of Juan de Fuca, and Puget Sound in Washington State and British Columbia, Canada, especially during the spring, summer, and fall (Ford et al. 2000; Krahn et al. 2004, cited in NMFS 2008). There are seasonal and temporal differences in habitat use by the three southern resident pods in Puget Sound (Hauser 2006, cited in NMFS 2008). The west side of San Juan Island and Haro Strait is the most commonly used area among all three pods during the summer, but other regions (e.g., the south end of Vancouver Island) are used in varying extents by the three pods during the summer (Krahn et al. 2004). While the summer range has been fairly well defined, the movements and distribution during non-summer are poorly understood for the southern resident killer whale population. Recent data suggests that J pod is more frequently sighted in Puget Sound than the other two pods during non-summer months (Krahn et al. 2004).

Southern resident killer whale generally spend the majority of their time in deeper water and only occasionally enter water less than about 16 feet (5 meters) deep (Heimlich-Boran 1988, Baird 2000, 2001, cited in NMFS 2008). Most foraging is done over deep open water (41percent of sightings), shallow slopes (32 percent), or deep slopes (19 percent). Frequently, pods forage within 50-100 meters of shore (Ford et al. 1998, cited in NMFS 2008).

5.12.2. Critical Habitat

Critical habitat for southern resident killer whales was designated on November 29, 2006 (71 FR 69054) in three specific areas: 1) Summer Core Area in Haro Strait and waters around the San Juan Islands; 2) Puget Sound; and 3) the Strait of Juan de Fuca. Critical habitat includes approximately 2,560 square miles of Puget Sound, excluding areas with water less than 20 feet deep relative to extreme high water. There is no critical habitat designated in Hood Canal, Willapa Bay, or Grays Harbor.

The PCEs for southern resident killer whale critical habitat are:

PCE 1. Water quality to support growth and development;

PCE 2. Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth

PCE 3. Passage conditions to allow for migration, resting, and foraging.

5.13. Humpback Whale

The humpback whale was listed as endangered on June 2, 1970 (35 FR 8491). A final recovery plan for the humpback whale was published in November 1991 (NMFS 1991).

5.13.1. Status in the Action Area

Humpback whale migratory routes pass through Washington's coastal waters, but not the inland waters of Puget Sound (75 FR 68474). Individual humpback whales have been reported to occasionally enter Puget Sound (75 FR 68474) and John Calambokidis, of Cascadia Research Collective, estimates their entry into Puget Sound occurs about once a year (Calambokidis and Steiger 1990; John Calambokidis, pers. comm. 2011). Falcone et al. (2005) reported 10 humpback whale sightings in the Strait of Juan de Fuca and Strait of Georgia from 1990 through 2004, whereas only 2 humpback whale sightings were reported in Puget Sound during this same time period.

5.13.2. Critical Habitat

Critical habitat has not been proposed or designated for the humpback whale.

5.14. Marbled Murrelet

The Washington/Oregon/California population of marbled murrelet was listed as threatened by USFWS on October 1, 1992 (57 FR 45328). USFWS published a recovery plan for the species in 1997 (USFWS 1997).

5.14.1. Status in the Action Area

The marbled murrelet belongs to the diving seabird family, Alcidae. Murrelets live primarily in a marine environment, but during the summer nesting season they fly inland to nest, typically in low-elevation old growth and mature coniferous forests (Hamer 1995; Hamer and Cummins 1991). At sea, murrelets can be found as dispersed pairs, in flocks, or in aggregates (crowded or massed into a dense cluster) (Strachan et al. 1995; Strong et al. 1996). Marbled murrelets forage predominantly within 1.25 mile (2 kilometers) of shore (Strachan et al. 1995), although the species can be found further offshore (Piatt and Naslund 1995; Ralph and Miller 1995). Thompson (1996) found that in Washington State, murrelets were most numerous within 200 meters of shore, and rarely found at or beyond 1,200 meters from shore. Speich and Wahl (1995) observed that murrelets tend to be most abundant over eelgrass and kelp substrate, on shorelines with broad shelves, and along shorelines with narrow shelves where kelp is present in the Strait of Juan de Fuca and Puget Sound. They reported that significant numbers of murrelets might also be found in areas of tidal activity. Murrelets feed primarily on fish and invertebrates (Burkett 1995).

Murrelets can potentially be found in all five regions of the action area.

5.14.2. Critical Habitat

Critical habitat for the marbled murrelet was designated on May 24, 1996 (61 FR 26256) and revised on October 5, 2011 (76 FR 61599). Critical habitat was identified in the terrestrial environment but not in the marine environment. There are two PCEs for marbled murrelet.

PCE 1. Individual trees with potential nesting platforms

PCE 2. Forested areas within 0.8 kilometers (0.5 miles) of individual trees with potential nesting platforms, and with a canopy height of at least one-half the site-potential tree height

5.15. Western Snowy Plover

The Pacific Coast population of the western snowy plover was listed as threatened on March 5, 1993 (58 FR 12864). On April 21, 2006, USFWS found that the Pacific Coast population of western snowy plover constituted a valid DPS (71 FR 20607). In 2007 USFWS published a recovery plan for the species (USFWS 2007).

5.15.1. Status in the Action Area

Coastal populations of snowy plovers nest on sand spits, dune-backed beaches, unvegetated beach strands, open areas around estuaries, and beaches at river mouths; utilizing areas with little, or no vegetation above the high tide line (Stenzel et al. 1981; Wilson-Jacobs and Meslow 1984; Warriner et al. 1986). Saltpans, lagoons, dredge spoils, and salt evaporators along the coast are used less extensively by nesting plovers (Warriner et al. 1986). Most adults arrive in Washington during late April, with maximum numbers present in mid-May to late June. Nest initiation and egg laying occurs from late April to late June, with fledging occurring from late June through August (WDFW 1995).

Historically, five coastal areas supported nesting plovers in Washington (WDFW 1995, cited in Pearson et al. 2010). From 1993 through 2010, the number of nesting locations occupied during recent years has ranged from four to two sites (Pearson et al. 2010). The estimated 2010 Washington breeding adult population was 43 (Pearson et al. 2010). All of the breeding adults observed were found on two nesting sites. In Washington, nesting snowy plovers are only present at Damon Point and Oyehut Wildlife Area at Ocean Shores, South Beach north of Willapa Bay, and Leadbetter Point in Willapa National Wildlife Refuge. Wintering snowy plovers are regularly observed at Leadbetter Point and have been found only rarely on other beaches (WDFW 1995).

5.15.2. Critical Habitat

Critical habitat for snowy plovers along the coast of Washington, Oregon, and California was revised by USFWS on June 19, 2012 (77 FR 36737). Approximately 24,527 acres of critical habitat in Washington, Oregon, and California have been designated. Four units in Washington, totaling 6,077 acres, were designated as critical habitat: Copalis Spit (Grays Harbor County), Damon Point (Grays Harbor County), Midway Beach and Shoalwater/Graveyard Spit (Pacific County), and Leadbetter Spit and Gunpowder Sands Island (Pacific County).

The PCEs essential to the conservation of the Pacific Coast WSP are the following: Sandy beaches, dune systems immediately inland of an active beach face, salt flats, mud flats, seasonally exposed gravel bars, artificial salt ponds and adjoining levees, and dredge spoil sites, with:

PCE 1. Areas that are below heavily vegetated areas or developed areas and above the daily high tides;

PCE 2. Shoreline habitat areas for feeding, with no or very sparse vegetation, that are between the annual low tide or low water flow and annual high tide or high water flow, subject to inundation but not constantly under water, that support small invertebrates, such as crabs, worms, flies, beetles, spiders, sand hoppers, clams, and ostracods, that are essential food sources;

PCE 3. Surf- or water-deposited organic debris, such as seaweed (including kelp and eelgrass) or driftwood located on open substrates that supports and attracts small invertebrates described in PCE

2 for food, and provides cover or shelter from predators and weather, and assists in avoidance of detection (crypsis) for nests, chicks, and incubating adults;

PCE 4. PCE 4. Minimal disturbance from the presence of humans, pets, vehicles, or human-attracted predators, which provide relatively undisturbed areas for individual and population growth and for normal behavior.

6. Environmental Baseline

The environmental baseline represents the set of environmental conditions, captured as of the consultation benchmark date, to which the direct and indirect effects of the proposed action would be added. It "includes the past and present impacts of all Federal, State, or private activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process" (50 CFR 402.02).

The environmental baseline includes the collective effects of past and ongoing human activities "leading to the current status of the species, habitat (including designated critical habitat), and ecosystem, within the action area" (USFWS and NMFS 1998). It is a "snapshot" of a species' health at a specified point in time. The environmental baseline also encompasses those effects resulting from activities that are presently covered under a concluded ESA consultation.

The environmental baseline benchmark date for this PBA is 18 March 2012. This is the date the 2012 version of the NWPs was issued and represents the first action in a series of actions undertaken or to be undertaken by the Corps authorizing shellfish activities described in this PBA. While the PBA action includes issuance of other type of permits, including individual permits and future versions of the NWPs, this date is the starting point for all these permitting actions and is thus the appropriate date for determining environmental baseline effects to which effects of the action should be added.

The general physical, chemical, and biological conditions of the environmental baseline have been well documented in the prior ESA consultation for NWP 48 (Jones and Stokes 2007, NMFS 2009, USFWS 2009) and are considered to still be broadly representative of the conditions in 2012. This information is incorporated by reference. The following discussion broadly supplements and updates this prior information and focuses specifically on historical shellfish activities and their influence on the environmental baseline. Specific elements of the environmental baseline, such as current eelgrass and forage fish spawning distributions, are discussed and presented in the effects section and Appendices of the PBA in the context of effects.

North and South Puget Sound (including Strait of Juan de Fuca) and Hood Canal

The majority of the following information in this section is referenced from the 2012 State of the Sound: A Biennial Report on the Recovery of Puget Sound (Puget Sound Partnership 2012).

In Puget Sound and Hood Canal, marine water quality conditions have generally declined over the past ten years. Low dissolved oxygen continues to be a significant problem in a number of locations. The largest driver of declining marine water quality has been nitrate concentrations. Human activity is suspected to be the cause of the increase. The trend in marine sediment quality is not clear. Of concern is a reduction in the benthic invertebrate community in the Bainbridge Basin of Central Puget Sound.

There continues to be about 36,000 acres of shellfish beds closed to harvest due to water contamination. This represents about 19% of the 190,000 acres of WDOH classified commercial and recreational shellfish beds. Some shellfish areas were upgraded and others downgraded. Between 2007 and 2011 improvements in water quality led to a net increase of 1,384 acres in shellfish beds open to harvesting. In South Puget Sound, Oakland Bay and Henderson Inlet gained 799 acres and 240 acres, respectively, upgraded because of improving water quality. However, in North Puget Sound, Samish Bay had a significant WDOH downgrade of 4,047 acres of shellfish growing areas. Oil spills also led to localized shellfish closures. In 2012, Penn Cove (North Puget Sound) shellfish beds were closed temporarily due to a 7,000 plus gallon spill.

On average, eelgrass coverage has not changed in recent years. At individual sites where a change in coverage was detected, more areas showed declines than increases. Small, shoreline fringing eelgrass beds throughout the Sound are in decline. Hood Canal has the greatest number of sites where eelgrass has decreased, with 83% of the monitored sites indicating a decline. In North Puget Sound, 73% of sites in the Saratoga-Whidbey Basin were in decline.

South and Central Puget Sound have shown no significant recent change in spawning herring stocks. The population of the historically most abundant stock, the spring spawning Cherry Point herring in North Puget Sound, has declined by 90% since 1973 and remains critically low with no sign of recovery. Urban development continues to increase in central Puget Sound. Shoreline armoring increased a net of 6 miles from 2007 to 2010.

A total of 2,300 acres of estuarine habitat restoration projects were completed between 2007 and 2011. This includes the 2009 Nisqually estuary restoration where 4 miles of dikes were removed resulting in an increase in the salt marsh habitat in South Puget Sound by 50%. In 2015, the largest dam removal in U.S. history was completed on the Elwha River, which flows into the Strait of Juan de Fuca. Since 2009 WDNR has designated four new aquatic reserves at Cherry Point, Smith and Minor Islands, and Protection Island (North Puget Sound locations), and at Nisqually Reach (South Puget Sound). As of 2012, Washington State Department of Transportation has removed barriers to fish passage at 168 sites and have identified an additional 785 sites for barrier removal. Natural Resource Damage Assessment efforts have been active in the heavily industrialized Duwamish and the Puyallup river deltas which have resulted in improved habitat conditions in localized areas.

Between 2006 and 2011, 2,176 acres/year of non-federal Puget Sound basin forest was converted to developed cover. This amount probably under-reports small changes, such as clearing for residential development.

Grays Harbor and Willapa Bay

Currently two sediment locations in Grays Harbor are listed on Ecology's 303(d) list of impaired waterbodies: one for chlorinated benzene chemicals in the outer Grays Harbor reaches and one for numerous organic compounds and metal in an inner Grays Harbor reaches (Corps 2014c).

Two indigenous species of burrowing shrimp (ghost shrimp *Neotrypaea californiensis* and mud shrimp *Upogebia pugettensis*) can make sediments too soft and unstable for clam and oyster cultivation. From 1963 through 2014, commercial shellfish growers in Grays Harbor and Willapa Bay have used the N-methyl carbamate "carbaryl" pesticide to control burrowing shrimp (WDOE 2015a).

In recent years there have been efforts to remove the non-native seagrass (*Zostera japonica*) from Willapa Bay. This has included the use of harrowing and other mechanical methods (PCSGA 2013a). In April 2014, the herbicide imazamox was applied to aquaculture acreage in 2014 under an NPDES permit (WDOE 2015b).

In Willapa Bay, the acreage of Spartina (a noxious weed that grows in the upper intertidal zone) has declined as a result of chemical and mechanical means so that in 2012 only about 1.3 acres remain (WDOE 2015a).

Environmental baseline and shellfish activities

Shellfish activities including aquaculture and the harvest of wild shellfish have occurred in Washington State for over 100 years. Corps authorization of these activities began in the 1970s with the permitting of rafts for shellfish aquaculture (no permits older than this were located in the Corps archives). The authorizations were predominantly for RHA Section 10 purposes. The Corps began exercising its CWA jurisdiction on a national level with the issuance of NWP 48 as discussed previously. Habitat restoration projects focused on shellfish have also been permitted by the Corps in recent years. As a result of this regulatory history, the recent history of shellfish activity has been fairly well documented. All of the historical shellfish activities and their effects on the environment are part of the environmental baseline.

Table 6-1. Summary of continuing activities that are part of the environmental baseline

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound	Total
# of individual footprints	28	251	209	375	71	934
# footprints with floats and/or FLUPSYs	0	3	0	3	0	6
Continuing active floating acres	0	2	23	20	64	109
Continuing active ground-based acres	1,145	16,395	926	2,331	1,290	22,087
Total continuing active acres	1,145	16,397	949	2,351	1,354	22,196

The commercial aquaculture activities that are classified as continuing active in the proposed action are among the historical activities that are part of the environmental baseline. Acreage classified as continuing active has by definition been engaged in shellfish activity since at least 2007 and likely for much longer in many cases. The effects on habitat and listed species from these activities have similarly been occurring for as long as the activities have been active. The number of individual geographic footprints for continuing active aquaculture and their associated acreage are summarized in Table 6-1. The specific locations of these activities are illustrated in Appendix D. Under the proposed action, activities on these lands would be reauthorized during the period of the PBA. Given this overlap between the environmental baseline and the proposed action as it pertains to continuing active aquaculture, effects of these activities are presented in the effects sections (Sections 7 and 8). A summary of the relative contribution of the continuing active aquaculture acreage to the total commercial aquaculture acreage is presented in Table 6-2.

Acreage identified as continuing fallow may also have been engaged in shellfish activity at some point in the past according to permit applications, but is not engaged in shellfish activity presently (as of the 18 March 2012 benchmark date). According to permit applications, no shellfish activity has occurred on fallow lands since at least 2007 and most for a much longer time period (e.g., decades). The aquatic habitat has likely adjusted to or been modified by shellfish cultivation and harvest activities that have been occurring for many years on the continuing active acreage. The status of the aquatic habitat on fallow acreage is unknown since shellfish activities on these lands have not occurred for many years. Based on the permit application record which indicates the fallow areas have not had active cultivation since at least 2007, it is assumed for the purpose of the PBA that the fallow lands exist currently in an unmodified or ‘recovered’ state. A resumption of shellfish activity in these areas may therefore result in impacts to the aquatic habitat similar to the impacts that might result from aquaculture initiated in areas classified as new. Any effects to listed species or designated critical habitat associated with resuming or initiating aquaculture in these fallow areas or the new commercial aquaculture activities are not components of the environmental baseline but represent new effects on habitat and listed species relative to the environmental baseline.

Table 6-2. Percent of total commercial aquaculture acres that are classified as continuing active

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound	Total
Total commercial aquaculture acres	3,065	25,965	1,789	3,578	4,002	38,400
Total continuing active acres	1,145	16,397	949	2,351	1,354	22,196
Total continuing fallow acres	1,820	9,468	402	780	2,333	14,803
New acres	100	100	438	448	315	1,401
% of total classified as new	3%	< 1%	24%	13%	8%	4%
% of total classified as continuing fallow	59%	36%	22%	22%	58%	39%
% of total classified as continuing active	37%	63%	53%	66%	34%	58%

Similar to new commercial aquaculture, the other broad categories of shellfish activity that could be authorized under the PBA including subtidal geoduck harvest, recreation, and restoration are treated as 'new' activities for the purpose of the PBA and Conservation Measures. In some cases, there may have been historical shellfish activity on a given new acreage such as a prior geoduck harvest. However, the PBA assumes that any historical subtidal geoduck harvest, recreation, or restoration related shellfish activity is sufficiently in the past to no longer be influencing habitat conditions at that site. Similar to the fallow acreage, these areas are assumed to have recovered from any prior disturbance that may have occurred.

Table 6-3. Continuing aquaculture activities with separate ESA consultation (as of July 2014)

	Grays Harbor		Willapa Bay		Hood Canal		South Puget Sound		North Puget Sound		Total w/ESA
	total	w/ ESA	total	w/ ESA	total	w/ ESA	total	w/ ESA	total	w/ ESA	
Continuing footprints	28	0	251	4	209	21	375	7	71	0	32
Continuing active acres	1,145	0	16,397	32.3	949	6.8	2,351	3.3	1,354	0.0	42
Continuing fallow acres	1,820	0	9,468	0.5	402	0.0	780	1.0	2,333	0.0	2
Total acres	2,965	0	25,865	33	1,351	7	3,131	4	3,687	0	44

Since 2013, there have been a number of shellfish activities authorized by the Corps that have had ESA compliance addressed through an individual project specific ESA consultation. These include both continuing (Table 6-3) and new (Table 6-4) commercial aquaculture activities. Since the ESA compliance for these activities has been completed, any associated effects on ESA listed species and designated critical habitat is part of the environmental baseline. When the current permit for these activities expires (e.g., in 2017 for those authorized with an NWP), the PBA could be used to address ESA compliance for the reauthorized activities. The reauthorized activities would not be part of the environmental baseline, but would be part of the proposed action.

Table 6-4. New shellfish activities with separate ESA consultation (as of July 2014)

		Grays Harbor		Willapa Bay		Hood Canal		South Puget Sound		North Puget Sound		Total w/ESA
		total	w/ ESA	total	w/ ESA	total	w/ ESA	total	w/ ESA	total	w/ ESA	
authorized	New footprints	0	0	0	0	1	1	15	15	0	0	16
	New acres					7	7	18	18			26
pending	New footprints	0	0	0	0	7	1	15	14	0	0	15
	acres cultivated					31	18	30	27			45
total	New footprints	0	0	0	0	8	2	30	29	0	0	31
	acres cultivated	0	0	0	0	38	26	49	45	0	0	71

Comparison to environmental baseline for the 2007 NWP 48 consultation

The benchmark date for the 2007 NWP 48 consultation was 12 March 2007. This was the date the new NWP 48 was issued. Permit actions by the Corps, specifically verification of ongoing commercial aquaculture activities, were anticipated to begin shortly after this date. At the time the 2007 PBA was completed, the Corps had very little information on the extent, acreage, or scope of the commercial aquaculture activities. Based on the description of the NWP 48, it was assumed that the fallow acreage was part of a normal rotation of activities. All of these ongoing activities including both the active and fallow components were considered to be broadly part of the normal operation of each of the commercial aquaculture activities in the 2007 PBA action. These activities predated the benchmark date and in most cases were presumed to be ongoing for many years before this date. These activities were therefore all components of the environmental baseline for the purpose of ESA. Similarly, the effects of all these activities, both on the active and fallow acreages, were considered part of the environmental baseline. The effect of the action was to authorize these activities for another five years into the future thus extending the period of effects.

During the next few years (2007- 2009), applications were submitted for all the commercial shellfish aquaculture activities requesting verification under NWP 48. From this information, the geographic location and extent of the activities was determined including the acreage that was in active culture and the acreage that was currently in a fallow status. Some of this information was submitted after the initial PBA submittal in 2007 and was used to finalize the two resulting BiOps.

The Corps authorized many of these activities in 2012 and as a result learned that the previously identified fallow acreage was still fallow in 2012. In most cases, this acreage is still fallow today. Since no activity had occurred on the fallow lands for at least five years since 2007, the habitat condition of these areas is likely different than if it had been engaged in aquaculture or some regular rotation of aquaculture. It has likely 'recovered' from any prior aquaculture impact or exists (as of the 2012 benchmark) in an unmodified (by aquaculture) state. When aquaculture is initiated or resumed on these fallow lands, there are likely to be new impacts on the habitat or to ESA listed species relative to the environmental baseline for this 2015 PBA which has a benchmark date of 2012 for the environmental baseline. This results in different effects for aquaculture activities conducted on fallow lands under the 2015 PBA action compared to the 2007 PBA action. This difference is most likely due to a lack of information about the fallow acreage in 2007 and an incorrect assumption about the activities conducted on this acreage at that time.

7. Effects of the Proposed Action

The proposed action includes the initiation and continuation of aquaculture, implementation of a number of recreation and restoration related shellfish projects, and harvest of native subtidal geoducks. Aquaculture consists of a collection of individual activities that each have their own effects. These effects may be relatively short-term or longer lasting. The effects of these individual activities are discussed below in Section 7.1. Of equal or more relevance to ESA listed species are the effects of the collective activities, their frequency, duration, timing, geographic location, and general scale across the landscape. The restoration, recreation, and subtidal geoduck harvest activities result in effects that are limited in duration because the work may only be conducted once on a given footprint. In some cases, the effects of a recreation activity could be similar to aquaculture. The frequency and geographic scale of the activities are discussed Section 7.2. The relevance of these effects to ESA listed species and critical habitat is discussed in Section 8.

7.1. Effects of Individual Activities

The effects described below are written from the perspective of a worst-case effects scenario relative to issues such as work timing and husbandry practices. The purpose of this approach is to ensure the full range of possible effects is discussed. A brief summary of these effects is provided in Table 7-1 for the culture methods and many of the individual activities.

7.1.1. Water Quality

Bivalves themselves remove phytoplankton and suspended particles from the water column. High densities of bivalves that occur with aquaculture can locally decrease phytoplankton, nutrients, and suspended material increasing water clarity (WDNR 2014b; Straus et al. 2013; Heffernan 1999; Newel 2004). Wastes from the cultured species are excreted into the water column and ultimately settle to nearby sediments.

Many of the shellfish activities (e.g., dredging, dive harvest) physically disturb the substrate which results in localized turbidity, increases in suspended sediment, and potentially changes in other water quality parameters such as lower dissolved oxygen (Mercaldo-Allen and Goldberg 2011, Heffernan 1999). These water quality effects may be delayed for activities conducted at low tide ‘in the dry’ until the tide floods the area. There may be a turbidity plume emanating from the actively worked area at low tide for some activities such as intertidal geoduck harvest. In-water activities such as dredging and dive harvest may affect water quality during the period of activity and a short period afterwards. These effects on water quality are temporary and not expected to persist longer than a period of hours or days (Mercaldo-Allen and Goldberg 2011).

7.1.2. Substrate and Sediments

Physical disturbance of the substrate can occur as a result of anchors placed for rafts or surface longlines, from bed preparation activities (e.g., tilling, harrowing, substrate leveling), planting activities (e.g., installation of nets), harvest (e.g., raking, dredge, hydraulic harvest), the grounding of vessels and support structures, and the general traffic of personnel and equipment. Sediment compaction can occur from vessel grounding, vehicle and personnel traffic. Topographic variation and natural debris such as large wood and boulders are often removed. In some cases this can result in filling of tidal channels in order to level a bed. Bed preparation techniques vary widely as do their effects depending on the specific cultured species and individual grower practices. Bed preparation and harvest activities such as dredging, tilling, raking, and hydraulic harvest result in turning over the sediments may temporarily alter the physical composition and chemistry of the sediment (Mercaldo-Allen and Goldberg 2011, Bendell-Young 2006, WDNR 2014b). Hydraulic harvest in geoduck culture areas results in liquefaction of the substrate.

Subtidal geoduck harvest temporarily leaves behind a series of depressions, or holes where the clams are extracted. The number of depressions created across a harvested area in a tract depends on the density of geoducks. The fate of these depressions, in terms of the time to refill, depends on the substrate composition and tidal currents. The time for them to refill can range from several days up to 7 months (Goodwin 1978).

Many activities result in a change to the composition of the native substrate which is often mud or sandflats. Graveling results in a generally firmer substrate with a larger grain size. Oyster bottom culture results in a substrate that is predominantly or entirely oysters that are periodically removed during harvest. Longline and stake culture result in an altered substrate that is partially shaded/occupied by oysters and stakes. Culture techniques that use racks, bags, nets, and PVC tubes result in an altered substrate that is intermittently or more broadly surfaced with plastic. There can be wide variability in the coverage of the plastic structure across the substrate depending on the practices of individual growers. Bag culture could be sufficiently dense to completely cover an existing substrate over a relatively broad area (Figure 3-10). Similarly plastic nets placed for clam or geoduck culture could extend over multiple acres (Figure 3-18). Alternatively, structures may be placed in rows that result in alternating plastic versus native substrate (Figure 3-11, Figure 3-19). Where the profile of the artificial structure is low, for example with bags resting on the substrate or area nets, sediment may gradually accumulate on top of the structure resulting in a return, at least in part, to a substrate similar to what existed before the activities were initiated. Periodic maintenance of the nets may remove this accumulated sediment. The artificial structure can be present for multiple years in a particular location (e.g., geoduck tubes) or can remain almost continuously over time as new crops are quickly planted after harvest (e.g., clam bags, area nets for clam culture).

Activities that involve placement of structure such as rafts, floating longlines, oyster longline, and rack and bag culture can affect water currents and circulation patterns, can lead to changes in rates of erosion and sedimentation, and altered tidal channels (WDNR 2014b, Wisehart 2007). Sedimentation and nutrient enrichment may occur from the settling of wastes to the substrate from the cultured species (Heffernan 1999, WDNR 2013a). Culture using rafts and longlines in particular often experience nutrient enrichment of the local sediments due to accumulation of biological waste and shell material from the cultured species. Anoxic sediments from nutrient enrichment have been documented below rafts (Hargrave et al. 2008; Heffernan 1999). Man-made debris such as metal and plastic can also accumulate beneath rafts.

7.1.3. Vegetation

Activities in areas classified as new by the PBA including subtidal geoduck harvest, recreation, and restoration activities, would not affect eelgrass or kelp due to a Conservation Measure. Aquaculture activities classified as continuing active and fallow would occur in areas containing eelgrass.

Effects on aquatic vegetation can occur where shellfish activities are co-located with aquatic vegetation including eelgrass and kelp. Rafts shade the underlying substrate limiting the growth of aquatic vegetation. They are typically sited in waters too deep for eelgrass. Macroalgae such as kelp could be negatively affected or excluded from areas beneath rafts (WDNR 2014b). Floating culture using lines suspended from buoys would typically have a smaller footprint than a raft so substrate shading may be limited depending on spacing of the lines.

Ground-based culture activities are often conducted in the same tidal zone occupied by eelgrass. In Puget Sound, WDNR inventoried eelgrass (*Z. marina*) at a minimum elevation of -41 ft MLLW at a site in central Puget Sound and a maximum elevation of +7.5 ft MLLW at a site in Hood Canal (WDNR 2011). The average minimum and maximum elevations throughout Puget Sound were +0.3 to +3.0 ft MLLW. This range encompasses the elevations where ground-based shellfish activities would occur. When shellfish activities are co-located in areas with eelgrass, a net loss in eelgrass is typically the result either as a result of bed preparation activities, competition for space with the culture species or equipment, or harvest (Tallis et al. 2009, Wagner et al. 2012, Wisehart 2007; Dumbauld et al. 2009, Ruisink et al. 2012, NMFS 2009, NMFS 2005, Rumrill and Poulton 2004). This is the case for all forms of ground-based culture. Eelgrass is replaced by oysters, culture bags, and geoduck tubes. Eelgrass often coexists within the culture area albeit at a reduced density. Bed preparation and harvest activities physically remove eelgrass (Ruesink and Rowell 2012; Tallis et al. 2009; Boese 2002, Simenstad and Fresh 1995). Use of vessels and floats can smother and cause physical disturbance to eelgrass due to grounding of the vessels (NMFS 2005). Longline and suspended bag culture may shade eelgrass and preclude it underneath the structure (Skinner et al. 2014; WDNR 2014b). Biofouling on cover nets can reduce light availability for eelgrass (WDNR 2013a). The magnitude and duration of effect may vary depending on culture method and individual grower practices. For example, dense, mature bottom oyster culture may totally preclude eelgrass during certain parts of the aquaculture cycle while lesser densities of oyster may allow eelgrass to coexist within the culture area.

Eelgrass recovery times after disturbance vary depending on the type of disturbance, environmental conditions, and the availability of local seed sources. Timeframes can range from less than two to greater than five years (Dumbauld et al. 2009; Tallis et al. 2009; Wisehart; 2007, Boese 2002).

7.1.4. Benthic Community

Most shellfish activities affect the existing benthic community to some degree due to the physical disturbance of the substrate. Each phase of the aquaculture cycle of activity which is characterized by bed preparation (e.g., tilling), planting (e.g., net installation), maintenance (e.g., cleaning area nets), and harvest results in physical disturbance of the benthic community and often a temporary decrease in abundance of many infaunal and epifaunal species (Vanblaricom et al. 2015; Mercaldo-Allen and Goldberg 2011; WDNR 2014b; Straus et al. 2013; Dumbauld 2008; Heffernan 1999; Bendell-Young 2006; Simenstad and Fresh 1995). Bed preparation activities often directly remove many species including bivalve predator species, bivalve competitor species, and commercial species such as bivalves/burrowing shrimp. Bag culture techniques result in bags with bivalves placed directly on the substrate smothering the existing benthic community. The magnitude and duration of the effect is variable depending on the activity, individual husbandry practices, and environmental conditions. The benthic community typically recovers in a period of weeks or months depending on the activity (Vanblaricom et al. 2015; WDNR 2014b; Mercaldo-Allen and Goldberg 2011; WDNR 2008).

Benthic community diversity and/or composition may be altered as a result of physical changes to the substrate depending on the specific culture method and activity. Oyster bottom culture results in a shift in the composition of the benthic community to an oyster dominated community. This may have positive, negative or neutral effects on individual species. Areas with mature oyster bottom culture may have a comparable level of species diversity and abundance to an eelgrass based habitat (Ferraro and Cole 2007). Once oysters are harvested, the benthic community may begin transition back to the pre-oyster based community that existed previously. Regular graveling can result in shifts in the composition of the benthic community due to the change in substrate composition over time (Simenstad and Fresh 1995, Simenstad et al. 1991). When activities result in removal of eelgrass, a corresponding change in the benthic community occurs (Carvalho et al. 2006, Simenstad and Fresh 1995). Changes in sediment chemistry from nutrient enrichment can result in decreased benthic community abundance and diversity for some culture methods (Heffernan 1999; Stenton-Dozey 2001). Shifts in benthic community composition diversity are less clear for other culture methods and the subject of active study.

Activities that include installation of artificial structure such as geoduck tubes, nets, bags, or longlines may result in shifts in benthic macrofauna. In a study of geoduck tubes, increased numbers of transient fish and macro invertebrate species were found when the structure was in place (McDonald et al. 2015). Effects ended when the structure was removed. Tubes and nets are typically in place for 2 to 3 years before harvest at 4 to 7 years. A study of rack and bag culture also suggested habitat benefits of the structure to certain fish and invertebrate species (Dealteris et al. 2004). Studies with area nets have been variable with no changes in species composition and diversity in some cases (Vanblaricom et al. 2015; Simenstad et al. 1993) and altered species diversity and composition measured in others (Bendell-Young 2006).

7.1.5. Fish and Birds

In-water activity, noise, and increases in suspended sediment would displace many fish species and birds from localized work areas. Temporary decreases in benthic community abundance would locally decrease available prey for fish. Eelgrass provides important habitat and prey for many fish and bird species including juvenile salmon. In areas where eelgrass is removed, the fish community may be negatively affected (NMFS 2005).

Forage fish are an important prey resource for many species including Chinook salmon, steelhead, bull trout and marbled murrelet. Several forage fish including Pacific herring, surf smelt, and Pacific sand lance spawn throughout the action area. Spawning and egg incubation could potentially be affected by shellfish activities. In the Puget Sound region, herring spawn in the lower half of the intertidal or shallow subtidal zone down to a depth of -10 ft MLLW depending on water clarity (Penttila 2007). Native eelgrass, *Z. marina*, is of primary importance as a herring spawning substrate. Spawning also occurs on other aquatic vegetation and rocks. The removal of vegetation, which may occur as a result of some of the shellfish activities could decrease available spawning habitat for herring. Spawning could potentially occur on shellfish gear such as racks or tubes. A Conservation Measure would prohibit certain shellfish activities during the period herring spawn is present at a given site. This would minimize, but not necessarily eliminate, impacts to herring eggs.

Sand lance deposit their eggs in substrate that is predominantly sand in the high intertidal above +5 ft MLLW. Surf smelt tend to spawn in substrates with a mix of sand and gravel above +7 ft MLLW (Penttila 2007). Shellfish activities conducted when spawning is occurring or after eggs have been deposited could potentially disturb these species or destroy eggs. Culture and harvest activities would not typically occur above +7 ft MLLW but would occur below that elevation in the zone where sand lance may deposit eggs. Above +7 ft, shellfish activities would still occur including general travel to and from shellfish activity areas, temporary storage/staging of equipment, and grounding of floats which all could result in trampling, smothering, or loss of eggs. Conservation Measures would minimize impacts from activities classified as new. These measures do not apply to the continuing active and fallow aquaculture activities.

Area nets used for clam and geoduck culture could potentially entrap fish, birds, or other aquatic species if they become loose or dislodged (Bendell 2015, Corps 2014b, Smith et al. 2006). This could occur due to variable husbandry practices with respect to net installation and maintenance, the high energy of the marine environment which makes securing nets difficult, and large wood debris strikes that create holes in the nets. Under the proposed action, anti-predator cover nets must be tightly secured to the substrate, maintained, and periodically inspected in accordance with the Conservation Measures. This should minimize, but not necessarily eliminate, the number of loose or dislodged nets. Rack and/or bag culture could also entrap fish species by creating a physical barrier across the tidelands (Figure 3-11). This barrier could temporarily impound water and/or prevent fish from returning to deeper water during a receding tide which would result in stranding fish on the tidelands. The density and orientation of the structure relative to water drainage patterns would be particularly important in determining the risk of this occurring. Finally, nets associated with floating rafts would exclude fish from habitat under the rafts. Net deployment may occasionally capture fish depending on the depth of the nets.

7.1.6. Contaminants

The use of vessels and vehicles could result in accidental discharges of fuel, lubricants, and hydraulic fluids. The effect on water quality depends on the type of contaminant spilled, time of year, spill volume, and success of containment efforts. The action includes Conservation Measures to minimize the risk of such spills in the aquatic environment.

7.1.7. Noise

Noise from equipment operation could temporarily disturb and displace both aquatic and upland species from the local area. The types of vessels commonly used for shellfish activities are listed in Table 3-1. To estimate noise produced by shellfish activities, an analysis was conducted using data from Wyatt (2008) for a commonly used vessel, a 21-foot Boston Whaler with a 250 horsepower Johnson 2-cycle outboard motor. Operating this vessel at full speed produced a sound measured at 147.2 decibels (dB) root mean square (RMS) re 1 microPascal at 1 meter[4]. Assuming a background underwater sound level of 120 dB RMS, which is the threshold established by NMFS for behavioral effects to marine mammals, and using the practical spreading loss model preferred by NMFS and USFWS, sound produced by this vessel would attenuate to 120 dB RMS within 65 meters (213 feet). Larger vessels could also be used on occasion which could potentially generate greater underwater sound levels.

The intermittent use of power equipment is likely to produce in air noise of up to 81 dBA for dive harvesting and 82 dBA for shoreline work. Over marine water, the 81 dBA value would attenuate to the background level (57 dBA) within 792 feet and over a terrestrial habitat the 82 dBA would attenuate to the background noise level of a rural environment (35 dBA) within 3793 feet (0.71 mile). Maximum surface noise levels from boat operations and dive support equipment for subtidal geoduck harvest was measured at 61 to 58 dBA at a distance of 100 feet where auxiliary equipment was housed on deck and 55 to 53 dBA where equipment was housed below deck (WDNR 2008).

7.1.8. Summary

Effects of the various shellfish activities on habitat are summarized in Table 7-1. It is a summary of worst-case effects that would not necessarily occur in all locations where the activity is occurring. Substantial local variability would be expected due to individual grower practices (e.g., densities, scale, techniques) and environmental conditions.

[4] In this document, underwater sound pressure levels given in units of dB RMS and dB peak are referenced to a pressure of 1 microPascal and sound pressure levels given in dB SEL (sound exposure level) are referenced to 1 $microPascal^2$ second unless otherwise noted.

Table 7-1. Summary of shellfish activity effects on habitat

Shellfish Activity	Cultured/ Harvested Species	Primary Effects on Habitat
floating culture and harvest methods		
floating culture with rafts, anti-predator nets	mussel	• altered benthic substrate dominated by shell/barnacle debris • nutrient enrichment of sediments; potential anoxia • decreased benthic species diversity and abundance • shaded substrate limiting or preventing aquatic vegetation • potentially trap fish, bird species within nets • contributes plastic debris to the aquatic environment (e.g., disks, nets)
surface longlines	mussel, oyster, clam	• limited shading of substrate, minor effects on aquatic vegetation
FLUPSYs	oyster, clam, geoduck	• shades substrate preventing or limiting growth of aquatic vegetation
ground-based culture and harvest methods		
oyster bottom culture	oyster	• altered benthic habitat and species composition • aquatic vegetation replaced by oyster habitat
longline, stake culture	oyster	• altered benthic habitat, nutrient enrichment; potential affect on benthic community composition • reduction of aquatic vegetation • increased sedimentation • potential disruption of fish travel patterns, foraging
rack and bag culture	oyster	• altered benthic habitat; potential affect on benthic community composition • aquatic vegetation removed • creates barriers to tidal flow; altered sedimentation/erosion patterns • contributes plastic debris to the aquatic environment • potential migration barrier and stranding of fish and other species • loss of forage fish spawning habitat (e.g., sand lance)
clam ground culture	clam	• altered substrate due to graveling, artificial structure (e.g., nets); shift in benthic community composition over time due to regular graveling • aquatic vegetation removed, reduced due to artificial structure, activities • loss of forage fish spawning habitat (e.g., sand lance)
bag culture (bags directly on substrate)	clam, oyster	• altered benthic habitat; potential affect on benthic community composition • aquatic vegetation removed, reduced due to artificial structure, activities • contributes plastic debris to the aquatic environment • loss of forage fish spawning habitat (e.g., sand lance)
geoduck culture	geoduck	• altered benthic habitat; potential affect on benthic community composition • aquatic vegetation removed, reduced due to artificial structure, activities • contributes plastic debris (e.g., PVC tubes, nets) to the aquatic environment
low tide activities		
install and maintenance of area nets	clam, geoduck	• altered benthic habitat; temporary decrease in benthic community abundance • lost and unsecured nets lead to fish and wildlife entanglement
'hand' harvest (rakes, shovels,	clam, oyster	• substrate disturbance, temporary decrease in benthic community abundance, aquatic vegetation (e.g., eelgrass)

Shellfish Activity	Cultured/ Harvested Species	Primary Effects on Habitat
containers)		• short-term increase in suspended sediments • potential loss of forage fish eggs (e.g., sand lance)
bed preparation (mechanized tilling, leveling substrate, hydraulic pre-harvest)	oyster, clam, geoduck	• substrate disturbance, temporary decrease in benthic community abundance, • aquatic vegetation removed, reduced • short-term increase in suspended sediments • altered, filled tidal channels
low tide hydraulic harvest	geoduck	• substrate disturbance, temporary decreases in benthic community abundance, • aquatic vegetation removed, reduced • short-term increase in suspended sediments
longline harvest	oyster	• substrate disturbance, temporary decreases in benthic community abundance, • aquatic vegetation removed, reduced
vehicle and vessel traffic on tidelands	oyster, clam, geoduck, mussel	• localized compaction of substrate , smothering of benthic community, aquatic vegetation • compaction, smothering of incubating surf smelt and sand lance eggs
temporary equipment storage on tidelands; use of floats, work platforms	oyster, clam, geoduck, mussel	• localized compaction of substrate , smothering of benthic community, aquatic vegetation • compaction, smothering of incubating surf smelt and sand lance eggs • shades substrate limiting or precluding vegetation
in-water activities		
dredging, harrowing, longline harvest	oyster, clam	• in-water disturbance, noise, increased suspended sediments • substrate disturbance, temporary decreases in benthic community abundance • aquatic vegetation (e.g., eelgrass) removed • potential loss of forage fish eggs (e.g., herring)
graveling	oyster, clam	• gradually alters substrate from mud/sand to firmer, gravelly substrate; altered benthic community over time • in-water disturbance, noise, increased suspended sediments
hydraulic dive harvest - intertidal	geoduck	• in-water disturbance, noise, increased suspended sediments • substrate disturbance, temporary decreases in benthic community abundance • aquatic vegetation (e.g., eelgrass) removed • potential loss of forage fish eggs (e.g., herring)
hydraulic dive harvest - subtidal	geoduck	• localized and minor effects on benthic community • in-water disturbance, noise, increased suspended sediments • disruption of fish travel patterns, foraging

7.2. Spatial Extent and Frequency of Effects

The following section discusses the scale and frequency of activities and effects resulting from the proposed action. Assumptions about the scale of the action are discussed in Section 3.4 and repeated in Section 7.3 where effects are summarized by geographic region. Assumptions about frequency are discussed in the following section.

7.2.1. Extent of Floating Activities

Floating aquaculture occurs in all of the geographic regions of the PBA except for Grays Harbor. In all cases the acreages involved are negligible in the context of each region. Activities are concentrated in a few embayments (e.g., Quilcene Bay, Penn Cove) where the acreage covers a larger percent of the embayment area (see figures in Appendix D). Effects would be limited to the immediate proximity of the work areas and would continue for the duration of the PBA and likely beyond. All of the floating rafts, FLUPSYs and floats are classified as continuing active which means effects associated from the structures themselves are not appreciably different from the environmental baseline.

7.2.2. Extent of Tideland Activities

The vast majority of the ground-based continuing active and fallow/new activities would occur in the intertidal zone as would all of the new aquaculture, restoration, and recreation activities. An unknown but likely insignificant percentage of the ground-based continuing aquaculture activities (both active and fallow) would occur in the shallow subtidal zone. For these reasons and to simplify the analysis, the entire ground-based acreage is considered intertidal. The percentage of the total intertidal acreage that would be devoted to shellfish activities within each PBA geographic region is summarized in Table 7-2. The total tideland acres are based on the area classified as marine tideland in the Washington State aquatic parcel GIS database (WDNR 2014a). Marine tidelands extend from ordinary high tide down to extreme low tide (WDNR 2013a). This analysis indicates proportionally how much of the intertidal habitat would be affected by the proposed action.

Table 7-2. Ground-based shellfish activity acreage relative to total tideland acreage

	Grays Harbor		**Willapa Bay**		**Hood Canal**		**South Puget Sound**		**North Puget Sound**		**Total**	
	acres	% of total tidelands	acres	% of total tidelands	acres	% of total tidelands	acres	% of total tidelands	acres	% of total tidelands	acres	% of total tidelands
Total marine tideland acres	41,115		49,194		11,378		30,075		84,283		216,045	
continuing fallow aquaculture	1,820	4.4%	9,468	19.2%	402	3.5%	780	2.6%	2,333	2.8%	14,803	6.9%
new - aquaculture	100	0.2%	100	0.2%	438	3.8%	448	1.5%	315	0.4%	1,401	0.6%
new - recreation	0	0.0%	0	0.0%	74	0.7%	41	0.1%	45	0.1%	160	0.1%
new - restoration	0	0.0%	0	0.0%	24	0.2%	126	0.4%	5	0.0%	155	0.1%
total cont. fallow & new	1,920	4.7%	9,568	19.4%	938	8.2%	1,395	4.6%	2,698	3.2%	16,519	7.6%
continuing active aquaculture	1,145	2.8%	16,397	33.3%	949	8.3%	2,351	7.8%	1,354	1.6%	22,196	10.3%
cumulative total (cont. fallow/new + cont. active)	3,065	7%	25,965	53%	1,887	17%	3,746	12%	4,052	5%	38,715	18%

For all regions combined, the continuing fallow and new shellfish activity would occur on 8% of the combined tidelands. This varies between a low of 3% in South Puget Sound to a high of 19% in Willapa Bay. Continuing active aquaculture activities occur on 10% of the combined tidelands across all the regions although there is quite a bit of variability ranging from a low of 2% in North Puget Sound to a high of 33% in Willapa Bay. The cumulative total percentage of tidelands with some form of shellfish activity is 18% across all the regions. This coarse scale analysis illustrates the geographic magnitude of the action. Comparatively higher percentages of tidelands may be affected in individual embayments within each region. For example, in South Puget Sound, shellfish activities are concentrated in the far south and west corner of the region (see Appendix D). In north Puget Sound, shellfish activities are concentrated in several smaller embayments including Samish Bay, Discovery Bay, and Kilisut Harbor.

The acreages classified as fallow and new contain relatively undisturbed habitat currently. The action would result in a change from this undisturbed habitat to an aquaculture farm. Activities with effects similar to those described in Section 7.1 would occur on this acreage over the 20 year period of the PBA and likely longer.

7.2.3. Frequency of Disturbance

Some of the proposed shellfish activities may only be conducted once in that footprint over the anticipated 20 year period of the PBA and thus would have a very limited period of effects. An example of this would be activities to support a habitat restoration project or a subtidal geoduck harvest. In other cases, multiple activities may occur on a given footprint annually or potentially more frequently for the duration of the PBA. For example active maintenance of cover nets for clams could occur monthly. Active oyster bottom culture on a given footprint could include two successive dredges, harrowing, and graveling each year. The frequency of activities on most acreage would fall somewhere in between these extremes. The variability in activity frequency among shellfish growers is also high. Table 7-3 lists frequencies of occurrence for a number of the activities. The information was gathered from individuals engaged in aquaculture in the State of Washington (Corps 2014a, Corps 2011).

Table 7-3. Shellfish activity frequency of occurrence and acres completed per day

Activity	Acres completed per day	Frequency of occurrence
mussel harvest	--	12-14 months
graveling	1	1 year
harrowing/tilling	5	1 - 4 years
dredge harvest (includes for transplanting)	0.5	1 - 4 years
longline mechanical harvest	0.125	3 years
geoduck harvest (in cultured areas)	.01 - .06	4 - 7 years
clam raking	0.05 - 0.1	3 yrs
clam mechanical harvest	0.8	3 years
net install, removal (clam, geoduck)	--	2 - 3 yrs

Note: This information does not necessarily encompass the full range of activity rates and frequencies for the activities. There is wide variability. The information is considered representative but is based on a limited sampling of aquaculture growers (sources Corps 2014a, Corps 2011).

For some areas, particularly larger aquaculture acreages, there is a progression of activity from one end of the acreage to the other that may occur over a series of days, weeks, or longer. Certain effects, such as increases in suspended sediment, from one part of the acreage may drift over locations where the activity had previously been completed thereby extending the duration of effects in that location. This is most applicable to those activities that take comparatively longer to conduct (see Table 7-3). For example, harvest of cultured geoduck is a comparatively time consuming activity that could occur for months at a particular location as it slowly progresses across the acreage.

Most of the activities occur at a frequency of only once every year, or once every few years on given acreage. In the context of the temporary impacts that occur with the activities, the relevance of this frequency is dependent on recovery from the impact. Effects that diminish quickly such as increases in suspended sediment are minor in the context of a once per year frequency. The collective activities conducted on a particular acreage may increase this to 3 or 4 times per year. Collectively the total period of effects is still minor and on the order of days. For impacts that require a slightly longer period for recovery such as the benthic community (weeks to months) following bed preparation or harvest activities, the period for effects would be comparatively longer. For impacts where recovery times are on the order of years, such as disturbance to eelgrass, an annual or every few year repeat disturbance may never allow a full recovery of the eelgrass from the impact or the impact would be repeated shortly after recovery is achieved.

In-water Disturbance

Activities conducted in-water include graveling, harrowing, dredging, mechanical longline harvest, and geoduck dive harvest where there is potential to directly affect fish species. To determine the frequency and extent of these in-water activities at a regional scale, estimates were made for the total acres per day worked and total activity days for each region. ‘Acres worked per day’ is an estimate of the number of acres that would be worked every day for one year to complete the tasks in one year. The analysis assumes the activity effort is equally spread across the entire year which may be unrealistic but does provide some indication of the relative scale of the collective activity level. 'Activity days per year' is an estimate of the number of days that are required to be worked in order to complete the task on the activity acres during one year. It is analogous to ‘man-days’. More detail including the methodology used to develop the estimates can be found in Appendix C. The locations of the specific in-water activities can be found in Appendix F. This analysis is for work that occurs in the intertidal zone, so it does not include subtidal geoduck dive harvest.

The analysis suggests work is regularly occurring, perhaps on a daily basis, at the regional scale. This is consistent with the idea that shellfish product must be delivered to market on a regular and perhaps daily basis. Willapa Bay is by far the region with the most work occurring. There are an estimated 139 acres that would be worked each work day to accomplish all the tasks in one year. Relative to the total tideland acreage per region, the acres worked per day estimate is negligible (0.3 % in Willapa Bay). If assume work only occurs once per month, this increases to 6% of the tidelands worked in Willapa Bay on that one day per month. In some small embayments where shellfish activities are more concentrated, this percentage of activity relative to the total tidelands in that one embayment would be higher.

Subtidal Disturbance

In-water activities would also occur for the subtidal geoduck element of the proposed action. These activities would all be conducted in subtidal waters. These activities are expected to occur just about every day on a limited acreage in the Hood Canal and two Puget Sound regions. The locations for the subtidal geoduck harvest tracts are illustrated in Appendix H. The vast majority, but not necessarily all, of the subtidal geoduck harvest would be expected to occur within these localized areas. The North Puget Sound region is about 1.4 million acres, Hood Canal is about 100,000 acres, and south Puget Sound about

300,000 acres. The total annual harvested acreage of about 6,000 acres under the proposed action would be distributed throughout these broad areas but concentrated along the shorelines in most cases. The estimated maximum acreage harvested per day comprise an insignificant percent of the total area within these regions.

Table 7-4. Estimated frequency in-water activities would be conducted in the intertidal zone (see Appendix C for details)

		acres engaged in in-water activities	in-water activity acres worked/day	in-water activity days/year
Grays Harbor	Continuing active	2,018	5.9	4,003
	Cont. fallow & new	2,885	9.5	5,579
	Subtotal	4,903	15.4	9,582
Willapa Bay	Continuing active	25,113	86.0	42,542
	Cont. fallow & new	15,164	53.2	25,340
	Subtotal	40,277	139.1	67,882
Hood Canal	Continuing active	645	1.6	1,408
	Cont. fallow & new	1,609	4.9	2,719
	Subtotal	2,254	6.6	4,127
South Puget Sound	Continuing active	2,283	7.9	3,959
	Cont. fallow & new	1,939	6.1	3,551
	Subtotal	4,222	14.0	7,510
North Puget Sound	Continuing active	1,649	6.0	2,531
	Cont. fallow & new	3,162	11.3	3,912
	Subtotal	4,811	17.3	6,443
Total	Continuing active	31,708	107.4	54,442
	Cont. fallow & new	24,759	85.0	41,101
	Grand Total	56,467	192.4	95,543

Note: acres worked/day assumes work occurs each work day throughout the year (260 work days/yr)

7.2.4. Cover Nets and Artificial Structure

Culture methods that result in a change to the substrate (e.g., bag culture, cover nets) would result in impacts that may be more or less continuous for the period of the PBA because there is no recovery or return to the prior substrate and habitat conditions. A new crop of bags would be placed shortly after the previous crop is harvested. Geoduck culture would result in periods with and without structure. Depending on individual grower practices, structure to support geoduck culture is expected to occur between 30 and 60% of the time for the anticipated 20 period of the PBA.

The placement of artificial structure for growing shellfish occurs in all the geographic regions of the PBA. The number of acres potentially with artificial structure is summarized by region in Table 7-5. These acreages are best interpreted as a maximum for each culture method which, if implemented, would result in a less than equivalent decrease in acreage for another activity in the region (see discussion in Appendix B). The geographic locations where cover nets would occur for the continuing active and fallow acres are illustrated in Appendix G. It is assumed that all new aquaculture activities will also employ methods using artificial structure. Restoration and recreation related activities are generally not expected to employ artificial structure although there may some exceptions.

Table 7-5. Artificial structure by region

		Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound
oyster longline/stake	active	732	4,377	268	171	719
	fallow	533	1,913	77	51	2,081
rack and/or bags (clam and oyster)	active	29	829	115	189	328
	fallow	6	72	23	51	2,050
geoduck tubes	active	0	1	453	931	369
	fallow	0	67	110	518	2,108
cover nets	active	0	3,380	538	2,011	637
	fallow	0	2,637	337	724	2,204
new aquaculture		100	100	438	448	315
total	active	861	8,687	1,812	3,750	2,368
	fallow & new	639	4,789	985	1,792	8,758
total (plastic structure only)	active	129	4,310	1,544	3,579	1,649
	fallow & new	106	2,876	908	1,741	6,677

Notes:
1. Acreages are likely overstated by some unknown amount due to double or triple counting associated with limited detail on permit applications (See App. B). Acreages are best interpreted as a maximum for each activity which, if implemented, would result in a less than equivalent decrease in acreage for another activity in the region.
2. All new acres assumed to potentially contain plastic structure or longline/stake.

7.2.5. Eelgrass

The continuing active and fallow aquaculture acres could potentially occur in areas with eelgrass. A geographic analysis was conducted to estimate the aquaculture acreage potentially co-located with eelgrass. A description of the analysis, detailed results, and figures illustrating geographic locations where aquaculture and eelgrass are co-located can be found in Appendix D. The results provide a conservative estimate of aquaculture co-located with eelgrass appropriate for the PBA. The results are summarized in Table 7-6. They suggest there is substantial overlap between eelgrass and much of the continuing active and fallow aquaculture acreage. This pattern occurs in all the geographic regions. An estimated 14,803 acres of continuing active aquaculture is potentially co-located with eelgrass across all the geographic regions. This results in reduced productivity and habitat function for this eelgrass as discussed in Section 7.1. This is an ongoing effect under the environmental baseline that will continue under the proposed action. An estimated 11,227 acres of continuing fallow acreage would be co-located with eelgrass under the proposed action. Effects to eelgrass in the fallow areas would be considered new effects relative to the environmental baseline. The magnitude of effect would be dependent on the type of culture method employed and the activities conducted as described in Section 7.1.

Willapa Bay has by far the most overlap between eelgrass and the continuing active and fallow acres. This is followed by the North Puget Sound and Grays Harbor regions where over 1,000 acres of eelgrass are estimated to overlap with the fallow acreage. Aquaculture activities (active and fallow) are more often than not co-located with eelgrass in Willapa Bay, Grays Harbor, and the North Puget Sound Region. In the Hood Canal region, aquaculture acreage is equally split between areas with and without eelgrass. The South Puget Sound region appears to be the notable exception where a minority of the acreage is co-located with eelgrass. Continuing aquaculture activities would occur in 49% of the total mapped eelgrass acreage in Willapa Bay and 21% of the mapped eelgrass in Hood Canal. These percentages are less in the other regions.

New aquaculture, recreation, and restoration related shellfish activities would not be located in eelgrass (*Z. marina*) under the proposed action. They would be located a minimum of 16 ft from the boundary of eelgrass per a Conservation Measure.

Table 7-6. Summary of shellfish activities potentially co-located with eelgrass

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound	Total
# continuing active footprints	17	161	34	2	21	235
continuing active acres	766	12,170	392	180	1,131	14,803
# continuing fallow footprints	13	81	42	1	13	150
continuing fallow acres	1,152	7,448	294	95	2,239	11,227
Total acres (active & fallow):	1,918	19,618	685	275	3,370	25,866
% of continuing active acreage potentially co-located with eelgrass	67%	74%	41%	8%	84%	66%
% of continuing fallow acreage potentially co-located with eelgrass	63%	79%	73%	12%	96%	76%
% of eelgrass in region potentially co-located with aquaculture (active & fallow)	5%	49%	21%	9%	7%	20%

Note: See Appendix D for more detail, summary of methodology, and geographic locations

7.2.6. Forage Fish

The continuing active and fallow acreages could be co-located with forage fish spawning areas and thus affect spawning success as discussed previously in Section 7.1. A geographic analysis was conducted to estimate the aquaculture acreage potentially co-located with forage fish spawning areas. A description of the analysis, detailed results, and figures illustrating geographic locations where aquaculture and forage fish spawning are co-located can be found in Appendix E. The analysis is summarized in Table 7-7 and suggests there is substantial overlap between forage fish spawning locations and aquaculture activities. There are an estimated total of 3,297 fallow acres across all regions co-located with forage fish spawning areas. In the two Puget Sound regions and in Hood Canal, active and fallow acreage is co-located with mapped spawning habitat for all three forage fish species analyzed. In Grays Harbor and Willapa Bay, aquaculture acreage appears co-located only with herring spawning areas.

Table 7-7. Summary of continuing active and fallow acreage potentially co-located with WDFW mapped forage fish spawning areas

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound	Total
Herring						
continuing active acres	73	2,200	211	79	486	3,049
continuing fallow acres	0	510	58	14	2,184	2,766
Surf smelt						
continuing active acres	0	0	130	532	59	721
continuing fallow acres	0	0	67	359	15	441
Sand lance						
continuing active acres	0	0	169	78	79	326
continuing fallow acres	0	0	28	20	42	90
total *active* acres co-located with spawning areas	73	2,200	510	688	623	4,094
% of total active acres co-located with spawning areas	6%	13%	54%	29%	46%	18%
total *fallow* acres co-located with spawning areas	0	510	153	394	2,241	3,297
% of total fallow acres co-located with spawning areas	0%	5%	37%	50%	96%	22%
cumulative total (active + fallow):	73	2,710	663	1082	2,864	7,391
% of cumulative total co-located with spawning areas	2%	10%	49%	34%	78%	20%

Note: See Appendix E for more detail, summary of methodology, and maps.

The analysis suggests that Willapa Bay and North Puget Sound are the regions where the most overlap may occur on an acreage basis. Relative to the total mapped herring spawning area in each region, activities in Willapa Bay tend to occur in well over half of the mapped spawning area, by far the largest proportion of any of the regions. Most of this overlap is with ongoing aquaculture activities. The North Puget Sound region contains the most fallow acres (2,241 acres) potentially co-located with forage fish spawning areas. Much of this is overlap with the herring spawning area in Samish Bay. The South Puget Sound region active and fallow acres are co-located more with surf smelt spawning areas relative to the other two species.

Table 7-8. Percent of total mapped herring spawning area potentially affected by continuing activities in active and fallow areas

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound
Total WDFW mapped herring spawning acres	462	4,691	5,179	4,740	33,730
% of total mapped herring acres that potentially overlap with continuing active acres	16%	47%	4%	2%	1%
% of total mapped herring acres that potentially overlap with continuing fallow acres	0%	11%	1%	0.3%	6%

7.3. Summary of Primary Effects by Region

This section summarizes the future expected activities and habitat effects for each of the geographic regions of the PBA. Assumptions about the aquaculture action discussed previously in Section 3 are repeated below and in Table 7-9 to provide context for the discussion. The assumptions are:

1) The future anticipated shellfish activities/species cultured on the *continuing active* acreage will remain largely the same relative to the activities that have been occurring over the recent history as described in permit applications.
2) The future anticipated shellfish activities/species cultured on the *continuing fallow* acreage will be consistent with that expressed in permit applications for each region. These activities closely mirror the activities on the continuing active acreage.
3) The future anticipated shellfish activities/species cultured on the *new* acreage is assumed to approximate the species cultured distribution estimates provided to the Corps from the shellfish industry illustrated in Table 7-9 under new acres (PCSGA 2013a).

7.3.1. Grays Harbor

Oyster bottom culture and its related activities predominate in Grays Harbor with longline culture also common. In-water activities common to the region include dredging, harrowing, and longline harvest. This is expected to continue in the future. Fallow and new acreage is also anticipated to be predominantly for oyster culture using the same methods. No cover nets are currently documented in Grays Harbor, and they would not be expected to occur for new activities except on a very limited basis. For purposes of the analysis, however; it is assumed that all new activities could contain cover nets or bags for clam culture. No restoration, recreation, or subtidal geoduck activities are expected to occur in Grays Harbor.

A total of 5% of the total tidelands in the region would be altered from the current relatively undisturbed condition to an aquaculture farm with corresponding effects on the habitat and species. Effects from activities conducted on this acreage would persist for as long as the anticipated time period of the PBA and likely beyond. Cumulatively, effects from all shellfish activities including on acreage classified as continuing active would occur on 7.5% of the tidelands in Grays Harbor. Effects would be concentrated in the North and South lobes of the embayment on the extensive tidelands in these areas (see Figure D-1).

Table 7-9. Summary of anticipated future aquaculture species cultured and methods

	Grays Harbor	Willapa Bay	Hood Canal	South Puget Sound	North Puget Sound
continuing active acres	1,145	16,397	949	2,351	1,354
cultured species distribution and methods	oyster dominant	oyster primary followed by clam, negligible geoduck	oyster most common followed closely by clam, less geoduck	relatively equal distribution of oyster, clam; slightly less geoduck	oyster and clam most common; less geoduck
oyster	95%	80-95%	40-60%	30-50%	50-60%
clam	1-5%	5-15%	20-40%	30-50%	30-40%
geoduck	0%	1%	10-20%	15-30%	1-10%
mussel	0%	1%	1%	1%	1%
oyster culture methods	bottom culture primary; longlines common	bottom culture primary; some longlines; limited rack & bag	bottom culture primary; some longlines; limited rack & bag	bottom culture dominant; limited rack & bag, longlines	bottom culture primary; longlines common; some rack & bag
clam culture methods	bottom	bottom	bottom	bottom	bottom
mussel culture methods	NA	surface longlines	rafts & surface longlines	rafts & surface longlines	rafts & surface longlines
continuing fallow acres	1,820	9,468	402	780	2,333
cultured species distribution and methods	same cultured species & methods as cont. active above	same cultured species & methods as cont. active above	same cultured species & methods as cont. active above	same cultured species & methods as cont. active above	same cultured species & methods as cont. active above
new aquaculture acres	100	100	438	448	315
oyster & clam	95%	25%	78%	62%	79%
geoduck	0%	50%	18%	33%	19%
mussel	5%	25%	4%	5%	2%
total aquaculture acres	3,065	25,965	1,789	3,578	4,002
recreation acres	0	0	74	41	45
restoration acres	0	0	24	126	5
subtidal geoduck acres	0	0	6,703	22,676	18,754

Note: only new suspended lines for mussels would be authorized under the PBA (i.e., not rafts)

There are an estimated 1,152 fallow acres co-located with eelgrass in Grays Harbor. The action assumes oyster bottom and longline culture methods would occur in these areas in the future. This would substantially reduce or eliminate the eelgrass in these areas at least during significant portions of the culture and harvest cycle. It does not appear that any fallow acreage is co-located with forage fish spawning areas so no impact to these species is anticipated.

Temporary habitat effects of the activities include short-term degradation of water quality, noise and general activity disturbance, and temporary decreases in benthic community abundance. These activities would be expected to displace fish and other species in the immediate vicinity of the activity. The frequency of in-water work is conservatively estimated to be 10 acres worked per day averaged over one year for activities on fallow and new acres and 15 acres per day for all shellfish activities, which is 0.04% of the total tideland area in the Grays Harbor region.

7.3.2. Willapa Bay

Oyster bottom culture is the primary culture method in Willapa Bay with a lesser amount of longline culture, limited oyster rack and bag culture and some clam culture. There does appear to be substantial acreage with cover nets. In-water activities common to the region include dredging, harrowing, graveling, and longline harvest. This relative distribution of culture methods and individual activities is expected to continue in the future on both continuing active and fallow acres. New activities are expected to be focused on geoduck culture with lesser amounts of clam, oyster, and mussel culture. No restoration, recreation, or subtidal geoduck activities are expected to occur in Grays Harbor.

A total of 19% of the total tidelands in the region would be altered from the current relatively undisturbed condition to an aquaculture farm with corresponding effects on the habitat and species. Effects from activities conducted on this acreage would persist for as long as the anticipated time period of the PBA and likely beyond. Cumulatively, effects from all shellfish activities including on acreage classified as continuing active would occur on 53% of the tidelands in Willapa Bay. Effects would occur throughout the region on the extensive tidelands that characterize the embayment.

There are an estimated 7,448 fallow acres co-located with eelgrass in Willapa Bay. The action assumes oyster bottom and the other activities listed above would occur in these areas in the future. This would substantially reduce or eliminate the eelgrass in these areas at least during significant portions of the culture and harvest cycle. There are an estimated 510 fallow acres co-located with herring spawning areas. Spawning in these areas would be negatively affected primarily by the loss of eelgrass spawning substrate.

Temporary habitat effects of the activities include short-term degradation of water quality, noise and general activity disturbance, and temporary decreases in benthic community abundance. These activities would be expected to displace fish and other species in the immediate vicinity of the activity. The frequency of in-water work is conservatively estimated to be 53 acres worked per day averaged over one year for activities on fallow and new acres and 139 acres per day for all shellfish activities, which is 0.3% of the total tideland area in the Willapa Bay region.

7.3.3. Hood Canal

Oyster and clam culture are both common in Hood Canal with a smaller amount of geoduck. Bottom culture is the primary method for growing all species. There are lesser amounts of longline and rack and/or bag culture. About 10% of the continuing footprints have cover nets. In-water activities that occur include graveling, dive harvest, and longline harvest. This relative distribution of culture methods and individual activities is expected to continue in the future on both continuing active, fallow, and new aquaculture acres. Subtidal geoduck harvest, and some restoration, and recreation related shellfish activities are also expected to occur in Hood Canal.

A total of 8% of the total tidelands in the region would be altered from the current relatively undisturbed condition to an aquaculture farm with corresponding effects on the habitat and species. Effects from activities conducted on this acreage would persist for as long as the anticipated time period of the PBA and likely beyond. Cumulatively, effects from all shellfish activities including on acreage classified as continuing active would occur on 16% of the tidelands. Hood Canal is a deep fiord like embayment characterized by narrow ribbons of tidelands along the shoreline interrupted by small estuaries at river mouths that have a somewhat greater tideland area depending on the size of the river. Activities and their effects would be focused along these shoreline areas and estuaries throughout the region.

There are an estimated 257 fallow acres co-located with eelgrass in Hood Canal. The action assumes oyster and clam bottom and the other activities listed above would occur in these areas in the future. This would substantially reduce or eliminate the eelgrass in these areas at least during significant portions of the culture and harvest cycle. There are an estimated 153 fallow acres co-located with forage fish spawning areas. Spawning in these areas would be negatively affected primarily by the loss of aquatic vegetation spawning substrate and smothering of eggs.

Temporary habitat effects of the activities include short-term degradation of water quality, noise and general activity disturbance, and temporary decreases in benthic community abundance. These activities would be expected to displace fish and other species in the immediate vicinity of the activity. The frequency of in-water work is conservatively estimated to be 5 acres worked per day averaged over one year for activities on fallow and new acres and 7 acres per day for all shellfish activities, which is 0.05% of the total tideland area in the Hood Canal region.

7.3.4. South Puget Sound

Oyster and clam culture are both common in South Puget Sound followed closely by geoduck. Bottom culture is the primary method for growing all species with some longline and rack and/or bag culture. Cover nets are common and occur on about 75% of the continuing footprints. In-water activities that occur include dredging, graveling, dive harvest, and longline harvest. This relative distribution of culture methods and individual activities is expected to continue in the future on both continuing active, fallow, and new aquaculture acres. Subtidal geoduck harvest, and some restoration, and recreation related shellfish activities are also expected to occur in South Puget Sound.

A total of 5% of the total tidelands in the region would be altered from the current relatively undisturbed condition to an aquaculture farm with corresponding effects on the habitat and species. Effects from activities conducted on this acreage would persist for as long as the anticipated time period of the PBA and likely beyond. Cumulatively, effects from all shellfish activities including on acreage classified as continuing active would occur on 12% of the tidelands. Activities and effects in the South Puget Sound region would be focused in the south and east part of the region along shoreline areas and in small embayments although new activities could occur throughout the region. Most of the acreage in some of these smaller estuaries may be engaged aquaculture.

There are an estimated 115 fallow acres co-located with eelgrass in South Puget Sound. The action assumes the shellfish activities listed above would occur in these areas in the future. This would substantially reduce or eliminate the eelgrass in these areas at least during significant portions of the culture and harvest cycle. There are an estimated 394 fallow acres co-located with forage fish spawning areas, primarily for surf smelt. Spawning in these areas would be negatively affected primarily by the smothering of eggs.

Temporary habitat effects of the activities include short-term degradation of water quality, noise and general activity disturbance, and temporary decreases in benthic community abundance. These activities would be expected to displace fish and other species in the immediate vicinity of the activity. The frequency of in-water work is conservatively estimated to be 6 acres worked per day averaged over one year for activities on fallow and new acres and 14 acres per day for all shellfish activities, which is 0.05% of the total tideland area in the South Puget Sound region. Given the concentration of activity acreage in the south and east corner of the region, the frequency of activity in this area would be quite a bit higher than this average.

7.3.5. North Puget Sound

Oyster and clam culture are both common in North Puget Sound with a very small amount of geoduck. Bottom culture is the primary method for growing all species with some longline, stake, and rack and bag culture. Cover nets are common and occur on about 46% of the continuing footprints. In-water activities that occur include graveling, harrowing, dive harvest, and longline harvest. This relative distribution of culture methods and individual activities is expected to continue in the future on both continuing active, fallow, and new aquaculture acres. Subtidal geoduck harvest, and some restoration, and recreation related shellfish activities are also expected to occur in North Puget Sound.

A total of 3% of the total tidelands in the region would be altered from the current relatively undisturbed condition to an aquaculture farm with corresponding effects on the habitat and species. Effects from activities conducted on this acreage would persist for as long as the anticipated time period of the PBA and likely beyond. Cumulatively, effects from all shellfish activities including on acreage classified as continuing active would occur on 5% of the tidelands. Activities and effects in the North Puget Sound region would be focused in a handful of embayments including Samish Bay, Discovery Bay, Sequim Bay, Kilisut Harbor and in the vicinity of Skagit Bay. The percent of tidelands engaged in shellfish activities in these embayments would be significantly higher than this regional average. For example, 50% of the tidelands in Samish Bay contain continuing active or fallow acreage. New activities could occur throughout the region.

There are an estimated 2,194 fallow acres co-located with eelgrass in North Puget Sound. The action assumes the shellfish activities listed above would occur in these areas in the future. This would substantially reduce or eliminate the eelgrass in these areas at least during significant portions of the culture and harvest cycle. There are an estimated 2,241 fallow acres co-located with forage fish spawning areas, primarily for herring. Spawning in these areas would be negatively affected by the loss of eelgrass spawning substrate.

Temporary habitat effects of the activities include short-term degradation of water quality, noise and general activity disturbance, and temporary decreases in benthic community abundance. These activities would be expected to displace fish and other species in the immediate vicinity of the activity. The frequency of in-water work is conservatively estimated to be 11 acres worked per day averaged over one year for activities on fallow and new acres and 18 acres per day for all shellfish activities, which is 0.02% of the total tideland area in the region. The frequency of activity in the embayments where activities are concentrated would be significantly higher than this regional average.

7.4. Interrelated Effects

The two interrelated/interdependent activities are vessel and vehicle traffic occurring to and from the shellfish activity areas and the use of upland storage sites. Effects of the interrelated vessel and vehicle traffic are similar to that described for vehicle and vessel traffic conducted as part of the proposed action (Section 7.1.7). The effects would simply be extended beyond the immediate vicinity of the shellfish activity areas. The additional traffic contributed by shellfish activities to the total traffic in the various geographic regions is negligible in most areas. In more remote locations, such as Willapa Bay, the shellfish activity traffic may constitute a high percentage of the total traffic. Conservation Measures would help to minimize any effects from vehicle and vessel traffic.

Upland storage sites would be used to store shellfish equipment such as nets, bags, racks, and tubes. Shell could also be stored at these sites. Effects to the environment from the use of these sites would be minor in part due to the Conservation Measures which would minimize effects to vegetation and require certain best management practices.

7.5. Cumulative Effects

Cumulative effects include those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

Non Federal actions in the area include State shellfish or angling regulations, State hatchery practices, discharge of stormwater and agricultural runoff, increased population growth, industrial development, and urbanization. State shellfish and angling regulation changes generally support greater restrictions on recreation to protect listed species. State hatchery practices may have negative effects on naturally produced salmonids through genetic introgression, competition, and disease transmission resulting from hatchery introductions. Future urban growth and industrial development within or near the action area may adversely affect water quality and estuarine productivity.

8. Effect Determinations

The proposed action includes the authorization or reauthorization by permit of work conducted in support of shellfish aquaculture, recreation, restoration, and subtidal geoduck harvest. These activities result in a pattern of effects on the environment that individually have varying levels of persistence ranging from several days (e.g., temporary increases in suspended sediment) to many years (e.g., degraded eelgrass, leveling of substrate). For aquaculture, this pattern includes a regular frequency to the individual and collective effects over time as the activities are repeated. In the continuing active aquaculture areas, this pattern of effects has been occurring since at least 2007 and pre-date the environmental baseline benchmark date. The effect of the action for continuing aquaculture is to continue this pattern of effects in these areas for the period of any permit. This pattern of effects does not currently occur in the fallow and new aquaculture areas. The proposed action assumes initiation of aquaculture activities and their pattern of effects in the continuing fallow and new areas. The effects from the three categories of aquaculture acreage (i.e., active, fallow, and new) would continue for the 20 year period of the PBA. The effects of the action on each of the ESA listed species are summarized below. Additional detail on individual effects can be found in the previous section.

The determination of effect conclusion for each species and critical habitat is based on the following definitions described in the ESA Consultation Handbook (USFWS and NMFS 1998).

- *No effect* - the appropriate conclusion when the action agency determines its proposed action will not affect a listed species or designated critical habitat.
- *May affect* - the appropriate conclusion when a proposed action may pose any effects on listed species or designated critical habitat.
- *Is not likely to adversely affect* - the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.
- *Is likely to adversely affect* - the appropriate finding in a biological assessment (or conclusion during informal consultation) if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not: discountable, insignificant, or beneficial (see definition of "is not likely to adversely affect"). In the event the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, then the proposed action "is likely to adversely affect" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "is likely to adversely affect" determination should be made.
- *Take* - to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct. Harm is further defined by FWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by FWS as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering.

8.1. Puget Sound Chinook Salmon

Of the five geographic regions that are included within the proposed action, Puget Sound Chinook salmon are potentially affected by activities conducted in three of the regions including Hood Canal, South Puget Sound, and North Puget Sound. They are not present in Willapa Bay or Grays Harbor and should not be affected by proposed activities conducted in these two regions.

8.1.1. Species Effects

The following effects to Chinook salmon are expected to occur during the anticipated 20 year period of the PBA. Specific geographic locations where effects to Chinook salmon are more likely to occur are estuaries at the mouths of rivers with spawning Chinook salmon populations (Appendix H). Such rivers with significant aquaculture acreage include the Nisqually, Skagit, and Skokomish Rivers. During the early part of the emigration season (e.g., February), juveniles are smaller and may be more vulnerable in these areas

Cover nets are located in many locations in the nearshore habitat where juvenile Chinook salmon would occur including at the mouths of the Nisqually, Skagit, and Skokomish Rivers (Appendix G). As discussed in Section 7.1, unsecured and damaged nets have been documented capturing and killing fish species. The action includes a Conservation Measure to minimize the degree this occurs. However, given the prevalence of nets, inconsistent husbandry practices, difficulty fully securing nets in the aquatic environment, proximity to major spawning rivers, and the 20 year time period of the PBA, some unknown amount of juvenile salmon entanglement in nets is likely to occur. Rack and/or bag culture may function in a similar manner resulting in the entrapment and/or stranding of juvenile salmon as the tide retreats from these areas (see Section 7.1). These would be considered adverse effects to this species.

Salmon prey species would be negatively affected by the proposed action. Invertebrate prey would be temporarily reduced following many of the individual activities resulting in decreased foraging success and displacement of juveniles for potentially months at a time in the most impacted areas. While the scale is relatively large with some amount of impacted acreage occurring nearly continuously for the duration of the PBA, it would still account for a small percent of the total area available for foraging at any one time. Shifts in the benthic community may occur across large tideland acreages due to alteration of the benthic substrate. This would have unknown consequences for the benthic invertebrates preferred by juvenile salmon.

The action would result in temporary in-water disturbance and noise associated with human activity and degradation of water quality such as increases in suspended sediments. These effects would occur broadly throughout the action area and occur on a near daily basis for the 20 year period of the PBA including when juvenile Chinook salmon are present. These activities would displace juveniles.

8.1.2. Critical Habitat

There are about 161,800 acres of designated nearshore critical habitat for Puget Sound Chinook salmon. Within this area, there are 4,654 acres of continuing active aquaculture activity (ground-based and floating), 3,515 acres of continuing fallow aquaculture, and 1,201 acres of new aquaculture. Together this represents 6% of the designated critical habitat. Recreation and restoration related shellfish activities would add another 315 acres of shellfish activities conducted within the critical habitat. There is some variation in the extent of effects depending on the geographic region. Effects from activities conducted on the new and fallow acreage would occur on 8% of the total tidelands in Hood Canal, 5% of the total tidelands in South Puget Sound, and 3% of the total tidelands in North Puget Sound (Table 7-2). Within these broad geographic regions, shellfish activities would be concentrated in certain areas or smaller embayments (Appendix D). This includes the southwest corner of Puget Sound, Samish Bay, Discovery Bay, Kilisut Harbor, and numerous locations in Hood Canal. Continuing fallow acreage occurs in the deltas of the Nisqually and Skokomish Rivers, and numerous smaller river deltas with Puget Sound Chinook salmon spawning populations. Since the critical habitat extends to a depth of 30 meters, the influence of these activities would be biased towards the shallower part of this range and occur predominantly in the intertidal elevation range.

Most of the subtidal geoduck harvest would also occur within Chinook salmon critical habitat. This activity would occur in deeper waters than the other shellfish activities. While the typical annual acreage for this activity is expected to be small on the order of 300 acres, the annual maximum harvested acreage is 6,050 acres under the proposed action which is about 4% of the critical habitat. This would be in addition to the maximum 6,000 acres annual harvest rate under the geoduck HCP. Combining all acreage where shellfish activities could occur annually, the cumulative total represents 13% of the Chinook salmon critical habitat. Appendix H illustrates the location of the continuing and new (as of July 2014) aquaculture activities relative to designated nearshore critical habitat for Puget Sound Chinook salmon.

The proposed action would not affect freshwater critical habitat and associated PCEs 1, 2, and 3. It would also not affect offshore areas and associated PCE 6. Potential effects to PCEs 4 and 5 for estuarine and nearshore areas are discussed below.

PCE 4. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh-and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

- Continuing fallow and new acreage would be altered from the current relatively undisturbed condition to an aquaculture farm with corresponding effects on the habitat. Natural structure and habitat such as large wood, boulders, and tidal channels would be removed. Artificial structure including plastic nets, bags, tubes, and metal stakes would be added. This would temporarily decrease benthic community abundance and may lead to shifts in species composition over time. Activities causing regular substrate and water column disturbance would occur regularly which would decrease benthic community abundance. Ongoing effects from the activities conducted on the continuing active acreage would continue to occur for the period of the PBA.
- Eelgrass would be substantially degraded or removed in areas identified as continuing fallow. The frequency of disturbance would likely result in a condition where eelgrass never fully recovers. The amount of eelgrass acreage impacted is roughly estimated to be 2,628 acres within the designated critical habitat. Eelgrass provides numerous habitat functions including sediment stabilization, improved water quality, and a substrate for Pacific herring spawning. It is also a key component of the estuarine and nearshore food web harboring numerous invertebrate salmon prey species, and provides cover for juvenile salmon from predators. Loss of eelgrass would negatively affect these habitat functions. These effects would be most evident in Samish Bay in the North Puget Sound Region, in numerous locations throughout Hood Canal including the Skokomish River delta, and in the Nisqually River delta in the South Puget Sound Region (see Appendix D).
- There would be reduced spawning success of forage fish prey species where aquaculture acreage is co-located with spawning. There are an estimated 2,788 fallow and 1,821 active aquaculture acres that are co-located with mapped forage fish spawning areas within the critical habitat.

PCE 5. Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural *cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.*

- Nearshore marine areas would be affected in a manner similar to that described above under PCE 4.

8.1.3. Effect Determination

The proposed action *may affect, likely to adversely affect* Puget Sound Chinook salmon and Puget Sound Chinook salmon designated critical habitat.

8.2. Lower Columbia River Chinook Salmon

Lower Columbia River Chinook salmon are presumed to occasionally occur in Willapa Bay, Grays Harbor, and the western part of the Strait of Juan de Fuca (North Puget Sound region). They are potentially affected by activities conducted in these regions.

8.2.1. Species Effects

The effects discussed above for Puget Sound Chinook salmon could also occur to lower Columbia River Chinook salmon in Willapa Bay and other parts of the action area where they may occur. However, given the only occasional presence of this species in the action area, effects would be insignificant or discountable.

8.2.2. Critical habitat

There is no designated critical habitat for lower Columbia River Chinook salmon within the action area.

8.2.3. Effect Determination

The proposed action *may affect, but is not likely to adversely affect* Lower Columbia River Chinook salmon. The proposed action would have *no effect* on Lower Columbia River Chinook salmon designated critical habitat.

8.3. Hood Canal Summer Chum Salmon

Of the five geographic regions that are included within the proposed action, Hood Canal summer chum salmon are potentially affected by activities conducted in the Hood Canal and North Puget Sound regions. They are not present in Willapa Bay or Grays Harbor and are not expected to occur in the south Puget Sound region.

8.3.1. Species Effects

When they first enter saltwater, juvenile chum are small, not strong swimmers, and typically remain in very shallow water close to the shoreline (Simenstad 2000). They are thus more vulnerable to the activities conducted under the proposed action at this stage in their life history. There are a number of relatively small streams (e.g., Jimmycomelately Cr., Tahuya River) and even some larger streams (e.g., Hamma Hamma River) with spawning chum populations that have substantial aquaculture acreage located at the river mouth (Appendix H). For example, of the approximately 140 acres of tidelands at the mouth of Jimmycomelately Cr., 68 are classified as fallow aquaculture and 11 acres are classified as active aquaculture. The fallow acreage alone represents about 50% of the total tideland area. It is possible substantial new acreage could also be initiated in one or several of these estuaries to the point where most of the estuarine tidelands are engaged in some form of aquaculture.

Cover nets are located in many locations in the nearshore habitat and smaller estuaries where juvenile chum salmon would occur (Appendix G). As discussed in Section 7.1, unsecured and damaged nets have been documented capturing and killing fish species. The action includes a Conservation Measure to minimize the degree this occurs. However, given the prevalence of nets, inconsistent husbandry practices, difficulty fully securing nets in the aquatic environment, proximity to major spawning rivers, and the 20 year time period of the PBA, some unknown amount of juvenile salmon entanglement in nets is likely to occur. Rack and/or bag culture may function in a similar manner resulting in the entrapment and/or stranding of juvenile salmon as the tide retreats from these areas (see Section 7.1).

Salmon prey species would be negatively affected by the proposed action. Invertebrate prey would be temporarily reduced following many of the individual activities resulting in decreased foraging success and displacement of juveniles for potentially months at a time in the most impacted areas. While the scale is relatively large with some amount of impacted acreage occurring nearly continuously for the duration of the PBA, it would still account for a small percent of the total area available for foraging at any one time. In localized areas such as at the mouths of the smaller streams mentioned above, the scale of effect may be greater depending on the timing of the work. Since activities could occur at any time of year, it is possible (perhaps likely given the scale and timeframe of the PBA) that an activity such as dredging or geoduck harvest could occur across a substantial portion of the acreage of one of these small estuaries immediately preceding and/or during the juvenile emigration period. This could result in substantial depletion of the benthic invertebrate prey community in this estuary during the time juvenile chum salmon are arriving. Juvenile chum emigrate early in the year when there is typically low prey abundance and they are known to migrate rapidly and far in search of prey (Tynan 1997, WDFW and Point No Point Treaty Tribes 2000). This scenario would add to the already low prey base at this time of year, increase competition between juveniles, and force additional travel in search of prey which may increase vulnerability to predators. If the activities were conducted in the main flow of the channel, chum may be vulnerable to injury from striking equipment.

The action would result in temporary in-water disturbance and noise associated with human activity and degradation of water quality such as increases in suspended sediments. These effects would occur broadly throughout the action area and occur on a near daily basis for the 20 year period of the PBA including when juvenile chum salmon are present. These activities would displace juveniles. They may be unable to avoid areas with high amounts of suspended sediments in some cases, for example in tidal channels adjacent to work areas. Given the narrow band of shallow water habitat along the shoreline in Hood Canal, it is possible a shellfish activity and its immediate effects could occupy most of this shoreline habitat in a localized area and potentially interrupt migration, forcing juveniles into deeper waters and increasing their vulnerability to predators.

The scale of the action acreage, proximity to juvenile salmon, and the 20 year timeframe of the PBA suggest all or most of the effects described above are likely to occur. They are therefore not discountable and would be considered adverse effects on chum salmon.

8.3.2. Critical Habitat

There are about 24,658 acres of designated nearshore critical habitat for Hood Canal summer chum salmon much of which extends into the North Puget Sound Region along the Olympic Peninsula. Within the boundary of the designated critical habitat, there are a total of 1,087 continuing active acres and 577 continuing fallow acres (Appendix H). There are also potentially 748 acres of new aquaculture assuming all the new acreage for the North Puget Sound region occurs within the critical habitat. Together this represents about 10% of the critical habitat that would be engaged in regular aquaculture activities. These activities would occur predominantly in the intertidal zone and would be spread throughout the critical habitat. Aquaculture activities are concentrated in a number of locations along Hood Canal including the Narrows and Quilcene Bay, and just north of Hood Canal in Discovery Bay and Kilisut Harbor. Recreation and restoration could add another 148 acres of shellfish activity within the critical habitat. Up to 3,000 acres of subtidal geoduck harvest under the PBA and 3,000 under the WDNR HCP could also occur within the critical habitat on an annual basis. Combining all acreage where shellfish activities could occur annually, the cumulative total represents 34% of the Hood Canal summer chum salmon critical habitat.

The proposed action would not affect freshwater critical habitat and associated PCEs 1, 2, and 3. It would also not affect offshore areas and associated PCE 6. Potential effects to PCEs 4 and 5 for estuarine and nearshore areas are discussed below.

PCE 4. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh-and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

- Continuing fallow and new acreage would be altered from the current relatively undisturbed condition to an aquaculture farm with corresponding effects on the habitat. Natural structure and habitat such as large wood, boulders, and tidal channels would be removed. Artificial structure including plastic nets, bags, tubes, and metal stakes would be added. This would temporarily decrease benthic community abundance and may lead to shifts in species composition over time. Activities causing regular substrate and water column disturbance would occur regularly which would decrease benthic community abundance. Ongoing effects from the activities conducted on the continuing active acreage would continue to occur for the period of the PBA.
- Eelgrass would be substantially degraded or removed in areas identified as continuing fallow. The frequency of disturbance would likely result in a condition where eelgrass never fully recovers. A total of 10% of the total eelgrass in Hood Canal is co-located with active aquaculture and another 8% co-located with fallow acres. Eelgrass provides numerous habitat functions including sediment stabilization, improved water quality, and a substrate for Pacific herring spawning. It is also a key component of the estuarine and nearshore food web harboring numerous invertebrate salmon prey species, and provides cover for juvenile salmon from predators. Loss of eelgrass would negatively affect these habitat functions. These effects would occur in numerous locations throughout the critical habitat (see Appendix D).
- There would be reduced spawning success of forage fish prey species where aquaculture acreage is co-located with spawning. There are an estimated 153 fallow and 510 active aquaculture acres that are co-located with mapped forage fish spawning areas in Hood Canal. Additional acres are co-located with spawning areas within the critical habitat north of the Hood Canal region along the Olympic Peninsula.

PCE 5. Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.

- Nearshore marine areas would be affected in manner similar to that described above under PCE 4.

8.3.3. Effect Determination

The proposed action *may affect, likely to adversely affect* Hood Canal summer chum salmon and Hood Canal summer chum salmon designated critical habitat.

8.4. Columbia River Chum Salmon

Columbia River chum salmon are presumed to occasionally occur in Willapa Bay, Grays Harbor, and the western part of the Strait of Juan de Fuca (North Puget Sound region). They are potentially affected by activities conducted in these regions.

8.4.1. Species Effects

The effects discussed above for Puget Sound Chinook salmon could also occur to Columbia River chum salmon in Willapa Bay and other parts of the action area where they may occur. However, given the only occasional presence of this species in the action area, effects would be insignificant or discountable.

8.4.2. Critical Habitat

There is no designated critical habitat for lower Columbia River chum salmon within the action area.

8.4.3. Effect Determination

The proposed action *may affect, but is not likely to adversely affect* Columbia River chum salmon. The proposed action would have *no effect* on Columbia River chum Salmon designated critical habitat.

8.5. Puget Sound Steelhead

Puget Sound steelhead are potentially affected by activities conducted in three of the geographic regions including Hood Canal, South Puget Sound, and North Puget Sound. They are not present in Willapa Bay or Grays Harbor and should not be affected by proposed activities conducted in these two regions.

8.5.1. Species Effects

Puget Sound steelhead are thought to move quickly to offshore areas once they enter saltwater with very limited time spent in the intertidal zone (78 FR 2726, Moore et al. 2015). Their interaction with shellfish activity areas is thus also expected to be very limited. Adults also would not typically occur in the intertidal zone.

If present in the intertidal zone, steelhead would be displaced by temporary in-water disturbance and noise associated with human activity and degradation of water quality such as increases in suspended sediments. These effects would occur broadly throughout the action area and occur on a near daily basis for the 20 year period of the PBA. Given the limited presence of steelhead in shellfish activity areas, these effects would be insignificant.

8.5.2. Critical Habitat

No saltwater or estuarine areas are proposed for designation as critical habitat for Puget Sound steelhead. The proposed action would not affect freshwater areas and would thus have no effect on freshwater critical habitat proposed for steelhead. There are two PCE's proposed for steelhead that are specific to saltwater areas. The PCEs and effects of the action on the PCEs are identical to that for Puget Sound Chinook salmon discussed above.

8.5.3. Effect Determination

The proposed action *may affect, but is not likely to adversely affect* Puget Sound steelhead and *may affect, likely to adversely affect* Puget Sound steelhead proposed critical habitat.

8.6. Coastal/Puget Sound Bull Trout

Coastal/Puget Sound bull trout occur in all geographic regions of the PBA with the possible exception of Willapa Bay although they potentially could occur here as well on an infrequent basis.

8.6.1. Species Effects

Adult and sub-adult bull trout could potentially be affected by the proposed shellfish activities. Subadult and adult bull trout forage in intertidal areas (Beamer et al. 2004). The smaller individuals forage for invertebrates while larger individuals consume fish species (e.g., surf smelt, herring) (Goetz et al. 2004). Since this species is active in the intertidal zone and they occur throughout the action area, they would occur in the same location as the proposed action activities.

Bull trout would be affected by temporary in-water disturbance and noise associated with human activity and degradation of water quality such as increases in suspended sediments. These effects would occur broadly throughout the action area and occur on a near daily basis for the 20 year period of the PBA. These activities would displace bull trout.

Cover nets are located in many locations in the nearshore habitat where bull trout would occur including Discovery Bay, Samish Bay, and at the mouths of the Nisqually, Skagit, and Skokomish Rivers (Appendix G). As discussed in Section 7.1, unsecured and damaged nets have been documented capturing and killing fish species. The action includes a Conservation Measure to minimize the degree this occurs. However, given the prevalence of nets, inconsistent husbandry practices, difficulty fully securing nets in the aquatic environment, proximity to major spawning rivers, and the 20 year time period of the PBA, some unknown amount of bull trout entanglement in nets is likely to occur. Rack and/or bag culture may function in a similar manner resulting in the entrapment and/or stranding as the tide retreats from these areas (see Section 7.1). These would be considered adverse effects to this species.

Prey species would be negatively affected by the proposed action. There would be reduced spawning success of forage fish species where fallow acreage is co-located with spawning. Shifts in the benthic community may occur across large tideland acreages due to alteration of the benthic substrate. Invertebrate prey would be temporarily reduced following many of the individual activities resulting in decreased foraging success and displacement of juveniles for potentially months at a time in the most impacted areas. While the scale is relatively large with some amount of impacted acreage occurring nearly continuously for the duration of the PBA, it would still account for a small percent of the total area available for foraging at any one time. This would be an insignificant effect on bull trout.

8.6.2. Critical Habitat

Appendix H illustrates the location of shellfish activities relative to designated nearshore critical habitat for bull trout. Each of the PCEs is listed below followed by a description of potential effects on the PCE.

PCE 1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

- The proposed action would have no effect on this PCE.

PCE 2. Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

- Shellfish activities may temporarily displace bull trout from local areas due to turbidity or general disturbance associated with the activity but this should not affect their general migration patterns.

PCE 3. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

- The action would temporarily decrease benthic community abundance and may lead to shifts in species composition over time. Activities causing regular substrate and water column disturbance would occur regularly which would decrease benthic community abundance.
- Eelgrass would be substantially degraded or removed in areas identified as continuing fallow. The frequency of disturbance would likely result in a condition where eelgrass never fully recovers. Eelgrass is a key component of the estuarine and nearshore food web harboring numerous invertebrate prey species and a substrate for Pacific herring spawning. Loss of eelgrass would negatively affect these habitat functions. Critical habitat where these effects would be most evident include Samish Bay, Nisqually delta, numerous locations throughout Hood Canal including the Skokomish River delta, and in Grays Harbor (see Appendix D).
- There would be reduced spawning success of forage fish species where aquaculture acreage is co-located with spawning. There are an estimated 2,788 fallow and 1,821 active aquaculture acres that are co-located with mapped forage fish spawning areas within the critical habitat in the Puget Sound and Hood Canal regions and 1,152 acres in Grays Harbor.

PCE 4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks, and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

- Continuing fallow and new acreage would be altered from the current relatively undisturbed condition to an aquaculture farm with corresponding effects on the habitat. Natural structure such as large wood or boulders would be removed. Artificial structure including plastic nets, bags, tubes, and metal stakes would be added.
- Natural processes on the fallow and new acreages would be minimized and replaced by regular shellfish activities associated with aquaculture.

PCE 5. Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

- The proposed action would have no effect on this PCE.

PCE 6. In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile *survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.*

- The proposed action would have no effect on this PCE.

PCE 7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

- The proposed action would have no effect on this PCE

PCE 8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

- The proposed action would degrade water quality (e.g., increases in suspended sediments) in localized areas of the nearshore marine habitat on a near daily basis for the 20 year period of the PBA.

PCE 9. Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

- The proposed action would have no effect on this PCE

8.6.3. Effect Determination

The proposed action *may affect, likely to adversely affect* bull trout and bull trout designated critical habitat.

8.7. Green Sturgeon Southern DPS

Within the action area, the green sturgeon is common in Willapa Bay and Grays Harbor during the summer and fall (Lindley et al. 2011). Although not common, they could also occur in the other geographic regions of the PBA.

8.7.1. Species Effects

Green sturgeon rarely occur in the Puget Sound and Hood Canal regions so there interaction with shellfish activities is unlikely in these regions. In Willapa Bay and Grays Harbor, both shallow estuaries with extensive tidelands, green sturgeon make use of intertidal mudflats to forage for benthic invertebrates (Dumbauld et al. 2008).

Navigation dredging and vessel strikes have been documented to cause mortality to several species of sturgeon (Clarke 2011, Stanford et al. 2009). Green sturgeon would also be vulnerable to these activities, although this has not been documented in the action area. Oyster dredging conducted under the proposed action is much different in character than that conducted for navigation both in the scale of the dredge operation and the dredge depth. Nevertheless, given the scale of acreage in the proposed action, the 20 year timeframe of the PBA, and the use of the intertidal areas where oyster dredging occurs by green sturgeon, injury to sturgeon from dredging or harrowing is possible. The high rate of in-water activity conducted in relatively shallow water, particularly in Willapa Bay, may pose a risk of vessel strikes to green sturgeon. Strikes of sturgeon species with large vessels have been documented outside of the action area (Stanford et al. 2009). The risk of a vessel strike in Willapa Bay is probably low, but given the rates of in-water activity, the presence of green sturgeon in shallow water where that activity occurs, and the 20 year timeframe of the PBA, this effect is not discountable.

Cover nets are located in many locations in Willapa Bay. As discussed in Section 7.1, unsecured and damaged nets have been documented capturing and killing fish species. The action includes a Conservation Measure to minimize the degree this occurs. However, given the prevalence of nets, inconsistent husbandry practices, difficulty fully securing nets in the aquatic environment, sturgeon use of tidelands for foraging, and the 20 year timeframe of the PBA, some unknown amount of entanglement in nets is possible. Rack and/or bag culture may function in a similar manner resulting in the entrapment and/or stranding as the tide retreats from these areas (see Section 7.1).

The scale of in-water activities and prevalence of nets, particularly in Willapa Bay, the 20 year timeframe of the PBA, and the use of the tidelands by green sturgeon, together suggest the risk of physical injury and/or entanglement is not discountable. These would therefore be considered adverse effects on green sturgeon.

8.7.2. Critical Habitat

Designated critical habitat for green sturgeon in estuarine areas occurs in the Willapa Bay and Grays Harbor regions of the PBA. Designated critical habitat in coastal marine areas occurs within the North Puget Sound region of the PBA. There is no freshwater critical habitat within the action area. Appendix H illustrates the location of shellfish activities relative to designated estuarine and coastal marine critical habitat. PCEs were developed for freshwater riverine systems, estuarine areas, and nearshore marine waters. Potential impacts to the estuarine and marine PCEs are discussed below.

The specific PCEs essential for the conservation of the Southern DPS in estuarine areas include:

PCE 1. Food resources. Abundant prey items within estuarine habitats and substrates for juvenile, subadult, and adult life stages. Prey species for juvenile, subadult, and adult green sturgeon within bays and estuaries primarily consist of benthic invertebrates and fishes, including crangonid shrimp, burrowing thalassinidean shrimp (particularly the burrowing ghost shrimp), amphipods, isopods, clams, annelid worms, crabs, sand lances, and anchovies.

- Continuing fallow and new acreage would be altered from the current relatively undisturbed condition to an aquaculture farm with corresponding effects on the habitat. Prey species would be negatively affected by the proposed action. Shifts in benthic community composition may occur across large tideland acreages in Grays Harbor and Willapa Bay due to alteration of the benthic substrate. This would have unknown consequences for the benthic invertebrate population. Invertebrate prey would be temporarily reduced following many of the individual activities resulting in decreased foraging success and displacement for potentially months at a time in the most impacted areas. Ongoing effects from the activities conducted on the continuing active acreage would continue to occur for the period of the PBA. While the scale is relatively large with some amount of impacted acreage occurring nearly continuously for the duration of the PBA, it would still account for a small percent of the total area available for foraging at any one time.

PCE 2. Water flow. Within bays and estuaries adjacent to the Sacramento River (i.e., the Sacramento-San Joaquin Delta and the Suisun, San Pablo, and San Francisco bays), sufficient flow into the bay and estuary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds.

- The Sacramento River estuaries are outside of the action area. The proposed action would have no effect on this PCE.

PCE 3. Water quality. Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages. Suitable water temperatures for juvenile green sturgeon should be below 24 °C. Suitable salinities range from brackish water (10 ppt) to salt water (33 ppt). Subadult and adult green sturgeon occupy a wide range of dissolved oxygen levels, but may need a minimum dissolved oxygen level of at least 6.54 mg 02/l (Kelly et al. 2007; Moser and Lindley 2007). Suitable water quality also includes water with acceptably low levels of contaminants (e.g., pesticides, PAHs, elevated levels of heavy metals) that may disrupt the normal development of juvenile life stages, or the growth, survival, or reproduction of subadult or adult stages.

- It is possible that some activities, such as harrowing, could temporarily decrease dissolved oxygen locally as anaerobic sediments are brought to the surface. This would not be a significant effect.

PCE 4. Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within estuarine habitats and between estuarine and riverine or marine habitats. We define safe and timely passage to mean that human-induced impediments, either physical, chemical, or biological, do not alter the migratory behavior of the fish such that its survival or the overall viability of the species is compromised (e.g., an impediment that compromises the ability of fish to reach thermal refugia by the time they enter a particular life stage).

- The proposed action would have no effect on migratory pathways for green sturgeon. Structure on the intertidal habitat and periodic harvest activities conducted at high tide could temporarily displace green sturgeon but these effects should be highly localized with no effect on broader migration patterns.

PCE 5. Water depth. A diversity of depths necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages. Subadult and adult green sturgeon occupy a diversity of depths within bays and estuaries for feeding and migration. Tagged adults and subadults within the San Francisco Bay estuary primarily occupied waters over shallow depths of less than 10 m, either swimming near the surface or foraging along the bottom (Kelly et al. 2007).

- The proposed action would only have negligible impacts on depths within the action area. Activities such as applying gravel to substrate or leveling activities would result in only minor and insignificant changes in the elevation of the substrate.

PCE 6. Sediment quality. Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages. This includes sediments free of elevated levels of contaminants (e.g., selenium, PAHs, and pesticides) that can cause adverse effects on all life stages of green sturgeon.

- The use of vessels and vehicles results in accidental discharges of fuel, lubricants, and hydraulic fluids. The effect on water quality depends on the type of contaminant spilled, time of year, spill volume, and success of containment efforts. The action includes Conservation Measures to minimize the risk of such spills in the aquatic environment.

Green sturgeon Southern DPS coastal marine area PCEs include:

PCE 7. Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within marine and between estuarine and marine habitats. We define safe and timely passage to mean that human- induced impediments, either physical, chemical, or biological, do not alter the migratory behavior of the fish such that its survival or the overall viability of the species is *compromised (e.g., an impediment that compromises the ability of fish to reach abundant prey resources during the summer months in Washington and Oregon estuaries).*

- Shellfish activities including subtidal geoduck harvest are very localized and unlikely to affect green sturgeon migration patterns.

PCE 8. Water quality. Coastal marine waters with adequate dissolved oxygen levels and acceptably low levels of contaminants (e.g., pesticides, PAHs, heavy metals that may disrupt the normal behavior, growth, and viability of subadult and adult green sturgeon). Based on studies of tagged subadult and adult green sturgeon in the San Francisco Bay estuary, CA, and Willapa Bay, WA, subadults and adults may need a minimum dissolved oxygen level of at least 6.54 mg O2/l (Kelly et al. 2007; Moser and Lindley 2007).

- The proposed action would cause temporary localized turbidity. The magnitude and extent of turbidity increases would have negligible effect on green sturgeon.

PCE 9. Food resources. Abundant prey items for subadults and adults, which may include benthic invertebrates and fish. Green sturgeon spend more than half their lives in coastal marine and estuarine waters, spending from 3–20 years at a time out at sea.

- Subtidal geoduck harvest would disturb benthic habitat and temporarily reduce benthic prey organisms in localized areas. Green sturgeon, if affected, may shift foraging to undisturbed locations. Given the scale and short term duration of this effect, green sturgeon would not be affected in a meaningful way.

8.7.3. Effect Determination

The proposed action *may affect, likely to adversely* affect green sturgeon and *may affect, not likely to adversely affect* green sturgeon designated critical habitat

8.8. Puget Sound Rockfish

The three ESA listed Puget Sound rockfish species occur within the Hood Canal, south Puget Sound, and north Puget Sound regions. They do not occur in the Willapa Bay or Grays Harbor region.

8.8.1. Species Effects

Juvenile boccacio and canary rockfish inhabit intertidal areas as juveniles before gradually moving to deeper water (Love et al. 1991). They feed on benthic invertebrates during this stage of their life history. Temporary in-water disturbance and noise associated with human activity and degradation of water quality such as increases in suspended sediments could displace them. These affects would occur broadly throughout the action area and occur on a near daily basis for the 20 year period of the PBA. Rockfish could be attracted to the altered bottom substrates (e.g., oyster substrate) that would occur as a result of the action. They would be periodically displaced from these areas when shellfish related activities occur.

Cover nets are located in many locations in the nearshore habitat where juvenile boccacio and canary rockfish may settle. As discussed in Section 7.1, unsecured and damaged nets have been documented capturing and killing fish species. The action includes a Conservation Measure to minimize the degree this occurs. However, given the prevalence of nets, inconsistent husbandry practices, difficulty fully securing nets in the aquatic environment, and the 20 year time period of the PBA, some unknown amount of rockfish entanglement in nets is likely to occur. Rack and/or bag culture may function in a similar manner resulting in the entrapment and/or stranding of rockfish as the tide retreats from these areas (see Section 7.1). These would be considered adverse effects to this species.

8.8.2. Critical Habitat

The critical habitat for rockfish includes 590 square miles of nearshore habitat and 414 square miles of deepwater habitat of Puget Sound, Washington. The portion of the action area designated as critical habitat includes parts of South Puget Sound, North Puget Sound, and Hood Canal.

In nearshore areas, the proposed critical habitat occurs from the shoreline from extreme high water out to a depth no greater than 30 meters (98 feet) relative to mean lower low water. In deepwater areas, the proposed critical habitat occurs from depths greater than 30 meters (98 feet). Appendix H illustrates the location of shellfish activities relative to the proposed critical habitat. Essential features of the proposed critical habitat are described below.

1. *In nearshore areas, juvenile settlement habitats with substrates such as sand, rock and/or cobble compositions that also support kelp are essential for conservation because these features enable forage opportunities and refuge from predators and enable behavioral and physiological changes needed for juveniles to occupy deeper adult habitats. Several attributes of these sites determine the quality of the area including a) the quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities, and b) water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities.*

    - Continuing fallow and new acreage would be altered from the current relatively undisturbed condition to an aquaculture farm with corresponding effects on the habitat. Natural structure such as large wood or boulders would be removed. Artificial structure including plastic nets, bags, tubes, and metal stakes would be added. This would temporarily decrease benthic community abundance and may lead to shifts in species composition over time. Activities causing regular substrate and water column disturbance would occur regularly which would decrease benthic community abundance. While the scale is relatively large with some amount of impacted acreage occurring nearly continuously for the duration of the PBA, it would still account for a small percent of the total area available for foraging at any one time.
    - There would be reduced spawning success of forage fish prey species where aquaculture acreage is co-located with spawning. Rockfish have diverse diets that include many different fish species and invertebrates (78FR 47635). This effect of forage fish would not affect prey availability for rockfish.

2. *In deepwater areas, benthic habitats or sites deeper than 30 meters (98 feet) that possess or are adjacent to areas of complex bathymetry consisting of rock and or highly rugose habitat are essential to conservation because these features support growth, survival, reproduction, and feeding opportunities by providing the structure for adult bocaccio to avoid predation, seek food and persist for decades. Several attributes of these habitats or sites determine the quality of the area including: (1) quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; (2) water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities; and (3) the type and amount of structure and rugosity that supports feeding opportunities and predator avoidance.*

    - The proposed action would not occur in waters deeper than -70 ft MLLW. There should be no effect on rockfish deepwater habitats.

8.8.3. Effect Determination

The proposed action *may affect, likely to adversely affect* canary rockfish and bocaccio. The proposed action *may affect, not likely to adversely affect* critical habitat for canary rockfish and bocaccio. The proposed action would have *no effect* on yelloweye rockfish or yelloweye rockfish critical habitat (only deepwater habitat designated).

8.9. Eulachon

Eulachon could potentially be found throughout the action area. They can occasionally be found in Willapa Bay and Grays Harbor due to their proximity to the spawning populations in the Columbia River. They are considered to be an infrequent visitor to most of the Puget Sound and Hood Canal Regions.

8.9.1. Species Effects

Effects on eulachon would be similar to those described above for the other fish species. They may be displaced from localized areas by increases in turbidity or by general in-water activity levels. Prey organisms would be reduced in localized areas following certain shellfish activities such as harvest. This may result in decreased foraging success in these localized areas. Individuals may shift foraging to undisturbed areas until prey items recover in the impacted area. Given the limited eulachon presence, these effects are insignificant.

8.9.2. Critical habitat

The proposed action would not affect freshwater designated critical habitat. While no specific saltwater areas are designated, PCEs were developed for saltwater areas. Effects to eulachon PCEs are discussed below.

PCE 1. Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation.

- The proposed action would have no effect on freshwater areas.

PCE 2. Freshwater and estuarine migration corridors free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted.

- Continuing fallow and new acreage would be altered from the current relatively undisturbed condition to an aquaculture farm with corresponding effects on the habitat. Natural structure such as large wood or boulders would be removed. Artificial structure including plastic nets, bags, tubes, and metal stakes would be added. This would temporarily decrease benthic community abundance and may lead to shifts in species composition over time. Activities causing regular substrate and water column disturbance would occur regularly which would decrease benthic community abundance. While the scale is relatively large with some amount of impacted acreage occurring nearly continuously for the duration of the PBA, it would still account for a small percent of the total area available for foraging at any one time.

PCE 3. Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival.

- Effects on nearshore habitat would be similar to that described above for estuaries under PCE 2.

8.9.3. Effect Determination

The proposed action *may affect, not likely to adversely affect* eulachon and eulachon designated critical habitat.

8.10. Southern Resident Killer Whale

The southern resident killer whale occurs primarily in the north and south Puget Sound regions of the PBA. They could also potentially occur in the very northern part of the Hood Canal region of the PBA. They are not known to visit Grays Harbor or Willapa Bay (NMFS 2008).

8.10.1. Species Effects

Potential effects on southern resident killer whale include noise and in-water obstacles from vessel traffic, subtidal dive harvest (e.g., air lines), and potentially anchor lines from floating culture methods. Encounters would be extremely unlikely and geoduck dive harvesters would typically exit the water if killer whales were in the area (WDNR 2008). The scale of these effects is small, and extremely localized in nature. Southern residents would be expected to easily avoid any interaction with the activities with minimal, if any, disturbance to their activity. These effects are discountable.

8.10.2. Critical habitat

Subtidal geoduck harvest, the operation of continuing rafts, and surface longlines would all occur within designated critical habitat for southern residents.

Effects to southern resident killer whale PCEs are discussed below.

PCE 1. Water quality to support growth and development;

- The proposed action would have limited effects on water quality in the form of minor turbidity and the potential for chemical/oil spills associated with vessel operations. In both cases these effects are of a scale that would result in negligible effects on the critical habitat.

PCE 2. Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth

- The primary prey species for southern residents are Chinook salmon from the Fraser River accounting for 80-90% of all Chinook consumed in one study (Hanson et al. 2010). While the action could result in some minor disturbance to juvenile Chinook salmon in Puget Sound and Hood Canal, there should be no effect on this prey species numbers or population growth.

PCE 3. Passage conditions to allow for migration, resting, and foraging.

- The proposed action would marginally increase the number of vessels on the water, create noise, and add structure such as air hoses for divers. It is doubtful these activities would affect southern residents although it is possible minor, insignificant deviations from travel paths could occur as a result of noise or vessel traffic.

8.10.3. Effect Determination

The proposed action *may affect, not likely to adversely affect* southern resident killer whale and southern resident killer whale designated critical habitat.

8.11. Humpback Whale

Humpback whales are occasionally spotted in the Puget Sound regions of the PBA as they migrate through the waters of Washington State.

8.11.1. Species Effects

Potential effects on humpback whale include noise and in-water obstacles from vessel traffic, subtidal dive harvest (e.g., air lines), and potentially anchor lines from floating culture methods. The scale of these effects is small, and extremely localized in nature. Humpbacks would be expected to easily avoid any interaction with shellfish activities with minimal, if any, disturbance to their activity.

8.11.2. Critical habitat

No critical habitat is designated for humpback whale.

8.11.3. Effect Determination

The proposed action *may affect, not likely to adversely affect* humpback whale.

8.12. Marbled Murrelet

Marbled murrelet occur in all regions of the action area.

8.12.1. Species Effects

Effects to marbled murrelet include temporary in-water disturbance and noise associated with human activity and degradation of water quality such as increases in suspended sediments. These affects would occur broadly throughout the action area and occur on a near daily basis for the 20 year period of the PBA and may temporarily displace murrelet from local areas.

Murrelets would be expected to forage primarily in deeper waters away from intertidal shellfish activities. Activities conducted in the subtidal zone are extremely localized and would be expected to have minimal effect on foraging behavior. If affected, murrelets would likely shift foraging behavior to a different location. The scale of activity is negligible relative to the foraging habitat available for murrelet. There would be reduced spawning success of forage fish species where fallow acreage is co-located with spawning. This is not likely to affect prey availability for murrelet given their broad foraging habitats.

These effects are insignificant or discountable.

8.12.2. Critical habitat

Appendix H illustrates the location of shellfish activities relative to marbled murrelet designated critical habitat. Murrelet critical habitat is located in upland forested areas. The PCEs also apply to these upland forest areas. No activity would occur in murrelet critical habitat and PCEs would not be affected.

8.12.3. Effect Determination

The proposed action *may affect, not likely to adversely affect* marbled murrelet. The proposed action would have *no effect* on marbled murrelet designated critical habitat

8.13. Western Snowy Plover

Western snowy plover occur within the Willapa Bay and Gray Harbor geographic regions of the PBA.

8.13.1. Species Effects

Human activity and vessel traffic could potentially disturb or displace individuals from localized areas. Since no activity would occur within 0.25 miles of snowy plover critical habitat under the proposed action, interaction between snowy plover and shellfish activities is expected to be infrequent.

Prey organisms would be reduced in localized areas following certain shellfish activities such as harvest. This may result in decreased foraging success in these localized areas. Individuals may shift foraging to undisturbed areas until prey items recover in the impacted area. Snowy plover prey availability would not be affected by the proposed action.

8.13.2. Critical habitat

Appendix H illustrates the location of shellfish activities relative to western snowy plover critical habitat. The PCEs essential to the conservation of the snowy plover include:

Sandy beaches, dune systems immediately inland of an active beach face, salt flats, mud flats, seasonally exposed gravel bars, artificial salt ponds and adjoining levees, and dredge spoil sites, with:

PCE 1. Areas that are below heavily vegetated areas or developed areas and above the daily high tides;

- The proposed action would not affect such areas other than through occasional human presence which could temporarily displace snowy plovers.

PCE 2. Shoreline habitat areas for feeding, with no or very sparse vegetation, that are between the annual low tide or low water flow and annual high tide or high water flow, subject to inundation but not constantly under water, that support small invertebrates, such as crabs, worms, flies, beetles, spiders, sand hoppers, clams, and ostracods, that are essential food sources;

- The proposed action would affect intertidal areas in Willapa Bay and Grays Harbor by adding artificial structure, creating oyster beds, and periodic disturbance associated with shellfish activities. There may be localized and temporary decreases in potential prey resources which may affect foraging success in these areas. This could result in snowy plovers shifting foraging to undisturbed locations until prey species have recovered in the disturbed areas. These activities would not occur within the critical habitat.

PCE 3. Surf- or water-deposited organic debris, such as seaweed (including kelp and eelgrass) or driftwood located on open substrates that supports and attracts small invertebrates described in PCE 2 for food, and provides cover or shelter from predators and weather, and assists in avoidance of detection (crypsis) for nests, chicks, and incubating adults;

- Surf deposited debris should be minimally affected by the action. Debris such as driftwood is typically removed from aquaculture areas. These activities would not occur within the critical habitat.

PCE 4. Minimal disturbance from the presence of humans, pets, vehicles, or human-attracted predators, which provide relatively undisturbed areas for individual and population growth and for normal behavior.

- Activities are excluded within 0.25 miles of the critical habitat. Activities such as vessel traffic may occur on occasion near the critical habitat.

8.13.3. Effect Determination

The proposed action *may affect, not likely to adversely affect* western snowy plover and western snowy plover designated critical habitat.

8.14. Summary

The determinations of effect on the ESA listed species and their critical habitat are summarized in Table 8-1.

Table 8-1. Summary of ESA determinations of effect.

Species	ESA Status	Determination of effect on species	Determination of effect on designated critical habitat
Puget Sound Chinook Salmon	threatened	**May affect, likely to adversely affect**	**May affect, likely to adversely affect**
Lower Columbia River Chinook Salmon	threatened	May affect, not likely to adversely affect	No effect
Hood Canal Summer Chum Salmon	threatened	**May affect, likely to adversely affect**	**May affect, likely to adversely affect**
Columbia River Chum Salmon	threatened	May affect, not likely to adversely affect	No effect
Puget Sound Steelhead*	threatened	May affect, not likely to adversely affect	**May affect, likely to adversely affect**
Coastal/Puget Sound Bull Trout	threatened	**May affect, likely to adversely affect**	**May affect, likely to adversely affect**
Canary Rockfish*	threatened	**May affect, likely to adversely affect**	May affect, not likely to adversely affect
Yelloweye Rockfish*	threatened	May affect, not likely to adversely affect	No effect
Bocaccio*	endangered	**May affect, likely to adversely affect**	May affect, not likely to adversely affect
Green Sturgeon	threatened	**May affect, likely to adversely affect**	May affect, not likely to adversely affect
Pacific Eulachon	threatened	May affect, not likely to adversely affect	May affect, not likely to adversely affect
Southern Resident Killer Whale	endangered	May affect, not likely to adversely affect	May affect, not likely to adversely affect
Humpback Whale	endangered	May affect, not likely to adversely affect	None designated
Marbled Murrelet	threatened	May affect, not likely to adversely affect	No effect
Western Snowy Plover	threatened	May affect, not likely to adversely affect	May affect, not likely to adversely affect

* Critical habitat is proposed for steelhead, canary rockfish, yelloweye rockfish and bocaccio.

9. Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires Federal agencies to consult with NMFS on activities that may adversely affect Essential Fish Habitat (EFH). The Act defined EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” Descriptions of EFH are provided in Fishery Management Plans produced by the Pacific Fisheries Management Council. The EFH mandate applies to all species managed under a Federal Fishery Management Plan (FMP). In Washington, there are FMPs for groundfish (PFMC 2005), coastal pelagic species (PFMC 1998), and Pacific salmon (PFMC 2014). A description of EFH from each Fisheries Management Plan and habitat areas of particular concern (HAPC) relevant to the proposed action are provided below.

Groundfish: *The Pacific Coast Groundfish FMP manages 80-plus species over a large and ecologically diverse area. Information on the life histories and habitats of these species varies in completeness, so while some species are well-studied, there is relatively little information on certain other species. Information about the habitats and life histories of the species managed by the FMP will certainly change over time, with varying degrees of information improvement for each species. For these reasons, it is impractical for the Council to include descriptions identifying EFH for each life stage of the managed species in the body of the FMP. Therefore, the FMP includes a description of the overall area identified as groundfish EFH and describes the assessment methodology supporting this designation.*

The overall extent of groundfish EFH for all FMU species is identified as all waters and substrate within the following areas:
• Depths less than or equal to 3,500 m (1,914 fathoms) to mean higher high water level (MHHW) or the upriver extent of saltwater intrusion, defined as upstream and landward to where ocean-derived salts measure less than 0.5 ppt during the period of average annual low flow.
• Seamounts in depths greater than 3,500 m as mapped in the EFH assessment GIS.
• Areas designated as HAPCs not already identified by the above criteria.

Habitat areas of particular concern (HAPC) include estuaries, canopy kelp, and seagrasses. The estuary HAPC encompasses the Grays Harbor, Willapa Bay, Hood Canal, and South Puget Sound regions of the PBA, and significant parts of the North Puget Sound region as illustrated in Figure 3-1.

Certain activities conducted in estuaries were identified as causing impacts to groundfish EFH. Activities identified relevant to the proposed action include dredging, vessel operations, overwater structures, and commercial utilization of habitat (i.e., aquaculture).

Coastal pelagic species: *Amendment 8 to The Coastal Pelagic Species Fishery Management Plan describes the habitat requirements of five pelagic species: Northern anchovy, Pacific sardine, Pacific (chub) mackerel, jack mackerel and market squid. These four finfish and market squid are treated as a single species complex because of similarities in their life histories and habitat requirements. EFH for coastal pelagic species is defined as all marine and estuarine waters from the shoreline along the coasts of California, Oregon and Washington offshore to the limits of the EEZ and above the thermocline. The southern boundary is the U.S.-Mexico maritime boundary. The northern boundary is more dynamic, and is defined as the position of the 10^o C isotherm, which varies seasonally and annually. These species may occur in shallow embayments and brackish water, but do not depend on these habitats to any significant degree.*

There are no HAPCs identified for coastal pelagic species. The FMP identified a number of activities 'that may directly or cumulatively, temporarily or permanently, threaten the physical, chemical and biological properties of the habitat utilized by CPS and/or their prey. The direct result of these threats is that EFH may be eliminated, diminished or disrupted.' Two of these identified activities are dredging and aquaculture. Described effects from dredging include degradation of water quality with potential impacts on aquatic vegetation. Effects from aquaculture are primarily related to discharge of organic waste and its accumulation in neighboring waters.

Pacific salmon: *EFH for the Pacific Coast salmon fishery means those waters and substrate necessary for salmon production needed to support a long-term, sustainable salmon fishery and salmon contributions to a healthy ecosystem. To achieve that level of production, salmon EFH must include all freshwater, estuarine, and marine habitats in, and off of, Washington, Oregon, Idaho, and California and the marine waters off Alaska that are currently occupied by stocks of salmon managed under this FMP, as well as most of the habitats that were historically occupied by those same stocks. EFH cannot be designated for salmon stocks that are not managed under the FMP, and cannot be designated for stocks that are listed as Ecosystem Component Species in the FMP.*

The geographic extent of freshwater EFH is identified as all water bodies currently or historically occupied by Council-managed salmon. In the estuarine and marine areas, salmon EFH extends from the extreme high tide line in nearshore and tidal submerged environments within state territorial waters out to the full extent of the Exclusive Economic Zone (EEZ) (200 nautical miles or 370.4 km) offshore of Washington, Oregon, and California north of Point Conception. Foreign waters off Canada, while still salmon habitat, are not included in salmon EFH, because they are outside United States jurisdiction.

There are five HAPCs for salmon include three freshwater habitats, estuaries, and marine and estuarine submerged aquatic vegetation (i.e., kelp and eelgrass).

Broad categories of activities which can adversely affect salmon EFH include artificial propagation of fish and shellfish, debris (e.g., large wood debris, macrophyte wrack) removal, and vessel impacts such as underwater noise.

Table 9-1. Life History Stage and Habitat Use for Fish Species with Designated EFH Potentially in the action area (PFMC 2005).

Species		Lifestage	Activity
Pacific Groundfishes			
Spotted ratfish	*Hydrolagus colliei*	Adults	All
Spotted ratfish	*Hydrolagus colliei*	Juveniles	Feeding
Soupfin shark	*Galeorhinus galeus*	Adults	All
Soupfin shark	*Galeorhinus galeus*	Juveniles	Growth to Maturity
Spiny dogfish	*Squalus acanthias*	Adults	All
Spiny dogfish	*Squalus acanthias*	Juveniles	Feeding
Spiny dogfish	*Squalus acanthias*	Juveniles	Growth to Maturity
Leopard shark	*Triakis semifasciata*	Adults	All
Leopard shark	*Triakis semifasciata*	Juveniles	
Big skate	*Raja binoculata*	Adults	All
California skate	*Raja inornata*	Adults	All
California skate	*Raja inornata*	Eggs	
Longnose skate	*Raja rhina*	Adults	All
Kelp greenling	*Hexagrammos decagrammus*	Adults	All
Kelp greenling	*Hexagrammos decagrammus*	Larvae	

Species		Lifestage	Activity
Lingcod	*Ophiodon elongatus*	Adults	Feeding
Lingcod	*Ophiodon elongatus*	Eggs	
Lingcod	*Ophiodon elongatus*	Juveniles	Feeding
Lingcod	*Ophiodon elongatus*	Larvae	Feeding
Sablefish	*Anoplopoma fimbria*	Adults	All
Sablefish	*Anoplopoma fimbria*	Eggs	
Sablefish	*Anoplopoma fimbria*	Juveniles	Feeding
Sablefish	*Anoplopoma fimbria*	Larvae	
Cabezon	*Scorpaenichthys marmoratus*	Adults	All
Brown rockfish	*Sebastes auriculatus*	Adults	Feeding
Brown rockfish	*Sebastes auriculatus*	Larvae	Feeding
Copper rockfish	*Sebastes caurinus*	Adults	
Copper rockfish	*Sebastes caurinus*	Larvae	Feeding
Splitnose rockfish	*Sebastes diploproa*	Juveniles	Feeding
Splitnose rockfish	*Sebastes diploproa*	Larvae	Feeding
Yellowtail rockfish	*Sebastes flavidus*	Adults	All
Quillback rockfish	*Sebastes maliger*	Adults	All
Black rockfish	*Sebastes melanops*	Adults	All
Black rockfish	*Sebastes melanops*	Juveniles	Feeding
Blue rockfish	*Sebastes mystinus*	Adults	Feeding
Blue rockfish	*Sebastes mystinus*	Juveniles	Feeding
Blue rockfish	*Sebastes mystinus*	Larvae	Feeding
China rockfish	*Sebastes nebulosus*	Adults	Feeding
Tiger rockfish	*Sebastes nigrocinctus*	Adults	Feeding
Bocaccio	*Sebastes paucispinis*	Juveniles	Feeding
Redstripe rockfish	*Sebastes proriger*	Larvae	Feeding
Pacific sanddab	*Citharichthys sordidus*	Adults	Growth to Maturity
Pacific sanddab	*Citharichthys sordidus*	Larvae	Feeding
Petrale sole	*Eopsetta jordani*	Adults	All
Petrale sole	*Eopsetta jordani*	Eggs	
Petrale sole	*Eopsetta jordani*	Larvae	Feeding
Pacific cod	*Gadus macrocephalus*	Larvae	
Rex sole	*Glyptocephalus zachirus*	Adults	Feeding
Flathead sole	*Hippoglossoides elassodon*	Adults	All
Flathead sole	*Hippoglossoides elassodon*	Eggs	
Flathead sole	*Hippoglossoides elassodon*	Juveniles	Feeding
Flathead sole	*Hippoglossoides elassodon*	Larvae	Feeding
Butter sole	*Isopsetta isolepis*	Adults	All
Rock sole	*Lepidopsetta bilineata*	Adults	All
Rock sole	*Lepidopsetta bilineata*	Eggs	
Rock sole	*Lepidopsetta bilineata*	Larvae	Feeding

Species		Lifestage	Activity
Pacific hake	*Merluccius productus*	Adults	All
Pacific hake	*Merluccius productus*	Juveniles	Feeding
Pacific hake	*Merluccius productus*	Juveniles	Growth to Maturity
Dover sole	*Microstomus pacificus*	Eggs	
English sole	*Parophrys vetulus*	Adults	All
English sole	*Parophrys vetulus*	Eggs	
English sole	*Parophrys vetulus*	Juveniles	Feeding
English sole	*Parophrys vetulus*	Larvae	Feeding
Starry flounder	*Platichthys stellatus*	Adults	All
Starry flounder	*Platichthys stellatus*	Eggs	
Starry flounder	*Platichthys stellatus*	Juveniles	Feeding
Starry flounder	*Platichthys stellatus*	Larvae	
Sand sole	*Psettichthys melanostictus*	Adults	All
Sand sole	*Psettichthys melanostictus*	Eggs	
Sand sole	*Psettichthys melanostictus*	Juveniles	Feeding
Sand sole	*Psettichthys melanostictus*	Juveniles	Growth to Maturity
Pacific Salmon			
Chinook salmon	*Oncorhynchus tsawytscha*	Juveniles	Feeding
Chinook salmon	*Oncorhynchus tsawytscha*	Adults	
coho salmon	*O. kisutch*	Juveniles	Feeding
coho salmon	*O. kisutch*	Adults	
Puget Sound pink salmon	*O. gorbuscha*	Juveniles	Feeding
Puget Sound pink salmon	*O. gorbuscha*	Adults	
Coastal Pelagic Species			
Northern Anchovy	*Engraulis mordax*		
Jack Mackerel	*Trachurus symmetricus*		
Pacific Sardine	*Sardinops sagax*		
Pacific (Chub) Mackerel	*Scomber japonicus*		
Market Squid	*Loligo opalescens*		

9.1. Effects

EFH for groundfish, coastal pelagic, and salmon species and HAPCs for groundfish and salmon occur throughout the geographic area where the proposed action would occur. The effects of the action on habitat and ESA listed species are discussed in Sections 7 and 8. A brief summary of these effects on EFH is provided below. The previous sections of the document should be consulted for more detail on these effects.

An adverse effect on EFH is defined as *any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions. (50 CFR 600.810)*

Groundfish and Pacific salmon EFH would be altered from the current relatively undisturbed condition to an aquaculture farm with corresponding effects on the habitat. This includes replacement of fine grained sediments with plastic materials, loss of eelgrass, and regular disturbance of the benthic community which decreases prey availability. Other impacts include temporary increases in suspended sediments, noise and disturbance associated with vessel traffic and aquaculture operations.

Coastal pelagic EFH would be affected by degraded water quality associated with increased suspended sediment and loss of eelgrass.

9.2. Conclusion

As discussed in the PBA and summarized above, the activities authorized under the proposed action would affect EFH. While these effects would be minimized by the implementation of the many Conservation Measures, the proposed action would result in *adverse effects to EFH* for groundfish, coastal pelagic, and Pacific salmon species.

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Appendix A.

DRAFT Programmatic ESA Consultation Specific Project Information Form

Shellfish Activities in Washington State Inland Marine Waters

DRAFT Programmatic ESA Consultation Specific Project Information Form
Shellfish Activities in Washington State Inland Marine Waters
Version: June 2014

Eligibility for Programmatic Consultation - ***to be filled out by Corps***
This application:
___Meets all of the requirements of this programmatic consultation
___Does not meet all of the requirements of this programmatic consultation. This form constitutes a reference biological evaluation in association with:
NMFS reference:
USFWS reference:

1. **Programmatic Activity**: Shellfish Activities in Washington State Inland Marine Waters.

2. **Action Area**: This programmatic covers specific shellfish activities between the tidal elevations of mean higher high water (MHHW) and -70 ft mean lower low water (MLLW) in Willapa Bay, Grays Harbor, Puget Sound, Hood Canal, and the Straits of Juan de Fuca and Georgia excluding the specific areas listed below:

- all areas within 0.25 miles of snowy plover ESA designated foraging or nesting habitat, including but not limited to Leadbetter Point in Pacific County and Copalis Spit in Grays Harbor County
- all areas within 200 ft of any bird, land mammal, insect, or plant critical habitat either designated or proposed under the ESA (e.g., Taylor's checkerspot butterfly, streaked horn lark).

2. **Drawings and Photographs:** ***Drawings and photographs must be submitted.***
Drawings must include a vicinity map; and plan, profile, and cross-section drawings of the proposed structures; and over- and in-water structures on adjacent properties. One map must show (1) the boundaries of the project area (area of ownership/lease), with latitude and longitude coordinates for each corner of the project area, (2) the name(s) of the cultivated species, and (3) where any canopy predator nets are being used. Also, show the area within the project area where shellfish activities would occur and areas where shellfish activities would not occur. The tidal elevations where shellfish activities would occur should also be shown. (For assistance with the preparation of the drawings, please refer to our *Drawing Checklist* located on our website at www.nws.usace.army.mil Select Regulatory – Regulatory/Permits – Forms.)

Include photographs showing the entire project area, including the shoreline, current overwater structures, and location of the proposed project. The photographs should be taken at ground level and at low tide and should show a panoramic view of the entire project area in the dry. Photographs should clearly show the presence or absence of vegetation and the substrate composition. Close up photographs of the substrate and/or vegetation should be included if there are any areas of particular interest. To most accurately reflect vegetation distribution, photos should be taken at low tide during June 1 through September 30.

3. **Date: __________**

4. **Applicant name**:
   Mailing address:______________________________________
   Work phone: _____ Home phone: ______ Cell phone:_____ Email:_____________

5. **Authorized agent name**:
   Mailing address:______________________________________
   Work phone: _____ Home phone: ______ Cell phone:_____ Email:_____________

6. **Location where proposed work will occur:**
   Address (street address, city, and county):___________________________________
   Waterbody: _________
   ¼ Section: ______Section ______Township ______Range:_______
   Latitude: _________ Longitude:___________
   Tidal elevation_______________

7. **Description of Work**: Describe in detail what is being installed (e.g. shellfish species/structures). Include dimensions and materials being used. Describe cultivation, maintenance and harvest methods for each species. If using nets, provide description and acreage of coverage. Describe any fill material being placed (e.g., gravel or shell material). Describe use of any nursery/grow-out structures. Attach additional pages as necessary.

8. **Methodology**: Describe methods and timing of work in more detail. Include site preparation, maintenance, equipment used, and harvest techniques.

9. **Description of how the area will be accessed (e.g., by shore or by vessel):**

10. **Forage Fish Habitat**: Go to the Washington Department of Fish and Wildlife (WDFW) website for the location of documented marine beach spawning habitat .

Check box if WDFW documented habitat is present for these species at your site.

Surf Smelt: _____ Pacific Herring:_____ Sand Lance:________

For NEW activities….
Attach a report from a qualified biologist determining if the area has potential spawning habitat for sand lance or surf smelt. The report should include (1) a description of the type of substrate present at the tidal elevations where spawning typically occurs, (2) photos of the substrate, and

(3) provide a determination of the suitability of the substrate for spawning.. Information on spawning requirements for these species is available at WDFW's marine beach spawning website.

Check box if potential habitat is present for these species.

Surf Smelt: _____ Pacific Herring:_____ Sand Lance:________

11. **Vegetation:** Are vegetated shallows (e.g., native eelgrass *Zostera marina*) or kelp present in the vicinity? If yes, please describe the location, species, distance to the project area, and density in or adjacent to the project area.

If native eelgrass (*Zostera marina*) is present within an area new to shellfish activities, the eelgrass will be delineated and a map or sketch prepared and submitted with this form. Surveys to determine presence and location of eelgrass will be done during times of peak above-ground biomass: June-September. The following information must be included to scale: parcel boundaries, eelgrass locations, and on-site dimensions, shellfish activity locations and dimensions. Contact the Corps prior to conducting the delineation for recommended eelgrass delineation methodology.

Check box if an eelgrass delineation is attached:_________

12. **Programmatic Conditions**: In order to meet all ESA requirements for this programmatic consultation, all programmatic conditions listed below **must be met**. Check each condition that you will meet. Check each item "not applicable" if they do not apply to your project. If you checked "will not meet" for any of the conditions, you must complete the "Will Not Meet" section at the end of this document.

Will Meet	**Will Not Meet**	**Not Applicable**	**PROGRAMMATIC CONDITIONS**
			1. Gravel and shell shall be washed prior to use for substrate enhancement (e.g. frosting, shellfish bed restoration) and applied in minimal amounts using methods that result in **less than 1-inch** depth on the substrate annually. Shell material shall be procured from clean sources that do not deplete the supply of shell bottom. Shells shall be cleaned or left on dry land for a minimum of one month or both before placement in the marine environment. Shells from the local area shall be used whenever possible. Shell or gravel material shall not be

			applied so that it piles onto the substrate. Use of a split-hull (e.g., hopper-type) barge to dump the material is prohibited.
			2. The placement of gravel or shell directly into the water column (i.e., graveling or frosting) shall not be conducted between February 1 and March 15 in designated critical habitat for Hood Canal summer chum salmon.
			3. For '**new**[5]' activities only, gravel or shell material shall not be applied to enhance substrate for shellfish activities where native eelgrass or kelp[6] is present.
			4. Turbidity resulting from oyster dredge harvest shall be minimized by adjusting dredge bags to "skim" the surface of the substrate during harvest.
			5. Unsuitable material (e.g., trash, debris, car bodies, asphalt, tires) shall not be discharged or used as fill (e.g., used to secure nets, create nurseries, etc.).
			6. For '**new**' activities only, shellfish activities (e.g., racks, stakes, tubes, nets, bags, long-lines, on-bottom cultivation) shall not occur within 16 horizontal feet of native eelgrass (*Zostera marina)* or kelp. If native eelgrass is present in the vicinity of an area new to shellfish activities, the eelgrass shall be delineated and a map or sketch prepared and submitted to the Corps. Surveys to determine presence and location of eelgrass shall be done during times of peak above-ground biomass: June—September. The following information must be included to scale: parcel boundaries, eelgrass locations and on-site dimensions, shellfish activity locations and dimensions.
			7. For '**new**' activities only, activities shall not occur above the tidal elevation of +7-ft. (MLLW) if the area is listed as documented surf smelt spawning habitat by WDFW. A map showing the location of documented surf smelt spawning habitat is available at the WDFW website.
			8. For '**new**' activities only, activities shall not occur above the tidal elevation of +5-ft. (MLLW) if the area is listed as documented sand lance spawning habitat by WDFW. A map showing the location of documented sand lance spawning habitat is available at the WDFW website.
			9. If conducting 1) mechanical dredge harvesting, 2) raking, 3) harrowing, 4) tilling, leveling or other bed preparation activities, 5) frosting or applying gravel or shell on beds, or 6) removing equipment or material (net, tubes, bags) within a documented or potential spawning area for Pacific herring outside the approved work window, the work area shall be surveyed for the presence of herring spawn prior to the activity occurring. Vegetation, substrate, and materials (nets, tubes, etc.) shall be inspected. If herring spawn is present, these activities are

[5] New Activities are the specific footprint of those activities that were undertaken after March 18, 2007.
[6] Kelp is defined as rooted/attached brown algae in the order *Laminariales*.

			prohibited in the area where spawning has occurred until such time as the eggs have hatched and herring spawn is no longer present. A record shall be maintained of spawn surveys including the date and time of surveys; the area, materials, and equipment surveyed; results of the survey, etc. The Corps and the Services shall be notified if spawn is detected during a survey. The record of spawn surveys shall be made available upon request to the Corps and the Services
			10. For '**new**' activities only, activities occurring in or adjacent to potential spawning habitat for sand lance or surf smelt shall have a spawn survey completed by an approved biologist[7] prior to undertaking bed preparation, maintenance, and harvest activities if work shall occur outside approved work windows for these species. If eggs are present, these activities are prohibited in the areas where spawning has occurred until such time as the eggs have hatched and spawn is no longer present. A record shall be maintained of spawn surveys including the date and time of surveys; the area, materials, and equipment surveyed; results of the survey, etc. The Corps and Services shall be notified if spawn is detected during a survey. The record of spawn surveys shall be made available upon request to the Corps and the Services.
			11. All shellfish gear (e.g., socks, bags, racks, marker stakes, rebar, nets, and tubes) that is not immediately needed or is not firmly secured to the substrate will be moved to a storage area landward of MHHW prior to the next high tide. Gear that is firmly secured to the substrate may remain on the tidelands for a consecutive period of time up to 7 days. Note: This is not meant to apply to the wet storage of harvested shellfish.
			12. All pump intakes (e.g., for washing down gear) that use seawater shall be screened in accordance with NMFS and WDFW criteria. Note: This does not apply to work boat motor intakes (jet pumps) or through-hull intakes.
			13. Land vehicles (e.g., all-terrain, trucks) shall be washed in an upland area such that wash water is not allowed to enter any stream, waterbody, or wetland. Wash water shall be disposed of upland in a location where all water is infiltrated into the ground (i.e., no flow into a waterbody or wetland).
			14. Land vehicles shall be stored, fueled, and maintained in a vehicle staging area located 150 feet or more from any stream, waterbody, or wetland. Where this is not possible, <u>attach</u> (1) documentation as to why compliance is not possible, and (2) a copy of a spill-prevention plan. A clean-up kit shall be maintained and readily available on-site.

[7] For information on how to become an approved biologist, contact WDFW

			15. For boats and other gas-powered vehicles or power equipment that cannot be fueled in a staging area 150 ft. away from a waterbody or at a fuel dock, fuels shall be transferred in Environmental Protection Agency (EPA)-compliant portable fuel containers 5 gallons or smaller at a time during refilling. A polypropylene pad or other appropriate spill protection and a funnel or spill-proof spout shall be used in the event of a spill. A spill kit shall be available and used in the event of a spill. All spills shall be reported to the Washington Emergency Management Office at (800) 258-5990. All waste oil or other clean-up materials contaminated with petroleum products shall be properly disposed of off-site.
			16. All vehicles operated within 150 feet of any stream, waterbody, or wetland shall be inspected daily for fluid leaks before leaving the vehicle staging area. Any leaks detected shall be repaired in the vehicle staging area before the vehicle resumes operation and documented in a record that is available for review on request by the Corps and Services.
			17. The direct or indirect contact of toxic compounds including creosote, wood preservatives, paint, etc. within the marine environment shall be prevented. *[This does not apply to boats]*
			18. All tubes, mesh bags and area nets shall be clearly, indelibly, and permanently marked to identify the permittee name and contact information (e.g., telephone number, email address, mailing address). On the nets, identification markers shall be placed with a minimum of one identification marker for each 50 feet of net.
			19. All equipment, gear, and other structures including anti-predator nets, stakes, and tubes) shall be tightly secured to prevent them from breaking free.
			20. All new foam material (whether used for floatation of for any other purpose) must be encapsulated within a shell that prevents breakup or loss of foam material into the water and is not readily subject to damage by ultraviolet radiation or abrasion. Current un-encapsulated foam material shall be removed or replaced.
			21. Tires shall not be used as part of above and below structures or where tires could potentially come in contact with the water (e.g., floatation, fenders, hinges). Tires used for floatation currently shall be replaced with inert or encapsulated materials, such as plastic or encased foam, during maintenance or repair of the structure.
			22. At least once every three months, beaches in the project vicinity shall be patrolled by crews who shall retrieve debris (e.g., anti-predator nets, bags, stakes, disks, tubes) that escapes from the project area. Within the project vicinity, locations shall be identified where debris tends to

			accumulate due to wave, current, or wind action. After weather events these locations shall be patrolled by crews who shall remove and dispose of shellfish-related debris appropriately. A record shall be maintained with the following information and the record shall be made available upon request to the Corps, NMFS, and USFWS: date of patrol, location of areas patrolled, description of the type and amount of retrieved debris, other pertinent information.
			23. When performing other activities on-site, the grower shall routinely inspect for and document any fish or wildlife found entangled in nets or other shellfish equipment. In the event that fish or wildlife are found entangled, the grower shall: 1) provide immediate notice (within 24 hours) to WDFW (all species), Services (ESA-listed species) or Marine Mammal Stranding Network (marine mammals), 2) attempt to release the individual(s) without harm, and 3) provide a written and photographic record of the event, including dates, species identification, number of individuals, and final disposition, to the Corps and Services. Contact U. S. Fish and Wildlife Service Law Enforcement Office at (425) 883-8122 with any questions about the preservation of specimens.
			24. Vehicles (e.g., ATV's, tractors) shall not be used within native eelgrass beds. If there is no alternative for site access, attach a plan describing specific measures and/or best management practices that shall be undertaken to minimize negative effects to eelgrass from vehicle operation. The access plan shall include the following components: (a) frequency of access at each location, (b) use of only the minimum vehicles needed to conduct the work and a description of the minimum number of vehicles needed at each visit, and (c) consistency in anchoring/grounding in the same location and/or traveling on the same path to restrict eelgrass disturbance to a very small footprint.
			25. Vessels shall not ground or anchor in native eelgrass (*Zostera marina*) or kelp and paths through native eelgrass or kelp shall not be established. If there is no other access to the site or the special condition cannot be met due to human-safety considerations, attach a site-specific plan describing specific measures and/or best management practices that shall be undertaken to minimize negative effects to eelgrass from vessel operation and accessing the shellfish areas. The access plan shall include the following components: (a) frequency of access at each location, (b) use of only the minimum vehicles needed to conduct the work and a description of the minimum number of vehicles needed at each visit, and (c) consistency in anchoring/grounding in the same location and/or traveling on the same path to restrict eelgrass disturbance to a very

			small footprint.
			26. Unless prohibited by substrate or other specific site conditions, floats and rafts must use embedded anchors and midline floats to prevent dragging of anchors or lines. Floats and rafts that are not in compliance with this standard shall be upgraded to meet this standard during scheduled maintenance, repair, or replacement or before the end of the term of the next renewed authorization. [*Any alternative to using an embedded anchor must be approved by the NMFS*.]
			27. Activities that are directly associated with shellfish activities (e.g., access roads, wet storage) shall not result in removal of native riparian vegetation extending landward 150 ft horizontally from MHHW (includes both wetland and upland vegetation) and disturbance shall be limited to the minimum necessary to access or engage in shellfish activities.
			28. Native salt marsh vegetation shall not be removed and disturbance shall be limited to the minimum necessary to access or engage in shellfish activities.
			GENERAL CONDITIONS
			29. Vertical fencing/vertical nets or drift fences (includes oyster corrals) are not covered and shall not be used.
			30. New or maintenance to piles of any kind are not covered under this programmatic and shall not be used.
			31. Mooring buoys shall not be installed *[An additional, separate form is required for installation of mooring buoys.]*
			32. Cultivation of new species of shellfish not previously cultivated in Washington State is not covered under this programmatic and shall not occur.
			33. Attendant features, such as docks, piers, boat ramps, stockpiles, or staging areas are not covered by this programmatic and shall not occur. [*Additional forms may be available that address attendant features, please coordinate with Corps prior to submitting*.]
			34. Deposition of shell material back into waters of the United States as waste is not covered and shall not occur.
			35. Dredging or creating channels so as to redirect fresh water flow is not covered under this programmatic and shall not occur.
			36. New berms or dikes or the expansion or maintenance of current, authorized berms or dikes is not covered under this programmatic. Installation, expansion, or maintenance of berms or dikes shall not occur.
			37. Installation of “new” rafts is not covered under this programmatic and shall not occur.
			38. Expansion of continuing rafts is not covered under this programmatic and shall not occur.
			39. Installation of “new” or the relocation or expansion of

			FLUPSYs or floats is not covered under this programmatic and shall not occur.
			40. The use of materials that lack structural integrity in the marine environment (e.g., plastic children's wading pools) is not a covered under this programmatic and shall not occur.

*This programmatic ESA consultation does not cover the use of pesticides or chemicals to control invasive species.

If the applicant **has checked "Will Not Meet" for any of the above conditions**, or there are associated project activities or equipment not covered by this Programmatic Consultation, or new species and/or critical habitat is not covered under this Programmatic Consultation, then this section must be completed and the applicant must sign below.

Please contact the Corps if you have questions.

1. List the programmatic conditions that you will not meet and explain for each one why you can't meet the condition of this programmatic consultation.

2. List the associated project activities not covered by this Programmatic Consultation. Examples include new rafts, mooring buoys, or temporary use of sand bags. Attach an addendum to address these activities. You may require the assistance of a qualified biologist to prepare the addendum. Note: Some types of activities, such as mooring buoys, may have a specific project information form that can be used in combination with this form.

3. Are there species and/or critical habitat in the vicinity of the project that are not covered under this Programmatic Consultation?

4. How have you minimized impacts? Describe additional conservation measures or mitigation you are proposing. (Note: You may need to prepare and attach an addendum that includes an effect analysis. You may require the assistance of a qualified biologist to prepare the addendum.)

I, as the applicant, have read all the USFWS and NMFS requirements for their Programmatic Consultations dated XXXXX and XXXXXX, respectively. These requirements are listed on the Seattle District Corps webpage at XXXXXXX. I understand that informal consultation with National Marine Fisheries Service and U.S. Fish and Wildlife Service will be initiated with this form. I will not proceed with construction until I receive written notification from the U.S. Army Corps of Engineers that the proposed work is authorized.

______________________________________ ______

Applicant Date

Appendix B

Summary of commercial shellfish activities proposed in permit applications received by the Corps from 2007 to 2014

The proposed action includes the authorization and reauthorization of continuing aquaculture activities. Applications for all activities that qualify as continuing have been received by the Corps. The activities proposed in these applications are summarized in this appendix. The continuing activities are organized by those that were previously authorized by the Corps and those that are pending as of July 2014. New shellfish activities proposed in permit applications received as of July 2014 are also included but tallied separately.

The purpose of this information is to provide insight into the relative commonality of the various activities in each of the regions. For example, the information indicates that oyster culture in Grays Harbor is primarily conducted by bottom culture and longlines. Except for the floating activities, the acreages in this appendix are NOT realistic estimates of the acreage engaged in the various activities. In most cases, the acreages are overstated by some unknown factor due to the limited information in permit applications. Applications typically identify a list of the shellfish activities that are proposed, a total active cultivation acreage, and possibly a total fallow acreage. Applicants are not required to assign precise acreages to each individual activity. The acreage total is based on the assumption that each individual activity proposed in an application is conducted on the entire acreage in the application. This is unlikely to occur in many cases. For example, an applicant that proposes to grow both oysters and clams is not likely to grow them both on the same acreage. The summary therefore would overstate the acreage engaged in the two culture methods. In some cases, individual activities may both occur on a given acreage (e.g., dredging and harrowing). Many applicants propose to culture only one species using a single method. In these cases, the summary would accurately tally the acreage for those activities. Due to a more detailed review and their limited scale, the summary for the floating activities is considered a realistic estimate of the acres engaged in these activities.

Table B-1. Commercial aquaculture activities proposed in permit applications (2007-2014) for Grays Harbor

Grays Harbor - continuing activities

		oyster							clam				geoduck		mussel			other					
		surface longline	seed raft	longline	stake	rack and bag	bottom	dredge	seed raft	bottom	bag	mechanical harvest	seed raft	bottom	bottom	raft	surface longline	harrowing/ leveling	frosting	cover nets	Floats	FLUPSYS	intakes/ outfalls
authorized	continuing footprints	0	0	14	0	3	21	21	0	5	0	0	0	0	0	0	0	5	0	0	0	0	0
	active acres			732	0	29	1,080	996		343								290					
	fallow acres			533	0	6	1,800	1,767		7								185					
pending	continuing footprints	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	active acres																						
	fallow acres																						
total	continuing footprints	0	0	14	0	3	21	21	0	5	0	0	0	0	0	0	0	5	0	0	0	0	0
	active acres	0	0	732	0	29	1,080	996	0	343	0	0	0	0	0	0	0	290	0	0	0	0	0
	fallow acres	0	0	533	0	6	1,800	1,767	0	7	0	0	0	0	0	0	0	185	0	0	0	0	0
	total acres	0	0	1,265	0	35	2,880	2,763	0	350	0	0	0	0	0	0	0	475	0	0	0	0	0

Grays Harbor - new activities

		oyster							clam				geoduck		mussel			other					
		surface longline	seed raft	longline	stake	rack and bag	bottom	dredge	seed raft	bottom	bag	mechanical harvest	seed raft	bottom	bottom	raft	surface longline	harrowing/ leveling	frosting	cover nets	Floats	FLUPSYS	intakes/ outfalls
authorized	new footprints	0	na	0	0	0	0	0	na	0	0	0	na	0	0	na	0	0	0	0	na	na	0
	acres																						
pending	new footprints	0	na	0	0	0	0	0	na	0	0	0	na	0	0	na	0	0	0	0	na	na	0
	acres																						
total	new footprints	0	na	0	0	0	0	0	na	0	0	0	na	0	0	na	0	0	0	0	na	na	0
	acres																						

Table B-2. Commercial aquaculture activities proposed in permit applications (2007-2014) for Willapa Bay

Willapa Bay - continuing activities

		oyster							clam				geoduck		mussel			other					
		surface longline	seed raft	longline	stake	rack and bag	bottom	dredge	seed raft	bottom	bag	mechanical harvest	seed raft	bottom	bottom	raft	surface longline	harrowing/ leveling	frosting	cover nets	Floats	FLUPSYS	intakes/ outfalls
authorized	continuing footprints	0	0	35	3	8	219	136	0	131	0	0	0	2	3	0	2	21	107	22	3	0	0
	active acres			4,134	243	829	15,918	11,071		11,825				1	361		2	746	9,024	3,320			
	fallow acres			1,903	10	72	9,063	7,236		7,394				67	27		27	700	5,074	2,637			
pending	continuing footprints	0	0	0	0	0	2	1	0	3	0	0	0	0	0	0	0	0	3	1	0	0	0
	active acres						73	60		77									77	60			
	fallow acres						0	0		0.5									0.5	0			
total	continuing footprints	0	0	35	3	8	221	137	0	134	0	0	0	2	3	0	2	21	110	23	3	0	0
	active acres	0	0	4,134	243	829	15,991	11,131	0	11,902	0	0	0	1	361	0	2	746	9,101	3,380	0	0	0
	fallow acres	0	0	1,903	10	72	9,063	7,236	0	7,394	0	0	0	67	27	0	27	700	5,075	2,637	0	0	0
	total acres	0	0	6,037	253	902	25,054	18,367	0	19,296	0	0	0	68	388	0	29	1,446	14,175	6,017	0	0	0

Willapa Bay - new activities

		oyster							clam				geoduck		mussel			other					
		surface longline	seed raft	longline	stake	rack and bag	bottom	dredge	seed raft	bottom	bag	mechanical harvest	seed raft	bottom	bottom	raft	surface longline	harrowing/ leveling	frosting	cover nets	Floats	FLUPSYS	intakes/ outfalls
authorized	new footprints	0	na	0	0	0	0	0	na	0	0	0	na	0	0	na	0	0	0	0	na	na	0
	acres																						
pending	new footprints	0	na	0	0	0	0	0	na	0	0	0	na	0	0	na	0	0	0	0	na	na	0
	acres																						
total	new footprints	0	na	0	0	0	0	0	na	0	0	0	na	0	0	na	0	0	0	0	na	na	0
	acres																						

Table B-3. Commercial aquaculture activities proposed in permit applications (2007-2014) for Hood Canal

Hood Canal - continuing activities

		oyster							clam				geoduck		mussel			other					
		surface longline	seed raft	longline	stake	rack and bag	bottom	dredge	seed raft	bottom	bag	mechanical harvest	seed raft	bottom	bottom	raft	surface longline	harrowing/ leveling	frosting	cover nets	Floats	FLUPSYS	intakes/ outfalls
authorized	continuing footprints	1	1	8	2	10	194	0	1	185	1	0	1	12	2	1	3	0	7	28	0	0	0
	active acres		0.3	240	14	108	948	0	0.3	969	7		0.3	447	105	0.3	11		328	537			
	fallow acres		4	52	0	20	145	0	4	143	3		4	110	25	4	5		57	118			
pending	continuing footprints	0	0	1	0	0	2	0	0	3	0	0	0	1	0	1	0	0	0	2	0	0	0
	active acres			14			1			15				5		12				1			
	fallow acres			25			219			244				0		10				219			
total	continuing footprints	1	1	9	2	10	196	0	1	188	1	0	1	13	2	2	3	0	7	30	0	0	0
	active acres	0	0	254	14	108	949	0	0	984	7	0	0	453	105	12	11	0	328	538	0	0	0
	fallow acres	0	4	77	0	20	364	0	4	387	3	0	4	110	25	14	5	0	57	337	0	0	0
	total acres	0	4	331	14	128	1,313	0	4	1,370	10	0	4	563	130	26	16	0	384	876	0	0	0

Hood Canal - new activities

		oyster							clam				geoduck		mussel			other					
		surface longline	seed raft	longline	stake	rack and bag	bottom	dredge	seed raft	bottom	bag	mechanical harvest	seed raft	bottom	bottom	raft	surface longline	harrowing/ leveling	frosting	cover nets	Floats	FLUPSYS	intakes/ outfalls
authorized	new footprints	0	na	0	0	0	1	0	na	1	0	0	na	0	0	na	0	0	0	1	na	na	0
	acres						7			7										7			
pending	new footprints	0	na	1	0	0	1	0	na	1	0	0	na	6	0	na	0	0	0	6	na	na	1
	acres			3			3			3				28						28			
total	new footprints	0	na	1	0	0	2	0	na	2	0	0	na	6	0	na	0	0	0	7	na	na	1
	acres	0		3	0	0	10	0		10	0	0		28	0		0	0	0	35			0

Table B-4. Commercial aquaculture activities proposed in permit applications (2007-2014) for South Puget Sound

South Puget Sound - continuing activities

		oyster							clam				geoduck		mussel			other					
		surface longline	seed raft	longline	stake	rack and bag	bottom	dredge	seed raft	bottom	bag	mechanical harvest	seed raft	bottom	bottom	raft	surface longline	harrowing/ leveling	frosting	cover nets	Floats	FLUPSYS	intakes/ outfalls
authorized	continuing footprints	0	1	3	2	24	137	3	0	189	1	0	2	225	3	2	1	0	81	286	1	2	0
	active acres		1	153	6	185	1,315	302		1,579	4		11	904	2	11	6		895	1,520			
	fallow acres		0	27	10	51	584	130		628	0		7	501	1	7	0		292	639			
pending	continuing footprints	0	0	0	2	0	13	1	0	14	0	0	0	22	0	0	1	0	5	28	0	0	0
	active acres				12		539	370		541				27			1		403	490			
	fallow acres				14		69	50		74				17			0		64	85			
total	continuing footprints	0	1	3	4	24	150	4	0	203	1	0	2	247	3	2	2	0	86	314	1	2	0
	active acres	0	1	153	18	185	1,855	672	0	2,119	4	0	11	931	2	11	7	0	1,299	2,011	0	0	0
	fallow acres	0	0	27	24	51	654	180	0	702	0	0	7	518	1	7	0	0	356	724	0	0	0
	total acres	0	1	180	42	236	2,509	852	0	2,821	4	0	18	1,449	2	18	7	0	1,654	2,735	0	0	0

South Puget Sound - new activities

		oyster							clam				geoduck		mussel			other					
		surface longline	seed raft	longline	stake	rack and bag	bottom	dredge	seed raft	bottom	bag	mechanical harvest	seed raft	bottom	bottom	raft	surface longline	harrowing/ leveling	frosting	cover nets	Floats	FLUPSYS	intakes/ outfalls
authorized	new footprints	0	na	0	0	0	1	0	na	2	0	0	na	15	0	na	0	0	0	15	na	na	0
	acres						0.5			1				18						18			
pending	new footprints	0	na	0	0	0	1	0	na	1	0	0	na	14	0	na	0	0	0	14	na	na	0
	acres						4			4				27						27			
total	new footprints	0	na	0	0	0	2	0	na	3	0	0	na	29	0	na	0	0	0	29	na	na	0
	acres	0		0	0	0	4	0		5	0	0		45	0		0	0	0	45			0

Table B-5. Commercial aquaculture activities proposed in permit applications (2007-2014) for North Puget Sound

North Puget Sound - continuing activities

		oyster							clam				geoduck		mussel			other					
		surface longline	seed raft	longline	stake	rack and bag	bottom	dredge	seed raft	bottom	bag	mechanical harvest	seed raft	bottom	bottom	raft	surface longline	harrowing/ leveling	frosting	cover nets	Floats	FLUPSYS	intakes/ outfalls
authorized	continuing footprints	0	0	3	31	6	46	0	0	46	0	1	0	8	1	0	0	1	24	32	0	0	0
	active acres			51	56.03	72	172	0		232		6		105	1			12	33	157			
	fallow acres			1	6.11	50	109	0		143		0		58	4			6	17	89			
pending	continuing footprints	0	1	3	0	2	12	1	0	10	0	0	0	3	0	2	1	1	5	8	0	0	0
	active acres		7	612		257	1,008	509		998				264		62	2	509	981	480			
	fallow acres		0	2,074		2,000	2,166	0		2,115				2,051		0	0	0	2,058	2,115			
total	continuing footprints	0	1	6	31	8	58	1	0	56	0	1	0	11	1	2	1	2	29	40	0	0	0
	active acres	0	7	663	56	328	1,180	509	0	1,230	0	6	0	369	1	62	2	521	1,014	637	0	0	0
	fallow acres	0	0	2,075	6	2,050	2,276	0	0	2,258	0	0	0	2,108	4	0	0	6	2,075	2,204	0	0	0
	total acres	0	7	2,738	62	2,378	3,456	509	0	3,488	0	6	0	2,477	5	62	2	527	3,090	2,841	0	0	0

North Puget Sound - new activities

		oyster							clam				geoduck		mussel			other					
		surface longline	seed raft	longline	stake	rack and bag	bottom	dredge	seed raft	bottom	bag	mechanical harvest	seed raft	bottom	bottom	raft	surface longline	harrowing/ leveling	frosting	cover nets	Floats	FLUPSYS	intakes/ outfalls
authorized	new footprints	0	na	0	0	0	0	0	na	0	0	0	na	0	0	na	0	0	0	0	na	na	0
	acres																						
pending	new footprints	0	na	0	0	0	0	0	na	0	0	0	na	0	0	na	0	0	0	0	na	na	0
	acres																						
total	new footprints	0	na	0	0	0	0	0	na	0	0	0	na	0	0	na	0	0	0	0	na	na	0
	acres																						

Appendix C

Estimated frequency of intertidal shellfish aquaculture activities conducted in-water

Table C-1. Frequency of intertidal shellfish aquaculture activities conducted in-water

In-water activity:	Graveling			Harrowing			Dredging			Longline harvest			Dive harvest - geoduck culture			Total		
	acres	acres worked /day	activity days /year	acres	acres worked /day	activity days /year	acres	acres worked /day	activity days /year	acres	acres worked /day	activity days /year	acres	acres worked /day	activity days /year	total acres	acres worked /day	activity days /year
Grays Harbor																		
Continuing active	0	0.0	0	290	1.1	58	996	3.8	1,992	732	0.9	1,953	0	0.00	0	2,018	5.9	4,003
Continuing fallow	0	0.0	0	185	0.7	37	1,767	6.8	3,534	533	0.7	1,421	0	0.00	0	2,485	8.2	4,992
New	100	0.4	100	100	0.4	20	100	0.4	200	100	0.1	267	0	0.00	0	400	1.3	587
Fallow & New	100	0.4	100	285	1.1	57	1,867	7.2	3,734	633	0.8	1,688	0	0.00	0	2,885	9.5	5,579
Subtotal	100	0.4	100	575	2.2	115	2,863	11.0	5,726	1,365	1.8	3,641	0	0.00	0	4,903	15.4	9,582
Willapa Bay																		
Continuing active	9,101	35.0	9,101	746	2.9	149	11,131	42.8	22,262	4,134	5.3	11,024	1	0.00	6	25,113	86.0	42,542
Continuing fallow	5,075	19.5	5,075	700	2.7	140	7,236	27.8	14,472	1,903	2.4	5,074	0	0.00	0	14,914	52.5	24,761
New	50	0.2	50	50	0.2	10	50	0.2	100	50	0.1	133	50	0.04	286	250	0.7	579
Fallow & New	5,125	19.7	5,125	750	2.9	150	7,286	28.0	14,572	1,953	2.5	5,207	50	0.04	286	15,164	53.2	25,340
Subtotal	14,226	54.7	14,226	1,496	5.8	299	18,417	70.8	36,834	6,087	7.8	16,231	51	0.04	291	40,277	139.1	67,882
Hood Canal																		
Continuing active	328	1.3	328	0	0.0	0	0	0.0	0	240	0.3	640	77	0.06	440	645	1.6	1,408
Continuing fallow	57	0.2	57	0	0.0	0	0	0.0	0	52	0.1	140	2	0.00	11	111	0.3	208
New	359	1.4	359	359	1.4	72	359	1.4	718	342	0.4	911	79	0.06	451	1,498	4.6	2,511
Fallow & New	416	1.6	416	359	1.4	72	359	1.4	718	394	0.5	1,051	81	0.06	462	1,609	4.9	2,719
Subtotal	744	2.9	744	359	1.4	72	359	1.4	718	634	0.8	1,691	158	0.12	902	2,254	6.6	4,127

Table C-1 (cont). Frequency of intertidal shellfish aquaculture activities conducted in-water

In-water activity:	Graveling			Harrowing			Dredging			Longline harvest			Dive harvest - geoduck culture			Total		
	acres	acres worked /day	activity days /year	acres	acres worked /day	activity days /year	acres	acres worked /day	activity days /year	acres	acres worked /day	activity days /year	acres	acres worked /day	activity days /year	total acres	acres worked /day	activity days /year
South Puget Sound																		
Continuing active	1,299	5.0	1,299	0	0.0	0	672	2.6	1,344	153	0.2	407	159	0.12	909	2,283	7.9	3,959
Continuing fallow	356	1.4	356	0	0.0	0	180	0.7	360	27	0.0	73	27	0.02	157	591	2.1	945
New	300	1.2	300	300	1.2	60	300	1.2	600	300	0.4	800	148	0.11	845	1,348	4.0	2,606
Fallow & New	656	2.5	656	300	1.2	60	480	1.8	960	327	0.4	873	175	0.13	1,002	1,939	6.1	3,551
Subtotal	1,955	7.5	1,955	300	1.2	60	1,152	4.4	2,304	480	0.6	1,280	334	0.26	1,910	4,222	14.0	7,510
North Puget Sound																		
Continuing active	1,014	3.9	1,014	12	0.0	2	509	2.0	1,018	51	0.1	136	63	0.05	360	1,649	6.0	2,531
Continuing fallow	2,075	8.0	2,075	6	0.0	1	0	0.0	0	1	0.0	3	0	0.00	0	2,082	8.0	2,079
New	255	1.0	255	255	1.0	51	255	1.0	510	255	0.3	680	59	0.05	337	1,080	3.3	1,833
Fallow & New	2,330	9.0	2,330	261	1.0	52	255	1.0	510	256	0.3	683	59	0.05	337	3,162	11.3	3,912
Subtotal	3,344	12.9	3,344	273	1.1	55	764	2.9	1,528	307	0.4	819	122	0.09	697	4,811	17.3	6,443
Total																		
Continuing active	11,742	45.2	11,742	1,048	4.0	210	13,308	51.2	26,616	5,310	6.8	14,160	300	0.23	1,714	31,708	107.4	54,442
Continuing fallow	7,563	29.1	7,563	891	3.4	178	9,183	35.3	18,366	2,516	3.2	6,710	29	0.02	168	20,183	71.1	32,985
New	1,064	4.1	1,064	1,064	4.1	213	1,064	4.1	2,129	1,047	1.3	2,792	336	0.26	1,918	4,576	13.9	8,116
Fallow & New	8,627	33.2	8,627	1,956	7.5	391	10,247	39.4	20,495	3,563	4.6	9,502	365	0.28	2,086	24,759	85.0	41,101
Grand Total	20,369	78.3	20,369	3,003	11.6	601	23,555	90.6	47,111	8,873	11.4	23,662	665	0.51	3,800	56,467	192.4	95,543

Table C-1 (cont). Frequency of intertidal shellfish aquaculture activities conducted in-water

Notes:
1. The analysis for continuing acres is based on information received by the Corps in permit applications. If an applicant proposed one of the in-water activites listed in the above table, the analysis assumes the entire acreage associated with the application is engaged in that activity. This assumption is likely correct for those applicants culturing a single species and using the same method for their entire acreage. For those applicants that employ several different methods across their total acreage (e.g., to culture multiple species), the above analysis would likely overstate the actual acreage engaged in that activity. The above estimates are therefore likely high but considered 'in the ballpark' (i.e., less than a factor of 2) based on a comparison of the total acres column with the total acres of continuing active cultivation in Table 3-5.
2. Since activities conducted on new acreage are largely unknown the following assumptions were made. New acreage represents new aquaculture acreage only since these activites are generally not expected to occur for restoration or recreation projects. Estimates provided by PCSGA for future anticipated species culture (Table 3-9) were used to allocate the new acreage among the various categories of activity. New geoduck acreage was assumed to be engaged in geoduck dive harvest only. The remaining acreage was assumed to be engaged in all four of the other in-water activities (graveling, harrowing, dredging, and longline harvest). This approach likely overestimates the acreage for each of these individual activities because not all of the activites are likely to occur on all of the non-geoduck new acres.
3. Table summarizes in-water shellfish activites that occur predominantly in the intertidal zone. A small but unknown percentage of the summarized activites would occur in the subtidal zone. Subtidal geoduck harvest is excluded from this analysis because it occurs in deeper waters.
4. Acres worked/day is estimate of the number of acres that would be worked every day for one year to complete the task in one year. Acres worked/day = (total acres) x (frequency - see note 6) ÷ 260 days/yr). Estimate assumes 260 working days per year which is equivalent to a five day work week. In reality, effort is not likely to be equally spread across the entire year but would be concentrated during certain periods. If assume work only once per month, then multiply result by 21.7 (260 days/yr ÷ 12 months/yr).
5. Activity days/year is estimate of the number of days that are required to be worked in order to complete the task on the activity acres during one year assuming the typical acres worked per day rates are accomplished. Activity days/year = total acres x frequency (see note 6) ÷ acres completed per day (see note 7). For example, activity days per year for harrowing new acres in Grays Harbor = 100 (for # new acres) x 1 (for frequency of once per year) ÷ 5 (for # acres that can be harrowed in one day) = 20 activity days per year which means it takes 20 full days to complete all the harrowing work associated with new acres in Grays Harbor.
6. The frequency (recurrence/year) of each activity occurring on a given acre was assumed to be once a year for frosting, harrowing, and dredging, once every three years for long-line harvest of oyster, and once every five years for dive harvest of cultured geoduck (see discussion in main text of document). Dredging estimate assumes each acre would be dredged twice in succession to remove oysters. This was treated as two dredge activity days in the analysis.
7. The average assumed activity rates for graveling (1 acre/day), harrowing (5 acres/day), dredging (0.5 acre/day) and longline oyster harvest (0.125 acre/day) are from informal survey of past and likely future permit applicants (Corps 2014a).
8. The average assumed activity rate for dive harvest of cultured geoduck (0.035 acre/day) is from Corps 2011, where the average daily harvest area was estimated to range from 0.01 to 0.06 acre/day for a two diver team. It is assumed that 75% of the total geoduck acreage would be harvested by divers (Anchor 2009).
9. The above analysis assumes that the implementation of the various activities is equally spread across the year. Realistically, activities are more likely to be concentrated during certain times of the year or accomplished during shorter periods of more concentrated effort. There is also likely to be variability among individual applicants regarding the frequency and timing of how they implement the above activities. Nevertheless, these averages provide an indication of the scale of the activites over time.

Appendix D

Continuing active aquaculture acres potentially co-located with eelgrass

This appendix provides estimates for the number of continuing aquaculture footprints and acres that are co-located with eelgrass. The estimates are based on a single point coordinate for each aquaculture footprint provided in permit applications. The analysis assumed that if the single point coordinate was located within or upland of mapped eelgrass, the entire acreage associated with that coordinate was co-located with eelgrass. This is a conservative assumption and likely results in an overestimate of the acreage co-located with eelgrass. Two eelgrass inventories from WDNR were used for the analysis. Towed underwater video from 2000 to 2012 was used by WDNR to map eelgrass (*Z. marina*) within Puget Sound and the Strait of Juan de Fuca (WDNR 2013b). Eelgrass maps developed from aerial photography in the late 1990's were used for analysis in Grays Harbor and Willapa Bay (WDNR 2001, Berry et.al. 2001). The latter inventory did not differentiate between *Z. marina* and *Z. japonica* which adds to the error for the estimates in these regions. *Z. marina* is typically found at lower tidal elevations with *Z. japonica* somewhat higher although there is some overlap (WDNR 2011). There is also likely considerable error in the 2001 inventory from the data collection method. WDNR (2001) indicates 39,861 acres of eelgrass in Willapa Bay and 36,415 acres in Grays Harbor. More recent estimates for eelgrass in Willapa Bay range from 17,000 acres for *Z. marina* and 9,000 acres for *Z. japonica* (Dumbauld and McCoy 2015) and 8,461 acres of *Z. marina* with a similar coverage area for *Z. japonica* (Ruesick et al. 2006). Estimates for *Z. marina* in Grays Harbor are 7,600 acres (Borde et al. 2003), 11,700 acres (Wyllie-Echeverria and Ackerman 2003), and 10,990 acres (Gatto 1978). This suggests WDNR (2001) may overestimate *Z. marina* coverage by about three-fold. In summary, these should be considered course estimates of the aquaculture acreage co-located with eelgrass appropriate for the broad action area.

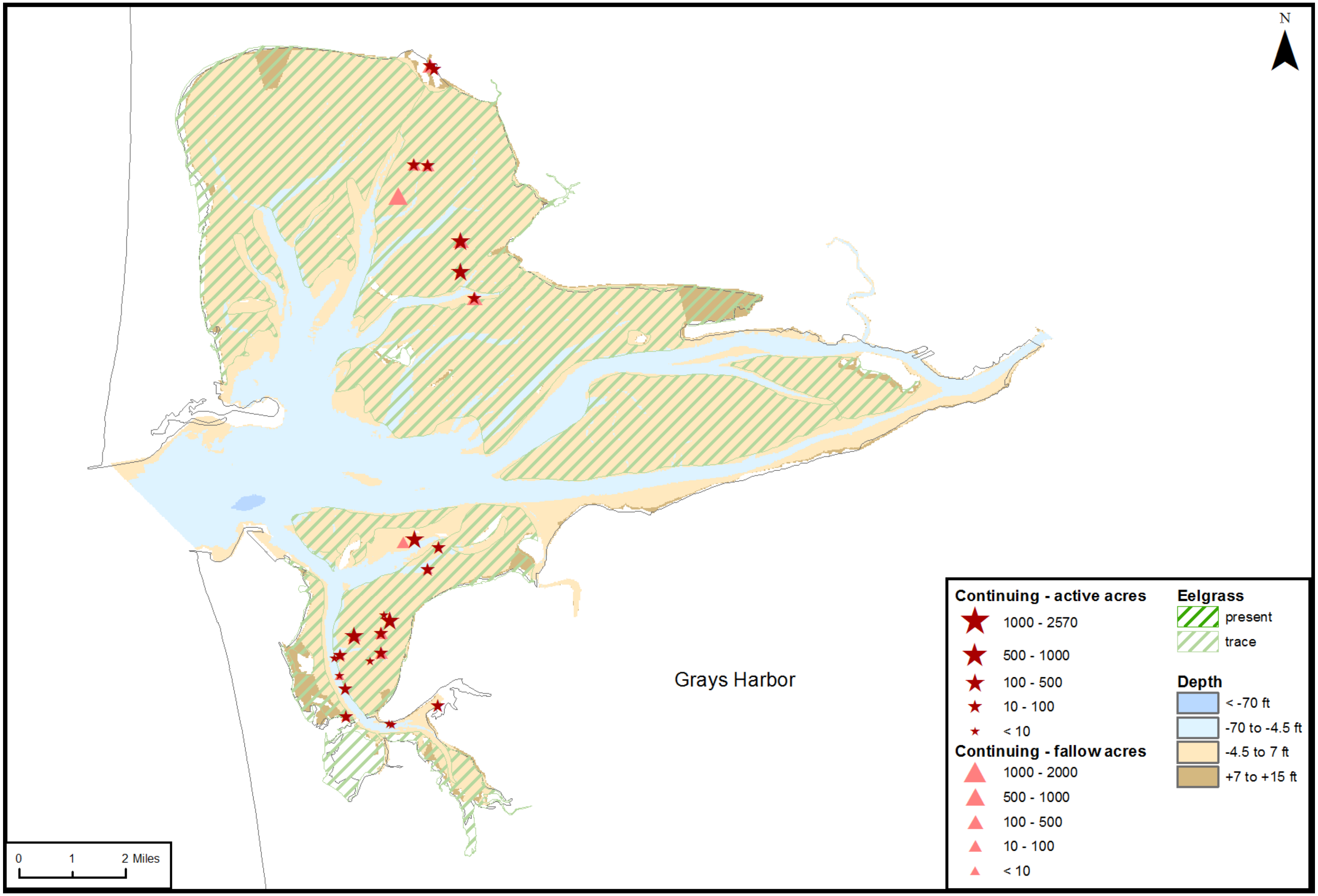

Figure D-1. Grays Harbor continuing acres and eelgrass

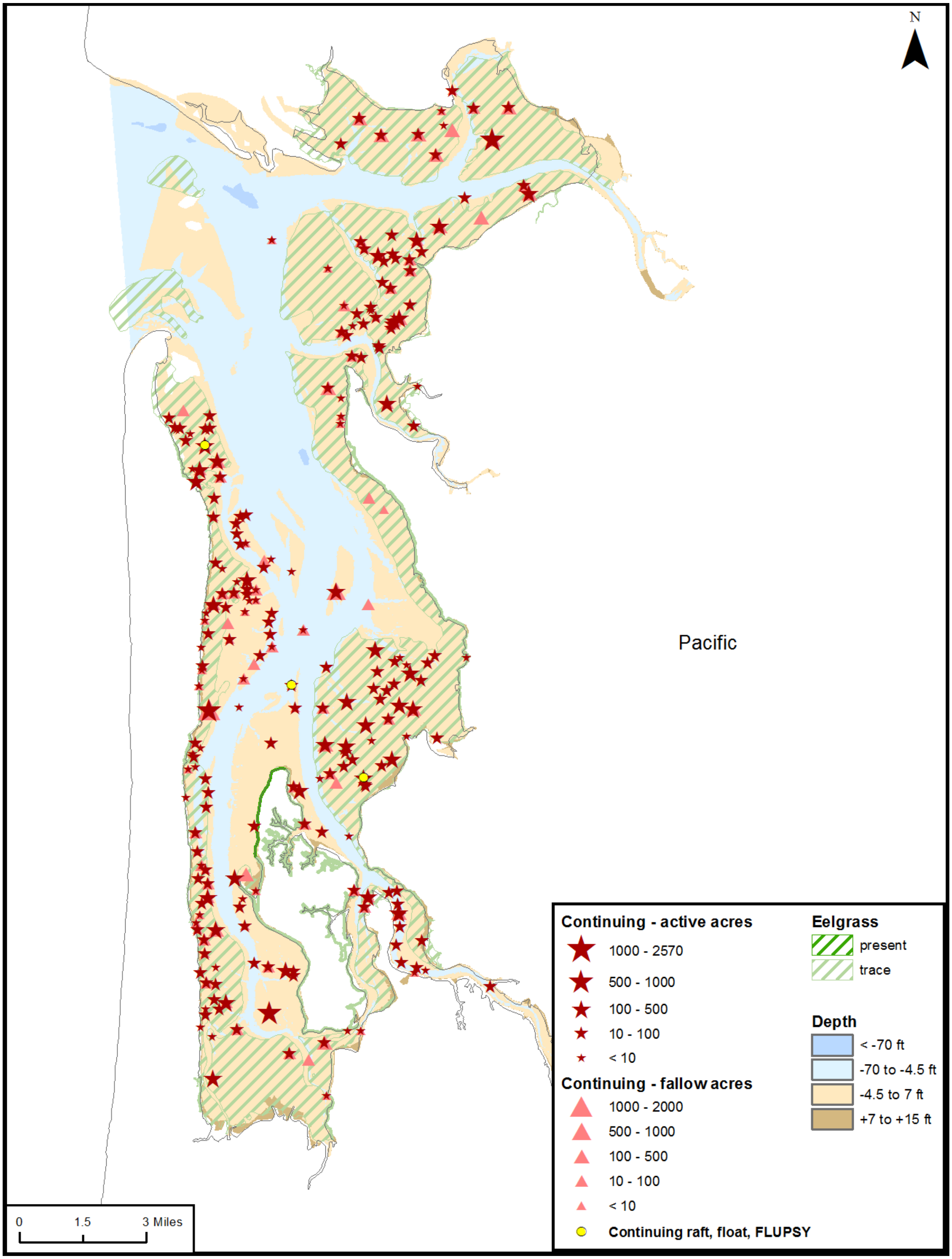

Figure D-2. Willapa Bay continuing acres and eelgrass

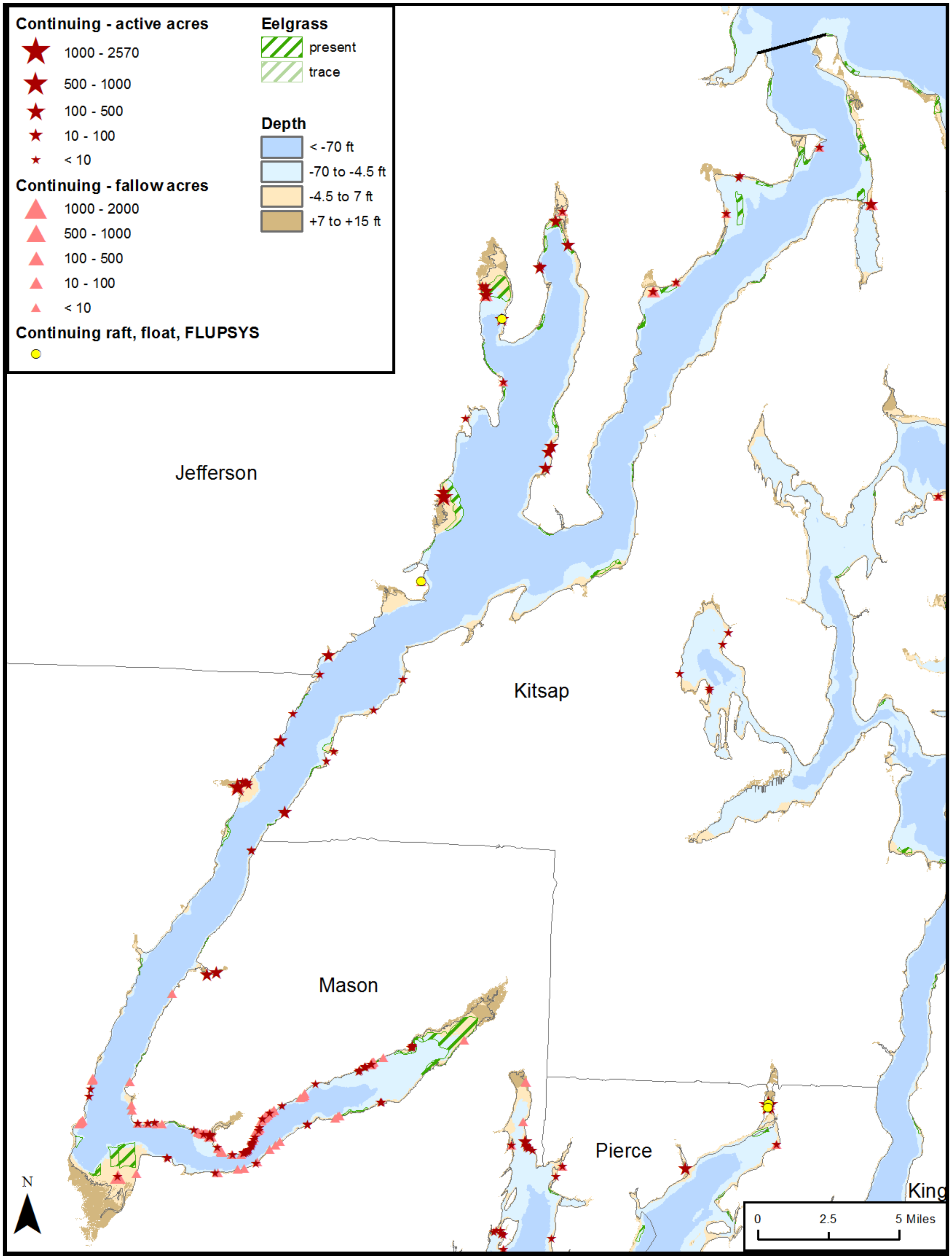

Figure D-3. Hood Canal continuing acres and eelgrass

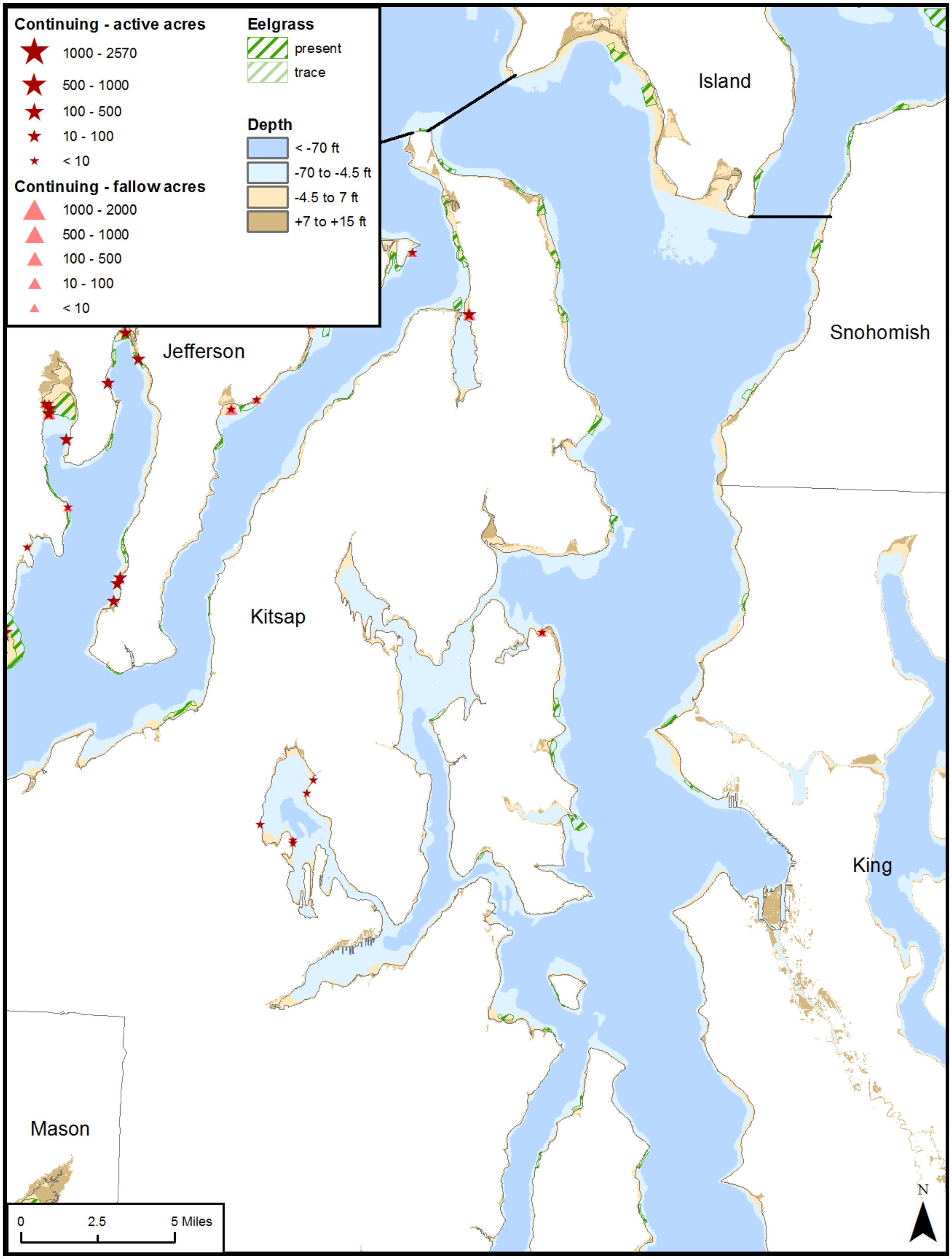

Figure D-4. South Puget Sound (north section) continuing acres and eelgrass

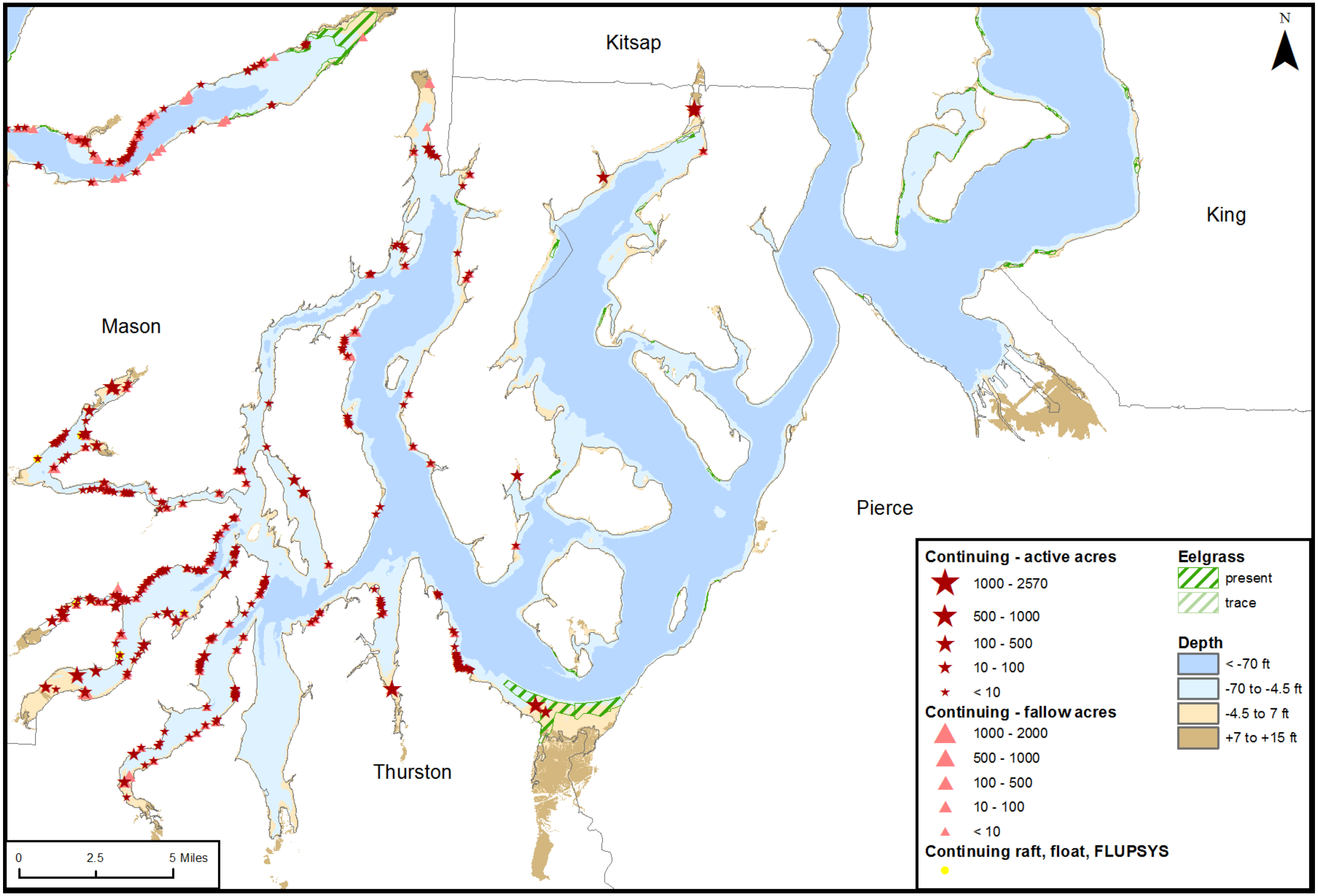

Figure D-5. South Puget Sound (south section) continuing acres and eelgrass

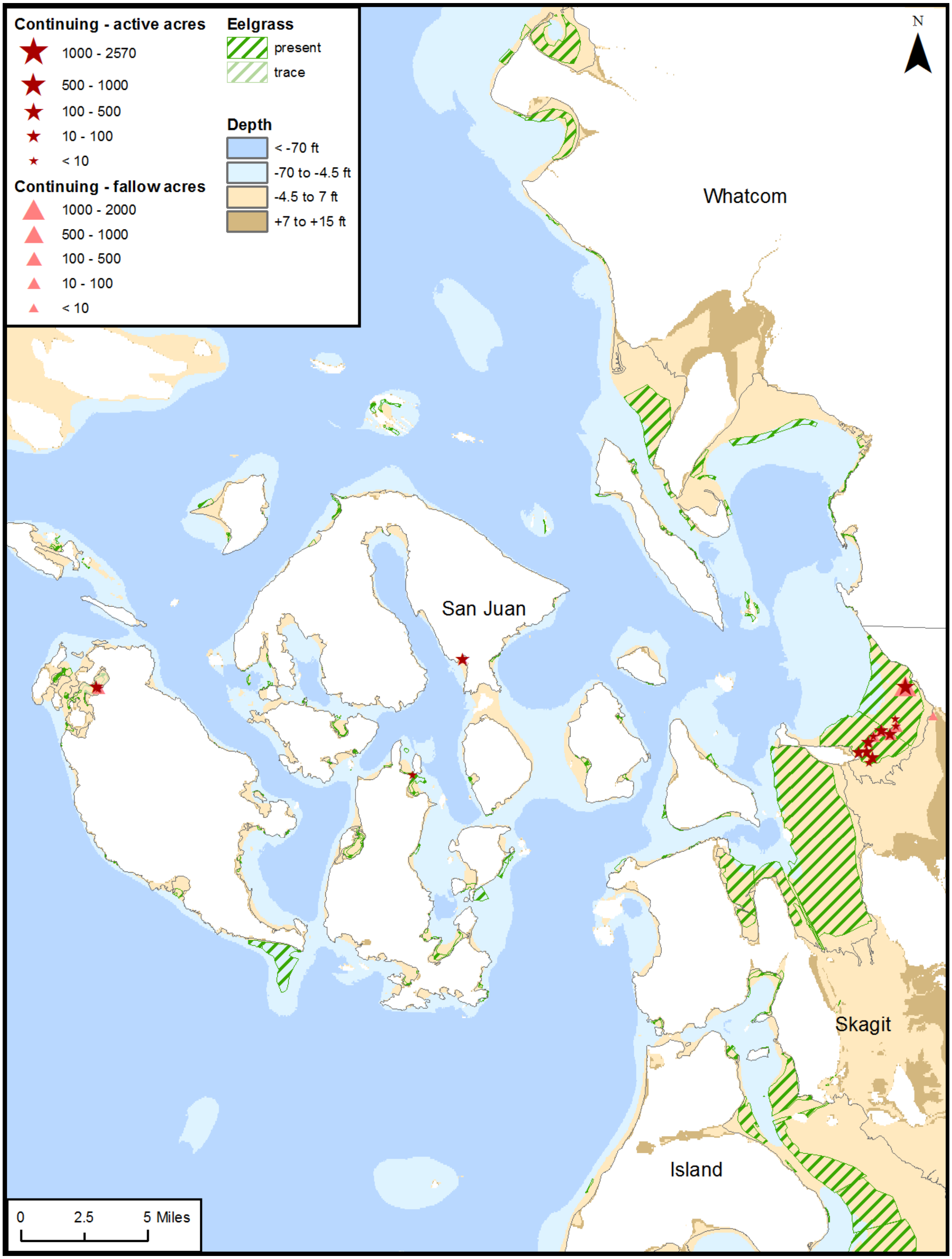

Figure D-6. North Puget Sound (north section) continuing acres and eelgrass

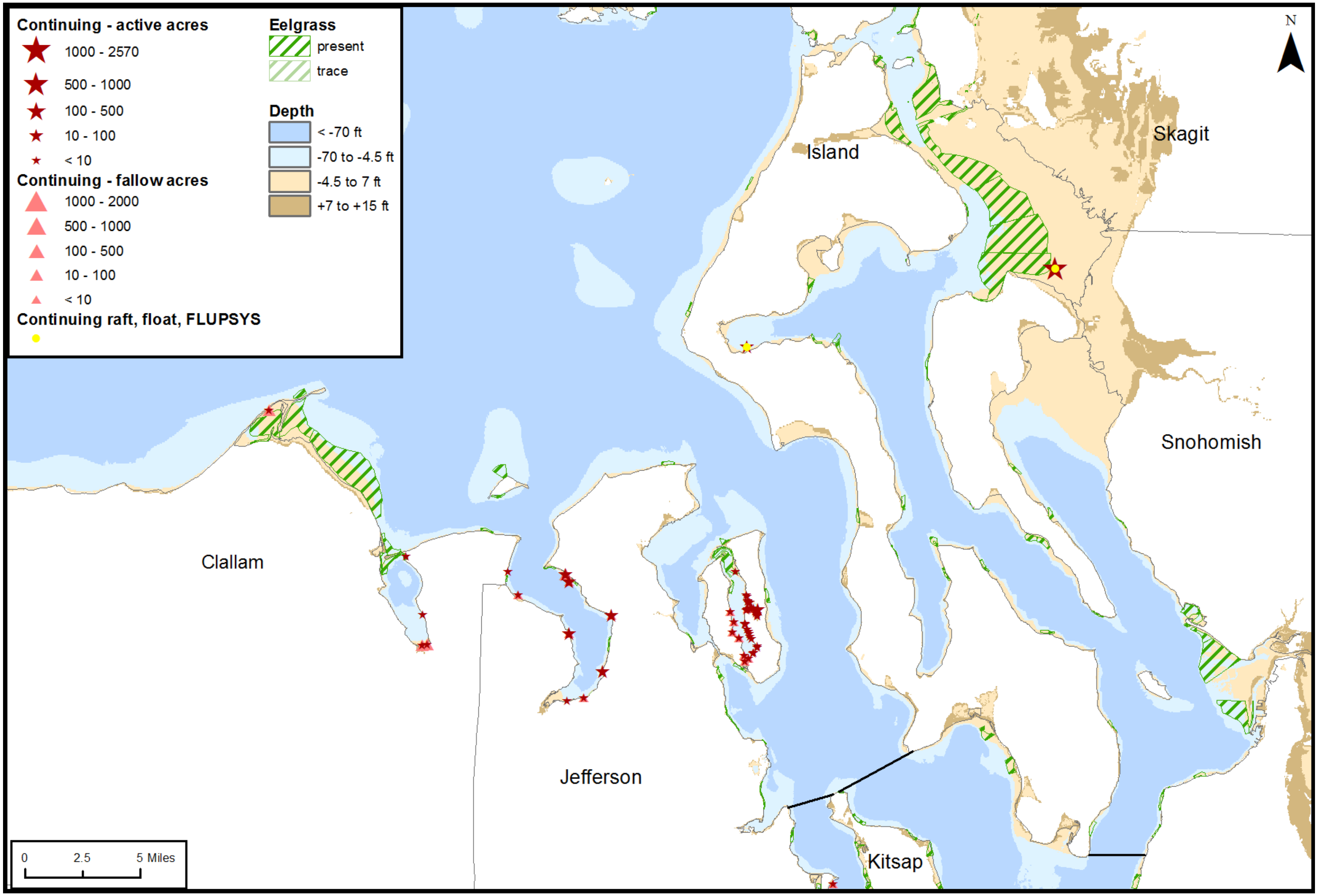

Figure D-7. North Puget Sound (south section) continuing acres and eelgrass

Table D-1. Estimate of continuing active and fallow aquaculture acres potentially co-located with eelgrass

		Grays Harbor			Willapa Bay			Hood Canal			South Puget Sound			North Puget Sound			Total		
		active	fallow	total	active	fallow	total	active	fallow	total	active	fallow	total	active	fallow	total	active	fallow	total
Total continuing aquaculture	# footprints	26	17	28	239	114	251	111	117	209	362	99	375	70	26	71	808	373	934
	acres	1,145	1,820	2,965	16,397	9,468	25,865	949	402	1,351	2,351	780	3,131	1,354	2,333	3,687	22,196	14,803	36,999
Aquaculture potentially co-located with eelgrass	# footprints	17	13	--	161	81	--	34	42	--	2	1	--	21	13	--	235	150	--
	acres	766	1,152	1,918	12,170	7,448	19,618	392	294	685	180	95	275	1,131	2,239	3,370	14,639	11,227	25,866
% of aquaculture acres potentially co-located with eelgrass		67%	63%	65%	74%	79%	76%	41%	73%	51%	8%	12%	9%	84%	96%	91%	66%	76%	70%
Total eelgrass acres in region				36,415			39,861			3,265			2,950			47,725			130,216
% of total eelgrass in region potentially co-located with aquaculture				5%			49%			21%			9%			7%			20%

Notes:
1. Analysis is based on a single point coordinate for each aquaculture footprint provided in permit applications. If single coordinate is located within or upland of WDNR mapped eelgrass boundary, assume entire acreage associated with that coordinate is co-located with eelgrass. The analysis is therefore conservative and should be considered a course estimate appropriate for the broad action area.
2. Eelgrass data for Willapa Bay and Grays Harbor from WDNR (2001), and for other regions from WDNR (2013b).

Appendix E

Shellfish activities and forage fish spawning

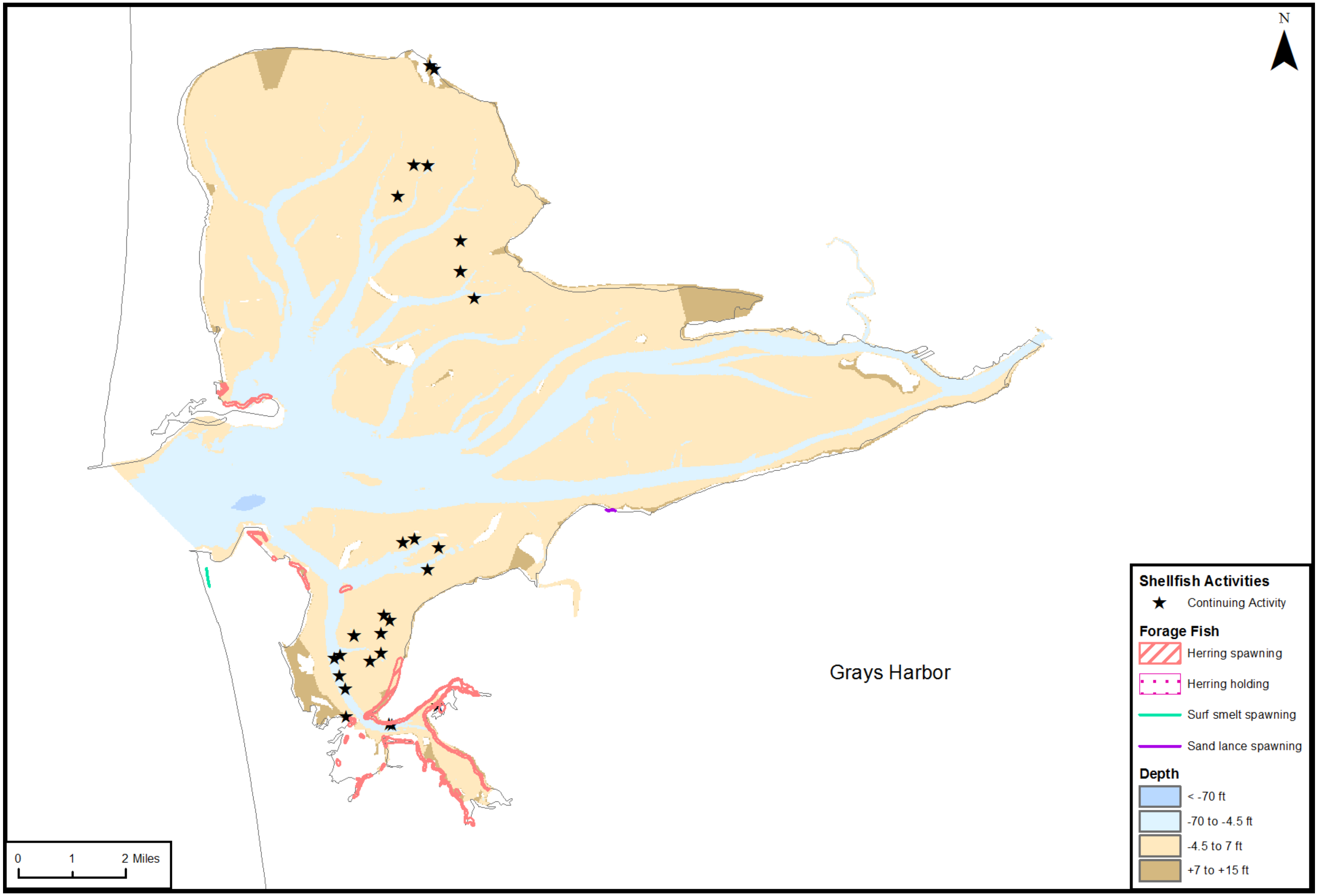

Figure E-1. Grays Harbor continuing acres and forage fish spawning areas

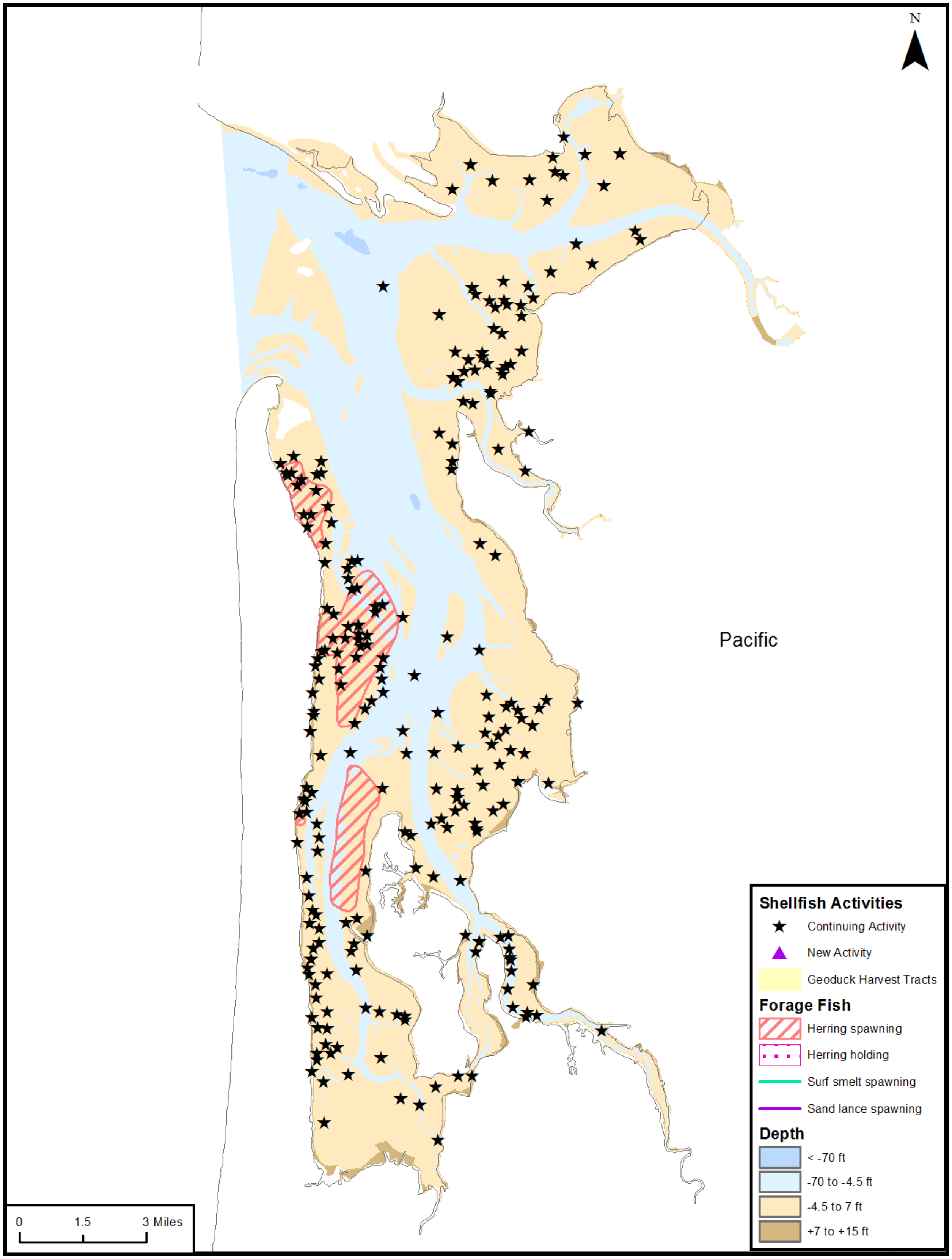

Figure E-2. Willapa Bay continuing acres and forage fish spawning areas

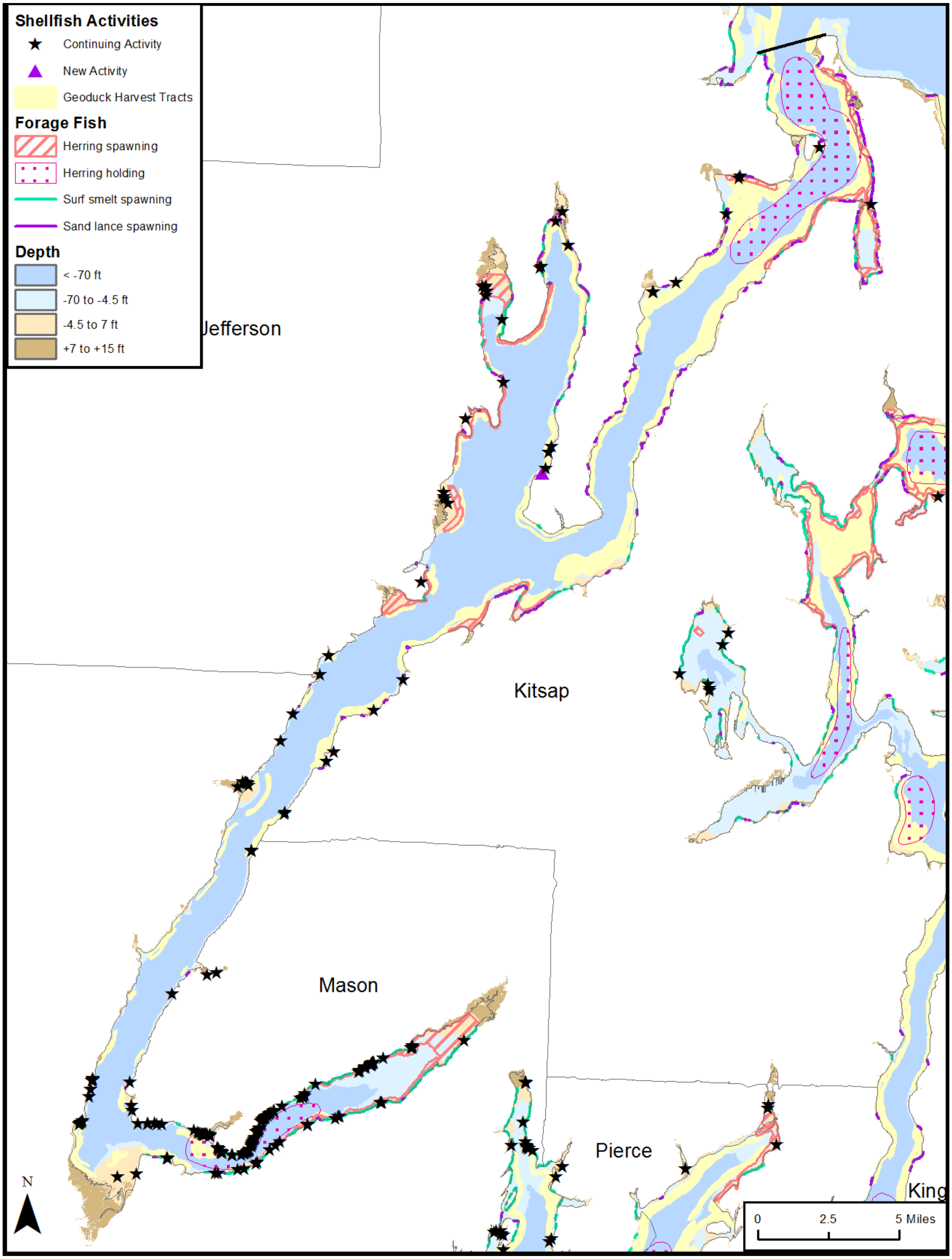

Figure E-3. Hood Canal continuing acres and forage fish spawning areas

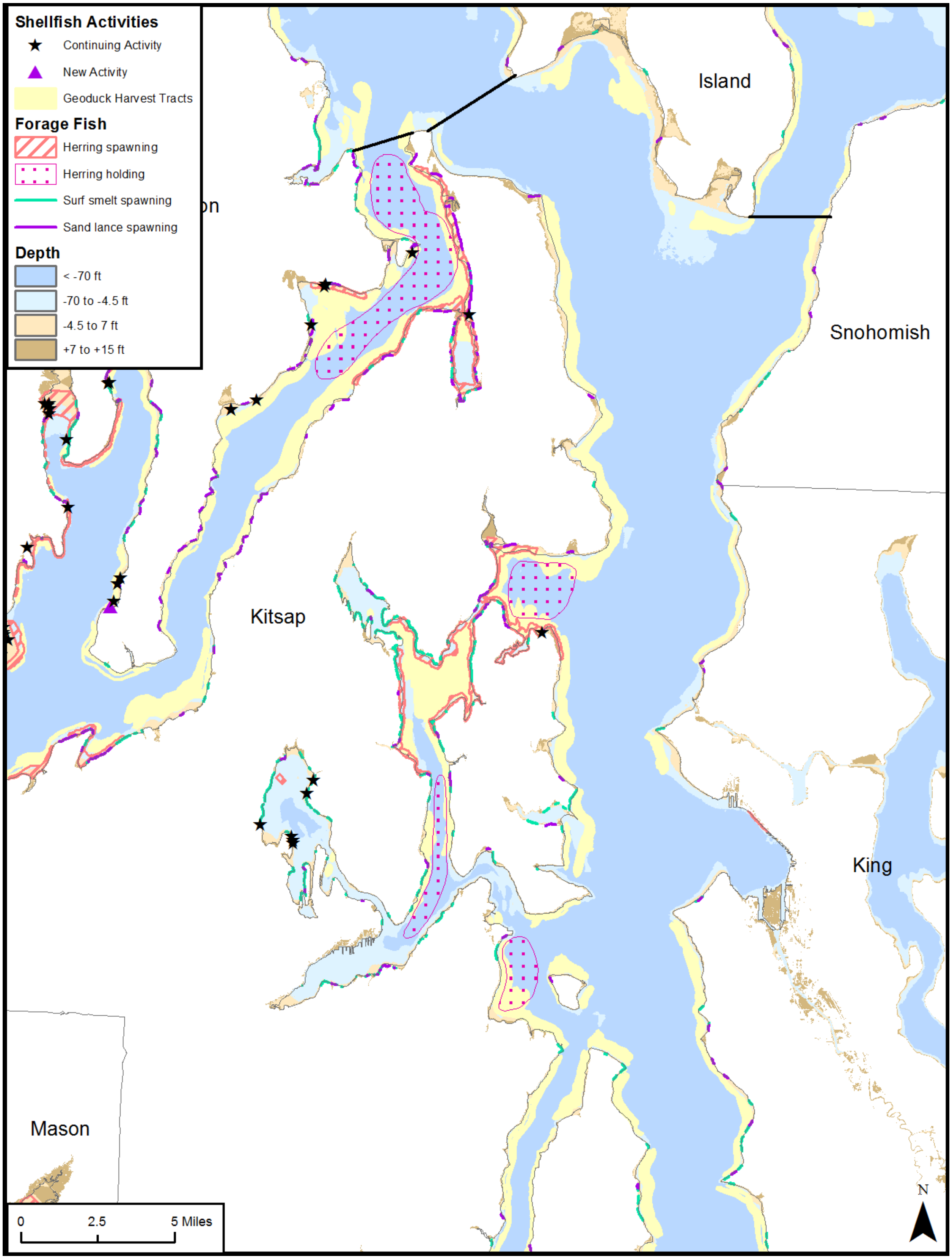

Figure E-4. South Puget Sound (north section) continuing acres and forage fish spawning areas

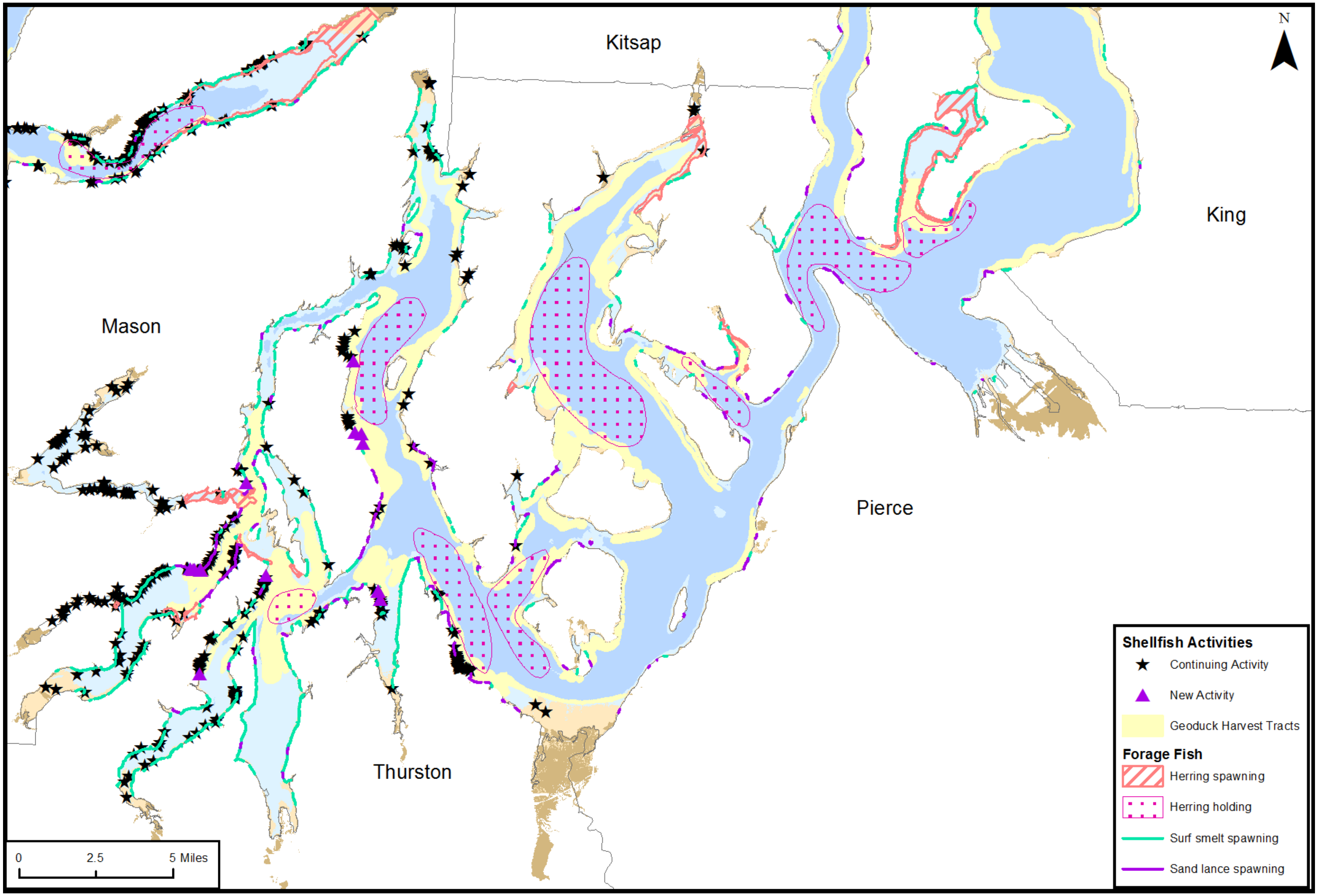

Figure E-5. South Puget Sound (south section) continuing acres and forage fish spawning areas

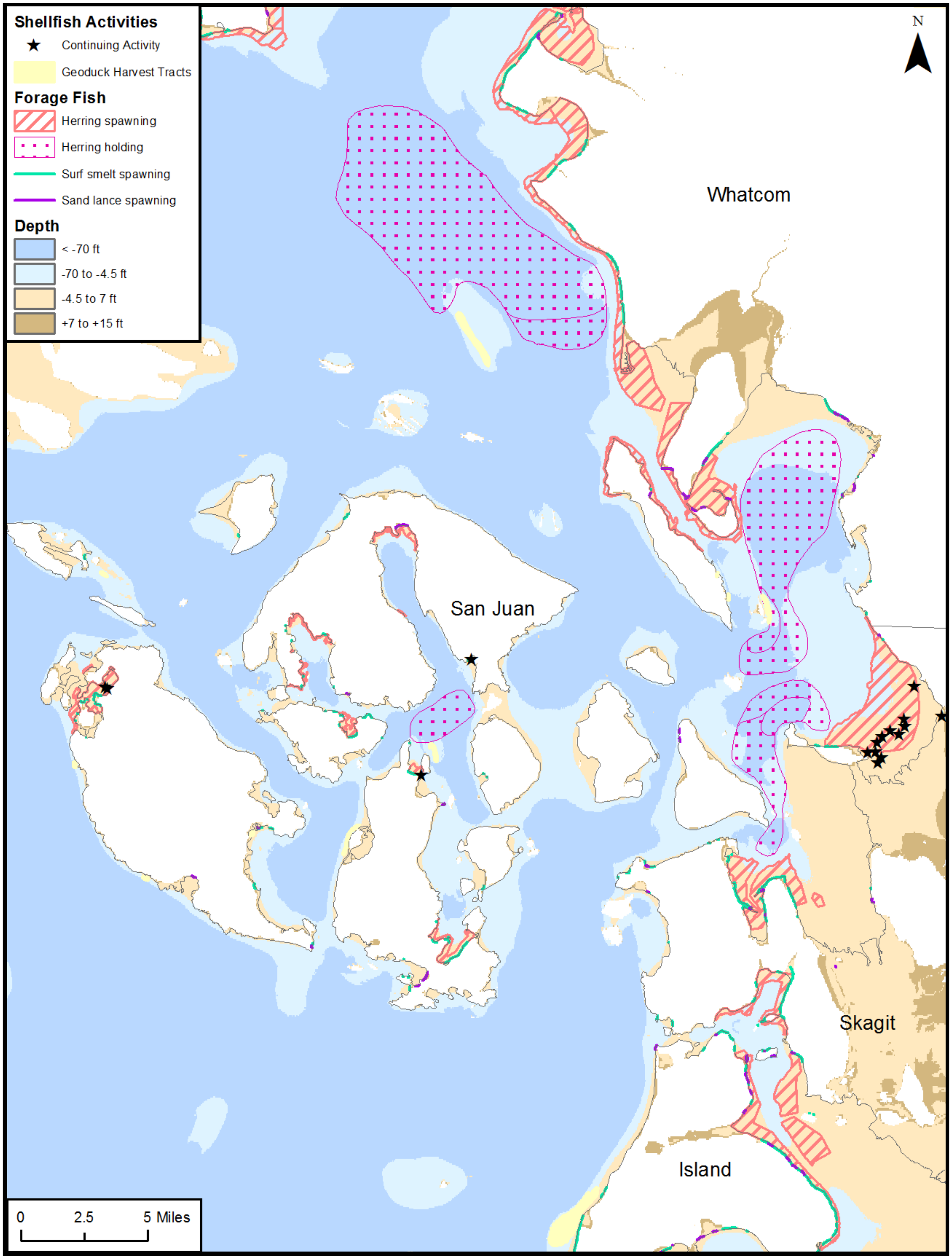

Figure E-6. North Puget Sound (north section) continuing acres and forage fish spawning areas

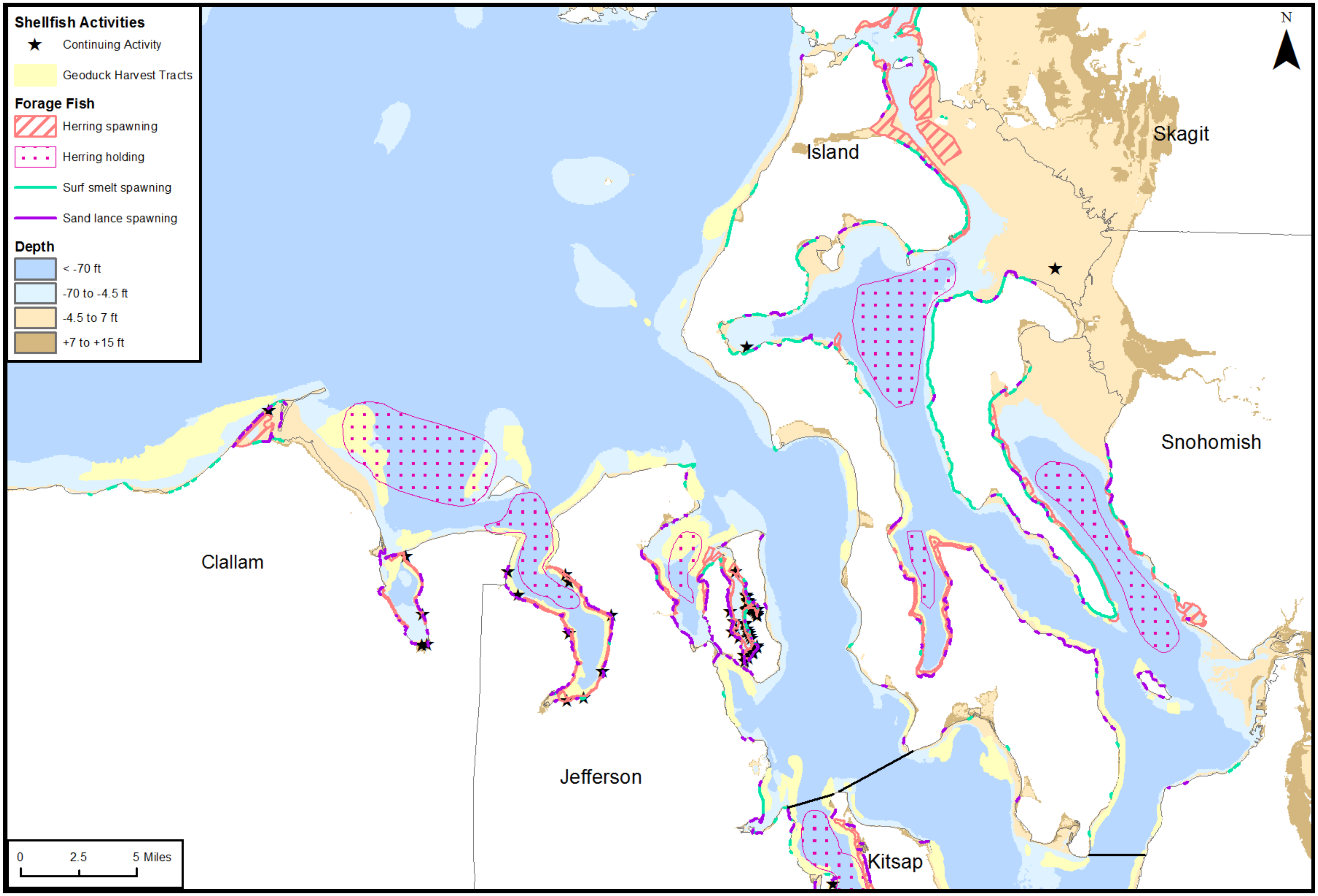

Figure E-7. North Puget Sound (south section) continuing acres and forage fish spawning areas

Table E-1. Summary of continuing *active* acreage potentially co-located with forage fish spawning areas

		Grays Harbor			Willapa Bay			Hood Canal			South Puget Sound			North Puget Sound			Total		
		auth	pend	total	auth	pend	total	auth	pend	total	auth	pend	total	auth	pend	total	auth	pend	total
Total continuing active aquaculture	# footprints	28	0	28	247	4	251	204	5	209	339	36	375	57	14	71	875	59	934
	active acres	1,145	0	1,145	16,305	89	16,394	906	32	938	1,780	565	2,345	279	1,073	1,352	20,415	1,758	22,173
active aquaculture in **herring** spawning area[3]	# footprints	3	0	3	31	0	31	20	3	23	4	2	6	23	5	28	81	10	91
	active acres	73	0	73	2,200	0	2,200	192	19	211	57	21	79	106	380	486	2,628	420	3,049
Total herring spawning acres in region				462			4,691			5,179			4,740			33,730			48,802
% herring acres potenitally co-located with continuing active aquaculture				16%			47%			4%			2%			1%			6%
active aquaculture within 500 ft of **surf smelt** spawning area[3]	# footprints	0	0	0	0	0	0	43	1	44	141	9	150	25	3	28	209	13	222
	active acres	0	0	0	0	0	0	118	12	130	519	13	532	56	3	59	693	28	721
active aquaculture within 500 ft of **sand lance** spawning area[3]	# footprints	0	0	0	0	0	0	9	0	9	52	4	56	25	1	26	86	5	91
	active acres	0	0	0	0	0	0	169	0	169	75	3	78	78	1	79	322	4	326
active aquaculture potentially co-located with spawning areas	# footprints	3	0	3	31	0	31	72	4	76	197	15	212	73	9	82	376	28	404
	active acres	73	0	73	2,200	0	2,200	479	31	510	651	37	688	240	383	623	3,643	451	4,094
% of total active acres potentially co-located with spawning areas		6%	0%	6%	13%	0%	13%	53%	97%	54%	37%	7%	29%	86%	36%	46%	18%	26%	18%

Notes

1. Analysis is based on a single point coordinate for each aquaculture footprint provided in permit applications. If single coordinate is located within herring spawing polygon or within proximity boundary, then assume entire acreage associated with that coordinate is co-located with spawning area. This assumption may overestimate acreage in spawning areas in some cases for example when only a percentage of the applicant acreage is actually co-located with the spawning area, and it may underestimate acreage in other cases for example when the single point identifies an adjacent upland location instead of an in-water location. In summary, it is unknown to what degree the analysis over- or underestimates co-location with spawnign areas. The analysis should be considered a course estimate appropriate for the broad action area.
2. 'auth': authorized since 2012, 'pend': permit application pending as of July 2014.
3. Spawning data from WDFW (2010b).

Table E-2. Summary of continuing *fallow* acreage potentially co-located with forage fish spawning areas

		Grays Harbor			Willapa Bay			Hood Canal			South Puget Sound			North Puget Sound			Total		
		auth	pend	total	auth	pend	total	auth	pend	total	auth	pend	total	auth	pend	total	auth	pend	total
Total continuing fallow aquaculture	# footprints	28	0	28	247	4	251	204	5	209	339	36	375	57	14	71	875	59	934
	fallow acres	1,820	0	1,820	9,441	1	9,442	157	254	411	671	121	792	166	2,166	2,332	12,255	2,542	14,797
fallow aquaculture in **herring** spawning area[3]	# footprints	0	0	0	16	0	16	9	1	10	2	1	3	6	4	10	33	6	39
	fallow acres	0	0	0	510	0	510	33	25	58	11	3	14	59	2,125	2,184	613	2,153	2,766
Total herring spawning acres in region				462			4,691			5,179			4,740			33,730			48,802
% herring acres potenitally co-located with continuing fallow aquaculture				0%			11%			1%			0.3%			6%			6%
fallow aquaculture within 500 ft of **surf smelt** spawning area[3]	# footprints	0	0	0	0	0	0	52	1	53	32	2	34	6	1	7	90	4	94
	fallow acres	0	0	0	0	0	0	42	25	67	355	4	359	9	6	15	406	35	441
fallow aquaculture within 500 ft of **sand lance** spawning area[3]	# footprints	0	0	0	0	0	0	6	0	6	10	1	11	10	0	10	26	1	27
	fallow acres	0	0	0	0	0	0	28	0	28	20	1	20	42	0	42	90	1	90
fallow aquaculture potentially co-located with spawning areas	# footprints	0	0	0	16	0	16	67	2	69	44	4	48	22	5	27	149	11	160
	fallow acres	0	0	0	510	0	510	103	50	153	386	8	394	110	2,131	2,241	1,108	2,189	3,297
% of total fallow acres potentially co-located with forage fish spawning areas		0%	0%	0%	5%	0%	5%	66%	20%	37%	57%	7%	50%	66%	98%	96%	9%	86%	22%

Notes

1. Analysis is based on a single point coordinate for each aquaculture footprint provided in permit applications. If single coordinate is located within herring spawing polygon or within proximity boundary, then assume entire acreage associated with that coordinate is co-located with spawning area. This assumption may overestimate acreage in spawning areas in some cases for example when only a percentage of the applicant acreage is actually co-located with the spawning area, and it may underestimate acreage in other cases for example when the single point identifies an adjacent upland location instead of an in-water location. In summary, it is unknown to what degree the analysis over- or underestimates co-location with spawnign areas. The analysis should be considered a course estimate appropriate for the broad action area.
2. 'auth': authorized since 2012, 'pend': permit application pending as of July 2014.
3. Spawning data from WDFW (2010b).

Appendix F

Continuing in-water activities

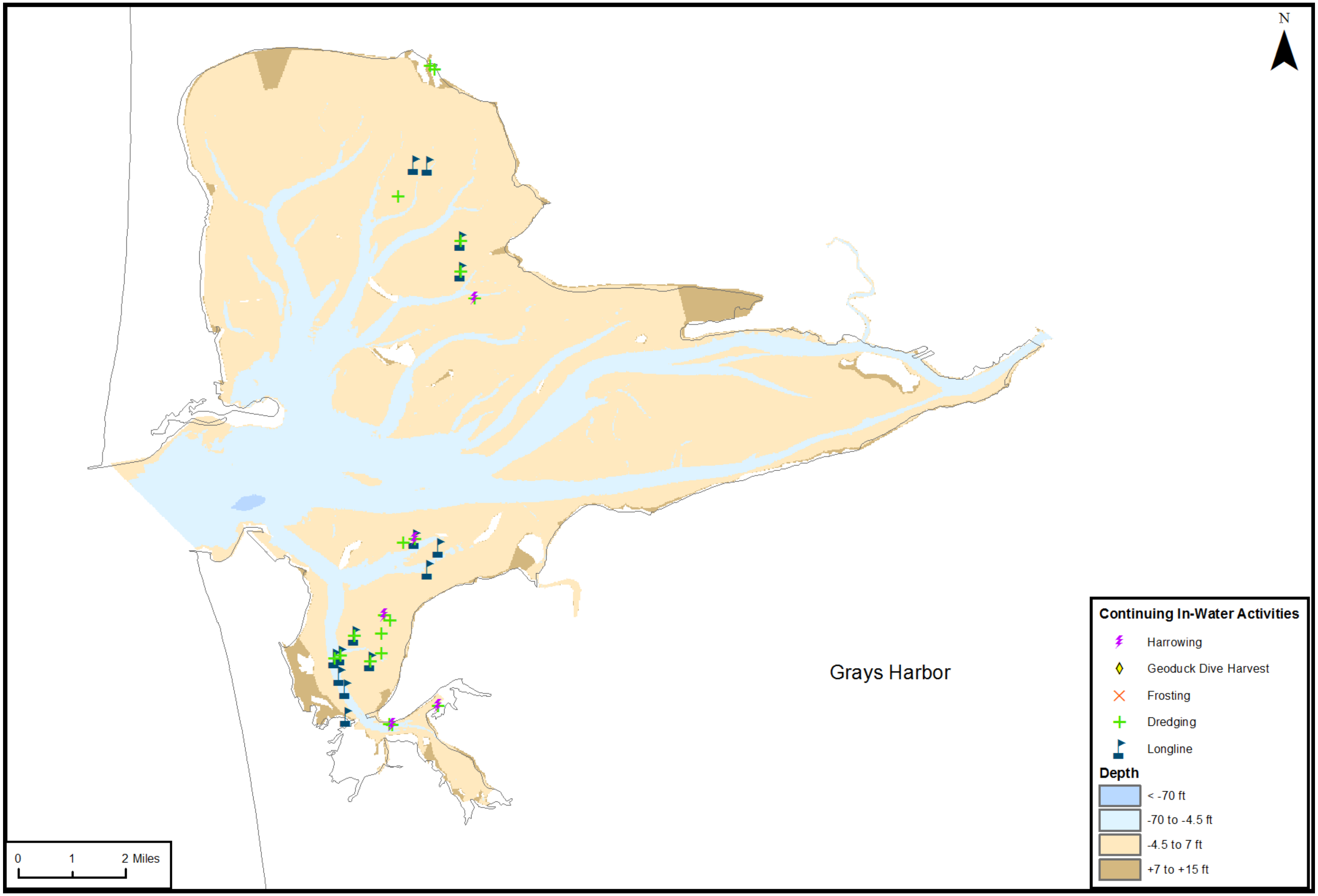

Figure F-1. Grays Harbor continuing in-water activities

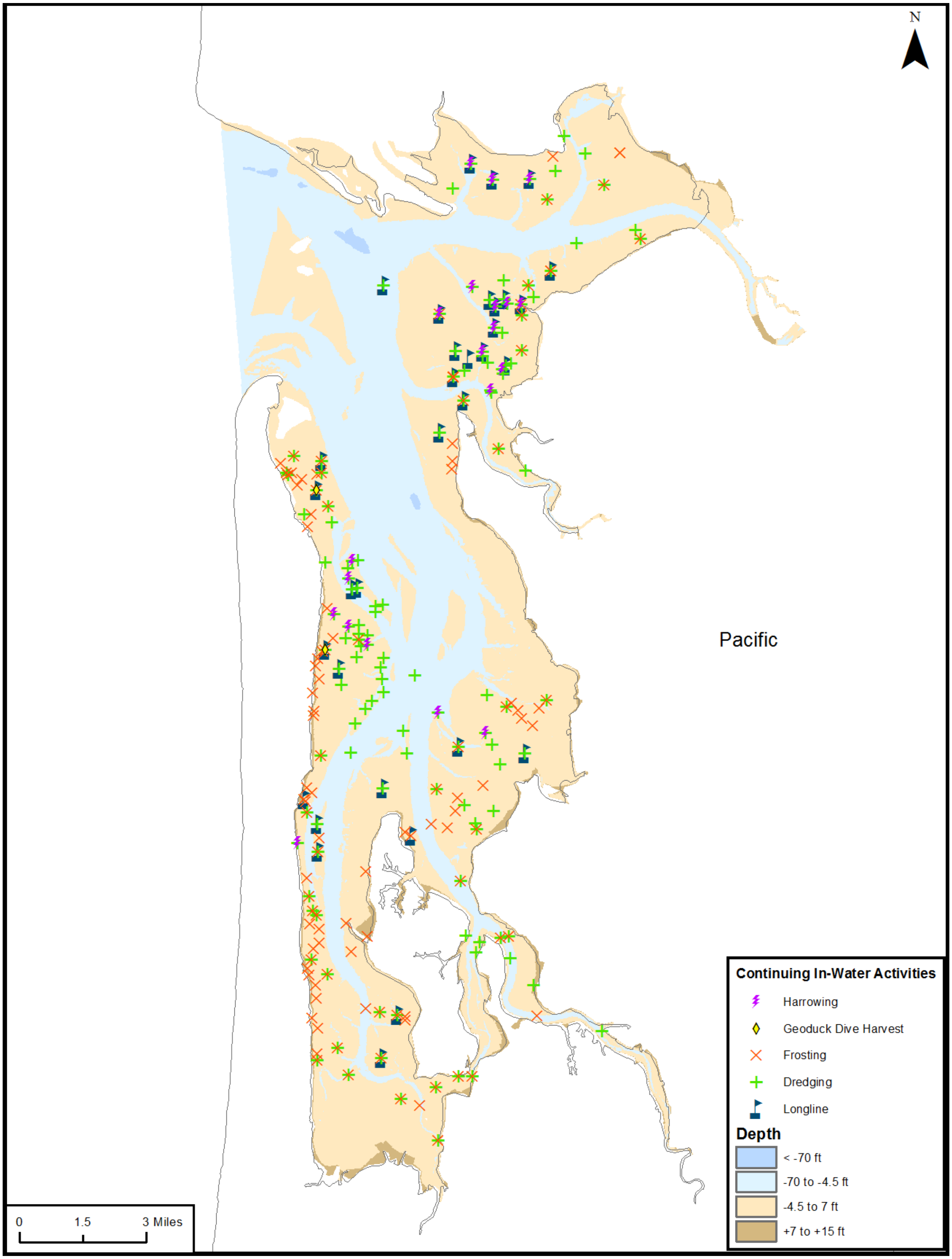

Figure F-2. Willapa Bay continuing in-water activities

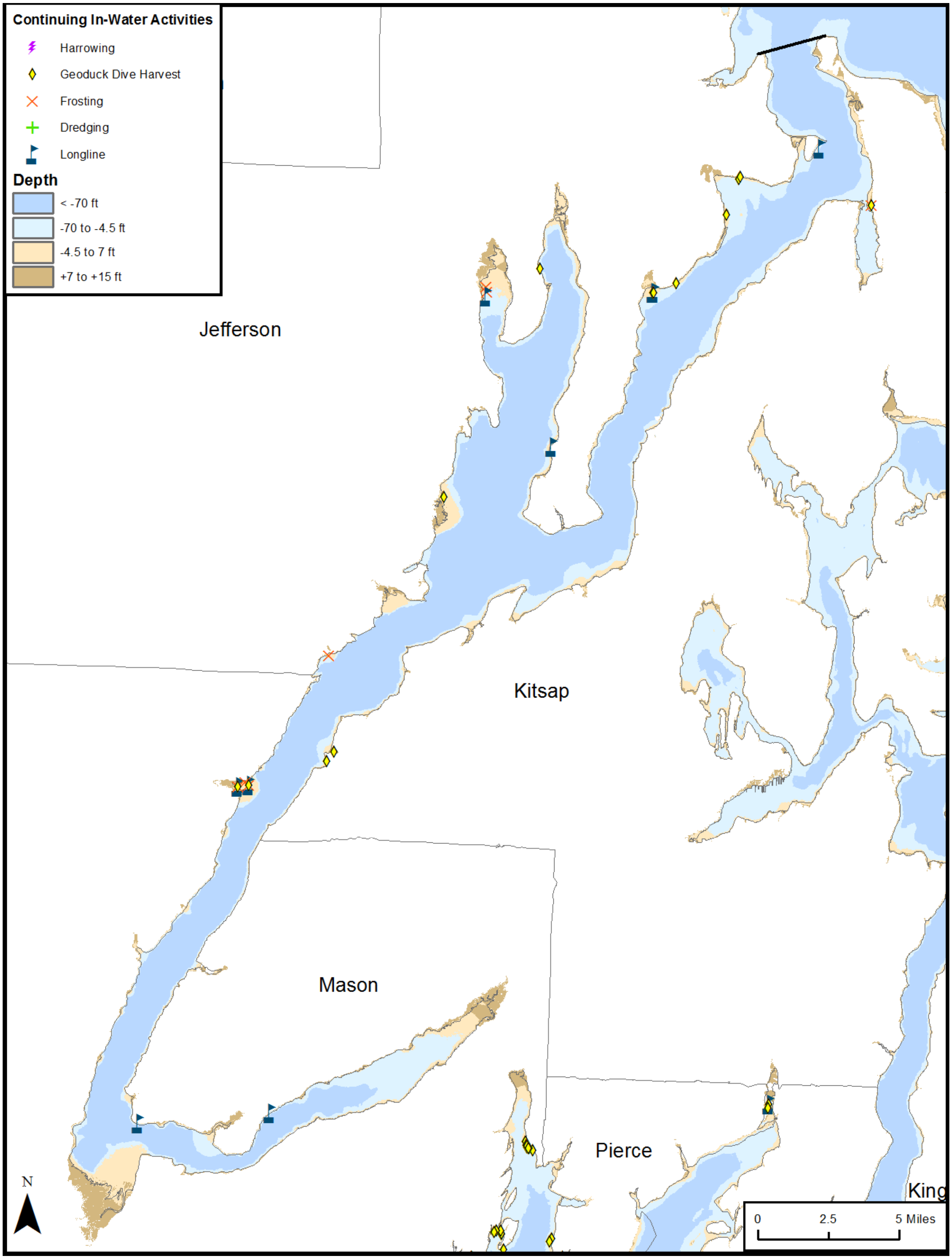

Figure F-3. Hood Canal continuing in-water activities

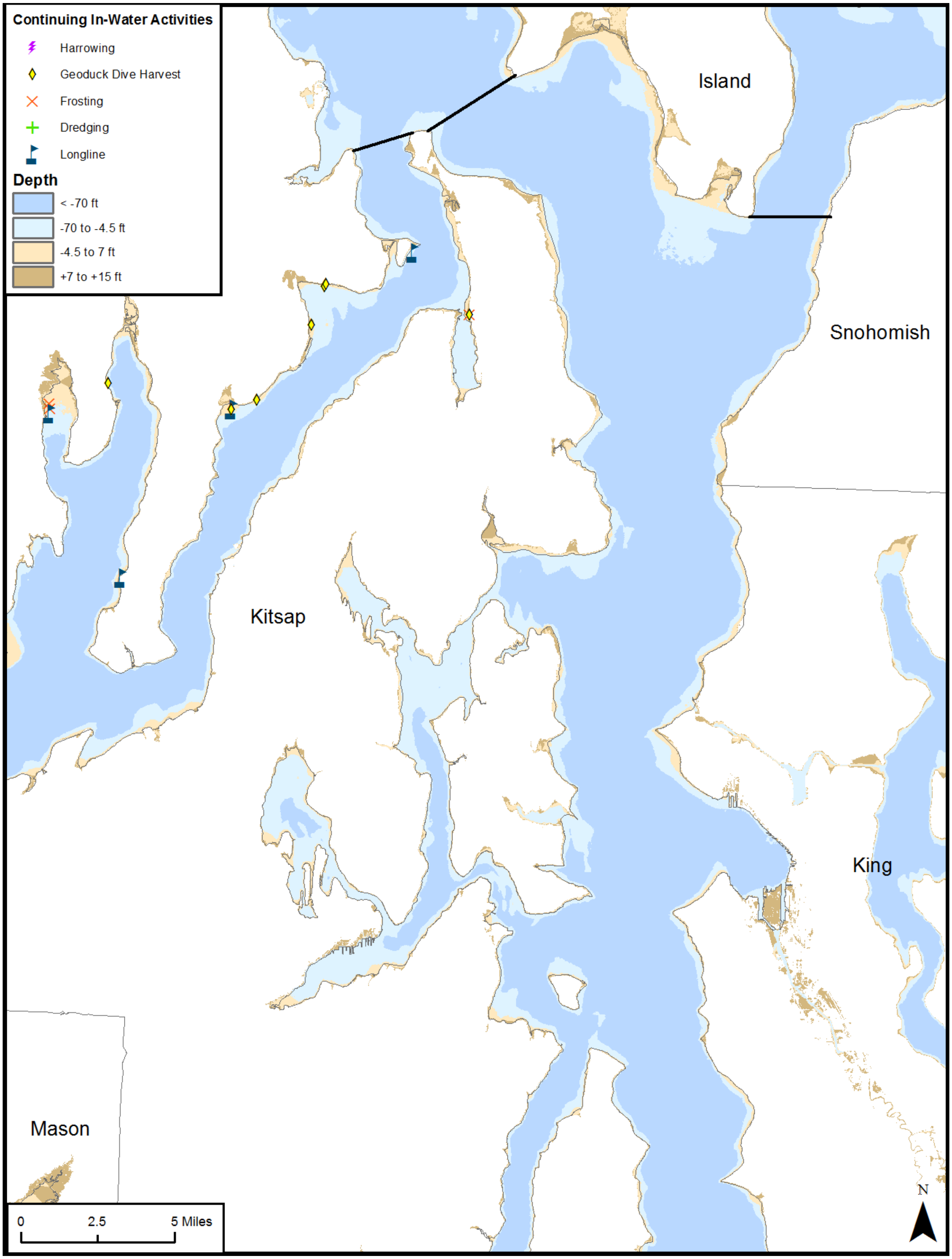

Figure F-4. South Puget Sound (north section) continuing in-water activities

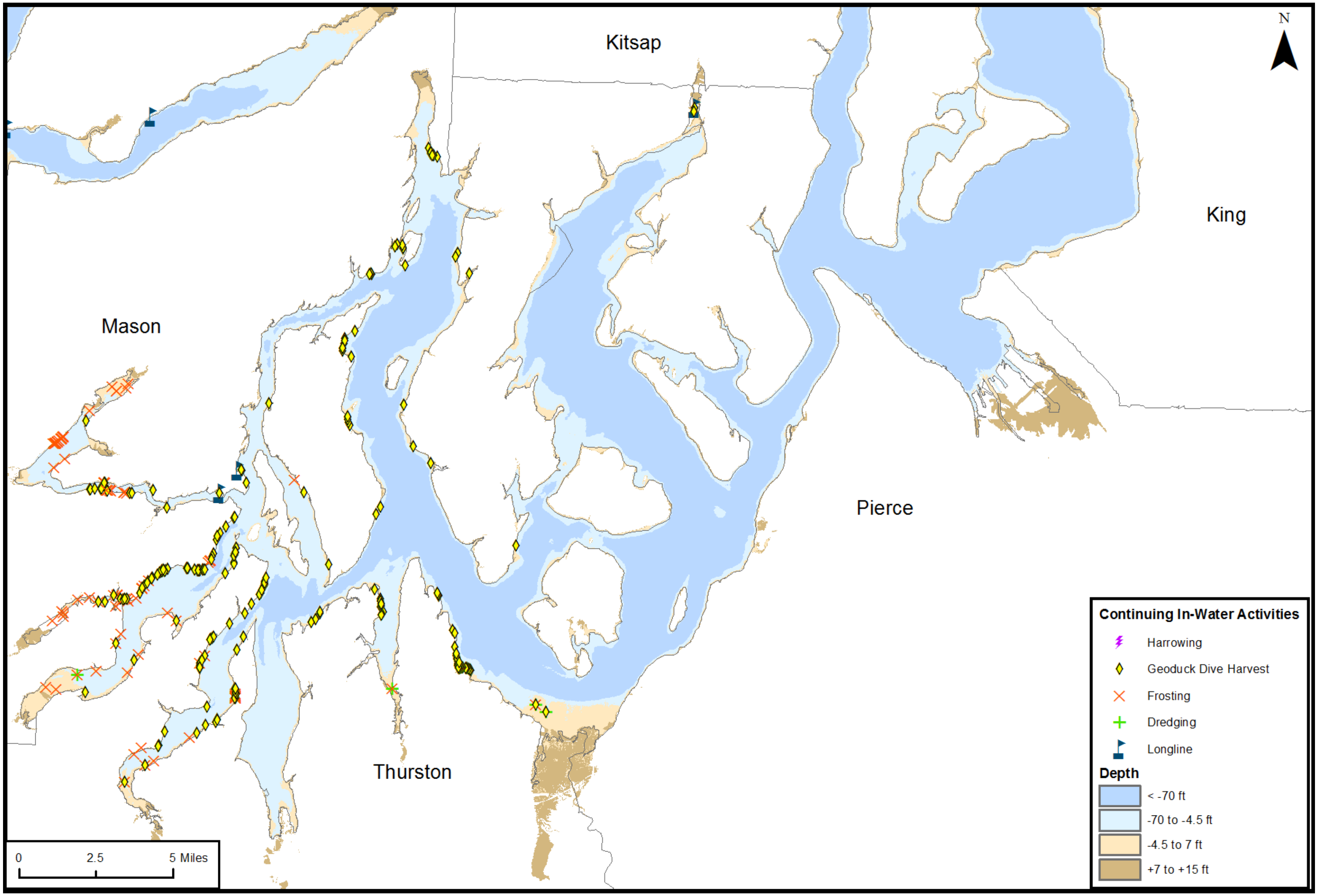

Figure F-5. South Puget Sound (south section) continuing in-water activities

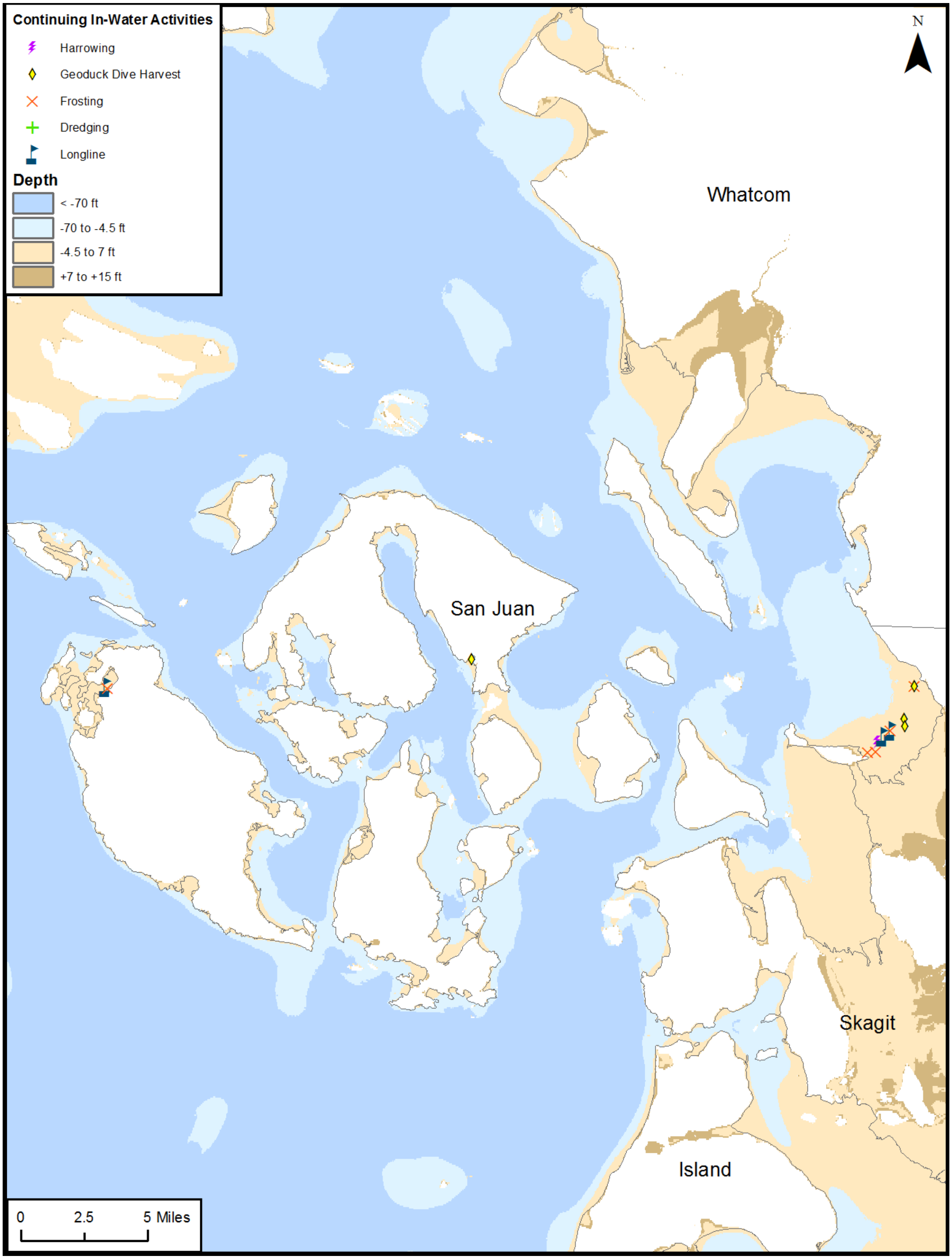

Figure F-6. North Puget Sound (north section) continuing in-water activities

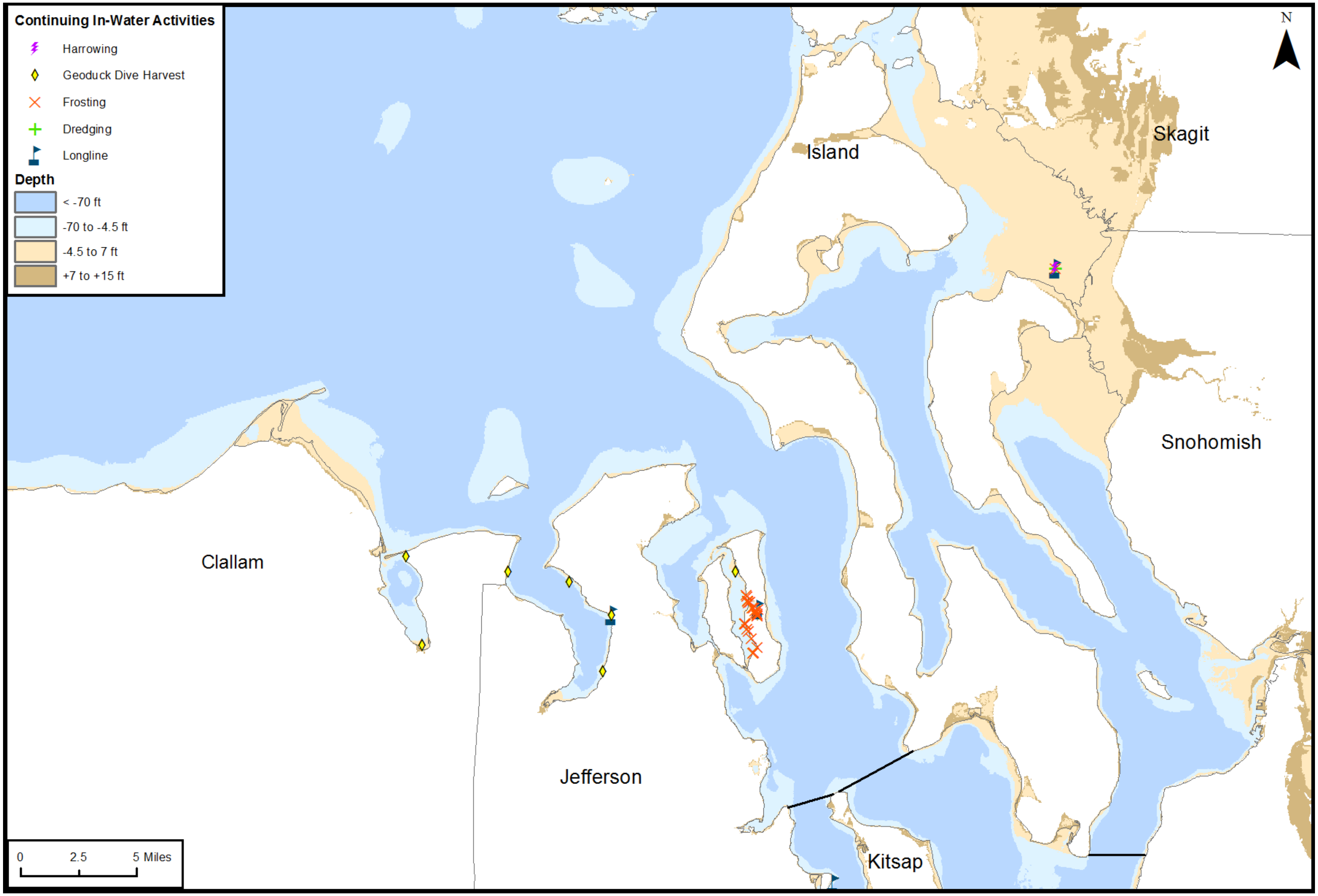

Figure F-7. North Puget Sound (south section) continuing in-water activities

Appendix G

Continuing and new activities (to date) with cover nets

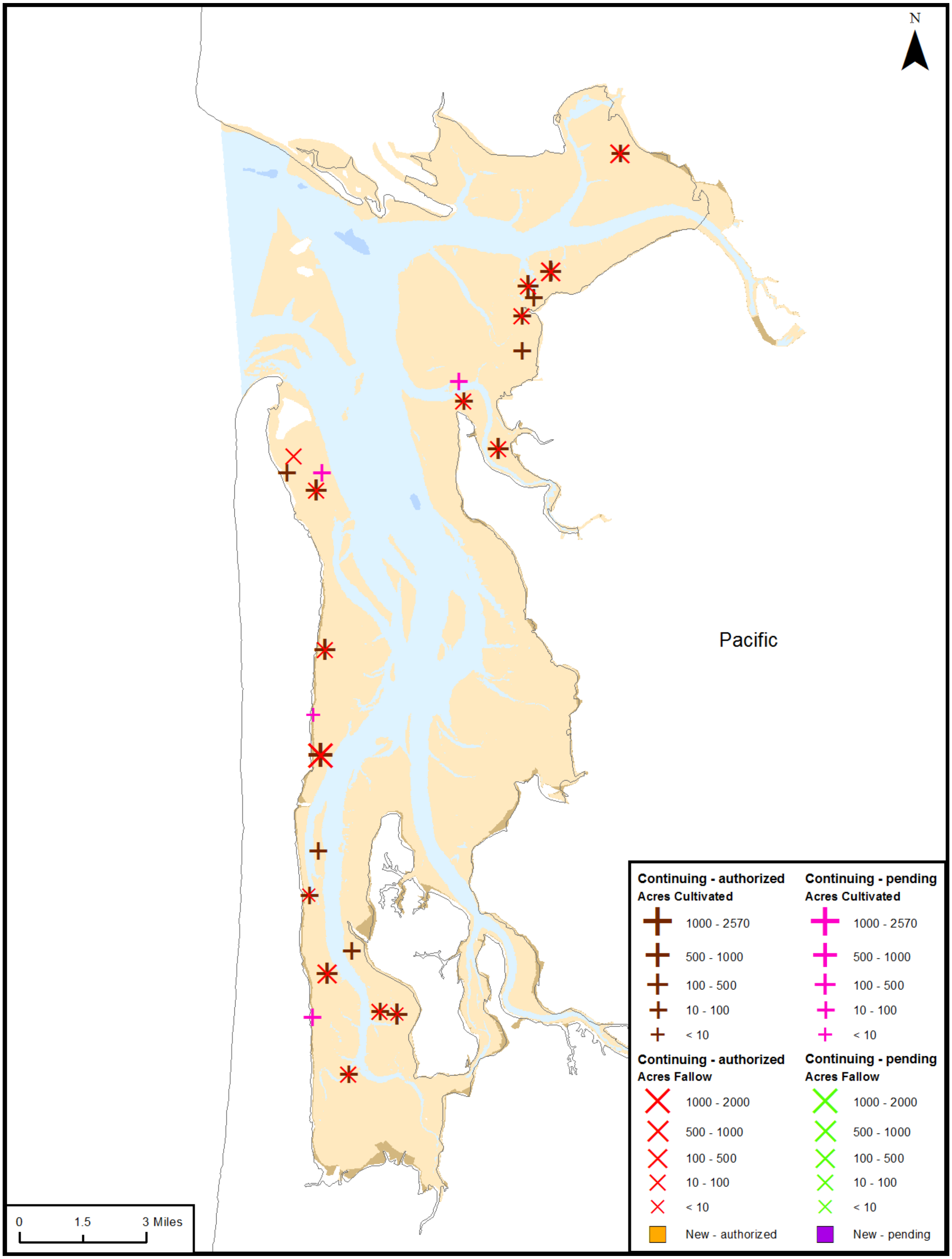

Figure G-2. Willapa Bay activities with cover nets

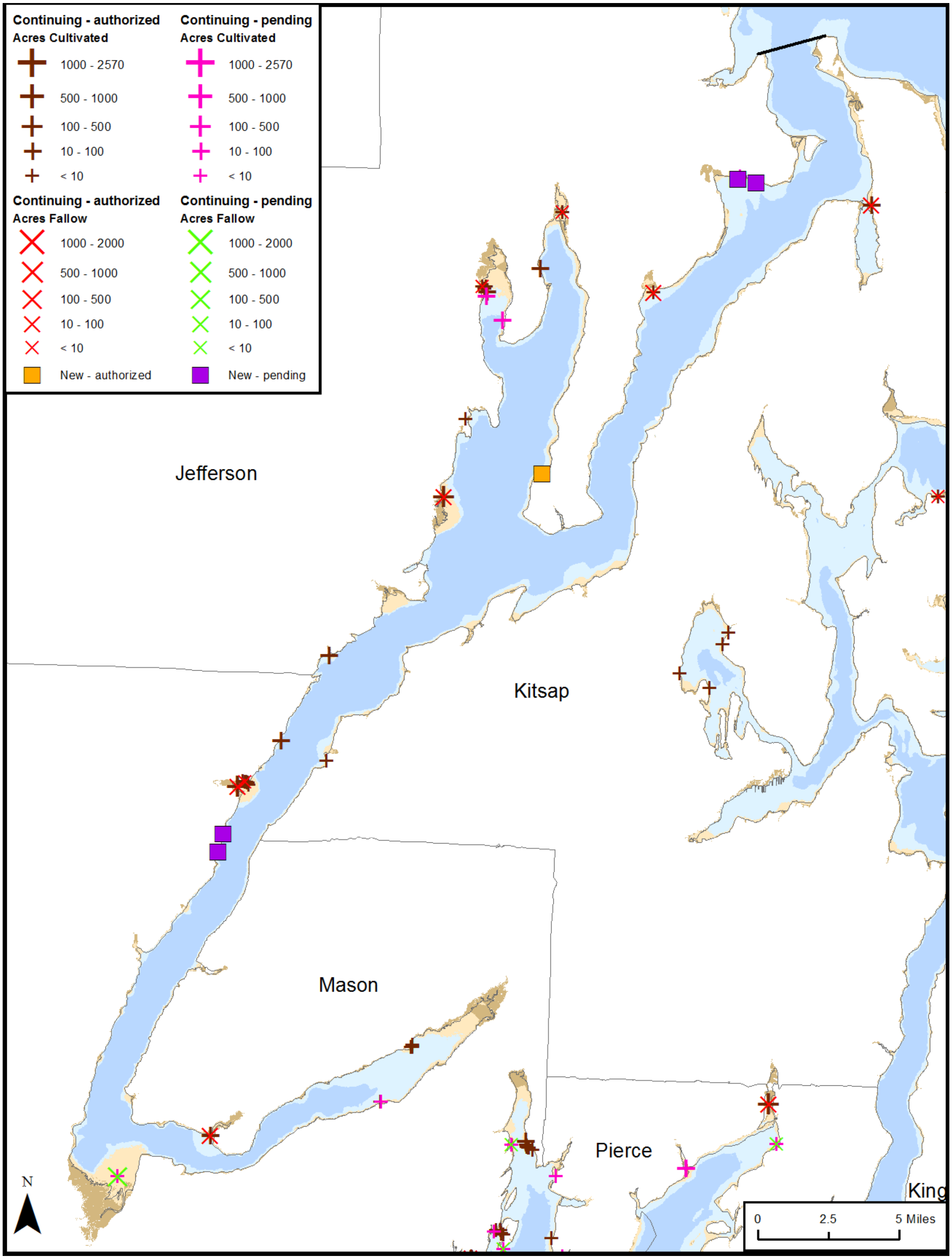

Figure G-3. Hood Canal activities with cover nets

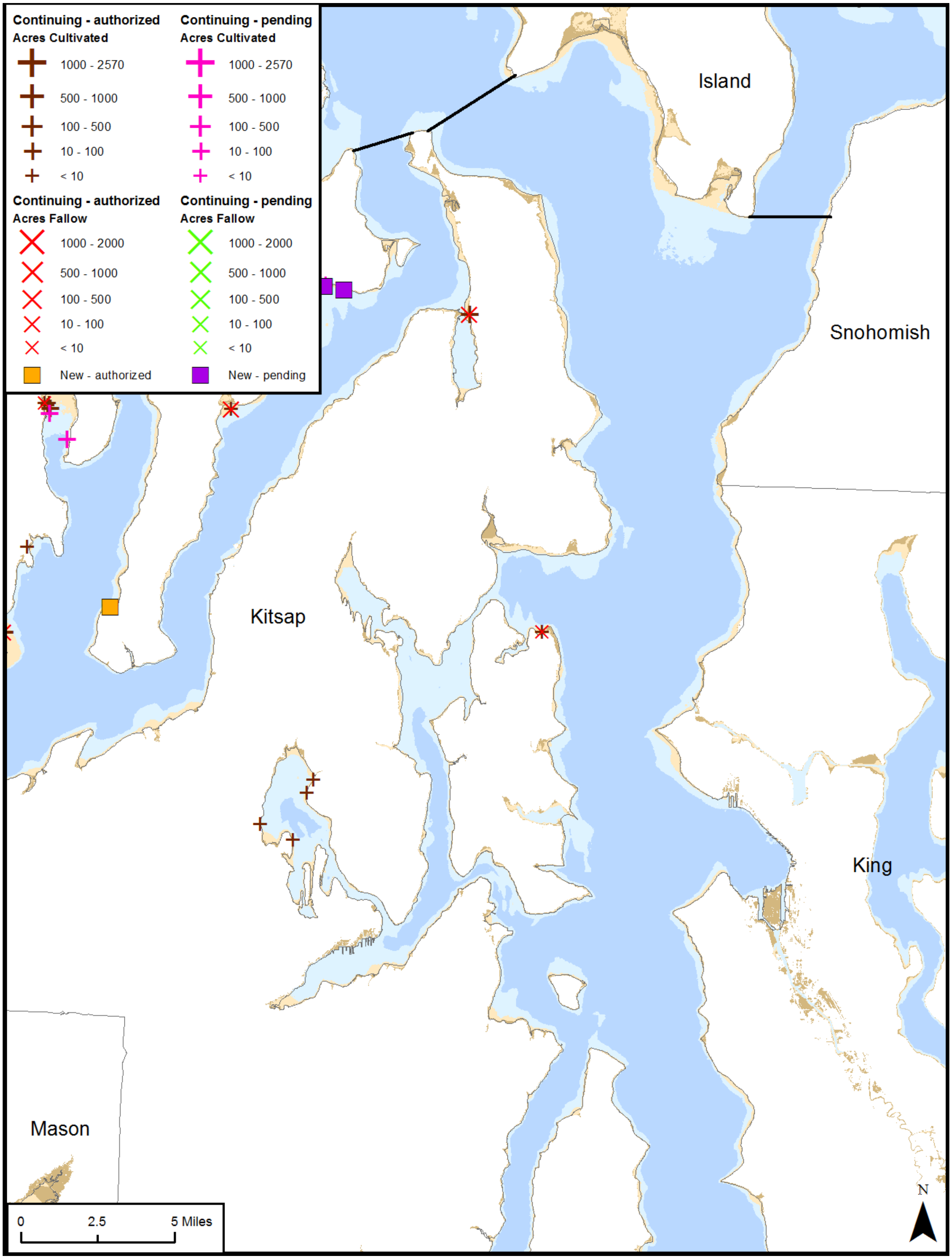

Figure G-4. South Puget Sound (north section) activities with cover nets

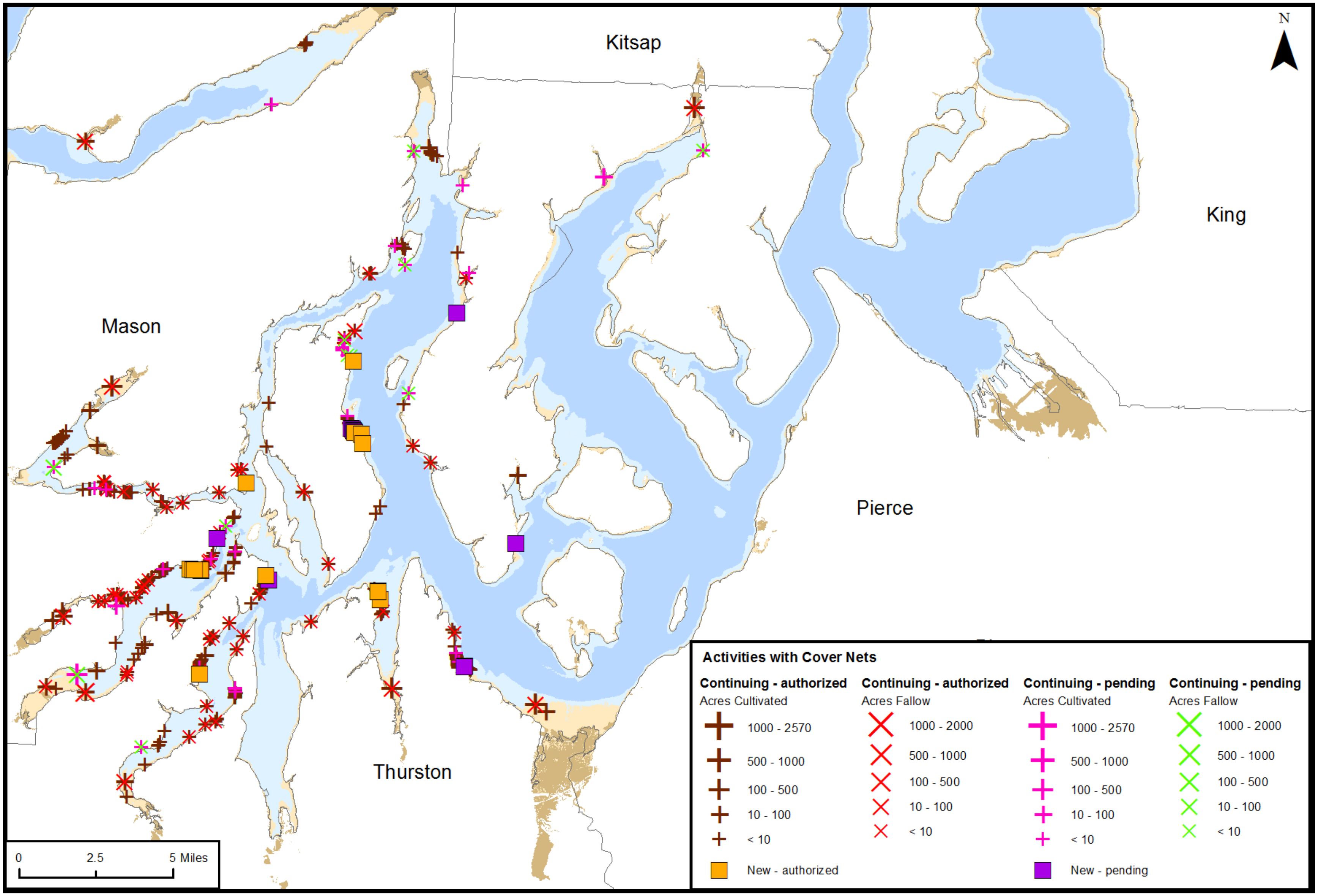

Figure G-5. South Puget Sound (south section) activities with cover nets

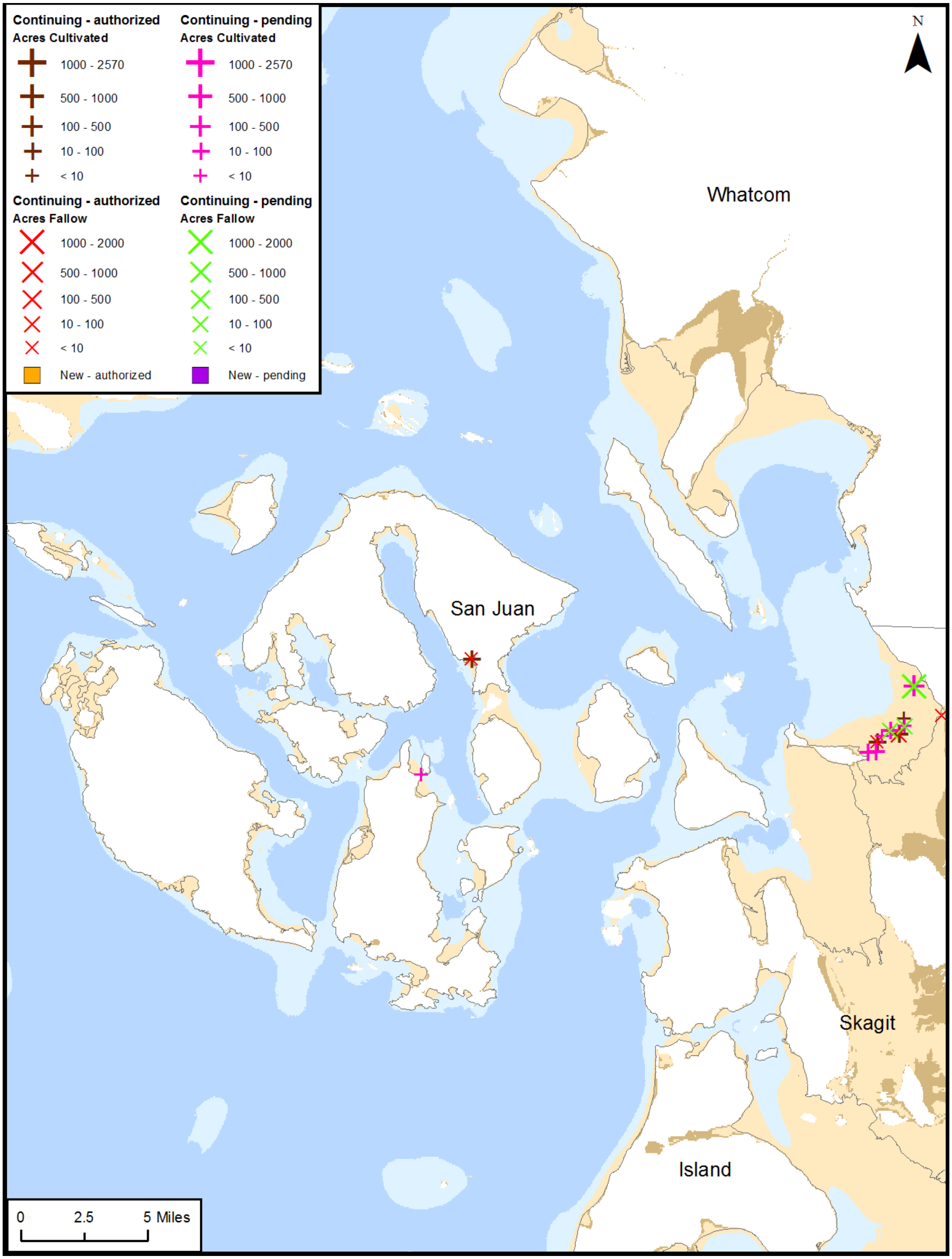

Figure G-6. North Puget Sound (north section) activities with cover nets

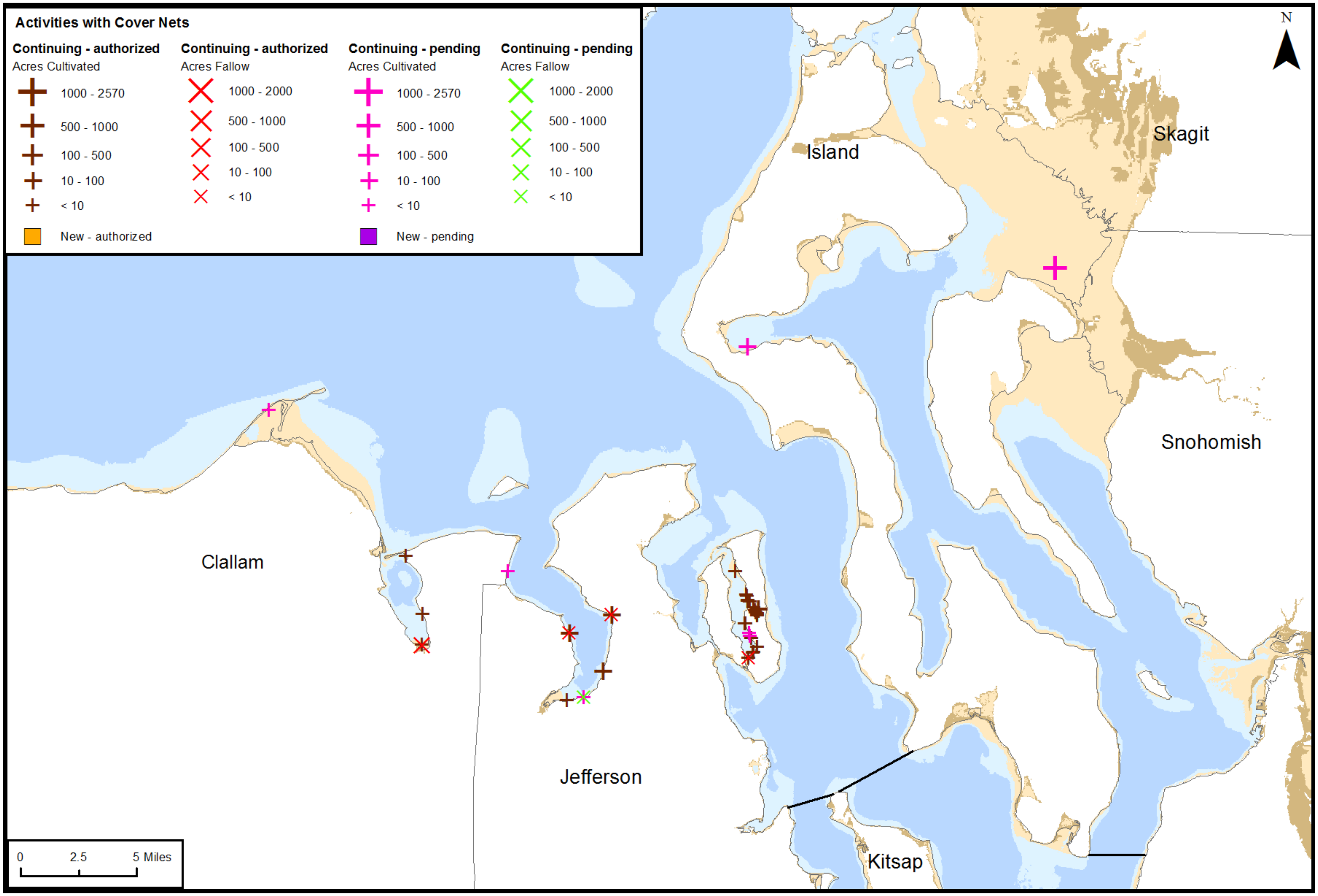

Figure G-7. North Puget Sound (south section) activities with cover nets

Appendix H

Critical habitat overlap with proposed activities

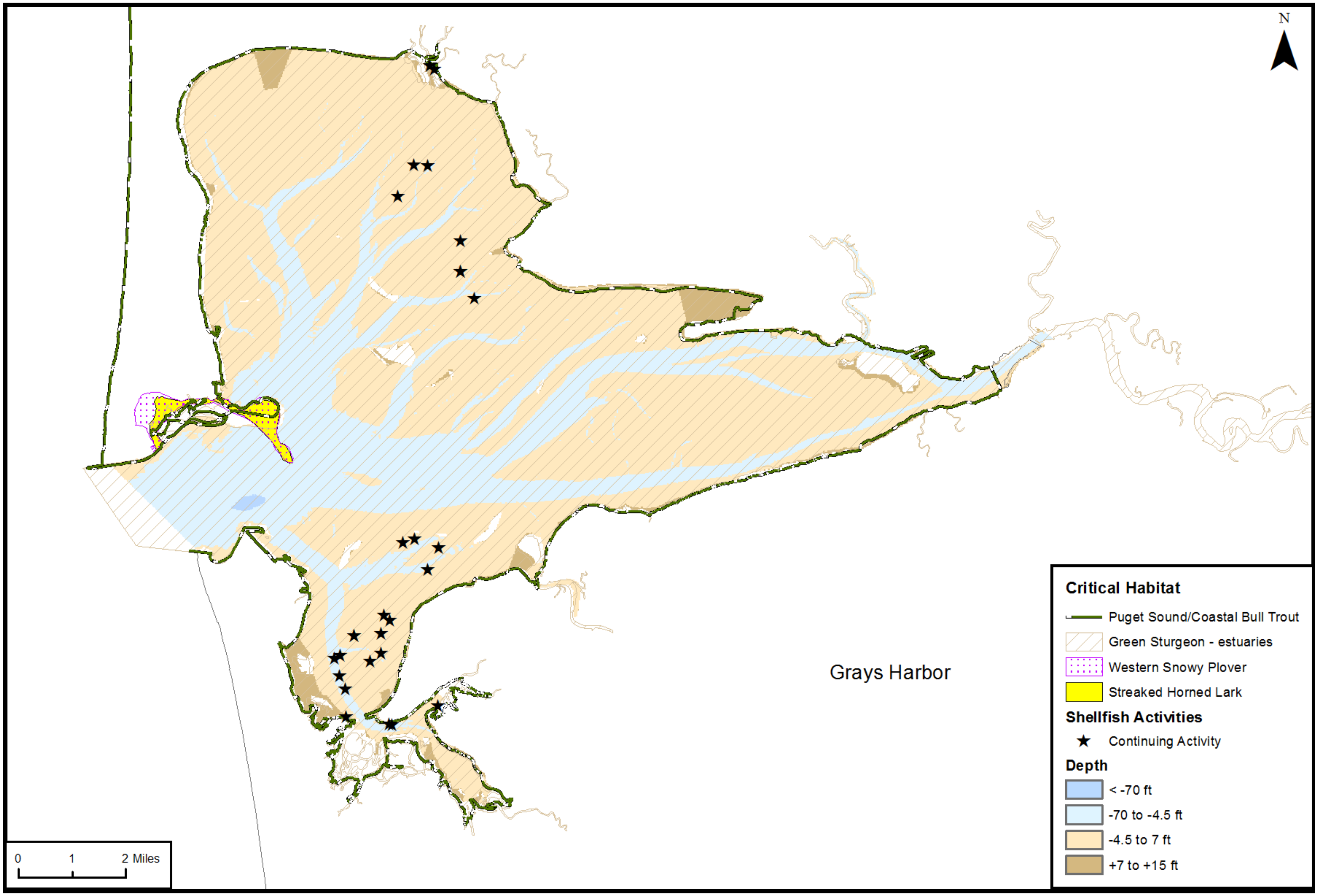

Figure H-1. Critical habitat and proposed activities in Grays Harbor

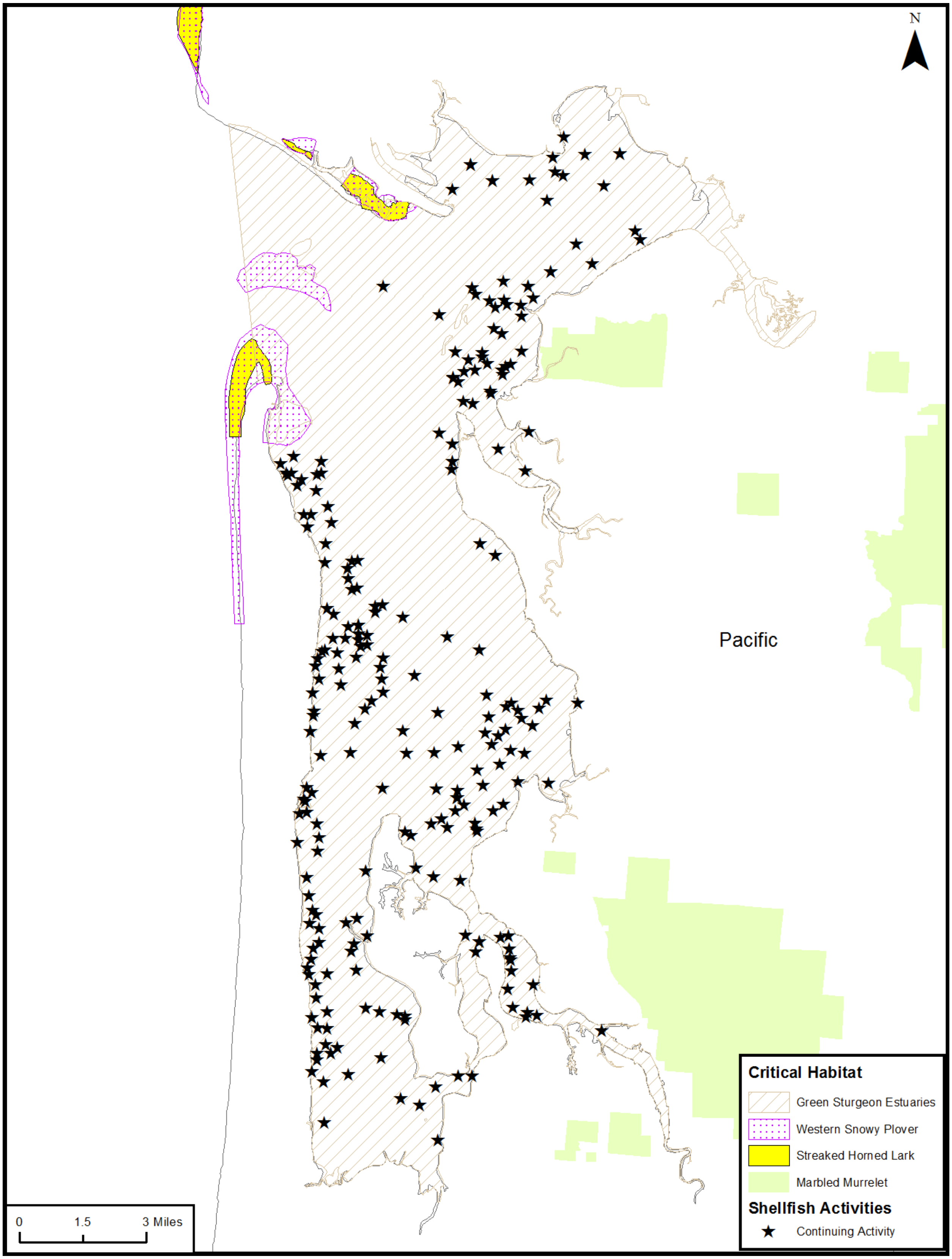

Figure H-2. Critical habitat and proposed activities in Willapa Bay

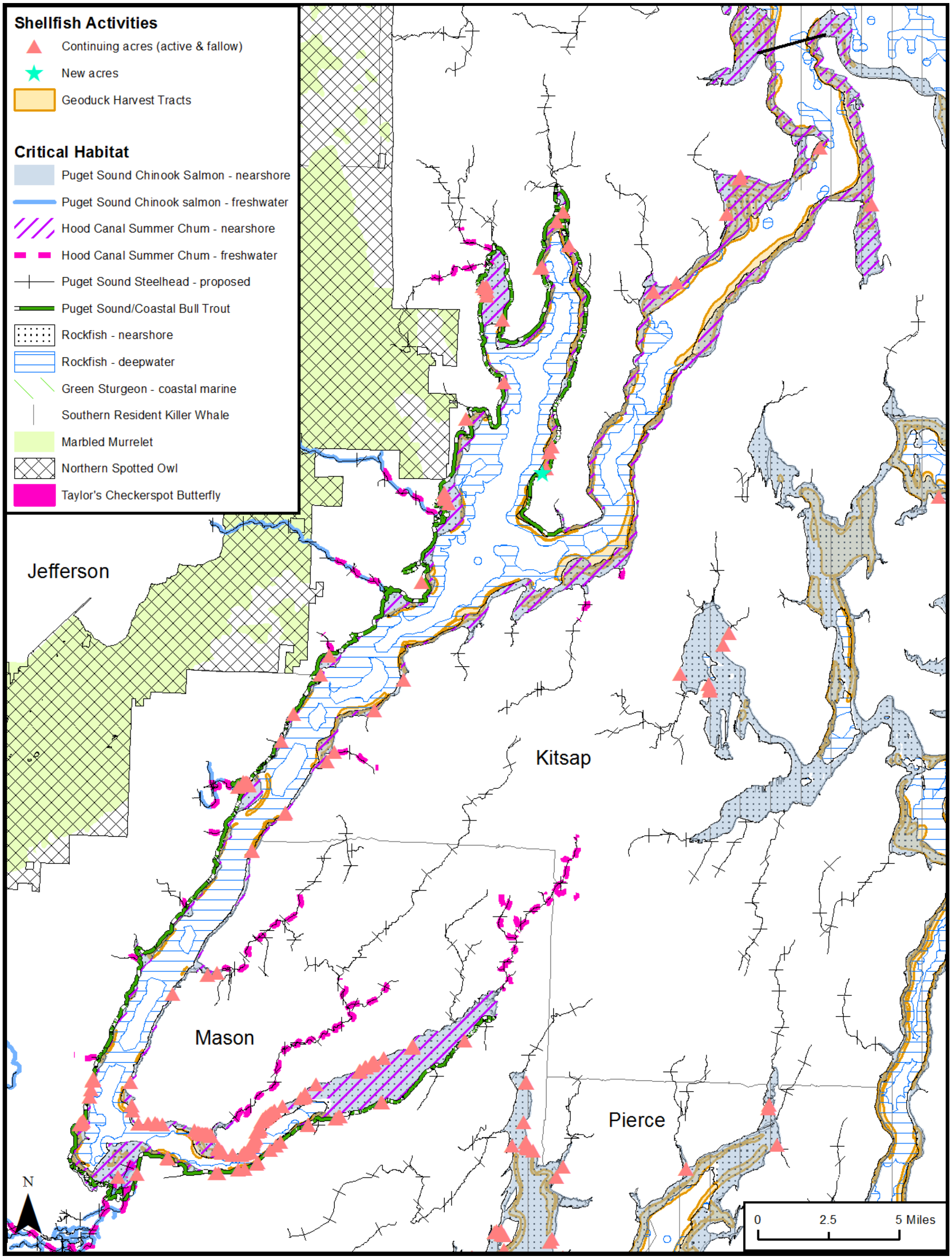

Figure H-3. Critical habitat and proposed activities in Hood Canal

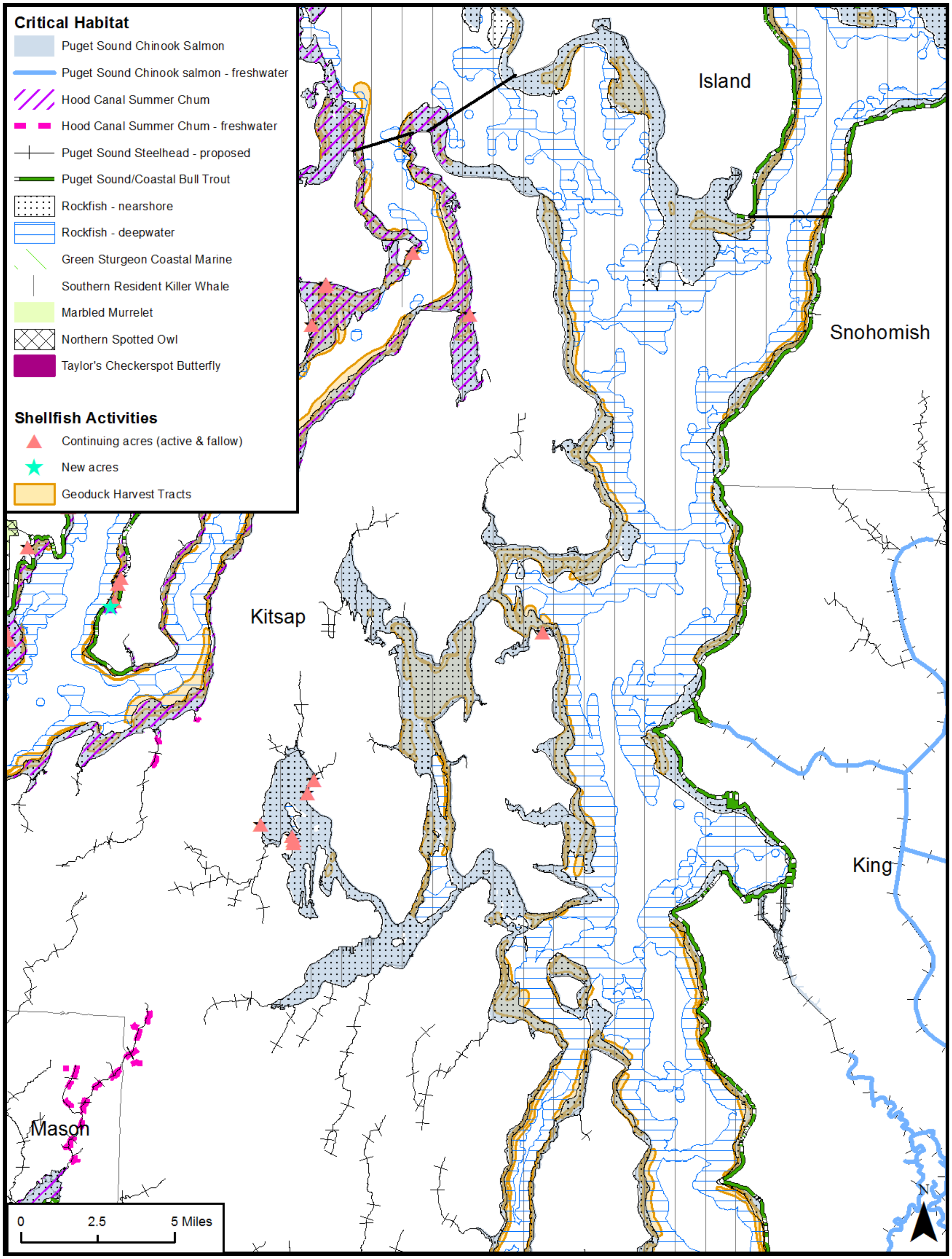

Figure H-4. Critical habitat and proposed activities in South Puget Sound (north section)

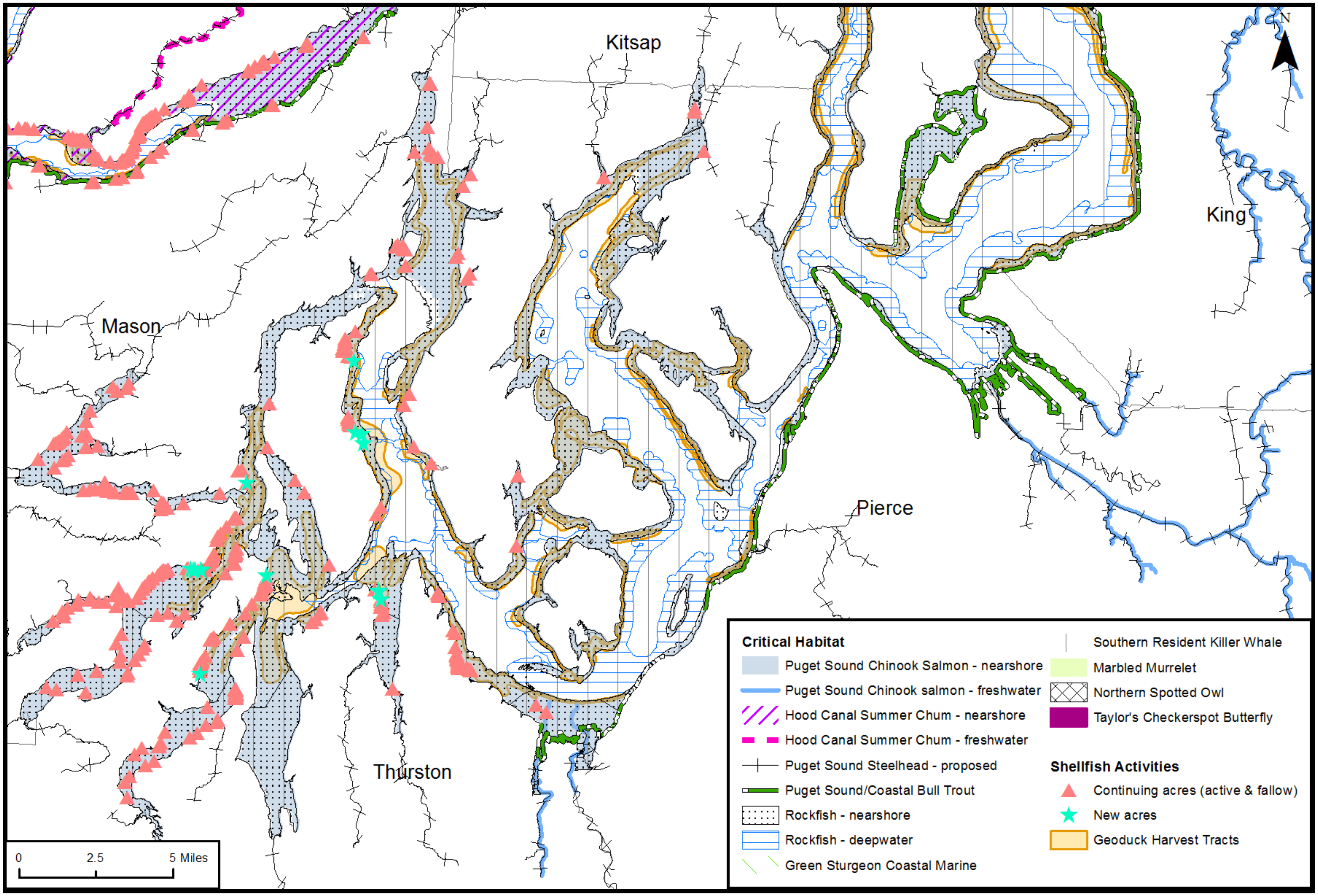

Figure H-5. Critical habitat and proposed activities in South Puget Sound (south section)

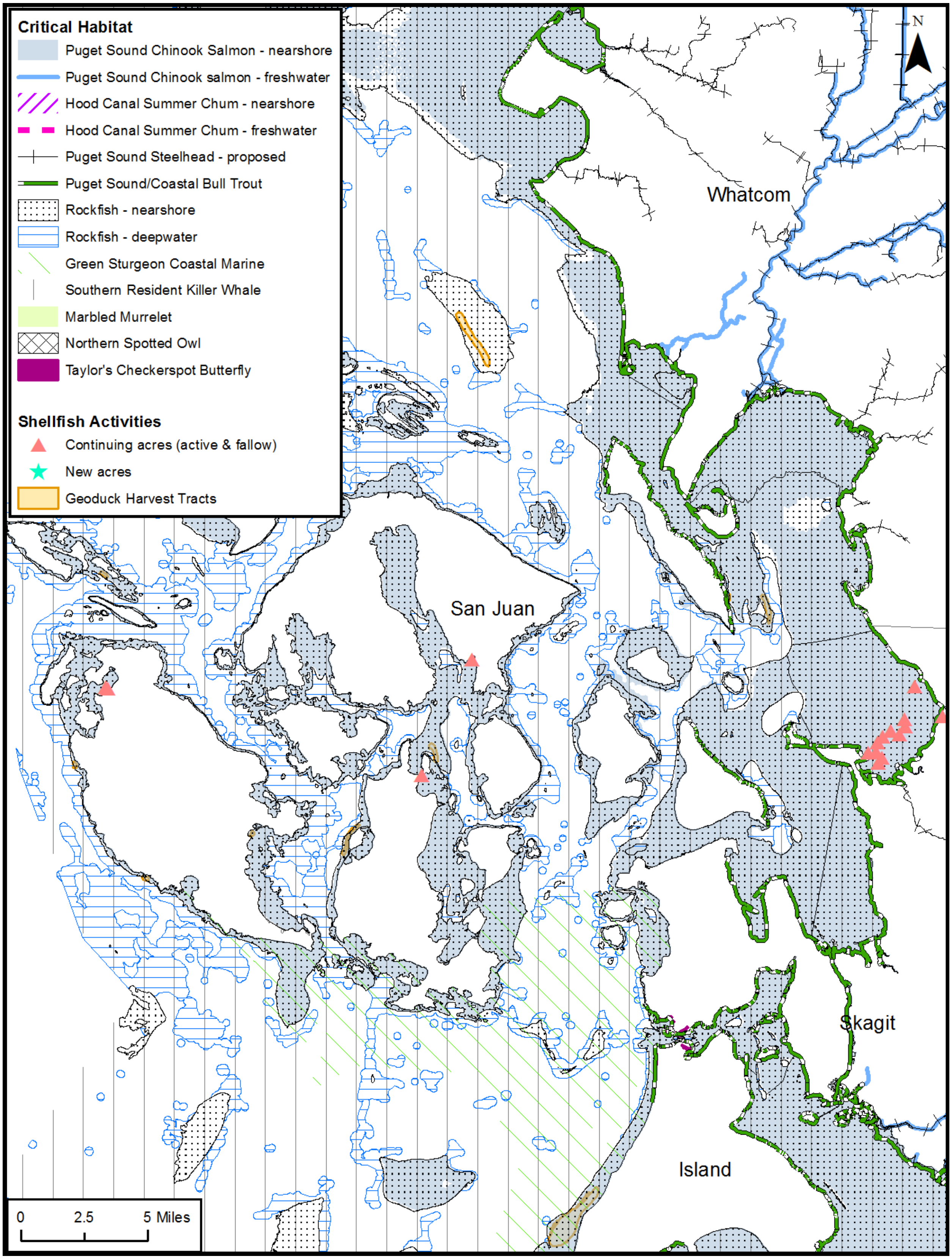

Figure H-6. Critical habitat and proposed activities in North Puget Sound (north section)

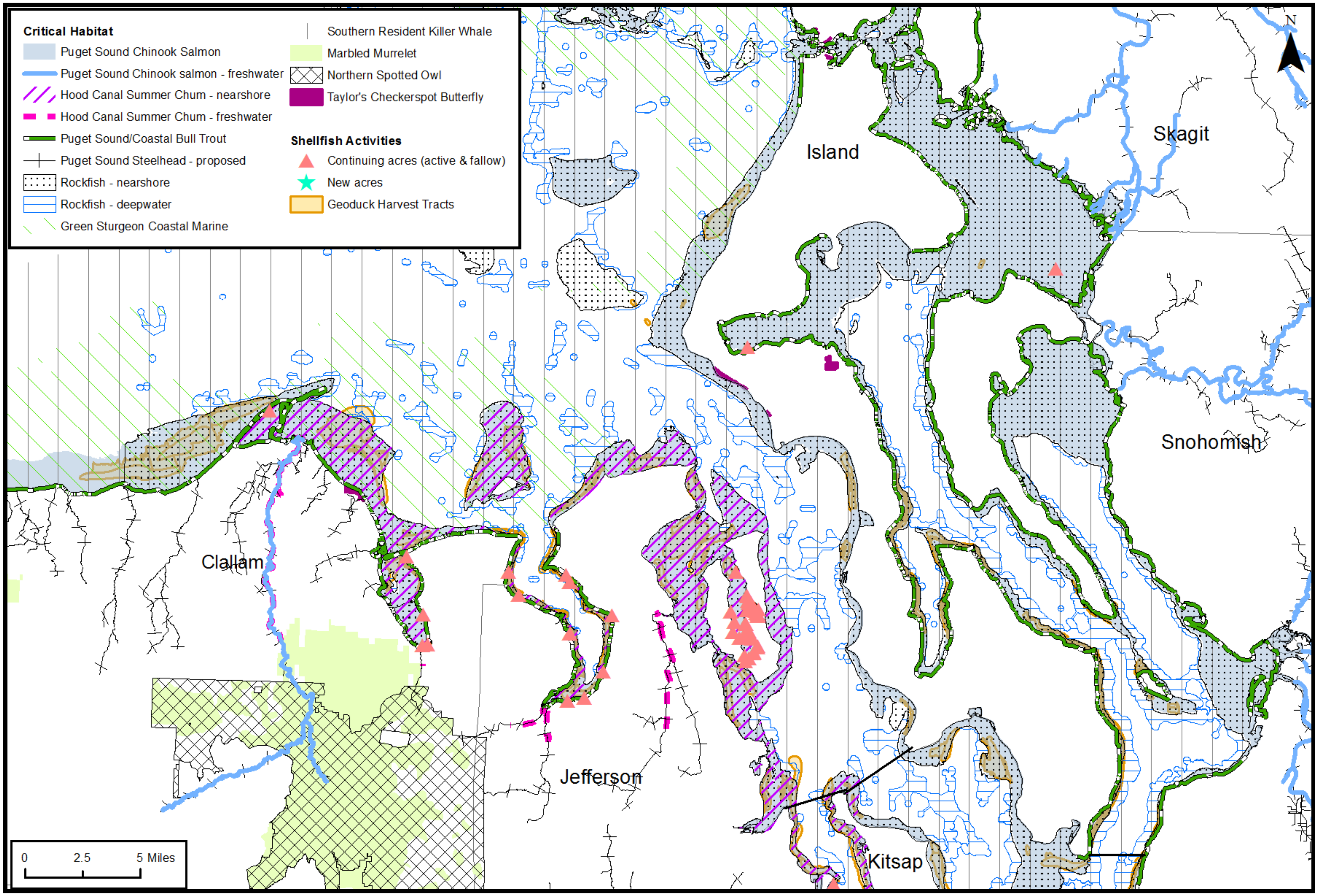

Figure H-7. Critical habitat and proposed activities in North Puget Sound (south section)