BP Cherry Point Dock Draft Environmental Impact Statement

May 2014

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COVER SHEET

Draft Environmental Impact Statement
BP Cherry Point Dock
Whatcom County, Washington

LEAD AGENCY:	Department of the Army U.S. Army Corps of Engineers, Seattle District
COOPERATING AGENCIES:	U.S. Coast Guard

ABSTRACT:

This Draft Environmental Impact Statement (Draft EIS) has been prepared as required by a court-ordered review of a previous permitting action in order to address the incremental environmental risk of operating the existing North Wing of the BP Cherry Point Marine Terminal dock (BP Cherry Point dock). As such, there is no new project application or revised purpose and need for the project to be considered in this Draft EIS. The purpose and need for the North Wing was to reduce tanker standby time in Puget Sound anchorage zones and to improve the efficiency of the BP Cherry Point dock while loading and unloading petroleum transport vessels. The North Wing was constructed and became operational in 2001 after the U.S. Army Corps of Engineers (USACE) issued a second Department of the Army (DA) permit (No. 92-1-00435) under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S. Code § 403).

This review has been prepared to support the USACE, Seattle District decision to continue without change;, modify with additional conditions; or revoke the previously issued DA permit for the North Wing. The USACE is examining the incremental environmental risk related to operation of the BP Cherry Point dock at maximum capacity with a single berth (the South Wing) and operating the dock with two berths (the North Wing and the South Wing) at projected future vessel traffic levels.

The Proposed Action is continuing the existing operations at the BP Cherry Point dock with two berths—one principally for import of crude oil and the other for distribution of refined petroleum products.

The USACE is responsible for preparing this Draft EIS in accordance with the National Environmental Policy Act (NEPA) for a DA permit issued under Section 10 of the Rivers and Harbors Act of 1899 . The NEPA requires preparation of an EIS to ensure that the USACE and any other federal agency that participates in this regulatory process are adequately informed of the potential environmental impacts of their decisions regarding permits issued under their jurisdiction.

The Draft EIS evaluates three alternatives, including the No Action Alternative. Potential direct, indirect, and cumulative impacts were evaluated for resources that could be affected by the proposed Project.

All comments concerning this Draft EIS are requested to be submitted by **August 6, 2014.**

For further information or to submit comments, contact the U.S. Army Corps of Engineers, Seattle District:

U.S. Army Corps of Engineers, Seattle District
4735 East Marginal Way South
Seattle, WA 98134
Attention: Olivia Romano
or
olivia.h.romano@usace.army.mil

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EXECUTIVE SUMMARY

WHAT IS THE PURPOSE OF THIS ENVIRONMENTAL IMPACT STATEMENT?

The purpose of this Environmental Impact Statement (EIS) is to examine the incremental environmental risk—principally from vessel traffic—related to operation of the North Wing of the BP Cherry Point Marine Terminal dock (BP Cherry Point dock). *Incremental environmental risk* is defined in this EIS as the change in environmental risk between operating the BP Cherry Point dock at maximum capacity with a single berth (the South Wing) and operating the dock with two berths (the North Wing and the South Wing) at projected future vessel traffic levels.

The Proposed Action is continuing the existing operations at the BP Cherry Point dock with two berths—one principally for import of crude oil and the other for distribution of refined petroleum products.

The U.S. Army Corps of Engineers (USACE) is responsible for preparing this EIS under the National Environmental Policy Act (NEPA) for a Department of Army (DA) permit issued under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S. Code § 403). The National Environmental Policy Act (NEPA) requires preparation of an EIS to ensure that the USACE and any other federal agency that participates in this regulatory process are adequately informed of the potential environmental impacts of their decisions regarding permits issued under their jurisdiction.

WHAT IS THE HISTORY LEADING UP TO PREPARATION OF THE EIS?

In 1971, the BP Cherry Point dock was permitted for construction of two berths, although only one berth (the South Wing) was constructed. The second berth (the North Wing) was constructed and became operational in 2001 after the USACE issued a second DA permit (No. 92-1-00435) under Section 10 of the Rivers and Harbors Act of 1899. In November 2000, a lawsuit was initiated against the USACE concerning the adequacy of the NEPA environmental review for permitting the North Wing.[1] The litigation required preparation of a vessel traffic study and completion of an EIS focused on the potential increased risk of vessel spills associated with operation of the North Wing.

WHAT IS THE PROJECT'S PURPOSE AND NEED?

The purpose and need for construction of the North Wing was to reduce tanker standby time in Puget Sound anchorage zones and to improve the efficiency of the BP Cherry Point dock while loading and unloading petroleum transport vessels.

This EIS was prepared as required by a court-ordered review of a previous permitting action in order to address the incremental environmental risk of operating a portion of the BP Cherry Point dock. As such, there is no new project application or revised purpose and need for the project to be considered in this EIS. The environmental review is intended to support the USACE's decision to continue without change, modify with additional conditions, or revoke the previously issued DA permit for the North Wing.

[1] The lawsuit questioned the DA permit's compliance with the Magnuson Amendment (33 U.S. Code §476.) A discussion of the Magnuson Amendment is included in Appendix H.

HOW WAS THE SCOPE OF THE EIS DETERMINED?

The scope of issues, geographic extent, and time frame of analysis in the EIS were established in two ways. First, the litigation settlement stipulated that a vessel traffic study was to be completed. It also specified the study area, time frame, and certain other parameters for the vessel traffic study.[2] Second, the public, government agencies, and tribes were invited to participate in a scoping process to provide further input to the USACE. The public scoping process included the following:

- A Notice of Intent (NOI) to prepare an EIS that was published in the Federal Register on August 16, 2006.
- A Public Scoping Notice that was published in the Federal Register on August 16, 2006.
- Public scoping meetings that were held at Port Angeles, Anacortes, Ferndale, and Seattle between September 5 and September 15, 2006.
- A tribal and agency scoping meeting that was held in Seattle on September 5, 2006.
- Public comments on scoping issues from all interested parties were received by the USACE from August 16 through September 15, 2006.

Sixty-one separate comments were received during the scoping process and were reviewed by the USACE. A summary of the scoping comments and the scope of the EIS are included in the Scoping Report (Appendix B).

WHAT IS THE SCOPE OF THE EIS?

Based on the outcome of the litigation and the results of the public and agency scoping process, the USACE determined that the scope of analysis to be included in this EIS included evaluation of:

- The incremental environmental effects of operating both wings of the BP Cherry Point dock at current and forecasted future vessel traffic levels for the years 2025 and 2030 compared to operating the South Wing of the BP Cherry Point dock at maximum capacity;
- The risk of potential accidents and oil spills considering vessels carrying crude oil and refined petroleum products to and from the BP Cherry Point dock within that portion of the Puget Sound bounded by the beginning of the Traffic Separation Scheme (TSS),[3] (approximately 8 miles west of "J" Buoy, offshore of Cape Flattery), Admiralty Inlet, and the U.S./Canadian border in the southern reaches of the Strait of Georgia;
- The effect of extended escorts for vessels transiting to the BP Cherry Point dock from the entrance to the Strait of Juan de Fuca to approximately Port Angeles, where escorting of vessels currently begins;
- The effect of posting a year-round vessel assist tug at Neah Bay; and

[2] The geographic scope of the EIS includes the Project area as defined by the geographic extent of the physical, chemical, and biological effects resulting from the Project, including the direct and indirect effects and effects of interrelated and interdependent activities. The Project area encompasses the north-south boundary marked by the TSS system, 8 miles west of the "J" Buoy at the entrance to the Strait of Juan de Fuca to the BP Cherry Point dock, and the vessel routes from the BP Cherry Point dock to the refineries near March Point. The geographic scope also includes the tidal zone (200 feet inland) within the defined Project area.

[3] The Traffic Separation Scheme is a traffic management route system operated jointly by the U.S. Coast Guard and Canadian Coast Guard. The TSS is used to regulate traffic at busy, confined waterways.

- The effect of discontinuing the use of the Huckleberry-Saddlebag Route from Cherry Point to Padilla Bay.

Elements not considered were construction of the North Wing and extension of the vessel traffic study to include vessel traffic along the Pacific coast and high seas vessel traffic routes.

USACE and the President's Council on Environmental Quality (CEQ) guidelines for implementation of NEPA require that an EIS evaluate the effect of the proposed action on relevant environmental resources, including direct, indirect, and cumulative effects. To comply with NEPA, this EIS evaluates the potential change in environmental risk associated with operating the North Wing of the dock, an increase in vessel traffic, and the associated potential accident and spill risks.

The EIS discusses potential effects on the following resources:

- Nearshore and Marine Resources, including federally and state-listed species
- Nearshore and Marine Habitats
- Water Quality
- Cultural Resources
- Land Use
- Recreation Resources
- Air Quality and Climate Change
- Tribal/Subsistence Fishing
- Socioeconomics and Environmental Justice

During scoping, several issues were identified for consideration in the EIS analysis. Upon further review, it was determined that some issues would not be included in the scope of analysis for the EIS. These issues and the reason they were not addressed are described in the EIS.

WHAT IS THE PROJECT EVALUATED IN THE EIS?

The scope of the EIS is to evaluate the incremental change in environmental risk between operating the BP Cherry Point dock at maximum capacity with a single berth (the South Wing) and operating the dock with two berths (the South Wing and the North Wing) at a level of utilization (vessel calls) projected for the years 2025 and 2030.

For the purpose of the EIS, the Project includes:

- Vessel traffic – tanker and barge traffic to and from the BP Cherry Point dock, including the marine route through the Strait of Juan de Fuca, Rosario Strait, and the waters off of Cherry Point in Washington. Also included are the operations of assist tugs during transit and moorage at the dock.
- Operation and maintenance of the BP Cherry Point dock's North Wing, which consists of a ship berth, loading equipment, control and metering equipment for loading refined petroleum product, oil spill preparedness and response equipment, and operation of these systems.

Because the scope of this EIS is to address the incremental environmental risk of operating a portion of the BP Cherry Point dock, operation of the refinery, tank farm, and interconnecting piping between these facilities are not part of the Project considered in the EIS.

The BP Cherry Point dock consists of two wings (the South Wing and the North Wing) in a “Y”-shaped configuration that are connected to the shore and the BP Refinery tank farm with a trestle and pipelines. Figure ES-1 is an aerial view of the BP Cherry Point dock.

Figure ES-1 Aerial View of BP Cherry Point Dock

Source: NOAA 2013.

Figure ES-2 shows the layout of the dock including the North and South Wings. The trestle that connects the dock to the shore (shown as the “approach trestle” in Figure ES-2) includes vessel unloading and loading equipment and a vehicle roadway and pipelines for transfer of crude oil and refined petroleum product between the dock and the refinery tank farm. Each wing on the dock consists of a single vessel berth, mooring dolphins, and a loading platform. The trestles that connect the wings to the dock (the “connecting trestles in Figure ES-2) include two platforms for vehicle maneuvering, oil spill equipment, and a berth for support vessels (workboats and an oil spill skimmer support vessel).

The South Wing is configured to unload or load both crude oil and refined petroleum product. The North Wing is configured to load and unload only refined petroleum product. The dock includes segregated piping for movement of refined petroleum product from the refinery tank farm to the North Wing.

Unloading or loading crude oil at the North Wing would require modification to the existing piping, valving, and loading system on the North Wing. BP does not seek to construct or modify any facilities as part of the Proposed Action.

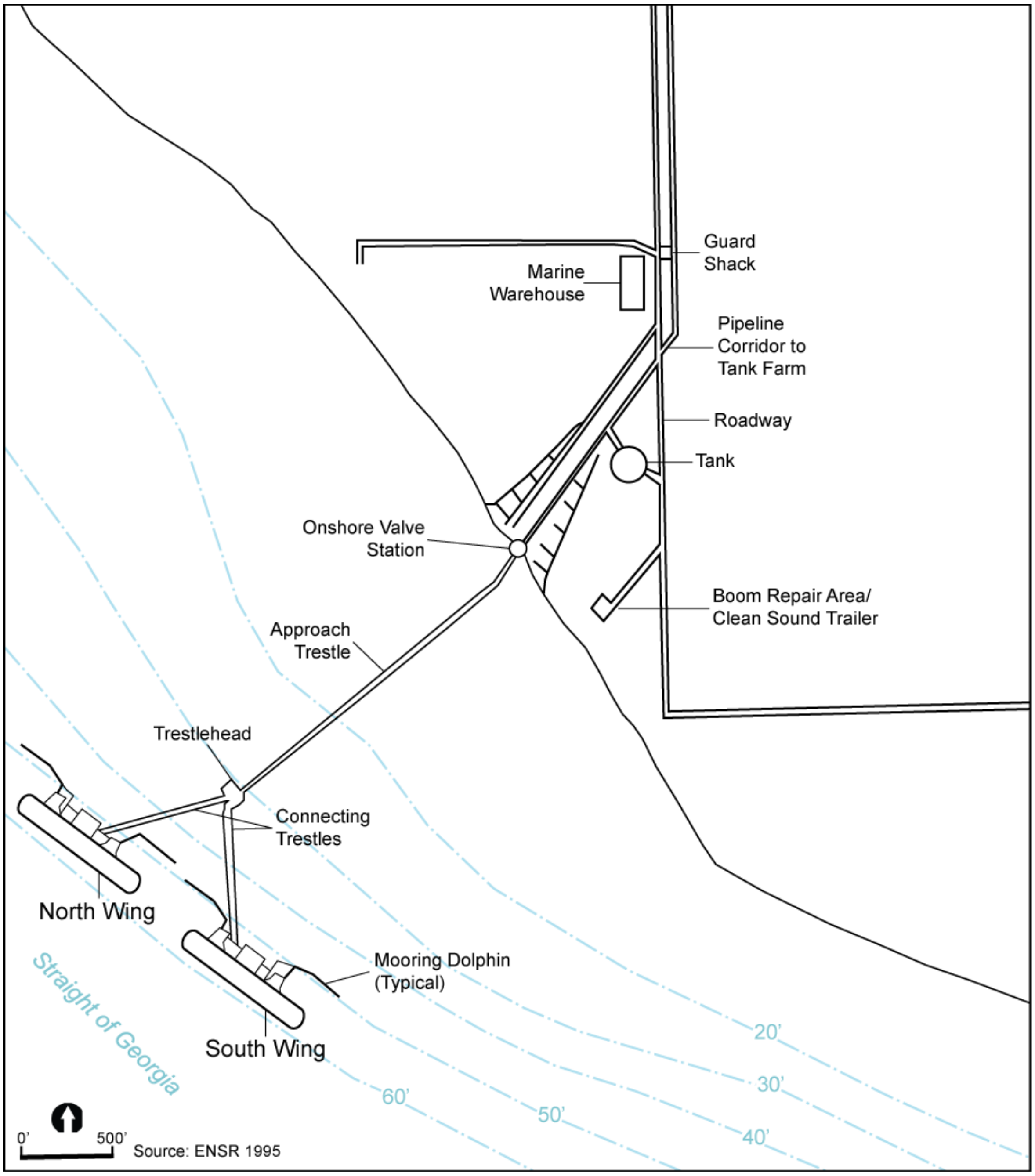

Figure ES-2 BP Cherry Point Dock Configuration

Ships approach the dock under the direction of the ship's master and a harbor pilot, and are assisted to the dock by two tugs. The BP Cherry Point dock requires tankers to use a minimum of two assist tugs for docking and undocking. Barges, including articulated tugs and barges (ATBs), are required to use a minimum of one assist tug for docking and undocking. After docking and securing all lines, spill retention booms are deployed to enclose the vessel loading area.

Vessels are permitted to conduct unloading and loading operations only in calm and moderate wind/wave conditions. When winds reach a predetermined strength, unloading and loading operations cease and the vessel moves to a temporary anchorage, as directed by the U.S. Coast Guard (USCG), to wait for winds and waves to subside to a safe level.

Other features of the dock and its operation include oil spill prevention and response, an oily water collection system, dock maintenance, and ballast water discharge restrictions.

HOW DOES VESSEL TRAFFIC MOVE TO AND FROM THE BP CHERRY POINT DOCK?

Vessels transiting to the BP Cherry Point dock are controlled through their transit of the study area by the USCG and/or the Canadian Coast Guard (CCG). Vessels from Alaska, Oregon, California, and international origins enter the western end of the Strait of Juan de Fuca and travel to the vicinity of Port Angeles, Washington, where a pilot comes on board. Vessels check-in with the joint USCG/CCG Cooperative Vessel Traffic System (CVTS) prior to entering the Strait of Juan de Fuca and remain under either USCG or CCG control during transit to and from ports within the Strait of Juan de Fuca, Puget Sound, and the Georgia Strait.

For a portion of the transit, tankers carrying oil or oil products are required to take two escort tugs in company. Most vessels continue through Rosario Strait to the southern reach of the Strait of Georgia and on to the BP Cherry Point dock. During transit through Rosario Strait, vessel traffic is limited to one-way passage by USCG vessel traffic rules. Occasionally, vessels transiting to the BP Cherry Point dock may travel north through Haro Strait and then northeast through Boundary Pass to the BP Cherry Point dock.

ATBs and traditional barges (collectively referred to as *barges*) and some tank ships may transit to the BP Cherry Point dock from lower Puget Sound (generally Seattle and Tacoma). These vessels transit through Admiralty Inlet and north along the western side of Whidbey Island, through Rosario Strait, and then north to the BP Cherry Point dock. Vessels departing from the BP Cherry Point dock take the routes described above in reverse, using the outbound or southbound TSS lanes as appropriate. Vessels approaching the BP Cherry Point dock may be required to temporarily anchor at a designated local anchorage if the berths at the dock are occupied or unavailable.

Tank ships and barges having called at the BP Cherry Point dock may then transit to the refineries located at March Point in Padilla Bay through the Huckleberry-Saddlebag or the Guemes Channel Routes. The Huckleberry-Saddlebag Route is adjacent to Lummi Island and Sinclair Islands. Figure ES-3 shows the vessel traffic routes in proximity to the BP Cherry Point dock.

HOW WAS THE DOCK USED IN THE PAST?

The primary measure of dock activity is the annual number of vessel calls. BP records of vessel calls from January 1998 through December 2010 show that an annual average of 321 vessel calls occurred at the BP Cherry Point dock. These calls included tank ships delivering crude oil feed stock to the refinery and tank ships or barges exporting refined petroleum product to market destinations. During this period, approximately 16.4 vessels on average arrived per month to deliver crude oil. During the same period, approximately 26.8 vessels on average per month loaded and departed from the BP Cherry Point dock to deliver refined petroleum product to market destinations. Total annual vessel calls have ranged from a low of 247 in 1998 to a high of 416 in 2007. The annual maximum number of calls (416) in 2007 consisted of 191 crude oil carriers and 225 refined petroleum product carriers.

Figure ES-3 Vessel Traffic Routes

A second measure of dock activity is the annual volume of crude oil and refined petroleum product transferred across the dock (total material transfer). From 1998 through 2010, the total material transfer at the BP Cherry Point dock ranged from a low of approximately 91,027,240 barrels (bbl) (3.823 million gallons) in 2005 to a high of 115,282,883 bbl (4.842 million gallons) in 2000. The variation of material transfer for this period was partly influenced by the outage of the Olympic Pipeline in 1999.

While the average number of vessel calls was 321 calls per year (from 1998 to 2010), the maximum capacity of the South Wing was determined to be approximately 335 calls per year. This includes consideration for dock weather outages and maintenance activities, in addition to vessel mooring and loading/unloading operations.

WHAT ARE THE PROJECTED FUTURE OPERATIONS OF THE DOCK?

BP provided projections of reasonably foreseeable changes in vessel traffic to and from the BP Cherry Point dock through calendar years 2025 and 2030, based on continued operation of the refinery at its current level of production. During the period from 1998 to 2010, annual vessel calls have ranged from 247 to 416, and annual material transfer at the dock has ranged from 91 to 115 million barrels. The range in both annual vessel calls and material transfer demonstrates the variability in dock operations and the difficulty of forecasting future traffic projections based on refinery operations. However, BP provided three vessel traffic forecast scenarios based on variations in market conditions:

- **Increased Pipeline Deliveries (Low-Range Forecast – between 170 and 220 vessel calls per year).** Assumes that deliveries by pipeline of crude oil to supply the refinery from Alberta resources would increase. Since its initial forecast, BP installed a Rail Logistics Facility at the refinery (which began operations on December 26, 2013) to enable deliveries of crude oil from domestic sources—principally the Bakken field in the Mid-West by rail. This may reduce the need for delivery of crude oil by tanker and the number of annual tanker calls at the BP Cherry Point dock.
- **Current Conditions (Medium-Range Forecast – between 320 and 400 vessel calls per year).** Assumes that the degree of reliance on offshore and Alaskan crude oil sources would continue. This scenario results in a level of annual calls in the same range as has occurred in the past.
- **Potential Future Growth (High-Range Forecast – between 350 and 420 vessel calls per year).** Recognizes that existing North Slope Alaska production declines may not be replaced by new onshore or offshore production in Alaska and that crude oil supplies must be obtained from a broader geographic array of sources. This is expected to lead to an increase in the number of vessel calls at the BP Cherry Point dock.

For each scenario, a range of calls was established—split between crude oil deliveries and refined petroleum product distribution. Under the upper limit of future vessel traffic growth conditions (the high-range forecast), the 2030 forecast predicts that the BP Cherry Point dock could receive between 350 and 420 vessel calls per year through 2030.

WHAT ALTERNATIVES WERE CONSIDERED IN THE EIS?

NEPA requires consideration of reasonable alternatives to the Project that could minimize impacts on the environment, including the No Action Alternative. The EIS considered the following actions:

- **Proposed Action.** Under the Proposed Action, BP would continue to operate the North and South Wings in their present configuration. The USACE would modify a DA permit for continued operation and maintenance of the dock, with conditions including prohibiting the use of the North Wing for unloading or loading crude oil.

- **No Action Alternative.** Under the No Action Alternative, the current DA permit would be revoked and BP would be required to remove the North Wing facility.
- **Alternative A.** Alternative A would be identical to the Proposed Action except that the conditions on operations of the North Wing including prohibiting unloading and loading crude oil would not be included.

HOW WAS THE RISK OF POTENTIAL ACCIDENTS AND OIL SPILLS EVALUATED IN THE EIS AND WHAT WERE THE RESULTS?

Two detailed technical studies were used to examine the risk of potential accidents and oil spills:

- **Vessel Traffic Risk Assessment (GWU VTRA).**[4] This study was prepared by a George Washington University-led team that used a traffic simulation to assess the incremental risk of vessel accidents and potential oil spills based on current and future vessel traffic calling at the BP Cherry Point dock. The GWU VTRA also incorporates several traffic management mitigation measures.
- **Vessel Traffic Analysis (TGA VTA).**[5] This study was prepared by The Glosten Associates, Inc. to estimate changes in vessel traffic accident risk and the associated risk of oil spills attributable to the upper limit of forecasted vessel traffic calling at the BP Cherry Point dock. It should be noted that the TGA VTA statistical model incorporates a number of assumptions and simplifications to accommodate gaps in data or the absence of historical incidents in some categories. The results of the TGA VTA should not be viewed as accurate forecasts of spill events. What can usefully be obtained from the model results is the direction and relative magnitude of changes in specific risk statistics when comparing different cases.

The result of these two studies formed the bases for assessing the incremental environmental risk of operation of the North and South Wings together compared to operating only the South Wing. Both the GWU VTRA and the TGA VTA examined the annual ***change in the probability of potential accidents*** and the ***potential volume of oil that could be released*** from accidents involving tank ships and barges bound for the BP Cherry Point dock.

Tank ship traffic calling at the BP Cherry Point dock accounts for 1.1 percent of all traffic in Puget Sound (normalized for time spent in transit) and 2.6 percent of all traffic in Puget Sound when adding barges calling at Cherry Point. Because the majority of the barge traffic is on routes to the southern reaches of Puget Sound, it can be inferred that approximately 1.1 percent of the traffic entering Puget Sound and transiting the Strait of Juan de Fuca is traffic destined for the BP Cherry Point dock (van Dorp et al. 2008).

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4 The *GWU VTRA* refers to van Dorp, J.R., J.R.W. Merrick, J.R. Harrald, and M. Gabowksi. 2008. Assessment of Oil Spill Risk due to Potential Increased Vessel Traffic at Cherry Point, Washington. Final Report. Submitted to BP on August 31, 2008.

5 The *TGA VTA* refers to The Glosten Associates, Inc. 2013. BP Cherry Point Vessel Traffic Analysis. Draft Study Report. Prepared for Cardno ENTRIX, Seattle, WA. Prepared by The Glosten Associates, Inc. in collaboration with Environmental Research Consulting, Cortlandt Manor, NY, and Northern Economics, Inc., Anchorage, AK. (File No. 12121.01.) May 15.

The general conclusions regarding the incremental increase in potential accidents and oil spills from the GWU VTRA and the TGA VTA include the following:

- At current and future traffic levels up to the maximum capacity of a single-wing dock, operation of a second wing reduces the potential for accident, oil spill, and potential oil spill volume. (GWU VTRA)
- At future traffic levels at the upper limit projected for operation of the BP Cherry Point dock, an increase in the potential for accidents and oil spills may occur irrespective of the dock configuration. (TGA VTA)
- The addition of traffic generated by the other proposed projects (cumulative projects) in the region will likely increase the potential for accidents and oil spills. (TGA VTA)
- The type of accident likely to produce the largest cumulative spill volume includes spills caused by equipment failures, fires, explosions, operator errors, and structural failures. (TGA VTA)
- The subarea with the greatest potential change in spill size (but not frequency) may be the Cherry Point area at the upper limit of projected annual calls on two wings compared to the maximum annual calls on a single wing projected by BP. (TGA VTA)

These results are specific to different future vessel traffic forecasts. Future economic conditions related to the sources of supply of crude oil to the BP Refinery and alternative means of delivering that crude oil by land-based systems (pipeline and rail) suggest that the low- or mid-range vessel traffic forecast is more likely to occur.

WHAT ARE THE POTENTIAL ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION AND ALTERNATIVES?

The environmental resources in the Project area were analyzed to determine the likely environmental consequences of:

- Operation activities at and in the maneuvering area of the North Wing;
- Changes in the number of vessels transiting to the BP Cherry Point dock through the Project area;
- Removal of the North Wing;
- Spill of crude oil or refined petroleum product in the Project area; and
- Clean-up actions in the event of a spill.

Regardless of the results of the vessel traffic study, a spill of any size theoretically could occur anywhere in the Project area. For this reason, the potential impacts from a spill of crude oil or refined petroleum product and the associated clean-up actions are discussed broadly for each resource in this EIS but are not included in this executive summary. The remaining three factors that could affect environmental resources are provided in Table ES-1.

The two vessel traffic studies addressed the potential for spills of crude oil and refined petroleum product under current and future conditions, and generally concluded that (1) operation of a second wing reduces the potential for accident, oil spill, and potential oil spill volume at current and future traffic levels up to the maximum capacity of a single-wing dock (approximately 335 calls per year) (GWU VTRA); and (2) an increase in the potential for accidents and oil spills may occur irrespective of the dock configuration at future traffic levels at the upper limit of vessel traffic projected for operation of the BP Cherry Point dock (up to 420 calls per year) (TGA VTA).

If the number of future tank ship and barge calls continues in BP's current conditions (mid-range) forecast or low-range forecast, the likelihood of any increase in spill frequency or volume is reduced with operation of the North Wing under these scenarios. Should the number of vessel calls increase to the annual maximum of 420 calls, the potential frequency of accidents and spills may be slightly increased.

Under the No Action Alternative with only one wing in operation under current vessel traffic forecast conditions, the potential frequency of accidents and associated oil outflow would increase, with associated higher risks to environmental resources from crude oil spills and clean-up activities.

Table ES-1 provides a summary of the potential impacts on resources in the Project area from the Proposed Action, Alternative A, and the No Action Alternative.

Table ES-1 Potential Impacts on Resources in the Project Area from the Proposed Action, Alternative A, and the No Action Alternative

	Proposed Action and Alternative A		No Action Alternative
Resource Area	Incremental Impacts from Operations at the North Wing	Incremental Impacts from Changes in Vessel Traffic	Impacts from Removal of the North Wing
Nearshore and marine resources	Hazardous material spills at the BP Cherry Point dock are not expected to occur in sufficient magnitude or frequency to adversely affect nearshore and marine resources, including federally and state-listed species. Aquatic invasive or nuisance species could be introduced though ballast water discharge; however, the risk of introduction would be minimized by compliance with U.S. Coast Guard and state regulations. BP provides reception facilities for the discharge of cargo tank ballast. Maintenance activities would be limited in duration and magnitude, and are not expected to adversely affect nearshore or marine resources. Temporary effects on fish could result from lighting during loading.	Vessel collisions with marine mammals could occur; however, marine mammals generally detect and move away from vessels. Changes in vessel traffic would not significantly alter existing background noise levels. Birds and fish are likely to move out of the area when vessels are present, resulting in minimal impacts. Entrainment of eggs and larvae suspended in the water column would increase as vessel traffic increases; however, effects are not likely to adversely affect fish in the study area. Changes in vessel traffic are not likely to adversely affect federally or state-listed species.	Increased noise and human disturbance could temporally displace fish, marine mammals and avian species from the vicinity of the BP Cherry Point dock. Removal of the North Wing would result in the loss of approximately 140,000 square feet of man-made benthic substrate that has been colonized by aquatic organisms. Regeneration of natural benthic habitats with associated benefit to aquatic species is expected to occur. A temporary increase in suspended sediment during removal of the piles would occur in the vicinity of the dock that may temporarily affect critical habitat for ESA-listed species through decreases in prey population or habitat availability from increased disturbance and turbidity.

Table ES-1 Potential Impacts on Resources in the Project Area from the Proposed Action, Alternative A, and the No Action Alternative (Continued)

Resource Area	Proposed Action and Alternative A		No Action Alternative
	Incremental Impacts from Operations at the North Wing	Incremental Impacts from Changes in Vessel Traffic	Impacts from Removal of the North Wing
Nearshore and marine habitat	Aquatic invasive or nuisance species could be introduced though ballast water discharge; however, the risk of introduction would be minimized by compliance with U.S. Coast Guard and state regulations. BP provides reception facilities for the discharge of cargo tank ballast. Temporary effects on nearshore habitat could result from lighting during loading. Accidental releases of small quantities of hazardous materials may occur, but in such small quantities that they are not likely to affect marine resources.	The water column would experience increased turbulent mixing of the surface layers in the area immediately surrounding the vessel path and wake. However, vessels would stay within the Cooperative Vessel Traffic System, an area that is already disturbed by existing vessel traffic.	Removal of the North Wing would eliminate any lighting and minor shading effects on habitat in the vicinity of the dock. Removal of the North Wing would result in the loss of approximately 140,000 square feet of man-made benthic substrate that has been colonized by aquatic organisms. Regeneration of natural benthic habitats, with associated benefit to aquatic species, is expected to occur.
Water quality	Accidental temporary releases of small quantities of hazardous materials may occur, but in such small quantities that they are not likely to contribute to a reduction in water quality at the North Wing.	Water quality is not expected to change as a result of changes in vessel traffic.	Removal of the North Wing could result in temporary decreases in water quality from re-suspension of particulate materials and possible contamination from hazardous materials.
Cultural resources	Spills and releases currently do not occur in sufficient volume or frequency to adversely affect archaeological sites and historic resources near the North Wing.	Cultural resources are not expected to be affected by a change in the number of calling vessels.	Removal of the North Wing could cause physical disturbance or introduction of contaminants, altering the chemical composition of the sediment matrix comprising archaeological sites. Indirect impacts from construction activities, including noise and vibration from construction equipment, could temporarily affect historic resources, archaeological sites, and traditional cultural properties on the shoreline in the vicinity of the dock.
Land use	Continued operations at the North Wing are not expected to affect land use in the study area.	A change in the number of vessels is not expected to affect land use in the study area.	Nearby residents may be temporarily affected by noise, road traffic, and heavy equipment use.
Recreation resources	Continued operations at the North Wing are not expected to affect recreation resources in the study area.	Increased interactions between recreationists and vessels may occur with an increase in vessels; changes in behavior of wildlife may affect wildlife watching opportunities.	Potential short-term impacts on recreational fishermen and boaters may occur during dock removal because of temporary exclusion from the construction area and construction noise.

Table ES-1 Potential Impacts on Resources in the Project Area from the Proposed Action, Alternative A, and the No Action Alternative (Continued)

	Proposed Action and Alternative A		No Action Alternative
Resource Area	Incremental Impacts from Operations at the North Wing	Incremental Impacts from Changes in Vessel Traffic	Impacts from Removal of the North Wing
Air quality and climate change	Decreasing vessels in the area by limiting queuing and waiting at anchor would reduce emissions (including greenhouse gases [GHGs]). Newer Category 3 engines would emit fewer oxides of nitrogen (NO_X), sulfur dioxide (SO_2), and fine particulate matter ($PM_{2.5}$). U.S. Environmental Protection Agency (EPA) standards for newly built Category 3 marine diesel engines apply beginning in 2011, and long-term standards will begin in 2016.	Combustion of marine fuel would result in the release of GHGs, including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Air emissions are not expected to increase because of the overall lower emission rates associated with new EPA standards for Category 3 marine diesel engines. No portion of the study area is likely to violate the national ambient air quality standards or the Washington ambient air quality standards.	Heavy machinery and work boats would cause some temporary increase in emissions, including GHGs.
Tribal/subsistence fishing	Continued operations at the North Wing are not expected to change existing effects on subsistence fishing in the study area.	The presence of deep draft vessels could interrupt troll vessel and gillnet fishing; crab and shrimp pots placed in transit lanes and maneuvering areas could be damaged.	Disturbance of man-made benthic habitat and temporary suspension of sediment may cause temporary impacts on subsistence fishing resources in the area adjacent to the North Wing.
Socioeconomics and environmental justice	A minor increase in employment and income could result from increased dock operations. No impacts on environmental justice populations are expected.	Changes in vessel traffic may cause minor to negligible impacts on coastal residents and in-water and nearshore activities, such as commercial vessel traffic, aquaculture, fishing, boating, and beach recreation. An increase in sales and taxes is possible if the number of vessels sold and registered in the State of Washington increases. Minor and limited potential impacts on environmental justice populations may occur related to in-water activities such as fishing and boating.	Dock removal could create short-term jobs that could generate local and non-local spending and minor state and local sales and use taxes.

WILL THE PROJECT CONTRIBUTE TO ANY CUMULATIVE EFFECTS IN THE STUDY AREA?

Cumulative effects are those effects that could occur in the same geographic area and during the same time as the effects from the Project. They include effects associated with past, present, and future projects, plans, or programs that are reasonably likely to occur.

For the EIS, the following projects, plans, and programs were included in the cumulative effects analysis:

- Cherry Point Aquatic Reserve;
- BP Rail Logistics Facility;
- Oil production from the Alaska North Slope with substantial volumes by 2016;
- Expansion of Kinder Morgan's Transmountain Pipeline to export oil to Asia by 2016;
- Oil production from the Alaska Outer Continental Shelf beginning in 2024; and
- Bulk carrier and tug traffic calling at the Gateway Pacific Terminal by 2030.

The North Wing of the BP Cherry Point dock was constructed prior to implementation of the Cherry Point Aquatic Resource Management Plan, which states that the existing industrial uses at Cherry Point do not conflict with aquatic reserve status (WSDNR 2010).[6] The Proposed Action is therefore not expected to cumulatively affect the Cherry Point Aquatic Reserve.

BP recently constructed a Rail Logistics Facility (RLF) designed to receive and unload crude oil and other feedstock transported by rail for processing at the BP Cherry Point refinery. Utilization of the RLF to deliver crude to the refinery may displace crude deliveries by pipeline and/or ship by up to 46 to 58 vessel calls annually (assuming daily rail deliveries and depending on the average tanker crude oil cargo size that is displaced).

Operation of the North Wing generally reduces the risk of accident and oil spill. However, the addition of other future projects that could occur independently from operation of the North Wing at the BP Cherry Point Dock could increase deep draft traffic in the Puget Sound, which may increase risk. In the cumulative effects analysis, projects under development include expansion of Kinder Morgan terminal facilities in Vancouver, other facilities in the Vancouver area, and the Gateway Pacific Terminal at Cherry Point. The addition of this "cumulative" traffic could increase the potential risk of accident and oil spill by up to 34 percent. However, this increase would be independent of the reduction of risk attributable to operation of the North Wing at the Cherry Point Dock.

ARE ANY MITIGATION MEASURES PROPOSED?

BP does not create any new operations or variation in its current operations with operation of both the North and South Sings at its dock, compared to operation of only the South Wing. With operation of two wings, the same types and range of vessels calls at the BP Cherry Point dock are projected to occur; the same sequence of events for mooring, loading or unloading, and departure would take place; and the same routes for transiting into and out of Puget Sound are expected to be used. The incremental risk analysis indicates that the risk of accident and oil outflow will be reduced with operation of the North Wing up to approximately 335 calls per year and that the risk could be increased to some small degree at traffic levels between 335 and 420 calls year.

An integrated system of vessel design requirements, vessel traffic control during transit, pilotage, operating procedures for loading and unloading cargos, oil spill prevention and response, and overall management of marine traffic is currently in place in Puget Sound to avoid and minimize the risk of accident and oil spill. This system has been developed and implemented under the authority of the Washington State Department of Ecology, the USCG, and the CCG.

In addition to risk avoidance and minimization efforts already implemented, a reduction in risk is predicted to occur under the current (medium-range) and low-range future vessel traffic scenario

[6] Washington State Department of Natural Resources (WSDNR). 2010. Cherry Point Environmental Aquatic Reserve Management Plan. November.

forecasted by BP with operation of the North Wing. Should traffic increase to BP's high-range vessel traffic scenario, the current risk mitigation system is capable of recognizing the risk and modifying or incorporating new procedures to minimize the small increase in potential risk. Under these circumstances, no additional mitigation measures are proposed specific to the vessel traffic calling at the BP Cherry Point dock.

HOW WILL THIS EIS BE COMPLETED?

The Draft EIS is now available for review and comment by members of the public, regulatory agencies, and tribes for a specific period of time. The USACE has issued a Notice of Availability that specifies the time period for this review and how to submit comments on the Draft EIS to the USACE. After the close of the comment period, the USACE will review all comments received. Response to some comments may include changes to the Draft EIS. After all changes to the Draft EIS have been completed, a record of all comments received and responses to these comments will be prepared and incorporated into the Final EIS. The Final EIS then will be published by the USACE. A public notice announcing the availability of the Final EIS and the USACE's decision regarding the DA permit will be issued to complete the EIS process under NEPA.

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Acronyms

9th Circuit Court	U.S. Court of Appeals 9th Circuit
AIS	Automated Identification System
Alaska Crude	Alaska North Slope crude oil
ANS	aquatic nuisance species
ARCO	Atlantic Richfield Company
ATB	articulated tug and barge
ATBA	area to be avoided
bbl	barrels
BMP	best management practice
BP	BP West Coast Products, LLC
B.P.	before present
BP Cherry Point dock	BP Cherry Point Marine Terminal dock
BP refinery	BP Cherry Point Refinery
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAA	Clean Air Act
CBG	census block group
CCG	Canadian Coast Guard
CEQ	Council on Environmental Quality
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2-e	CO_2-equivalent
CPS	coastal pelagic species
CVTS	Cooperative Vessel Traffic System
DAHP	Department of Archaeology and Historic Preservation
DA permit	Department of the Army permit
DO	dissolved oxygen
DPS	distinct population segment
dwt	deadweight tons
ECA	Emission Control Area
Ecology	Washington State Department of Ecology
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	environmental impact statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ERC	Environmental Research Consulting
ERTV	emergency response towing vessel

ESA	federal Endangered Species Act
ESU	evolutionary significant unit
FMR	fire-modified rock
FR	Federal Register
FRP	Facility Response Plan
GHG	greenhouse gas
GPT	Gateway Pacific Terminal
GRP	Geographic Response Plan
GWU	George Washington University
GWU VTRA	George Washington University Vessel Traffic Risk Analysis
HABS	Historic American Building Survey
HAER	Historic American Engineering Record
HAPC	habitat area of particular concern
HCs	hydrocarbons
HFCs	hydrofluorocarbons
HFO	heavy fuel oil
ICS	Incident Command System
kHz	kiloHertz
km	kilometer
LOCs	levels of concern
m^3	cubic meters
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MBTA	Migratory Bird Treaty Act
MCTS	Marine Communications and Traffic Service
µg/L	micrograms per liter
mg/L	milligrams per liter
MHHW	mean higher high water
MHW	mean high water
mL	milliliters
MLLW	mean lower low water
MLLWS	mean lower low water spring
MLW	mean low water
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
mph	miles per hour
msl	mean sea level
MX	Marine Exchange of Puget Sound
N_2O	nitrous oxide
NAAQS	national ambient air quality standards
NANPCA	Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990
NBIC	National Ballast Information Clearinghouse

NCO	National Oil and Hazardous Substances Pollution Contingency Plan
NEI	Northern Economics, Inc.
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NISA	National Invasive Species Act of 1996
NMFS	National Marine Fisheries Service
nmi	nautical miles
NO	nitrogen oxide
NO_2	nitrogen dioxide
NO_x	oxides of nitrogen
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPS	National Park Service
NRHP	National Register of Historic Places
NWACP	Northwest Area Contingency Plan
NWIFC	Northwest Indians Fisheries Commission
NWR	national wildlife refuge
OA	Ocean Advocates et al.
OCS	Outer Continental Shelf
OPA 90	Oil Pollution Act of 1990
OSRO	oil spill removal organization
PacFIN	Pacific Fisheries Information Network
PAHs	polycyclic aromatic hydrocarbons
Parks Commission	Washington State Parks and Recreation Commission
Pb	lead
PFCs	perfluorocarbons
PFMC	Pacific Fishery Management Council
PM_{10}	respirable particulate matter
$PM_{2.5}$	fine particulate matter
PNW	Pacific Northwest
ppm	parts per million
ppt	parts per trillion
RCW	Revised Code of Washington
RLF	Rail Logistics Facility
ROC	reactive organic compound
SEPA	Washington State Environmental Policy Act
SF_6	sulfur hexafluoride
SIP	State Implementation Plan
SO_2	sulfur dioxide
spp.	Species
SHPO	State Historic Preservation Officer

SMA	Shoreline Management Act
SOC	Standard of Care
TCP	traditional cultural property
TGA	The Glosten Associates
TGA VTA	*BP Cherry Point Vessel Traffic Analysis* (The Glosten Associates 2013)
TSP	total suspended particulate matter
TSS	Traffic Separation Scheme
U&A	usual and accustomed grounds and stations
UGA	Urban Growth Area
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USFWS	U.S. Fish and Wildlife Service
USCG	U.S. Coast Guard
VEAT	Vessel Entries and Transits for Washington Waters
VOC	volatile organic compound
VRP	Vessel Response Plan
VTOSS	Vessel Traffic Operation Support System
VTRA Report	*Assessment of Oil Spill Risk due to Potential Increased Vessel Traffic at Cherry Point, Washington* (van Dorp et al. 2008)
VTSPS	Vessel Traffic Service Puget Sound
WAAQS	Washington ambient air quality standards
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WHR	Washington Heritage Register
WSDNR	Washington State Department of Natural Resources
WSDOT	Washington State Department of Transportation

Glossary

Allision. A vessel striking a fixed object, such as a pier or navigation aid. The term *collision* refers to a vessel striking another vessel.

Anadromous fish. Fish that are born in freshwater, spend their life in the sea, and return to freshwater to spawn.

Aquaculture. Farming of fish, shellfish, or other aquatic plants and animals.

Area to be avoided (ATBA). A defined area with known navigational hazards or important resources from which all ships or certain classes of ships are excluded.

Articulated tub and barge (ATB). A tug with a mechanical connection to a barge. A hinged connection allows the tug to pitch independently of the barge, providing much better sea-keeping capability than conventional towed barge systems (http://www.oceantugbarge.com/PDF/history.pdf).

Attainment area. An area that has met federal standards for concentration of a monitored pollutant over a designated period (3 years in most cases).

Ballast water. Water used by deep-draft cargo vessels to maintain vessel stability and trim. The volume required depends on shipboard conditions affected by cargo weight and type. Changes in vessel weight as a result of cargo loading or unloading results in the necessity to discharge or fill ballast tanks accordingly. The vessels calling at the BP Cherry Point dock to take on refined petroleum product typically arrive already in ballast, whereas those arriving with a crude oil delivery take on ballast water to compensate for off-loaded cargo.

Bunkering. The oil transfer or operation to replenish fuel for vessels weighing 300 gross tons or more.

Caisson. A watertight structure within which construction work is performed under water.

Candidate species. A species proposed for listing under the Endangered Species Act at some time in the near future.

Category 3 marine diesel engines. Marine diesel engines with per-cylinder displacement at or above 30 liters. On April 30, 2010, EPA published a final rule in the Federal Register (75 CFR 22896) that established emission standards for these engines installed on large ocean-going U.S. vessels, such as tankers and barges. The final rule requires reductions in NO_X emissions and adopts standards for emissions of hydrocarbons and carbon monoxide CO from new Category 3 marine diesel engines.

Census block group (CBG). The smallest geographic area for which the U.S. Census Bureau provides consistent sample data; generally contains a population of 600 to 3,000 individuals.

Coastal pelagic species. Northern anchovy, jack mackerel, Pacific sardine, Pacific (chub or blue) mackerel, and market squid.

Criteria pollutants. The six pollutants for which the U.S. Environmental Protect Agency has established national ambient air quality standards (NAAQS), as directed by the Clean Air Act: nitrogen dioxide (N_{O2}), sulfur dioxide (SO_2), carbon monoxide (CO), particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$), and lead.

Critical habitat. Specific areas within the geographical area occupied by a species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation (http://www.nmfs.noaa.gov/pr/glossary.htm).

Dolphin. A stand-alone structure, usually consisting of a cluster of piles, a concrete mass supported by a number of piles, or a sheet pile cell, that is used to guide and/or moor vessels.

Dissolved oxygen (DO). Measurement of the amount of gaseous oxygen (O_2) in water. Adequate DO is necessary for good water quality and for survival of aquatic species. When oxygen levels in water drop below 5.0 milligrams per liter, aquatic life is put under stress. The lower the concentration, the greater the stress; low levels of DO over extended periods can kill fish.

Distinct population segment (DPS). A vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The federal Endangered Species Act provides for listing species, subspecies, or distinct population segments of vertebrate species. (http://www.nmfs.noaa.gov/pr/glossary.htm.)

Drift grounding. When a vessel loses propulsion, or propulsion and steering capability, and goes aground while adrift.

Emission control area (ECA). A sea area with stricter requirements concerning the use of bunker fuel compared to other sea areas. As of August 1, 2012, all large ships traveling within 200 nautical miles of the coasts of the United States and Canada are required to burn cleaner fuel (fuel with lower sulfur dioxide emissions).

Endangered species. Species that are in danger of extinction throughout all or a significant portion of their range.

Endangered Species Act (ESA). The act (16 USC 1531 et seq., 50 CFR Parts 17 and 222) that provides for protection and management of species that are federally listed as threatened or endangered and designated critical habitat for these species.

Entrainment. Direct uptake of aquatic organisms by the suction field generated by water intakes on vessels.

Environmental justice. Addresses the fair treatment of people of all races and incomes with respect to federal actions that affect the environment. Fair treatment implies that no group of people should bear a disproportionate share of negative impacts from an action.

Environmental risk. The probability of an incident (collision, allusion, power grounding, drift grounding, bunker transfer error, cargo transfer error, or other non-impact error). For incidents where an oil outflow occurs, *environmental risk* considers the combined volume of crude oil, refined petroleum product, or bunker oil potentially released.

Evolutionary significant unit (ESU). A Pacific salmon population or group of populations that is substantially reproductively isolated from other conspecific populations and that represents an important component of the evolutionary legacy of the species. The ESU policy (56 FR 58612) for Pacific salmon defines the criteria for identifying a Pacific salmon population as a distinct population segment (DPS), which can be listed under the ESA. (http://www.nmfs.noaa.gov/pr/glossary.htm.)

Exclusive Economic Zone (EEZ). A zone that extends up to 200 nautical miles from the coastline. Presidential Proclamation 5030 created the EEZ in 1983.

Gill nets. Vertical panels of netting usually set in a straight line. Targeted fish species are entangled in the net. Salmon fisheries in particular use gill netting because of their low incidence of catching non-target species.

Kelp. A group of primarily brown and some red algae (seaweeds) that are large, occur primarily in low intertidal to subtidal zones, and are attached to rock substrates. They are characterized as “floating” and “non-floating” based on whether the mature individuals form canopies on the water surface at high tides.

Lithics. Chipped stone artifacts manufactured with percussion and pressure techniques. Projectile points (or fragments), bifaces, flake tools, cores, and debitage are all common lithic artifacts found in archaeological sites.

Maintenance area. Regions previously designated as nonattainment areas that have since achieved attainment. (See definitions for “Attainment area” and “Nonattainment area.”)

Milligrams per liter (mg/L). A unit of the concentration of a constituent in water or wastewater. It represents 0.001 gram of a constituent in 1 liter of water and is approximately equal to one part per million (ppm).

National Register of Historic Places (NRHP). The federal list of historic, archaeological, and cultural resources worthy of preservation that was created under the National Historic Preservation Act. Historic properties listed in the NHRP include districts, sites, buildings, structures, and objects that are significant in American history, prehistory, architecture, archaeology, engineering, and culture.

Nonattainment area. An area that has violated federal standards for concentration of a monitored pollutant.

Northwest Indians Fisheries Commission (NWIFC). An organization that represents the treaty tribes of northwest Washington with regard to aboriginal subsistence and commercial fishing. (See definition for “usual and accustomed grounds and stations.”)

Osmoregulation. Maintaining the mineral and salt content in the blood while transitioning from a freshwater to saltwater (or more saline) environment.

Power grounding. When a vessel underway goes aground primarily due to a failure of the vessel’s steering capability or the vessel’s command structure.

Proposed species. Any species that is proposed in the Federal Register to be listed as a threatened or endangered species under the Endangered Species Act.

Raptors. Hawks, eagles, harriers, and falcons are medium to large birds with upright posture and strong, short, hooked beaks and acute vision that they use to catch live vertebrate prey. Vultures share these characteristics, but feed primarily on carcasses of large animals. Osprey are large diving hawks that subsist on a diet of live fish.

Recruitment. The time when a young fish enters a fishery (i.e., becomes large enough to be caught) or enters a specific habitat such as juvenile or adult habitat (http://www.nmfs.noaa.gov/pr/glossary.htm).

Salmonid species. Salmon, trout, and char.

Seabirds. A diverse assemblage of birds that are tied to marine habitats during for at least a portion of their life cycle. Loons, grebes, cormorants, auks, and puffins feed by diving deeply for fish or invertebrates, while gulls and terns feed near the water surface or shoreline. Albatrosses, shearwaters, and petrels spend much of their life at sea, feeding from the water's surface and coming to land only to nest.

Seine. A fishing net that hangs vertically in the water, with floats at the top and weights at the bottom. A ***purse seine*** is so called because the seine is drawn into the shape of a bag to enclose the catch; this type of fishing is done from a boat. A ***beach seine*** is fastened to the shore at one end, circled about a school of fish, and then drawn ashore.

Shell middens. Deposits of non-edible portions of shellfish species that are almost always located along marine water sources.

Shorebirds. A diverse group of birds re associated with shorelines and feed primarily on invertebrates or small aquatic creatures. They generally have longish legs and short to long beaks which they use to probe sand or mud substrates or to pick intertidal invertebrates from rocks. Most species migrate long distances. All but the phalaropes do not generally swim, but walk along shorelines and beaches.

Species complex. A subgroup of a species, with a similar distribution and life history pattern.

Stock. A group of fish that is genetically self-sustaining and isolated geographically or temporally during reproduction. As defined by the Marine Mammal Protection Act, a group of marine mammals of the same species or smaller taxa in a common spatial arrangement, that interbreed when mature (http://www.nmfs.noaa.gov/pr/glossary.htm).

Subsistence fishing. Fishing, other than sport fishing, that is carried out primarily to feed the family and relatives of the person who is fishing, or for traditional/ceremonial purposes.

Tainting. An objectionable oil-derived taste of fish and shellfish acquired from a spill of oil.

Threatened species. A species that is likely to become endangered throughout all or a significant portion of its range. (See definition for "Endangered species.")

Traditional cultural property (TCP). A place eligible for listing in the National Register of Historic Places because of its association with cultural practices and beliefs. Traditional fishing techniques often are used, such as rod and tackle, arrows and harpoons, throw nets and drag nets, and traditional fishing boats.

Traffic Separation Scheme (TSS). A traffic management route system ruled by the International Maritime Organization used to regulate traffic at busy, confined waterways. The traffic lanes indicate the general direction of the ships in that zone (http://en.wikipedia.org/wiki/Traffic_Separation_Scheme).

Treaty tribes. Indian tribes in Washington State who signed treaties with the United States in the mid-1850s to retain the right to fish at all "usual and accustomed grounds and stations." These are areas traditionally harvested for water-dwelling animals and plants before the treaty. The U.S. government recognizes 25 Indian tribes as parties to the Stevens-Palmer Treaties, and 24 tribes have usual and accustomed fishing places within the boundaries of the present-day state of Washington (Woods 2005).

Trestle. A pier-like structure used to provide access between shore and an offshore structure.

Trophic. A class of organisms that occupy the same position in the food chain.

Unclassified area. The air quality designation for an area when data are insufficient or inadequate to determine whether a pollutant concentration is violating the federal standard. (See definitions for "Attainment area," "Nonattainment area," and "Maintenance area.")

Usual and accustomed grounds and stations (U&As). Areas traditionally harvested by Indian tribes for water-dwelling animals and plants. Indian tribes in Washington State who signed treaties with the United States in the mid-1850s retained the right to "fish" at all U&A. The U.S. government recognizes that 24 tribes have usual and accustomed fishing places within the boundaries of the present-day state of Washington.

Vessel call. For this analysis, defined as a completion of a vessel's transit to the BP Cherry Point dock, a loading or unloading operation, and departure of the vessel for another destination.

Waterfowl. Medium to large plump-bodied birds with long necks and short wings commonly found on or near water. Waterfowl feed while on the water by diving or tilting their bodies so that their heads and necks are submerged to search for fish, plants and invertebrates.

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1 PURPOSE AND NEED

1.1. INTRODUCTION

The purpose of this environmental impact statement (EIS) is to examine the incremental environmental risk—principally from vessel traffic—related to operation of the North Wing of the BP Cherry Point Marine Terminal dock (BP Cherry Point dock). The BP Cherry Point dock is associated with the BP Cherry Point Refinery[1] (BP Refinery or the refinery); the dock enables the refinery to import crude oil for refinery feedstock and to export refined petroleum product to the Puget Sound region and the U.S. West Coast. *Incremental environmental risk* is defined in this EIS as the change in environmental risk between operating the BP Cherry Point dock at maximum capacity with a single berth (the South Wing) and operating the dock with two berths (the North Wing and South Wing) at a level of utilization projected for the years 2025 and 2030.

As discussed further in Chapters 2 and 3, the Proposed Action is continuing the existing operations at the BP Cherry Point dock with two berths—one principally for import of crude oil and the other for distribution of refined petroleum products.

1.2. PROJECT HISTORY

Although the BP Cherry Point dock was permitted for construction of two berths, a single-wing configuration initially was constructed in 1971. Following issuance of a Department of the Army permit (DA permit No. NWS-1992-00435) by the U.S. Army Corps of Engineers (USACE) under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S. Code [USC] 403) on March 1, 1996, a pier extension (the North Wing) was added to the existing BP Cherry Point dock that became operational in 2001. Ocean Advocates et al. (OA) filed a lawsuit at the United States District Court, Western District of Washington, in November 2000. The District Court ruled in favor of the USACE's finding that an EIS was not required and that issuance of the DA permit did not violate the Magnuson Amendment (33 USC 476). Following the District Court's entry of judgment, the parties stipulated to an injunction that prohibited the use of the North Wing for loading or unloading crude oil, unless BP applied for a permit. However, OA filed an appeal at the U.S. Court of Appeals for the Ninth Circuit (9th Circuit Court). In an amended opinion issued in March 2005, the 9th Circuit Court required the USACE to prepare a full EIS considering the impact of reasonably foreseeable increases in tanker traffic and reevaluating the DA permit's compliance with the Magnuson Amendment[2]. In addition, the 9th Circuit Court remanded the case to the District Court to consider OA's request for injunctive relief (freezing any vessel traffic to and from the terminal at pre-2000 levels pending completion of the National Environmental Policy Act [NEPA] process). In April 2006, the parties reached a Settlement Agreement concerning OA's request for injunctive relief and attorney fees.

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[1] The BP Cherry Point refinery was previously owned by Atlantic Richfield Company (ARCO). The facility, including the BP Cherry Point dock, was acquired by BP in April 2000 and became operational in 2001. The names ARCO and BP are used in this document as appropriate to reflect ownership.

[2] A discussion of the DA permit's compliance with the Magnuson Amendment is provided in Appendix H.

1.2.1. Permitting of the North Wing

The following summary provides background information regarding permitting of the BP Cherry Point dock North Wing.

In 1968, ARCO Products Company (the previous owner of the refinery at Cherry Point) applied to the USACE and other governmental agencies for approval to build a marine terminal adjacent to the refinery at Cherry Point, in the southern waters of the Strait of Georgia (Figure 1-1). Construction and operation of the marine terminal required a DA permit in accordance with USACE jurisdiction under Section 10 of the Rivers and Harbors Act of 1899. In January 1969, a DA permit was issued and then amended to allow construction of a dock structure with two wings, each with a single berth for ocean-going tank ships and barges. The dock was connected to the shore by a trestle with a roadway and piping for transfer of liquid cargos between the dock and the refinery tank farm.

Although permitted to construct a marine terminal with two wings, ARCO initially constructed a dock with only a single wing and connecting trestle. Construction of the South Wing was completed and the marine terminal became operational in September 1971.

In 1977, ARCO requested that the USACE reissue the 1969 DA permit as amended to allow construction of the second berth (the North Wing) in order to complete the original dock configuration. This DA permit application was subsequently withdrawn and a new application was submitted on April 4, 1992, (Application No. 92-1-00435) for completion of the North Wing. Consideration of this application by the USACE included a review of the environmental effects of the proposed North Wing in accordance with NEPA and resulted in the USACE issuing a DA permit under Section 10 of the Rivers and Harbors Act (DA permit No. 92-1-00435) on March 1, 1996.

ARCO began construction of the North Wing in 2000. After receiving a 1-year extension of the DA permit for construction, ARCO completed the project and began operation of the North Wing on September 20, 2001. Prior to the expansion, unloading and loading operations were performed at a single berth (the South Wing). The addition of the North Wing (second berth) allowed the South Wing to be dedicated to unloading crude oil and to load or unload refined petroleum product when needed (Figure 1-2). The North Wing is configured exclusively for loading and unloading refined petroleum products. Separation of these tasks was intended by BP West Coast Products, LLC (BP) to improve the efficiency and safety of operations.

1.2.2. Environmental Studies

The 9th Circuit Court's decision resulted in the following events:

- In 2008, the USACE undertook preparation of this EIS that focuses on the incremental environmental effects when comparing operation of the South Wing of the BP Cherry Point dock at maximum capacity to operation of the marine terminal with both the North and South Wings serving projected future vessel traffic in the year 2025.
- The USACE supervised preparation of a vessel traffic risk analysis by George Washington University (van Dorp et al. 2008) (referred to in this document as the *GWU VTRA*) to estimate changes in vessel traffic accident risk and the associated risk of oil spills attributable to incremental vessel traffic calling at the BP Cherry Point dock. The study used a traffic simulation methodology to provide the technical bases for evaluating the incremental vessel traffic accident risk and the environmental risk related to potential oil spills based on current and future vessel traffic calling at the BP Cherry Point dock.

Figure 1-1 Project Location Map

Figure 1-2 BP Cherry Point Refinery and Marine Terminal Showing "Y"-Shaped North and South Wings

The GWU VTRA also analyzed several vessel routing and traffic management mitigation measures, including the use of escort or assist tugs along the vessel traffic routes to and from the BP Cherry Point dock location. Vessel traffic management mitigation measures studied included (1) elimination of the Huckleberry-Saddlebag route followed by vessels transiting between the BP Cherry Point dock and March Point in Padilla Bay; and (2) the use of tethered escort tugs by vessels when passing between Huckleberry and Saddlebag Islands.

- The USACE also supervised preparation of a vessel traffic analysis by The Glosten Associates, Inc. (TGA 2013) (referred to in this document as the *TGA VTA*) to estimate changes in vessel traffic accident risk and the associated risk of oil spills attributable to the maximum forecasted vessel traffic calling at the BP Cherry Point dock.

1.3. PURPOSE AND NEED

In accordance with NEPA, the USACE must specify the underlying purpose and need for a proposed project (40 Code of Federal Regulations [CFR] 1502.13; 33 CFR 325.1[d][1]). Considered together, the purpose and need establish part of the framework for identifying the range of alternatives to a Proposed Action to be considered in an EIS. However, this EIS was not prepared as part of a permitting action for a newly proposed project as is normally the case in the regulatory process; therefore no "project application" or "purpose and need for the project" was to be examined in the EIS. Instead, as required by the 9th Circuit Court, the EIS was prepared as part of a USACE review of the existing DA permit and is intended to provide an environmental review to support the USACE's decision to continue without change, modify with additional conditions, or revoke the previously issued DA permit for the North Wing.

1.3.1. Project Purpose

The purpose and need for construction of the North Wing was to reduce tanker standby time in Puget Sound anchorage zones and to improve the efficiency of the BP Cherry Point dock while loading and unloading petroleum transport vessels.

1.3.2. Project Need

Operation of the North Wing is intended to reduce tank vessel traffic time in Puget Sound, reduce vessel standby time while at anchor and the spill risk associated with this standby time, improve the operational efficiency of the existing BP Cherry Point dock, and reduce demurrage costs.[3] Prior to operation of the North Wing, vessels bound for the BP Cherry Point dock encountered delays attributed to inadequate berthing space at the single-wing dock. These vessels often were required to anchor temporarily at three locations: Vendovi, Port Angeles, and the Cherry Point anchorage. Prior to operation of the North Wing, average demurrage was 902 hours per month. With operation of the North Wing, demurrage decreased by approximately 45 percent to approximately 500 hours per month (Figure 1-3).

To the extent that demurrage represents time at anchor, this also represents an increase in risk exposure for vessels calling at the BP Cherry Point dock.

When ARCO was operating the Cherry Point dock as a single-wing dock, it was sometimes necessary to interrupt loading of refined petroleum product to allow unloading of crude oil vessels in order to maintain the supply of crude oil to the refinery. In these circumstances, the refined petroleum product vessel disconnected from the dock, moved offshore to an anchorage, and waited for completion of an intervening crude oil transfer before returning to the dock to resume loading. These interruptions increased the number of transfers (mooring and connecting, or unmooring and disconnecting), vessel traffic maneuvering to and from the dock, and vessel time at anchor.

1.4. SCOPING PROCESS

On August 16, 2006, the USACE published a Notice of Intent (NOI) to prepare an EIS in the Federal Register (Appendix A). On the same date, the USACE also issued a special public notice of scoping, inviting interested parties to participate in the scoping process. This notice included the dates of public scoping meetings that would be held on September 5, 2006, at Port Angeles; September 7, 2006, at Anacortes; September 12, 2006, at Ferndale; and September 13, 2006, in Seattle—all in Washington State. The USACE extended an invitation to federal agencies, state agencies, tribes with jurisdiction, and all interested parties to attend an agency scoping meeting in Seattle on August 23, 2006. At each of the public scoping meetings and at the agency scoping meeting, a presentation was given and the participants were invited to provide input and comment. The presentation by the USACE included the overall purpose of the project, general scope of the VTRA, the EIS preparation process, and a description and schedule of opportunities for public input and comment.

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[3] *Demurrage* is a fee paid by the owner of the marine terminal to the vessel owner when a vessel provides the marine terminal a Notice of Readiness and the marine terminal is not ready to accept the vessel.

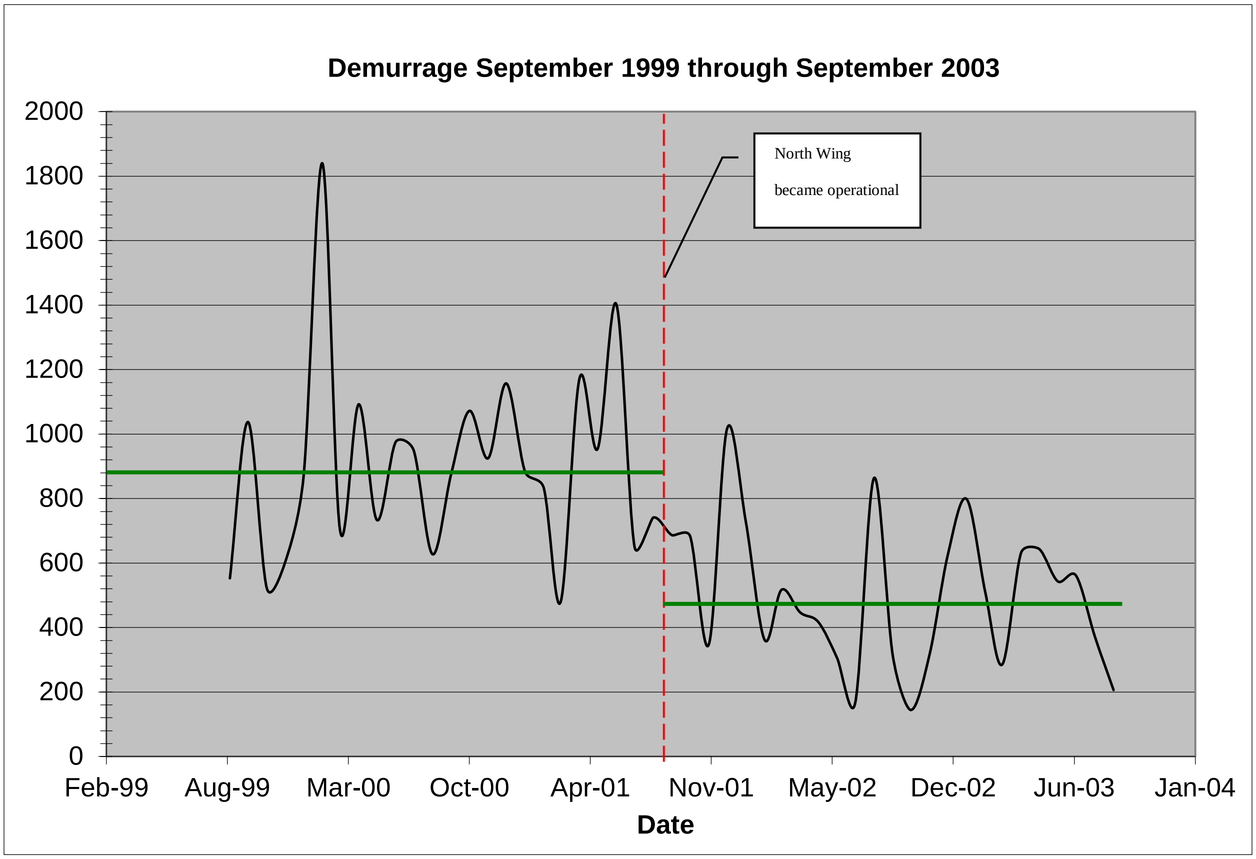

Figure 1-3 Demurrage at BP Cherry Point Dock (hours/month)

On September 15, 2006, the public and agency scoping period closed and the USACE prepared a scoping report (Appendix B). A total of 61 scoping comments were received from interested parties during the scoping process.

Comments received during the scoping process are included in the scoping report (Appendix B). Overall, comments related to the following general concerns:

- **GWU VTRA.** Comments suggested assumptions that should be used as part of the GWU VTRA, including operational requirements such as vessel routing, queuing while waiting, the use of escort tugs, data sources, and information on human factors related to vessel operations.
- **Oil Spills and Oil Spill Risk.** Comments suggested that the EIS identify and evaluate the effects of oil spills, particularly spills in the area of the BP Cherry Point dock and their impact on area resources.
- **EIS Process.** Comments recommended inclusion of specific agencies and organizations in the EIS preparation process and consideration of other federal and state laws and local programs.
- **Environmental Resources.** Comments recommended consideration of specific environmental resources, including herring, several federally and state-listed species, and the Washington State Department of Natural Resources (WSDNR) Cherry Point Aquatic Reserve.

- **<u>Project Study Area</u>.** Comments recommended consideration of impacts associated with articulated tug and barge (ATB)[4] and barge shipments near the Olympic Coast National Marine Sanctuary and between Puget Sound, Oregon, and California, and along the Pacific Coast.

1.5. SCOPE OF ANALYSIS – ISSUES TO BE ADDRESSED

Based on the 9th Circuit Court's decision, the district court's order of August 22, 2005, the Settlement Agreement reached by the parties, and the results of the public and agency scoping process, the scope of the analysis in this EIS includes evaluation of:

- The incremental environmental effects when comparing operating the South Wing of the BP Cherry Point dock at maximum capacity to operating both wings of the BP Cherry Point dock at current and forecasted future vessel traffic levels for the years 2025 and 2030;
- The risk of potential accidents and oil spills considering vessels carrying crude oil and refined petroleum products between, to, and from the BP Cherry Point Dock within that portion of Puget Sound bounded by the beginning of the Traffic Separation Scheme (TSS),[5] approximately 8 miles west of "J" Buoy, offshore of Cape Flattery, Admiralty Inlet, and the U.S./Canadian border in the southern reaches of the Strait of Georgia;
- The effect of extended escorts for vessels transiting to the BP Cherry Point dock from the entrance to the Strait of Juan de Fuca to approximately Port Angeles, where escorting vessels currently begin, and the effect of posting a year-round vessel assist tug (emergency response towing vessel or ocean-going tug) at Neah Bay; and
- The effect of discontinuing the use of the Huckleberry-Saddlebag route from Cherry Point to Padilla Bay.

The USACE and the President's Council on Environmental Quality (CEQ) guidelines for implementation of NEPA require that an EIS evaluate the effect of the Proposed Action on relevant environmental resources, including direct, indirect, and cumulative effects. This EIS evaluates the incremental increase in vessel traffic and the environmental effects of associated potential accidents and oil spills on:

- Nearshore and Marine Resources
- Nearshore and Marine Habitats
- Cultural Resources
- Land Use
- Recreation Resources
- Air Quality and Climate Change
- Tribal/Subsistence Fishing
- Socioeconomics and Environmental Justice

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[4] An *articulated tug and barge* is a tug with a mechanical connection to a barge. A hinged connection allows the tug to pitch independently of the barge, providing much better sea-keeping capability than conventional towed barge systems (http://www.oceantugbarge.com/PDF/history.pdf).

[5] Following scoping and consultation with the U.S. Coast Guard, it was determined that the study area should be extended to the beginning of the traffic separation system (TSS). The TSS is a traffic management route system ruled by the International Maritime Organization used to regulate traffic at busy, confined waterways. The traffic lanes indicate the general direction of the ships in that zone (http://en.wikipedia.org/wiki/Traffic_Separation_Scheme).

1.6. ISSUES CONSIDERED BUT NOT ADDRESSED IN DETAIL

During scoping, several issues were identified for consideration in the EIS analysis. Upon further review, it was determined that some issues would not be included in the scope of analysis for the EIS. These issues and the reasons for their exclusion are as follows:

- **Construction Impacts.** Construction of the BP Cherry Point dock North Wing was completed in 2001. BP does not seek to construct or modify any facilities as part of the Proposed Action, and impacts related to construction of the North Wing were not in dispute in the OA litigation. Impacts related to construction of the North Wing were previously evaluated as part of the Section 10 permit issuance and in the *ARCO Products Company Cherry Point Refinery Marine Terminal Pier Addition Biological Evaluation* (Berger/ABAM Engineers 2000). Therefore, North Wing construction impacts are not examined in this EIS.
- **Expanded Study Area.** Commenters suggested that the analysis of incremental oil spill risk from operation of the BP Cherry Point dock North Wing be expanded to offshore routes along the Washington coast to Oregon and California, and to include evaluation of the Area to be Avoided (ATBA) of the Olympic Coast National Marine Sanctuary. The simulation developed as part of the GWU VTRA was constructed using vessel track (transit) records gathered as part of operating the Cooperative Vessel Traffic System (CVTS) by the Canadian Coast Guard (CCG) and the U.S. Coast Guard (USCG). Because the CVTS does not extend beyond the entrance to the Strait of Juan de Fuca, the simulation and the detailed projections of accidents and releases were not available to analyze incremental oil spill effects along the coastal routes. The second vessel traffic study conducted by The Glosten Associates (2013) had the same limitation in study area as the GWU VTRA. With regard to the ATBA, the Washington State Department of Ecology (Ecology) publishes an annual statistical report on Vessel Entries and Transits for Washington Waters (VEAT). The VEAT report for 2005 reports that 99.2 percent of all oil tankers transited outside the ATBA (Ecology 2005); the report for 2010 indicates 99.3 percent compliance with the ATBA (Ecology 2010). For these reasons, and because vessels bound to and from BP Cherry Point comprise a small proportion of total vessel traffic traversing coastal routes outside the Strait of Juan de Fuca, the study area in the EIS was not extended to include coastal vessel routes.
- **Other Issues.** Commenters suggested renegotiation of the WSDNR lease, use of the “Barrel Tax” to address spill cleanup, and assessment of the “Free Trade Zone” on the Cherry Point Aquatic Reserve. These potential issues are not related to operation of the North Wing of the BP Cherry Point dock and thus are not directly, indirectly, or cumulatively affected by the incremental change in environmental risk related to dock operations. Therefore, these issues are not evaluated in the EIS.

1.7. LEGAL AUTHORITIES

This EIS is prepared under the following legal authorities:

- **National Environmental Policy Act.** Federal officials undertaking non-exempt federal actions must be informed of the environmental impacts of their actions through an environmental review under NEPA. The USACE completed an environmental review under NEPA for their decision to issue a DA permit for construction and operation of the North Wing (February 14, 1996 decision). As a result of the lawsuit and appeal filed by OA, the 9^{th} Circuit Court required the USACE to prepare an EIS.
- **Section 10 of the Rivers and Harbors Act.** Under Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403), the USACE is granted the authority to issue DA permits for construction and

maintenance of facilities in the waters of the United States. This includes docks and connecting structures for berthing and cargo transfer. Section 10 permits include two general provisions: (1) approval to construct a facility that must be completed in a specified time frame; and (2) authority to maintain the permitted structure in good working order. BP has certified that it has completed construction of the North Wing under DA Permit No. NWS-1992-00435; BP continues to operate the North Wing under the maintenance and operation provisions of the permit. There are no special provisions in the current DA permit that govern operation of vessels calling at the BP Cherry Point dock, including the North Wing. Vessel traffic in Puget Sound and adjacent waters in northwestern Washington are managed under the USCG CVTS.

- **33 CFR Part 325 (Section 325.7).** Section 325.7 defines the procedure under which the District Engineer may review and modify a current DA permit. This provision allows the District Engineer to review the circumstances of a DA permit and any permit conditions, and to modify, suspend, or revoke the permit if the circumstances warrant such an action. The 9th Circuit Court's requirement to prepare an EIS for the North Wing is, in effect, a review of the circumstances of the current permit; and this EIS is intended to provide the requisite information for review of the existing DA permit by the District Engineer. Because review of the permit has not been requested by the permittee, it is presumed that the permittee's Proposed Action for the EIS is maintenance of the DA permit in its current status. (See the discussion of Alternatives in Chapter 3.)

1.8. REFERENCES

Berger/ABAM Engineers, Inc. 2000. ARCO Products Company Cherry Point Refinery Marine Terminal Pier Addition. Submitted to The ARCO Cherry Point Refinery, Blaine, WA. March 31.

TGA. See The Glosten Associates, Inc.

The Glosten Associates, Inc. 2013. BP Cherry Point Vessel Traffic Analysis. Draft Study Report. Prepared for Cardno ENTRIX, Seattle, WA. Prepared by The Glosten Associates, Inc. in collaboration with Environmental Research Consulting, Cortlandt Manor, NY, and Northern Economics, Inc., Anchorage, AK. (File No. 12121.01.) May 15.

van Dorp, J.R., J.R. Harrald, J.R.W. Merrick, and M. Grabowski. 2008. Vessel Traffic Risk Analysis: Assessment of Oil Spill Risk due to Potential Increased Vessel Traffic at Cherry Point, Washington. Submitted by VTRA TEAM: J.R. van Dorp (GWU), J.R. Harrald (GWU), J.R.W. Merrick (VCU), and M. Grabowski (RPI). August 31.

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2 PROJECT DESCRIPTION

The scope of the EIS requires an evaluation of the change in environmental risk between operating the BP Cherry Point dock at maximum capacity with a single berth (the South Wing) and operating the dock with two berths (the North Wing and South Wing) at a level of utilization (vessel calls) projected for the years 2025 and 2030.

The Project includes:

- **Vessel Traffic.** Tanker and barge traffic to and from the BP Cherry Point dock, including the marine route through the Strait of Juan de Fuca, Rosario Strait, and the waters off of Cherry Point in Washington. Also included are the operations of assist tugs during transit and moorage at the dock.
- **Operation and Maintenance of the BP Cherry Point Dock North Wing.** A ship berth, loading equipment, and control and metering equipment for refined petroleum product loading, oil spill preparedness and response equipment, and operation of these systems.

The geographic scope of the EIS includes the Project area as defined by the geographic extent of the physical, chemical, and biological effects resulting from the Project, including the direct and indirect effects and effects of interrelated and interdependent activities. The Project area encompasses the north-south boundary marked by the TSS system, 8 miles west of the “J” Buoy at the entrance to the Strait of Juan de Fuca to the BP Cherry Point dock, and the vessel routes from the BP Cherry Point dock to the refineries near March Point (Figure 2-1). The geographic scope also includes the tidal zone (200 feet inland) within the defined Project area.

2.1. DESCRIPTION OF DOCK FACILITIES

The dock facilities are described here to facilitate the description of operations. The BP Cherry Point dock consists of two wings (South Wing and North Wing) that are connected to the shore and the BP Refinery tank farm with a trestle and pipelines (Figure 2-2). Each dock wing includes a single ship berth and mooring dolphins.[1] A trestle that connects the dock to the shore includes a vehicle roadway and pipelines for transfer of crude oil and refined petroleum product between the dock and the refinery tank farm, and vessel unloading and loading equipment. The general “Y”-shaped configuration of the dock is shown in Figure 1-2.

The dock is located approximately 655 meters (2,150 feet) offshore, where water depths are approximately 15–21 meters (49–69 feet) mean sea level (msl). The separate wings of the dock are connected to each other by a 548.64-meter- (approximately 1,800-foot-) long trestle that includes a roadway and piping for transfer of crude oil and refined petroleum product between the dock and the refinery tank farm.

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[1] A *dolphin* is a stand-alone structure, usually consisting of a cluster of piles, a concrete mass supported by a number of piles, or a sheet pile cell, that is used to guide and/or moor vessels.

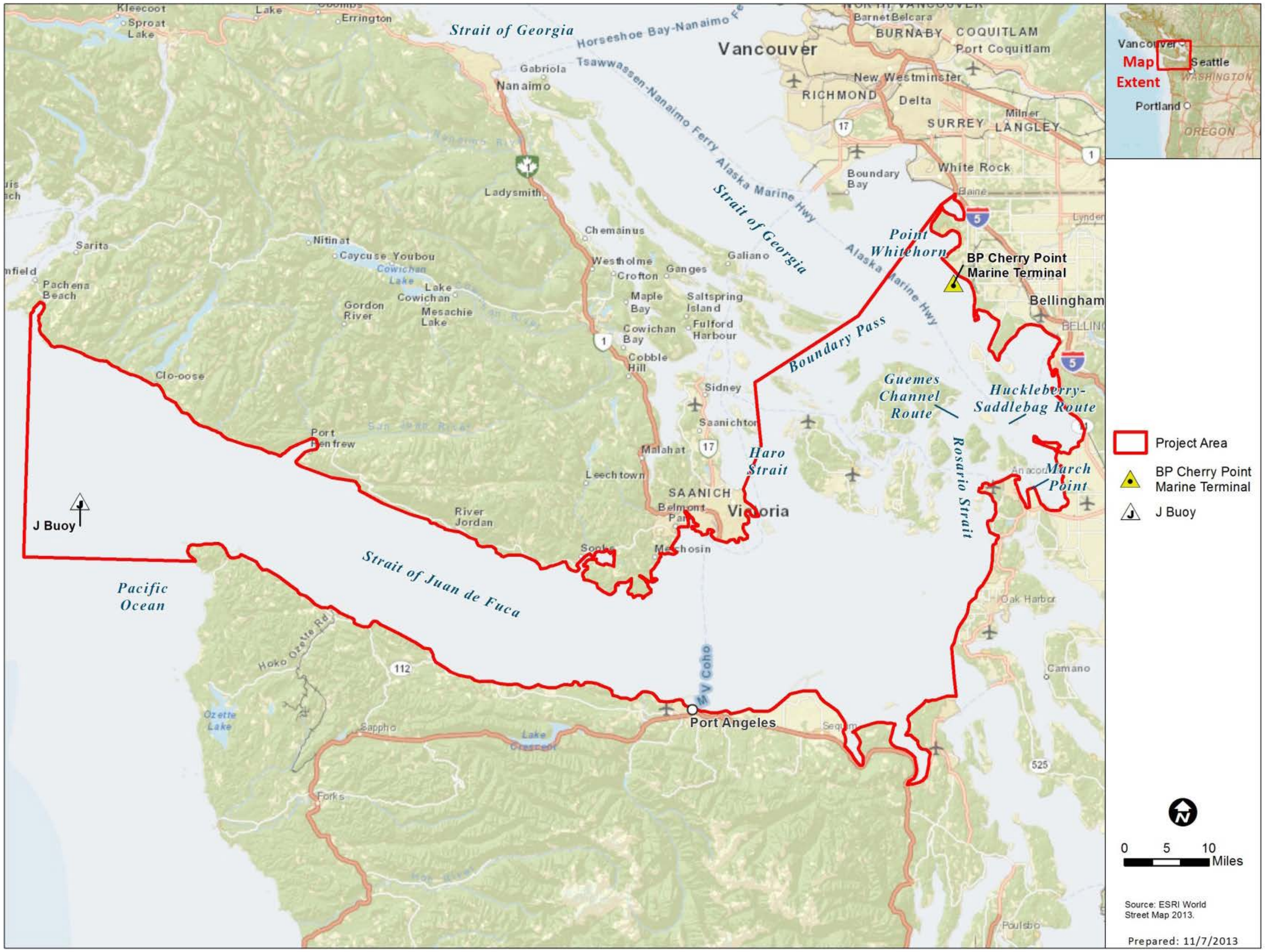

Figure 2-1 Project Area for the BP Cherry Point Dock EIS

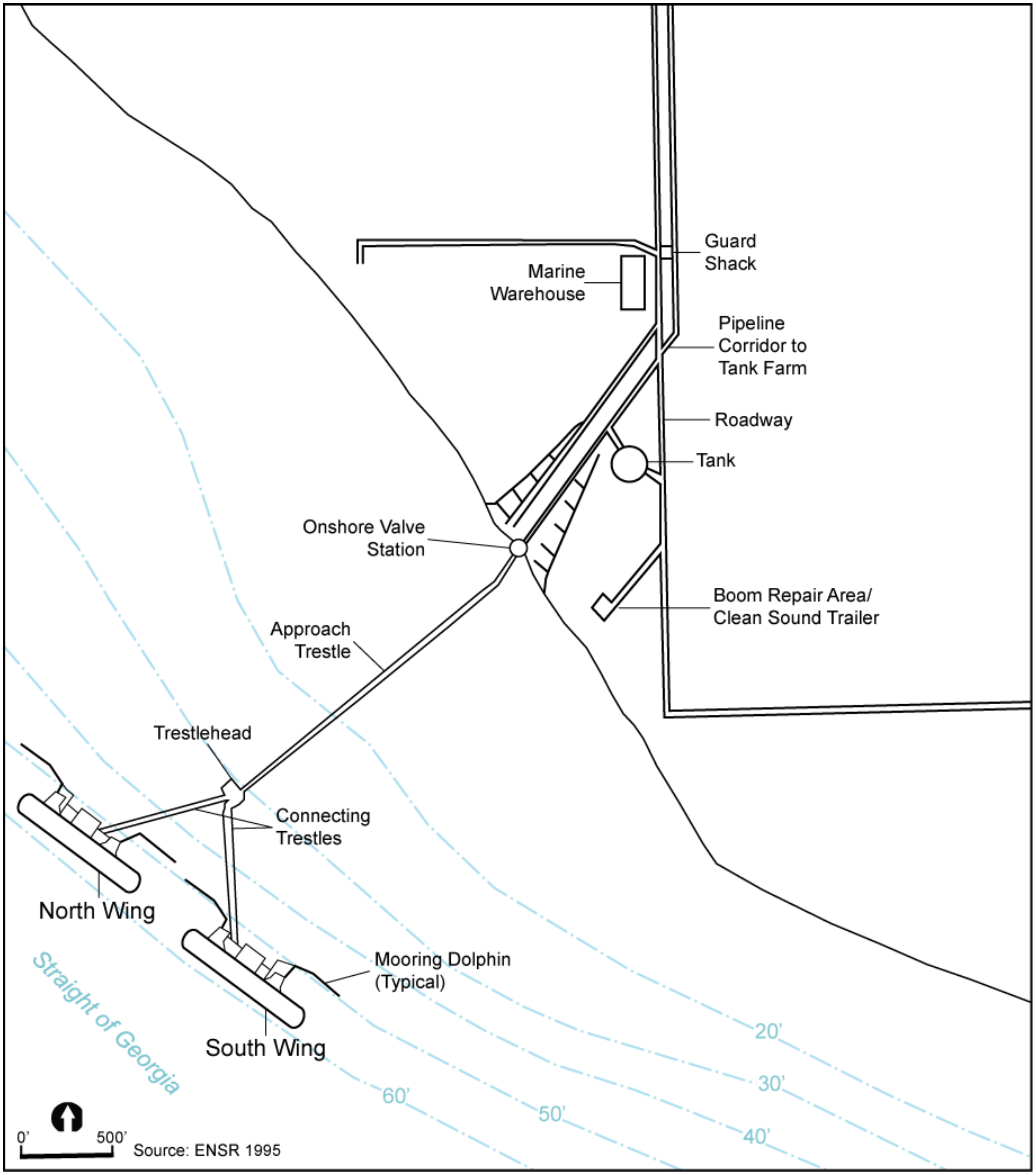

Figure 2-2 BP Cherry Point Dock Configuration

Each wing consists of a single vessel berth and loading platform. The loading platform for the North Wing is 58.67 meters (192.5 feet) long and 27.43 meters (90 feet) wide. It is positioned at the center of the 296-meter- (970-foot-) long berth, with mooring positions that allow both tankers and barges to call at the BP Cherry Point dock for loading operations. Water depth at the loading platform is 18.28 meters

(60 feet) msl. The connecting trestle is 290 meters (951 feet) long; it includes two platforms for vehicle maneuvering and oil spill response equipment.

All mooring dolphins and piles supporting the loading platform and connecting trestle constructed as part of the North Wing are coated steel caissons.[2] The coating material is not erosive and is non-toxic to marine life. All service platforms and areas that contain piping are curbed, providing containment for rainwater and inadvertent spills of fuel, lubricant, paint, or other material. All materials within containment are collected and disposed of onshore using approved materials disposal systems.

2.2. EXISTING DOCK OPERATIONS

When the dock was constructed, the South Wing was configured with piping and transfer arms to receive and to unload both crude oil and refined petroleum product. It also was configured to load crude oil and refined petroleum product when such operations were required. The North Wing was configured to load and unload only refined petroleum product. The configuration includes segregated piping for movement of refined petroleum product from the refinery tank farm to the North Wing. Unloading or loading crude oil at the North Wing would require modification to the existing piping, valving, and loading system on the North Wing.

With the North Wing in operation, the tasks of unloading crude oil and handling refined petroleum product have largely been separated. The North Wing is used exclusively for loading or unloading refined petroleum product. While the South Wing retains the capability to load and unload refined petroleum product, such operations on this wing now rarely occur. Use of the South Wing for handling refined petroleum product occurs most commonly when the hull configuration of a vessel or barge can be moored more safely at the South Wing than at the North Wing.

2.2.1. Docking

Ships approach the dock under the direction of the ship’s master and a maritime pilot, and are assisted to the dock by assist tugs. The BP Cherry Point dock requires tankers to use a minimum of two assist tugs for docking and undocking. Barges, including ATBs, are required to use a minimum of one assist tug for docking and undocking. After docking and securing all lines, spill containment boom is deployed to enclose the vessel loading area. A second spill containment boom is deployed to completely surround the ship during loading operations, when it is safe and effective to do so.

2.2.2. Unloading and Loading Operations

Vessels are permitted to conduct unloading and loading operations only in calm and moderate wind/wave conditions, as set forth in the *Revised Oil Handling Facility Operations Manual* (BP 2010a). When winds reach a predetermined strength of 35 miles per hour (mph), a precursor to increased wave height, dock operations personnel and the vessel master confer and determine when to cease transfer operations and unmoor a vessel. If winds reach a sustained level of 40 mph and waves are estimated at 5 feet, operations must cease and the vessel moves to a temporary anchorage as directed by the USCG, to wait for winds and waves to subside to a safe level.

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[2] A *caisson* is a watertight structure within which construction work is performed under water.

Unloading and loading occur through large overhead unloading/loading arms consisting of an articulated pipe that connects transfer pipelines to a shipboard manifold.[3] After the transfer arm is connected and the connection is leak tested, crude oil or refined petroleum product is pumped from/to storage tanks onshore through dedicated pipelines. The transfer arms include safety equipment for rapid shutdown in the event of premature disconnect, failure of the transfer arm, or failure at the vessel manifold that results in loss of primary containment of the material being transferred. The vessel occupies the dock on average from 24 to 27 hours, depending on the type of cargo being unloaded/loaded (see Table 2-4).

2.2.3. Oily Water Collection

All areas on the dock that contain piping, control valves, and transfer arms are within containment curbs that drain to an oily water collection system. All liquids collected in this system are piped ashore and processed by the refinery wastewater treatment system. The dock also has a roadway that provides vehicle access across the trestle to the dock wings.

2.2.4. Ballast Water Discharge

Tankers arriving at the BP Cherry Point dock to load cargo are often in ballast, having previously flooded their ballast water tanks to maintain the ship's stability. Management of ballast water discharge is regulated by federal and Washington State regulations[4] that prohibit discharge of untreated ballast water into the waters of the state and waters of the U.S. unless the ballast water has been subject to a mid-ocean ballast water exchange. As the cargo is loaded, ballast water is transferred internally or, if appropriately treated or subjected to a mid-ocean ballast water exchange and determined to be free of oil, discharged into marine waters. Reception facilities are available at the BP Cherry Point dock for vessels requiring the discharge of "dirty ballast"[5] from their cargo tanks. BP will not accept ballast containing methyl tert-butyl ether, and any dirty ballast that is received by the facility must undergo laboratory testing to ensure that it contains no chemicals that are inconsistent with the refinery NPDES permit or toxins to the site wastewater treatment system. BP reports that the Cherry Point dock has not accepted ballast water from vessels for treatment in the wastewater system since early 2001 (BP 2008a).

2.2.5. Dock Maintenance

Annual maintenance of dock equipment occurs in summer and consists of equipment inspection, replacement, painting, and repair, as appropriate. Major maintenance projects are conducted periodically; these projects may involve a large number of workers and may include work in the water from workboats. Annual preventive maintenance activities involving in-water, on-water, and underwater work is limited to July 16 through September 15. These activities are conducted under permits issued by the USACE and other appropriate state and federal agencies. Project-specific activities or other maintenance activities that fall outside the scope of the permits for annual dock maintenance are permitted separately.

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3 An *articulated pipe* is a series of vertical and near-vertical piping connected by water-tight flexible joints. A *manifold* is the pipeline onboard a vessel that runs from the cargo tanks so that material can be loaded or discharged.

4 Federal regulations at 33 CFR 151.2025; State regulations at Washington Administrative Code 220.150.

5 *Dirty ballast water* is ballast water that has been discharged from cargo tanks. BP will not accept dirty ballast water if it contains methyl tert-butyl ether (MTBE).

2.2.6. Oil Spill Prevention and Response

Only one significant spill has occurred at the BP Cherry Point dock since it began operating in 1971. On June 4, 1972, the T/V *World Bond* was moored at the BP Cherry Point dock and was in the process of unloading crude oil when a cast iron flange on the tanker failed and approximately 21,000 gallons (500 barrels [bbl]) of crude oil were discharged into the Strait of Georgia. A significant response effort was implemented to contain and recover the oil, and to clean up the shorelines. In addition to the T/V *World Bond* spill, other smaller spills have occurred. These spills have been generally on the order of cups of oil or refined petroleum product, with some releases as much as 1–10 bbl. As with the T/V *World Bond*, most of these other spills were the result of vessel tank overfills or faulty equipment onboard the tankers.

Following the T/V *World Bond* incident, the BP Refinery implemented new policies stipulating that all vessels calling on the dock must be vetted to determine that they are in good condition, including the piping, manifolds, flanges, and other oil transfer equipment. These policies also require that all vessels calling at the BP Cherry Point dock for the first time be inspected prior to docking and that any vessel not meeting the established criteria be prohibited from docking or transferring oil. Those criteria have been refined over the years and, to some degree, are now codified in both federal and state regulations. They are now part of BP's formal vetting process and incorporated into the *BP Cherry Point Refinery Port Information and Terminal Manual* (BP 2010b).

The BP Cherry Point dock is equipped with containment booms and clean-up equipment that can be readily deployed in the case of an oil spill. The vessel master is responsible for ensuring that adequate precautions have been taken to avoid or minimize pollution incidents. The following measures are checked prior to a vessel's arrival at the dock:

- All deck scuppers[6] and drains are plugged and sealed.
- An adequate supply of absorption material is available on deck for instant use.
- A pumping system is in place to draw off all deck water contaminated by oil or grease and transfer it to a containment tank.
- If the pumping system cannot keep up with rainwater, dock supervision may authorize pulling of scuppers under direct supervision of the deck crew with absorption pads, using a "decant" procedure.[7]
- A pumping system is in place to draw off all oil or oily liquid from the cargo manifold containment pan, with associated pipeline arrangement, for prompt transfer to a cargo or slop tank.
- All sea suctions are closed and sealed (except the segregated ballast system).
- No bilge water of any composition or from any compartment can be discharged overboard while in U.S. waters.
- No sewage from any compartment is discharged into U.S. waters.
- No garbage or refuse is discharged overboard while in U.S. waters.

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[6] A *scupper* is a hole in a ship's toe rail or combing to carry water overboard from the deck.

[7] *Decanting* separates the top layer of liquid for removal.

- Boiler tubes or stack (funnel) uptakes must not be blown while the vessel is at dock or as it approaches.
- Engine watch is advised that no stack (funnel) emission, white or black smoke, is allowed.

BP has installed and maintains oil spill containment booms in the water beneath the loading platform on each dock wing. Oil spill containment booms (transfer area boom and back fence boom) also are permanently deployed along the entire length of each berth. All surface runoff from dock areas, including rainwater and oil from drips and leaks, is drained into an oily water tank and pumped ashore via the ballast water line to be processed thorough the refinery's wastewater treatment system.

When weather conditions are within pre-established parameters, an additional oil containment boom is deployed around the outboard areas of the vessel after docking and prior to initiation of the transfer. Pre-booming in this manner is conducted in accordance with requirements established in Washington Administrative Code (WAC) 173-180-221 and per the *Safe and Effective Threshold Determination* (BP 2008b) and *Revised Oil Handling Facility Operations Manual* (BP 2010a) prepared for the BP Cherry Point dock and approved by Ecology. In addition to complying with federal and state regulations to reduce the likelihood or volume of an oil spill, BP uses a Vessel Assessment Process, is a member of the Oil Companies International Marine Forum (OCIMF), and participates in the Ship Inspection Report (SIRE) Program.

In the event of a spill, the vessel master or designee immediately stops oil transfer operations, notifies the berth operator, and secures the vessel. Clean-up actions are implemented immediately, and transfer of oil between ship and shore does not resume until approval has been granted by the USCG.

2.2.7. Vessel Traffic to and from the BP Cherry Point Dock

Vessels transiting to the BP Cherry Point dock from Alaska, Oregon, California, and international origins enter the western end of the Strait of Juan de Fuca and travel to the vicinity of Port Angeles, Washington, where a maritime pilot comes on board. Vessels check-in with the joint USCG/CCG CVTS prior to entering the Strait of Juan de Fuca and remain under USCG or CCG control during transit to and from ports within the Strait of Juan de Fuca, Puget Sound, and the Georgia Strait. Transits of vessels to and from the BP Cherry Point dock occur primarily within the TSS (Figure 2-1).

Tankers (except double-hull tankers less than 40,000 deadweight tons [dwt]) carrying oil or oil products are required to take two escort tugs in company at "R" Buoy, north of the New Dungeness Lighthouse, before continuing their transit to the BP Cherry Point dock (33 CFR 168.40). Most vessels then continue through Rosario Strait to the southern reach of the Strait of Georgia and on to the BP Cherry Point dock. During transit through Rosario Strait, large commercial vessels—typically laden tankers—are limited to one-way traffic by USCG vessel traffic rules. Under these rules, large commercial ships may not enter Rosario Strait for passage if another large commercial ship is transiting in the opposite direction. In rare instances, vessels transiting to the BP Cherry Point dock may travel north through Haro Strait and then northeast through Boundary Pass to the BP Cherry Point dock.

ATBs and traditional barges (collectively referred to as *barges*), and some tank ships may transit to the BP Cherry Point dock from lower Puget Sound (generally Seattle and Tacoma). From Puget Sound, these vessels transit westbound through Admiralty Inlet and then turn north and pursue a course in the TSS along the western side of Whidbey Island to its intersection with Rosario Strait (Figure 2-3). The vessels then enter Rosario Strait and transit north to the BP Cherry Point dock. Vessels departing from the BP Cherry Point dock would take the routes described above in reverse, using the outbound or southbound TSS lanes as appropriate.

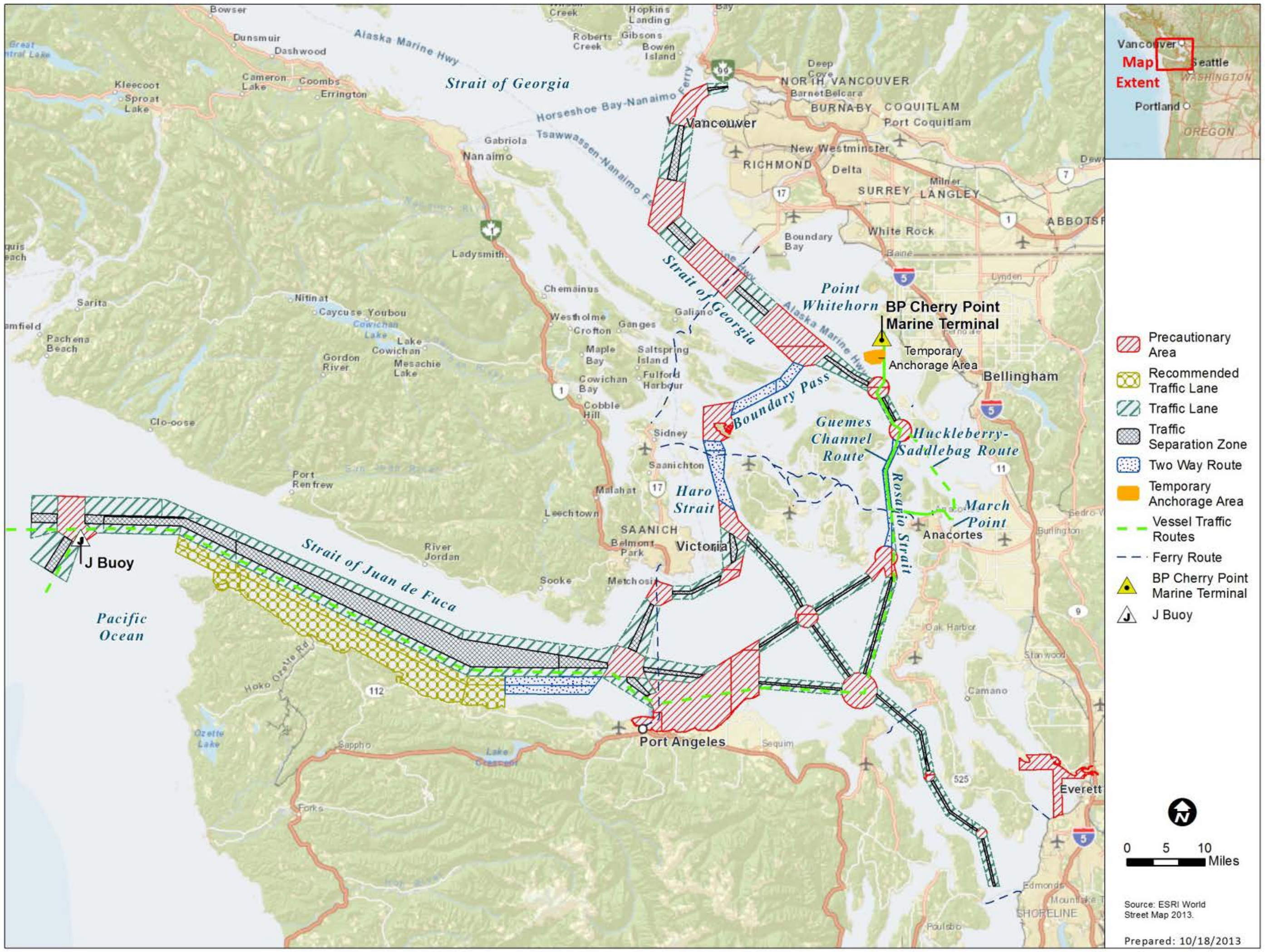

Figure 2-3 Traffic Separation Scheme

Vessels approaching the BP Cherry Point dock may be required to come to anchor at the designated temporary anchorage in the vicinity of Cherry Point or Vendovi Island, as directed by the USCG, if the berths are already in use (Figure 2-3).

Tank ships and barges having called at the BP Cherry Point dock may transit to the refineries located at March Point in Padilla Bay, adjacent to Anacortes. There are two routes to Padilla Bay: the Huckleberry-Saddlebag Route and the Guemes Channel Route. To use the Huckleberry-Saddlebag Route, vessels depart the TSS adjacent to Lummi Island and enter the channel between Lummi Island and Sinclair Island. Passing Vendovi Island, they navigate between Huckleberry and Saddlebag Islands to enter Guemes Channel from the east and access the refinery docks at March Point. The second route makes use of the one-way traffic lane south through Rosario Strait, past Cypress Island. The route turns eastward into Guemes Channel and enters Padilla Bay. Figure 2-4 illustrates the vessel routes between the BP Cherry Point dock and Padilla Bay. Since June 14, 2006, and per the Settlement Agreement between BP and the plaintiffs in *Ocean Advocates et al.*, voyage orders for vessels operated or chartered by BP and calling at the BP Cherry Point Refinery—and whose itineraries include a stop at March Point—have identified the Rosario Strait/Guemes Channel route as the preferred route, subject to vessel master discretion and safety conditions.

2.2.8. Summary of Past Dock Use and Vessel Calls

As described in Section 2.2.2, the tasks of unloading crude oil and handling refined petroleum product have largely been separated since construction of the North Wing. Prior to construction of the North Wing, both operations occurred on the South Wing. In some cases, vessels call at Cherry Point, deliver a partial cargo, and then continue on to other Pacific Northwest (PNW) refineries to deliver their remaining cargo.

Both tank ships and barges export refined petroleum product from the BP Refinery to local, regional, and international markets. Two classes of refined petroleum product are produced at the BP Refinery: (1) middle range (such as diesel, kerosene, and fuel oil); and (2) light range (such as gasoline). Export of refined petroleum product by tanker is principally to Portland, Oregon, and San Francisco and Los Angeles in California. Barges transport refined petroleum product to Seattle and Tacoma (Puget Sound); Portland, Oregon; and occasionally to California. Refined products also are exported to Vancouver, British Columbia and to overseas (typically Asian) markets when market conditions make those exports favorable.

The primary measure of dock activity is the annual number of vessel calls. BP vessel call records from January 1998 through December 2010[8] show that an annual average of 321 vessel calls occurred at the BP Cherry Point dock. These calls included tank ships delivering crude oil feed stock to the refinery and tank ships or barges exporting refined petroleum product to market destinations (Table 2-1). During this period, on average, approximately 12.1 vessels arrived per month to deliver crude oil. During the same period, approximately 14.6 vessels per month loaded and departed from the BP Cherry Point dock to deliver refined petroleum product to market destinations. Total annual vessel calls have ranged from a low of 247 in 1998 to a high of 416 in 2007. The annual maximum number of calls (416) occurred in 2007 and consisted of 191 crude oil carriers and 225 refined petroleum product carriers.

[8] The BP Cherry Point Refinery has progressed through a series of volume accounting tools since refinery startup in 1971. Access to historical data has become increasingly complicated as new technologies have been adopted that are incompatible with older volume accounting tools. Data from 1998 to 2010 were used so that more accurate comparisons could be made.

Figure 2-4 Vessel Traffic Routes

Table 2-1 Monthly and Annual Vessel Calls at BP Cherry Point Dock (1998–2010)

Year	Crude Oil Vessels[a]			Refined Petroleum Product Vessels[b]			Total Vessels		
	Total Annual	Average Monthly	Min/Max Monthly	Total Annual	Average Monthly	Min/Max Monthly	Total Annual	Annual Monthly	Min/Max Monthly
1998	114	9.5	8/12	133	11.1	9/13	247	20.6	8/13
1999	110	9.2	3/12	181	15.1	7/22	291	24.3	3/22
2000	108	9.0	7/11	195	16.3	14/20	303	25.3	7/20
2001	119	9.9	7/11	181	15.1	11/19	300	25.0	7/19
2002	140	11.7	9/14	161	13.4	6/18	301	25.1	6/18
2003	165	13.8	10/17	160	13.3	10/20	325	27.1	10/20
2004	137	11.4	5/14	150	12.5	7/16	287	23.9	5/16
2005	143	11.9	6/16	173	14.4	9/18	316	26.3	6/18
2006	141	11.8	7/15	193	16.1	9/20	334	27.9	7/20
2007	191	15.9	12/22	225	18.8	12/27	416	34.7	12/27
2008	188	15.7	12/18	191	15.9	14/18	379	31.6	12/18
2009	162	13.5	10/18	180	15.0	9/17	342	28.5	9/18
2010	174	14.5	12/17	158	13.2	10/15	332	27.7	10/17
Average	**146**	**12.1**		**175**	**14.6**		**321**	**26.8**	

[a] South Wing 1998–2010

[b] South Wing 1998–2001; North and South Wings 2001–2010

Source: BP 2013.

A second measure of dock activity is the annual volume of crude oil and refined petroleum product transferred across the dock (total material transfer). Not all vessels deliver or take on a complete cargo at the BP Cherry Point dock; they may call at other facilities in Puget Sound. From 1998 through 2010, the total material transfer of the BP Cherry Point dock ranged from a low of approximately 91,027,240 bbl in 2005 to a high of 115,282,883 bbl in 2000 (Table 2-2). On June 10, 1999, a section of the Olympic Pipeline near Bellingham, Washington ruptured, disrupting refined petroleum product deliveries via the Olympic Pipeline to market destinations. Prior to the incident, the Olympic Pipeline was delivering approximately 441,000 bbl a day of refined petroleum product to urban centers south of the BP Refinery. The pipeline was out of service between June 1999 and April 2001, which increased reliance on shipping refined petroleum product by tank ship and barge, and increased the volume of refined petroleum product moving across the BP Cherry Point dock.

Table 2-3 compares annual values for total material transfer and vessel calls for both crude oil and refined petroleum product. The annual total material transfer at the BP Cherry Point dock is affected by overall vessel size and the size of the cargo loaded or unloaded. While some vessels may arrive at the terminal fully loaded, only a portion of the overall cargo may be discharged. Similarly, a vessel calling to load refined petroleum product may already be partially loaded.

The annual material transfer across the dock and the number of vessel calls vary from year to year. Table 2-3 compares the average vessel calls and material transfer for crude oil and refined petroleum product for each year to the annual average for the entire period from 1998 through 2010. This comparison shows that the average cargo size for crude oil received has declined from 624,626 bbl in 1998 to approximately 369,052 bbl in 2010, while the average for the entire period was 474,776 bbl—indicating that crude oil cargo sizes have declined. This increase in the number of vessel calls and decrease in cargo size may be attributed to declining Alaska North Slope (ANS) crude[9] production, the historical source of crude oil for Cherry Point, and an associated change in crude oil sourcing strategy brought about by the purchase of the Cherry Point Refinery by BP in April 2000 (BP 2011a, BP 2014).

Table 2-2 Total Annual Material Transfer at BP Cherry Point Dock (1998–2010) (bbl)

Year	Crude Oil Receipts	Refined Petroleum Product Transfers	Total Annual Material Transfer
1998	71,207,327	31,183,212	102,390,539
1999	60,721,943	35,217,627[a]	95,939,570
2000	64,624,712	50,658,171[a]	115,282,883
2001	70,976,481	35,217,745[a]	106,194,226
2002	71,495,998	27,859,311	99,355,309
2003	72,991,103	29,872,460	102,863,563
2004	68,749,545	25,404,183	94,153,729
2005	62,369,592	28,657,648	91,027,240
2006	74,346,487	33,145,180	107,491,667
2007	71,840,417	37,787,207	109,627,624
2008	76,431,762	36,572,903	113,004,665
2009	71,153,897	36,666,874	107,820,771
2010	64,215,057	31,980,874	96,195,931
Average	**69,317,256**	**39,500,160**	**103,180,594**

bbl = barrels

[a] Olympic Pipeline out of service

Source: BP 2011b.

A similar pattern has occurred in the size of refined petroleum product cargo loads. During the same period, the annual number of vessel calls has increased from 247 in 1998 to 332 in 2010, with an average for the period of 321 vessel calls per year. These trends reflect an overall increase in annual product vessel calls even though refinery production has been stable at approximately 225,000 bbl per day for the period from 2001 through 2010.

9 The BP Cherry Point Refinery is configured to process crude stock sourced from Alaska North Slope producers. The reduction in this supply has caused BP to obtain supplies from alternative suppliers. However, to the extent that these supplies are substituting for Alaskan crude, they may need to be blended to obtain crude that will meet the BP Cherry Point refinery specifications. Obtaining crudes to blend may require BP to obtain its crude from a larger group of alternative suppliers rather than being able to rely on the single North Slope supply.

Table 2-3 Annual Volume and Vessel Calls at BP Cherry Point Dock (1998–2010) Compared to 1998–2010 Average Values

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	1998–2010 Average Values
Crude Oil														
Volume (bbl)	71,207,327	60,721,943	64,624,712	70,976,481	71,495,998	72,991,103	68,749,545	62,369,592	74,346,487	71,840,417	76,431,762	71,153,897	64,215,057	69,317,255
Variation from average	1.03	0.88	0.93	1.02	1.03	1.05	0.99	0.90	1.07	1.04	1.10	1.03	0.93	
Crude oil vessels	114	110	108	119	140	165	137	143	141	191	188	162	174	146
Variation from average	0.78	0.75	0.74	0.82	0.96	1.13	0.94	0.98	0.97	1.31	1.29	1.11	1.19	
Average load	624,626	552,018	598,377	596,441	510,686	510,686	442,370	501,821	527,280	376,128	406,552	439,222	369,052	474,776
Variation from average	1.32	1.16	1.26	1.26	1.08	1.08	0.93	1.06	1.11	0.79	0.86	0.93	0.78	
Refined Petroleum Product														
Volume (bbl)	31,183,212	35,217,627	50,658,171	35,217,745	27,859,311	29,872,460	25,404,183	28,657,648	33,145,180	37,787,207	36,572,903	36,666,874	31,980,874	33,863,338
Variation from average	0.92	1.04	1.50	1.04	0.82	0.88	0.75	0.85	0.98	1.12	1.08	1.08	0.94	
Refined petroleum product vessels	133	181	195	181	161	160	150	173	193	225	191	180	158	176
Variation from average	0.76	1.03	1.11	1.03	0.91	0.91	0.85	0.98	1.10	1.28	1.09	1.02	0.90	
Average load	234,460	194,573	259,785	194,573	173,039	186,703	169,361	165,651	171,737	167,943	190,484	203,705	202,411	192,405
Variation from average	1.22	1.01	1.35	1.01	0.90	0.97	0.88	0.86	0.89	0.87	0.99	1.06	1.05	

Table 2-3 Annual Volume and Vessel Calls at BP Cherry Point Dock (1988–2010) Compared to 1998–2010 Average Values (Continued)

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	1998–2010 Average Values
Total Vessels														
Total vessels	247	291	303	300	301	325	287	316	334	416	380	342	332	321
Variation from average	0.77	0.91	0.94	0.93	0.94	1.01	0.89	0.98	1.04	1.30	1.18	1.07	1.03	

bbl = barrels

2.2.9. Maximum Vessel Call Capacity of the South Wing

A comparison of operation of only the South Wing and operation of both wings requires determining the maximum capacity (number of vessel calls) for the South Wing. Prior to operation of the North Wing, 303 vessel calls was the highest annual number of calls at the South Wing (in 2000). This number of calls does not reflect the estimated maximum capacity of the South Wing. Based on an allocation of dock utilization between crude oil and cargo vessels, BP estimates that the South Wing could accommodate up to 335 vessel calls per year. This value was calculated based on the assumptions shown in Table 2-4.

Table 2-4 Calculation of Maximum Single-Wing Dock Capacity for the BP Cherry Point Dock

Out of service for maintenance (days/year)	5.5
Out of service for weather (days/year)	2.1
Available for operation (days/hours per year)	357.4/8,577.6
Average time per call – excluding loading/unloading (hours)	5.2
Average crude oil cargo size (bbl)	620,000
Average crude oil unloading rate (bbl per hour)	28,100
Average crude oil unloading time (hours)	22.06
Number of crude oil vessels/total annual volume (bbl)	138/85,560, 000
Total time at dock – crude oil vessels (hours)	3,762[a]
Average refined petroleum product cargo size (bbl)	194,000
Average refined petroleum product loading rate (bbl per hour)	10,100
Average product unloading time (hours)	19.21
Number of refined petroleum product vessels/total annual volume (bbl)	197/38,218,000
Total time at dock – refined petroleum product vessels (hours)	4,809[a]
Total dock utilization time (hours per year)	8,571[a]

bbl = barrels

[a] Includes mooring and unmooring, connecting and testing, loading and unloading equipment, and setting booms.

The maximum number of monthly calls (33 calls) at the South Wing occurred in July 1999, when it was both receiving crude oil and exporting refined petroleum product (BP 2011a). Operating at this rate annually would result in 396 calls per year, a rate of utilization approximately 18 percent higher than the estimated annual capacity of 335 calls for the single-wing dock. Operating the dock at the higher utilization rate would not allow for annual maintenance to be performed, weather outages, or other typical delays that occur in the docking cycle. A maximum operating rate of 335 vessel calls per year provides adequate time for all of the normal elements of operation required for continued dock availability and safe, compliant, and effective operation.

2.3. FUTURE DOCK OPERATIONS

BP provided projections of reasonably foreseeable changes in vessel traffic to and from the BP Cherry Point dock through calendar years 2025 and 2030, based on continued operation of the refinery at its current level of production (BP 2011c). BP represented that it has no active plans to change the level of production (BP 2011c). From 1998 to 2010, the number of vessel calls has ranged from 247 to 416 per year (Table 2-3). During the same period, the volume of crude oil imports and refined petroleum product exports across the BP Cherry Point dock has ranged from 91 to 115 million barrels per year (Table 2-2). The variation in both of these operating parameters demonstrates the variability in dock operations and the difficulty of developing future traffic projections based solely on refinery operations. The number of calls in a given year is affected by the average cargo size per call, the vessel origination or destination, the availability and cost of North American crude stocks delivered by pipe or rail, and other market factors.

While not able to provide a definitive forecast, BP provided three future forecast scenarios based on variations in key market conditions:

- **Increased Pipeline Deliveries (Low-Range Forecast).** Assumes that deliveries of crude oil to supply the refinery from Canadian resources by pipeline would increase.
- **Current Conditions Forecast (Medium-Range Forecast).** Assumes that the degree of reliance on waterborne crude oil sources would continue. This scenario results in a level of annual calls in the same range as has occurred in the past.
- **Potential Future Growth (High-Range Forecast).** Assumes an increase in the number of vessel calls at the BP Cherry Point dock. The ratio of crude oil and refined petroleum product may change from current conditions.

Since identification of the future vessel traffic scenarios above, BP has completed construction of a Rail Logistics Facility (RLF). The RLF is designed to receive crude oil and other feedstocks transported by rail for processing at the BP Cherry Point refinery and to improve the refinery's rail management capabilities. Although the RLF has the potential to reduce crude oil transfers over the BP Cherry Point dock, the three future vessel traffic scenarios provided by BP have not been revised to include the RLF. A reduction in crude oil transfers would not affect the volume of traffic using the North Wing. In addition, the volume of crude oil received by rail will depend on market factors that are difficult to predict, including the relative cost of crudes from North America and other locations, shipping costs, and refinery feedstock planning issues. Any reduction in crude oil or refined petroleum product traffic across the dock resulting from the RLF may be temporary. To ensure that the vessel traffic projections used in this EIS are conservative, potential future vessel traffic reductions associated with the RLF were not considered.

It should be noted that two vessel traffic studies were undertaken in support of the development of this Draft EIS. Each study used a different year to represent the future—2025 for one study and 2030 for the second. BP determined that there was no appreciable difference in the future forecast ranges of vessel calls between year 2025 and 2030; therefore, the same forecast scenarios were used for both studies (see Figure 2-5).

For each scenario, a range of vessel calls was established—split between crude oil deliveries and refined petroleum product distribution. Under the maximum predicted future vessel traffic growth conditions (the high-range forecast), the 2030 forecast predicts that the BP Cherry Point dock could receive between 350 and 420 vessel calls per year through 2030. This represents a potential increase of between 15 and 85 vessel calls a year (or between 4.5 and 25.3 percent) above the baseline capacity of 335 vessel calls per year for operation of the South Wing only. Vessels would likely be a mix of tank vessels carrying crude oil and refined petroleum product and barges carrying refined petroleum product. The high-range forecast also represents a change in the proportion of vessel calls for unloading crude oil versus loading refined petroleum product.

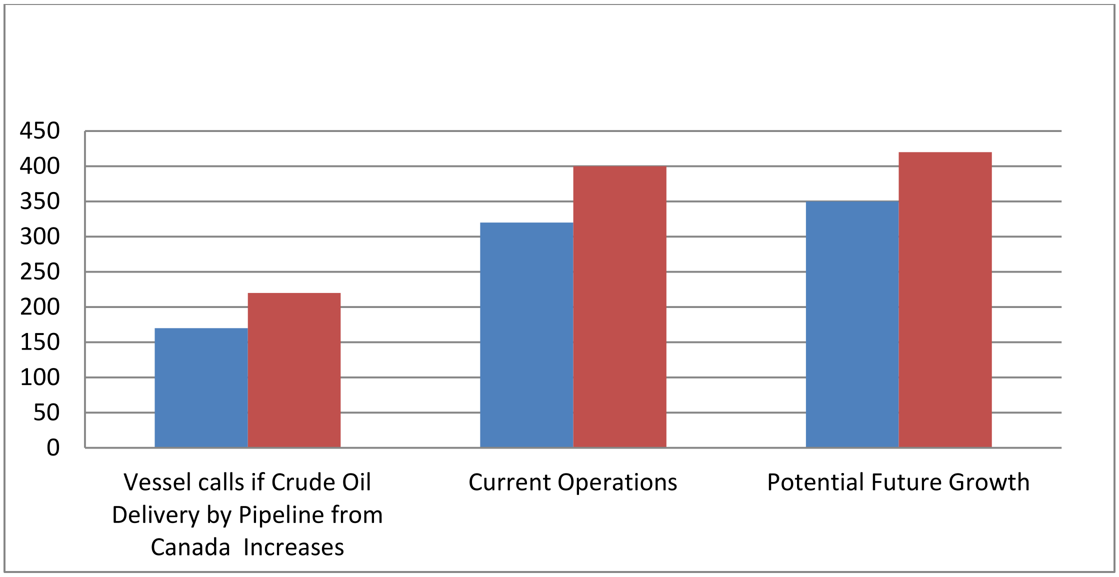

Figure 2-5 BP Forecast of Future Vessel Calls by Future Scenario (blue: lower bound forecast; red: upper bound forecast)

Under the continuation of current conditions, the vessel traffic forecast scenario (prior to installation and operation of the RLF) comprises 40 to 50 percent of vessel calls for delivery of crude oil and 50 to 60 percent for loading refined petroleum product. Under the high-range future scenario for marine transportation, the proportion of vessel calls for unloading crude oil is predicted to be 30 to 40 percent of total vessel calls, and the proportion of calls for loading refined petroleum product is predicted to be 60 to 70 percent of total vessel calls (BP 2011d). Under business development scenarios in which crude oil delivery by rail and pipeline would increase, vessel calls would likely decline from current numbers, and the proportion of calls for loading refined petroleum product would increase to 90 to 95 percent of all vessel calls. The remaining 5 to 10 percent of vessel calls would be for unloading crude oil (BP 2011d). (See Chapter 5 for additional discussion on forecasts for future operations.)

Between 2001 and 2010, the number of vessel calls exceeded BP's low-range estimate of future calls (170–220) every year, exceeded the medium-range forecast (320–400) in 2007, but did not exceed the high-range estimate of future calls (350–420) in any year (Table 2-1). Since the North Wing became operational in 2001, the number of calls has averaged approximately 321 vessels per year, which is within the range of the current conditions scenario.

Tank ship traffic calling at the BP Cherry Point dock accounts for 1.1 percent of all traffic in Puget Sound (normalized for time spent in transit) and 2.6 percent of all traffic in Puget Sound when adding barges calling at Cherry Point. Because the majority of the barge traffic is on routes to the southern reaches of Puget Sound, it can be inferred that approximately 1.1 percent of the traffic entering Puget Sound and transiting the Strait of Juan de Fuca is traffic destined for the BP Cherry Point dock (van Dorp et al. 2008).

2.4. VESSEL OPERATIONS

Vessel operations with potential environmental risk components include ballast water discharge and loading of bunker fuel for vessel locomotion, referred to as *bunkering*.

2.4.1. Ballast Water Discharge

Deep draft cargo vessels use ballast tanks filled with water to maintain ship stability and trim. The volume required depends on shipboard conditions affected by cargo weight and type. Change in vessel weight as a result of cargo loading or unloading results in the necessity to redistribute internal ballast or to discharge or fill ballast tanks accordingly. The vessels calling at the BP Cherry Point dock to take on refined petroleum product typically arrive already in ballast, whereas those arriving with a crude oil delivery take on ballast water to compensate for unloaded cargo.

When taking on ballast, organisms present in the surrounding water that are small enough to fit though the ballast intake screen can be taken onboard. During discharge, organisms in the ballast water may be released; the ballast water may contain non-native, nuisance, and exotic species that could cause damage to the marine environment. To prevent the release of invasive species, all ships calling at the BP Cherry Point dock are required to adhere to strict federal and state regulations regarding the discharge of ballast water within Washington state waters.

2.4.2. Ballast Water Laws and Regulations

Since the mid-1980s, new and existing oil tankers of at least 20,000 dwt and above have been required to be equipped with ballast tanks that are completely segregated from cargo and fuel tanks, a crude oil washing system, and cargo tank protection systems (46 USC 3705).

Under the National Invasive Species Act of 1996 (NISA), an amendment to the Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA), the USCG enforces nationwide ballast water regulations. Vessels calling at ports within the United States from outside the U.S. Exclusive Economic Zone (EEZ), or 200 nautical miles (nmi) offshore, are required to report ballast water management practices to the National Ballast Information Clearinghouse (NBIC) and to implement on-board plans for managing ballast water. Before entering the EEZ, vessel operators are required to conduct a mid-ocean ballast water exchange. Ballast water also can be discharged to an approved reception facility. In addition, the alternative use of an on-board water treatment system is required by regulation and will be phased in and eventually required on all vessels that seek to discharge ballast water. USCG regulations 33 CFR Part 151 and 46 CFR Part 162 were instituted in June 2012, in an effort to phase out ballast water exchange practices. Vessels calling at U.S. ports must be equipped with an approved on-board ballast water treatment system. This applies to all new ships constructed in or after December 2013. All existing vessels with a ballast water capacity between 1,500 and 5,000 cubic meters (m^3) must be in compliance by their first scheduled dry-docking after January 1, 2014. These regulations apply to all vessels calling at the BP Cherry Point dock for unloading crude oil or loading refined petroleum product.

Vessels calling at the BP Cherry Point dock also must comply with state regulations enacted in 2002 under House Bill 2466, the Ballast Water Management Act (Chapter 77.120 Revised Code of Washington [RCW]) that is administered by the Washington Department of Fish and Wildlife (WDFW). This state law regulates the ballast water discharge practices of ships originating from California, southern Oregon, northern British Columbia, and Alaska that are exempt from federal regulations. All vessels calling from these regions are required to exchange ballast water at least 50 nmi offshore or to use treatment systems approved by the State before they discharge ballast into state waters. Under this state regulation, all vessel operators must report ballast management practices to the WDFW and the NBIC. In addition, as of July 1, 2007, non-exchanged or untreated ballast water cannot be discharged into Washington State waters; vessels unable to properly manage ballast water are required to retain it onboard.

2.4.3. Estimated Ballast Water Discharge Volumes

Vessels arriving with ballast that will be discharged into Puget Sound waters must follow federal and Washington State laws concerning ballast water exchanges before entering state waters. Prior to discharge of segregated ballast, visual inspection of the tank must occur to ensure that no oil is in the segregated ballast.

- The volume of annual ballast water discharge was estimated by determining the proportion of vessels making a discharge when calling at the BP Cherry Point dock and the average discharge volume occurring at each call. Because all ballast water discharged in Puget Sound must be exchange water, the likely source and volume of the exchange water also was identified.
- Historical ballast discharge records (2004–2013) from the NBIC public database (2008) and from BP Cherry Point dock were used to forecast the changes in ballast water discharge rates resulting from projected vessel traffic and to identify the general source of ballast exchange water. From the NBIC database, records for vessels owned or chartered by BP (five vessels) and other vessels calling at Cherry Point, Washington of similar type and ballast capacity (24 vessels) were identified. From this sample, the percentage of calling vessels discharging ballast water was calculated.
- The average ballast water discharge volume per call was calculated from the average volumes reported by NBIC, as applied to the 351 refined petroleum product tanker calls at Cherry Point from 2004 to 2013 (Table 2-5). For comparison, the maximum potential discharge volume for refined petroleum product tankers was calculated by taking 90 percent of the average total ballast tank capacity, as reported in American Bureau of Shipping records (2001) (Table 2-6). BP has no record of any vessel discharging ballast water at the BP Cherry Point dock, nor would a crude oil vessel unloading cargo under routine operating conditions have any reason to discharge ballast water. For these reasons, Cherry Point crude oil vessels were assumed not to discharge ballast water within the study area.

Table 2-5 Ballast Water Discharge Status Reported to NBIC by Vessel Sample (2004–2013)

NBIC Reported Data	Refined Petroleum Product Tanker
Vessel calls	351
Vessel calls: no ballast discharged	12
Vessel calls: ballast discharged	339
Percent calls: no ballast discharged	3%
Percent calls: ballast discharged	97%

NBIC = National Ballast Information Clearinghouse
Source: NBIC 2008.

Table 2-6 Average Ballast Water Discharge Volume per Vessel Call (2004–2013) (m^3)

	Refined Petroleum Product Tanker	Source
Reported average volume discharged per call	16,705	National Ballast Information Clearinghouse 2008
90 percent of average total ballast tank capacity	21,171	American Bureau of Shipping 2001

- The NBIC database also records the source of a vessel's ballast water: overseas (outside of the EEZ), coastwise (within the EEZ), and unknown. For sources outside the EEZ, complete ballast water exchange must take place at least 200 nmi off shore; vessels originating within the EEZ must exchange ballast water at least 50 nmi offshore. The source of ballast exchange water that is discharged in Puget Sound waters was estimated based on NBIC records (Table 2-7).

Table 2-7 Ballast Water Discharges Reported to NBIC by Vessel Sample (2004–2013)

NBIC Reported Data	Refined Petroleum Product Tanker
Number of vessel calls	351
Source: overseas	3.5%
Source: coastwise	96.4%
Source: unknown	0.1%

NBIC = National Ballast Information Clearinghouse
Source: NBIC 2008.

The projected number of vessel calls to the BP Cherry Point dock in the 2030 high-range forecast scenario, with two operational wings, is 420 calls distributed between 126–168 crude oil tankers and 244–252 refined petroleum product tankers. This is compared to the maximum number of vessel calls with a single-wing operational capacity of 335 calls distributed between 138 crude oil tankers and 197 (based on maximum dock utilization) refined petroleum product tankers (Table 2-4). Because only 97 percent of calls by refined petroleum product tankers historically have reported an actual discharge of ballast water, this frequency was applied when determining the number of forecasted vessel calls that would discharge ballast water in the Cherry Point area.

Table 2-8 summarizes the potential change in vessel calls and ballast water discharge volumes when comparing dock operations at maximum single-wing capacity to the high-range forecast scenario for operations with both wings. Based on assumed historical ballast water discharge rates, discharge could increase approximately 761,581–891,212 m^3 (approximately 200–235 million gallons) under the high-range, double-wing scenario. Using the calculated maximum discharge (90-percent tank capacity), if each refined petroleum product vessel calling at the BP Cherry Point dock were to discharge ballast, discharge under the double-wing scenario would be approximately 965,177–1.129,462m^3 (approximately 254–298million gallons) more than under the maximum single-wing capacity. In all cases, under both federal and state regulation, the discharged ballast water would be subject to offshore or mid-ocean exchange or treated with an approved on-board ballast water treatment system.

The estimated distribution of ballast water sources for refined petroleum product and crude oil tankers calling at the BP Cherry Point dock was compared between the maximum single-wing capacity and the forecasted high-range, double-wing scenario capacity (2030) for both average and maximum ballast water discharges (Table 2-9).

Table 2-8 Comparison of Average Yearly Ballast Water Discharge Volume from 2010 to 2030

Criterion	BP Traffic Scenario	Refined Petroleum Product Vessels	Potential Change
Vessel calls/year	Single-wing maximum	197	47 – 55
	High-range two wings	244 – 252	
Vessel calls with ballast discharged/year	Single-wing maximum	191	46 – 53
	High-range two wings	237 – 244	
Average volume discharged/ year (m^3) from reported	Single-wing maximum	3,192,158	761,581 – 891,212
	High-range two wings	3,953,739 – 4,083,370	
Average volume discharged/ year (m^3) from calculated	Single-wing maximum	4,045,528	965,177 – 1,129,462
	High-range two wings	5,010,704 – 5,174,990	

Table 2-9 Comparison of Sources of Average Yearly Ballast Water Discharge from 2010 to 2030

Criterion	Volume Source	Single-Wing Maximum Capacity	2030 High-Range Forecast Two-Wing Capacity	Potential Change
Average volume discharged/ year (m^3) from reported	All sources	3,192,158	3,953,739 – 4,083,370	761,581 – 891,212
	Overseas	111,726	138,381 – 142,918	26,655 – 31,192
	Coastwise	3,077,241	3,811,405 – 3,936,369	734,164 – 859,128
	Unknown	3,192	3,954 – 4,083	762 – 891
Average volume discharged/ year (m^3) from calculated	All sources	4,045,528	5,010,704 – 5,174,990	965,177 – 1,129,462
	Overseas	141,593	175,375 – 181,125	33,781 – 39,531
	Coastwise	3,899,889	4,830,319 – 4,988,690	930,430 – 1,088,801
	Unknown	4,046	5,011 – 5,175	965 – 1,129

This analysis shows that any increases in ballast water discharge would primarily be from vessels travelling coastal routes and calling to load refined petroleum product. Because most refined petroleum product shipped from the BP Cherry Point dock is destined for Oregon (Columbia River) and California (San Francisco Bay and Los Angeles areas), the likely source of ballast water prior to exchanges is fresh or estuarine water (Columbia River/San Francisco Bay), and this water would be exchanged 50 nmi off the Pacific Coast.

2.4.4. Current Bunkering Practices

Some vessels calling at the BP Cherry Point dock will require fueling for transit to their voyage destination. Bunkering is a general term that denotes the transfer of fuel oil to replenish the fuel stocks for larger vessels. Bunkering operations are strictly regulated in Puget Sound by federal and state laws to enforce the use of procedures designed to prevent spills and protect the environment and to protect the safety of the operators during transfer operations. Bunker oil traditionally has been heavy, higher sulfur residual fuel oil. The BP Cherry Point dock does not have the facilities, piping, pumps, or loading arms to provide residual fuel oil bunkers, nor does it allow vessels calling at its dock to bunker from a bunker barge while moored at the BP Cherry Point dock.

Vessels calling at the BP Cherry Point dock that must refuel before departing Puget Sound typically obtain bunkers from a barge moored alongside while at anchor. Bunkering operations occur at several of the anchorages in the region, including Anacortes, Bellingham, Vendovi, and Port Angeles. Bunkering is also available at anchorages farther south in the Puget Sound. To use those locations, however, vessels would need to make a longer transit back and forth whereas the anchorages in proximity to Cherry Point would require less travel.

2.4.5. Future Bunkering Demand

Potential future changes in vessel calls to the BP Cherry Point dock would not significantly affect the number of bunker transfer operations that would occur in Puget Sound. The range of future vessel calls in the high forecast scenario (350–420 calls per year) is not significantly different from current operations (321 average actual calls per year and a maximum of 416 calls per year). Thus, the small difference in historical calls versus maximum forecasted calls at the BP Cherry Point dock would lead to a small increase in bunker transfers if all vessels required bunkering. By comparison, the potential changes in calls at the BP Cherry Point dock would be on the order of 1 percent per year of overall deep draft vessel traffic entering Puget Sound and the Strait of Georgia, which averages 16,000 vessels per year (Ecology 2000–2011).

2.4.6. Future Vessel Fueling Operations

Adoption of emission standards for ships by EPA[10] and amendment of the International Convention for the Prevention of Pollution from Ships[11] (MARPOL) in 2010 require that vessels greater than 400 gross tons transiting in U.S. waters within the 200-nmi Emission Control Area (ECA)[12] use low-sulfur fuels. This would include vessels calling at the BP Cherry Point dock and at other port facilities in Puget Sound and the Strait of Georgia. In the past, deep draft vessels typically have relied on less expensive, higher sulfur content No. 5 and No. 6 residual fuel oil to fuel their engines. Because the BP Cherry Point dock does not provide residual fuel oil nor allow vessels to fuel from bunker barges while moored at the dock, vessels calling at Cherry Point need to obtain bunker fuel at other locations in Puget Sound or at other ports of call.

Implementation of the ECA and the low-sulfur fuel standards now require vessels to carry two types of fuel or to rely exclusively on low-sulfur fuel. Refined petroleum products, including various grades of diesel currently produced at the BP Cherry Point Refinery, are low sulfur, are suitable for marine engine operation, and meet the lower emission standards. These products are routinely produced at the BP Cherry Point Refinery and loaded as cargo into tank ships and barges at the BP Cherry Point dock. BP has notified the USACE[13] of its intention to allow loading of these same products as vessel fuel to vessels

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[10] The EPA rule published on April 30, 2012, adopted standards that apply to Category 3 engines installed on U.S. vessels and marine diesel fuels produced and distributed in the United States.

[11] The International Maritime Organization (IMO) amended the International Convention for the Prevention of Pollution from Ships to designate an Emission Control Area up to 200 nmi off the west coast of the United States and Canada.

[12] An emission control area (ECA) is a sea area with stricter requirements concerning the use of bunker fuel compared to other sea areas. As of August 1, 2012, all large ships traveling within 200 nautical miles of the coasts of the United States and Canada are required to burn cleaner fuel (fuel with lower sulfur dioxide emissions).

[13] Personal communication from Scott McCreery (BP) to Olivia Romano (USACE) on April 14, 2014.

moored at the dock that are already discharging crude oil or loading refined petroleum product cargoes. Loading refined petroleum products to a vessel's fuel tank would occur concurrently with unloading or loading operations and would use the same loading arms, pumps, and piping already available on both the North Wing and South Wing of the dock. Vessel cargo transfer operations may currently use more than one loading arm to accommodate loading multiple cargo types in the same vessel.

BP has stated that no modifications to the capacity or capability of any piping to the dock, pumps, or loading arms would be required to support vessel fueling (BP 2014). BP has noted that two of the cargo loading arms and associated shutoff valves at the South Wing have reached the end of their useful life and will be removed as part of routine equipment replacement. However, BP plans to reinstall only one replacement arm. This arm will be of the same capacity as the loading arm that will be removed but will be approximately 10 feet longer to accommodate the range of vessel configurations currently calling at Cherry Point. In-kind replacement of the loading arm is a currently permitted activity under USACE, Whatcom County, and WDFW permits currently held by the BP Cherry Point Refinery (BP 2014).[14]

To the extent that refueling occurs during unloading of crude oil or loading of refined petroleum product at the BP Cherry Point dock, some fuel transfer operations may be avoided at anchorage within the Puget Sound region. Other vessels have sufficient low-sulfur fuel to transit into and out of Puget Sound without needing to acquire low-sulfur fuel.

BP also has indicated that it plans to engage in fueling services via barge to vessels at anchorages accessible from Cherry Point (BP 2014). The anchorages closest to Cherry Point include those at Port Angeles and at Vendovi, Bellingham, and March Point. Providing fueling services at anchor would involve loading a barge at the BP Cherry Point dock with refined petroleum product, an operation that already routinely occurs, and moving that barge to one of the anchorages in order to conduct a transfer operation and refuel a vessel requiring low-sulfur fuel. To the extent that BP's fueling services supply vessels already requiring fueling, they would displace tug/barge movements and transfer operations already taking place. BP has indicated that the refueling barge calls at the BP Cherry Point dock would not cause BP to exceed the maximum number of annual vessel calls projected under the high-range forecast.

Because all vessels refueled by BP would have refueled from another regional fueling service, BP's fueling services would not increase the number of barge movements or transfer operations occurring in the system. In addition, because refueling would occur at the same time as loading or unloading operations at the BP Cherry Point dock, and the volume of fuel would be smaller than the cargo loads being transferred, fueling services would not extend the time at dock for vessels loading or unloading cargoes.

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[14] BP currently holds the following permits: (1) Department of the Army, Corps of Engineers Nationwide Permit (NWP) 3, Seattle District Reference NWS-2007-985; (2) Whatcom County Shoreline Management Program Substantial Development Permit Exemption SHX2012-00039; (3) Washington Department of Fish & Wildlife Hydraulic Project Approval 128562-1.

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3 PROPOSED ACTION AND ALTERNATIVES

3.1 SCOPE OF USACE'S REGULATORY AUTHORITY – OVERVIEW OF ALTERNATIVES

The DA permit issued under Section 10 of the Rivers and Harbors Act in 1996 includes two primary elements: (1) approval to construct the North Wing; and (2) a requirement to maintain the North Wing of the BP Cherry Point dock during operations. Because construction of the North Wing has been completed, the remaining scope of the DA permit is operation and continued maintenance of the North Wing. The 9th Circuit Court directed the USACE to prepare an EIS and reevaluate the permit. Under 33 CFR Part 325 (Section 325.7), when reviewing a current DA permit, the USACE may take the following courses of action:

- Reaffirm the current permit with no modifications;
- Modify the current permit by adding conditions to be observed by the permittee during future operation and maintenance of facilities within the jurisdiction of the permit;
- Suspend the current permit, terminating current operations until resolution of the issues initiating review of the permit have been resolved; or
- Revoke the current permit.

If the USACE revokes the permit, it may require that facilities constructed under the current permit remain in place or be removed.

NEPA guidelines (40 CFR 1502.14) require that an EIS evaluate the Proposed Action, the No Action Alternative, and other reasonable alternatives to inform decision makers of the consequences of an agency's decision. In the typical project development process, an applicant files an application with the USACE, requesting a DA permit for a planned action. BP's predecessor (ARCO) filed such an application, a permit was granted, and construction of the North Wing was completed. Because review of the permit was initiated by the USACE in response to a judicial proceeding, there is no application filed by, or project proposed by, BP. The Proposed Action reflects an action proposed by the USACE in its review, not by BP.

The following alternatives were evaluated by the USACE with regard to the potential permit actions. More detailed descriptions of each alternative are presented in the subsections that follow.

- **Proposed Action.** Under the Proposed Action, BP would continue to operate the North and South Wings in their present configuration. The USACE would modify a DA permit for continued maintenance of the dock, with conditions that include prohibiting the use of the North Wing for unloading or loading crude oil.
- **No Action Alternative.** Under the No Action Alternative, the current DA permit would be revoked and BP would be required to remove the North Wing facility.
- **Alternative A.** Alternative A would be identical to the Proposed Action except that the conditions on operations of the North Wing, including prohibiting unloading and loading crude oil, would not be included.

Because the action considered is a review of current permit conditions without proposed construction of facilities, no site alternatives were considered. Several vessel traffic management measures were identified and evaluated in the vessel traffic studies described in Chapter 2. However, these were considered as potential minimization measures and not as Project alternatives because the USACE does not have jurisdiction to implement them.

3.2 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

3.2.1 Proposed Action – Modified DA Permit with Conditions

Under the Proposed Action, BP would continue to operate the North and South Wings in their present configuration. The USACE would modify a DA permit for continued maintenance of the dock, with conditions that include prohibiting the use of the North Wing for unloading or loading crude oil.

The Proposed Action includes the movement of vessel tanker and barge traffic to and from the BP Cherry Point dock, including the marine route through the Strait of Juan de Fuca, Rosario Strait, and the waters off of Cherry Point in Washington, and the operations of assist tugs during transit and moorage at the dock. The Proposed Action also includes operation and maintenance of the BP Cherry Point Dock North Wing including a ship berth, loading equipment, and control and metering equipment for refined petroleum product loading, oil spill preparedness and response equipment, and operation of these systems. Further descriptions of dock facilities, use and maintenance are provided in Chapter 2.

3.2.2 No Action Alternative – Revoked DA Permit and Removal of the North Wing

Under the No Action Alternative, the current DA permit would be revoked and BP would be required to remove the North Wing. This may require some reconfiguration of the loading and unloading equipment and the piping and pumps, and a return to the operations mode in a single-berth configuration. Ships waiting to use the dock would experience increased waiting time, and use of temporary anchorages would likely increase.

Under the No Action Alternative, removal of the North Wing would involve demolition and removal of structures in the water. Piping and equipment removal and removal of the North Wing deck structure likely would be conducted from large crane barges anchored alongside the North Wing. Concrete, steel, and other materials likely would be lifted from the dock and placed on materials barges which, when full, would then be towed to a nearby port where the demolition waste would be removed, sorted, and disposed of. After removal of the dock and pile caps, the dock's support structure would be similarly removed to a barge and disposed of. Finally, piles likely would be cut off at the seafloor and removed.

During removal of the dock structure (deck and substructure), workboats, barges, and tugs would operate in the construction zone. These activities would likely generate noise, with the potential for incidental contamination of marine waters from debris. Removal of the piles would require underwater construction techniques that may include cutting, with associated noise and water quality impacts. Removal of the piles would eliminate approximately 20,614 square feet of benthic substrate, as the surface of the piles has been colonized by aquatic organisms from the low-water mark to the seafloor.

Construction procedures during demolition and pier removal would include observation for the presence of listed marine mammals and temporary suspension of underwater noise-generating activities as required. Demolition activities would be scheduled to occur outside the herring spawning period. Screening, netting, and containment booms would be deployed to control debris falling into the water and typical best management practices (BMPs) would be implemented to avoid inadvertent fuel or other spills from construction equipment.

3.2.3 Alternative A – Reaffirmed DA Permit without Conditions

Under Alternative A, the USACE would reaffirm DA permit No. 92-1-00435, allowing BP to operate and maintain the dock and transfer facilities at the BP Cherry Point dock. No permit modifications or conditions would be included in Alternative A.

3.3 ALTERNATIVES CONSIDERED AND ELIMINATED FROM FURTHER ANALYSIS

Under the No Action Alternative, the USACE would revoke the current DA permit held by BP and require BP to remove the North Wing. An alternative to requiring removal of the North Wing would be allowing the North Wing to remain in its present condition but without loading or unloading capability. In this alternative, BP would simply abandon the North Wing. If the USACE revokes the current permit held by BP, ships would no longer be able to load refined petroleum product at the North Wing for shipment via tank ships or barges to other local destinations, or to destinations beyond the Puget Sound region. Ships also would no longer be able to unload refined petroleum products at the North Wing for further processing by the BP Refinery. Operation of the South Wing would revert to providing unloading and loading for both crude oil and refined petroleum products, which may require restoring dock piping, pumps, and loading/unloading arms to their pre-North Wing configuration. Existing aids to navigation lighting would remain operational as part of the overall BP Cherry Point dock. The North Wing would have no future use. Without ongoing maintenance, the berth would fall into disrepair, potentially becoming an eyesore and public health hazard. Therefore, this alternative was not carried forward for detailed analysis in the EIS.

No other alternatives were identified for consideration.

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4 AFFECTED ENVIRONMENT

4.1 INTRODUCTION

To assess the incremental environmental effects of potential spills of crude oil or refined petroleum product related to changes in vessel traffic, the existing environmental conditions in the Project area must first be documented.

Chapter 4 describes the existing environment that would be affected by the Project and alternatives under consideration in this EIS. Chapter 4 provides the basis for the impact assessment documented in Chapter 6 (Environmental Consequences).

4.1.1 Resources Considered in the EIS

This chapter provides detailed discussions of the affected environment for each resource area listed below:

- Nearshore and Marine Resources
- Nearshore and Marine Habitats
- Water Quality
- Cultural Resources
- Land Use
- Recreation Resources
- Air Quality and Climate Change
- Tribal/Subsistence Fishing
- Socioeconomics and Environmental Justice

The discussion of each resource includes the defined study area; the applicable regulations; and the overall existing condition of the resource, including the natural and physical environment. For each resource analyzed in the EIS, the study area is consistent with the Project area unless otherwise specified. For some resources (e.g., socioeconomics), the study area is larger than the Project area because potential effects extend beyond the Project area.

4.1.2 Resources Omitted from Detailed Analysis in the EIS

Not all environmental resources would be affected by the Project. Those that have been omitted are discussed below.

- **Soils and Geology.** Soils and geological resources are not discussed in a separate section in the EIS because the North Wing already has been constructed, and no other construction is proposed for the Project. Therefore, no impacts on soils and geological resources would occur under the Project. Section 6.11 addresses potential impacts on soils and geological resources under the No Action Alternative.

- **Aesthetic Resources.** Aesthetic resources are not discussed in a separate section in the EIS because no impacts are expected on this resource. Section 6.6, “Land Use” and Section 6.7, “Recreation” address minor aspects of the aesthetic environment; Section 6.11 addresses potential impacts on aesthetic resources under the No Action Alternative.

4.2 NEARSHORE AND MARINE RESOURCES

The study area for nearshore and marine resources is shown in Figure 2-1. The study area provides habitat for populations of nearshore and marine resources, including marine mammals, marine turtles, birds, fish, and invertebrates. This section describes the nearshore and marine resources, including federally listed species, present in the study area and provides the basis for identifying and interpreting potential impacts on these resources. Descriptions of individual species and their life history requirements are provided in Appendix F.

4.2.1 Regulatory Setting

The regulatory framework for evaluation of nearshore and marine resources includes:

- National Environmental Policy Act (NEPA)
- Endangered Species Act (ESA)
- Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act)
- Marine Mammal Protection Act (MMPA)
- Migratory Bird Treaty Act (MBTA)
- Bald and Golden Eagle Protection Act
- Washington Endangered Species Act

Except for NEPA, each of the regulatory authorities cited above are discussed in detail below.

4.2.1.1 Endangered Species Act of 1973

The ESA (16 USC 1531 et seq.; 50 CFR Parts 17 and 222) includes provisions for protection and management of species that are federally listed as threatened or endangered and designated critical habitat[1] for these species. *Endangered species* are species that are in danger of extinction throughout all or a significant portion of their range. *Threatened species* are species that are likely to become endangered throughout all or a significant portion of their range. A *proposed species* is any species that is proposed in the Federal Register for listing as a threatened or endangered species under the ESA. A *candidate species* is any species for which the U.S. Fish and Wildlife Service (USFWS) has sufficient information on its biological status and threats to propose the species for listing as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities. *Candidate species* receive no statutory protection under the ESA. Section 7 of the ESA directs federal departments and agencies to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any threatened, endangered, or proposed species—or result in the destruction or adverse modification of their designated critical habitat.

According to the ESA, it is illegal to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct" with regard to an endangered or threatened species. In addition, the body parts and products of endangered or threatened species cannot be imported, exported, or sold.

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[1] *Critical habitat* is defined as specific areas within the geographical area occupied by a species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation (http://www.nmfs.noaa.gov/pr/glossary.htm).

As part of the EIS preparation process, the federal lead agency must consult with the USFWS and the National Marine Fisheries Service (NMFS) under Section 7 of the ESA to examine potential effects in order to ensure that the Project is not likely to jeopardize the continued existence of listed species or result in destruction or adverse modification of critical habitat. A draft Biological Evaluation is included as Appendix G and will be submitted to NMFS and the USFWS for review.

4.2.1.2 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) (16 USC 1801 et seq.) is the primary law governing marine fisheries management in U.S. federal waters. The Act was first enacted in 1976 and amended most recently in 2006. The Magnuson-Stevens Act established a 200-mile fishery conservation zone, explains the role of regional fishery management councils, and describes their functions and operating procedures. The Act includes national standards for management and outlines the contents of fishery management plans. The Magnuson-Stevens Act is complemented by other federal and state laws, including the MMPA, the ESA, the Coastal Zone Management Act, and the National Marine Sanctuaries Act.

Under Section 305(b)(2) of the Magnuson-Stevens Act as amended by the Sustainable Fisheries Act on October 11, 1996, federal agencies are required to consult with the Secretary of Commerce on any actions that may adversely affect essential fish habitat (EFH). EFH descriptions were approved by NMFS on September 27, 2000, for west coast salmon fisheries; on June 10, 1999, for northern anchovy/coastal pelagics; and on March 3, 1999, for Pacific coast groundfish. An EFH assessment for the study area is provided in the draft Biological Evaluation included as Appendix G.

The EFH regulations also direct the regional fishery management councils to consider a second, more limited designation for each species: habitat areas of particular concern (HAPCs). Designated HAPCs are not afforded any additional regulatory protection under the Magnuson-Stevenson Act; however, federal projects with potential adverse impacts on HAPCs are more carefully scrutinized during the consultation process. Currently, only Amendment 14 to the Pacific Salmon Fishery Management Plan has addressed the HAPC for Chinook, coho, and pink salmon.

4.2.1.3 Marine Mammal Protection Act

The MMPA was enacted in 1972 and amended in 1994. The Act prohibits, with certain exceptions, “take of marine mammals in U.S. waters and by U.S. citizens on the high seas, and importation of marine mammals and marine mammal products into the U.S.” *Take* as defined under the MMPA is the “act of hunting, killing, capture, and/or harassment of any marine mammal; or, the attempt at such.” The MMPA defines *harassment* as “any act of pursuit, torment, or annoyance which has the potential to (a) injure a marine mammal in the wild; or (b) disturb a marine mammal by causing disruption of behavioral patterns, which includes, but is not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.” Jurisdiction for the MMPA is shared by the USFWS and NMFS.

In December 2013, the National Oceanic and Atmospheric Administration (NOAA) published *Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals – Acoustic Threshold Levels for Onset of Permanent and Temporary Threshold Shifts*. In administration of the MMPA and ESA, NMFS considers the onset to permanent threshold shift (PTS) [2] with level (a) harassment under the

[2] Animals exposed to sufficiently intense sound exhibit an increased hearing threshold for that sound (i.e., poorer sensitivity) for some period of time following exposure; this is called a noise-induced threshold shift. If the hearing threshold does not return to the pre-exposure value, it is called a *permanent threshold shift* (PTS) (Southhall et al. 2007). A human-based example is a worker in a loud factory setting becoming hard of hearing over time.

MMPA and "harm" under the ESA and the onset of temporary threshold shift[3] (TTS) with level (b) harassment under the MMPA and "harassment" under the ESA. NOAA proposed this new guidance to reflect the increasing understanding of marine mammal hearing. The proposed guidance recognizes that hearing sensitivity varies among marine mammal groups and organizes marine mammal species into five groups: low-frequency cetaceans, the baleen whales; mid-frequency cetaceans, most dolphins including killer whales and beaked whales; high-frequency cetaceans, including true porpoise and pygmy sperm whales; pinnipeds in water; and pinnipeds on land. In addition, the guidance presents dual criteria for each group: one measured in dB_{peak} re 1µPa (sound pressure), and one measured in dB cumulative sound exposure level ($SEL_{cum)}$. The latter criterion was developed to reflect that exposures to a sound source over extended periods can accumulate as much energy as exposure to a louder sound source for a shorter period. That is to say, exposure to sound levels that would cause TTS for extended periods could result in PTS.

4.2.1.4 Migratory Bird Treaty Act

The MBTA was enacted in 1918; the Act implements various treaties and conventions between the United States and Canada, Japan, Mexico, and the former Soviet Union for protection of a shared migratory bird resource. Under the MBTA, it is unlawful to "pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not." Exceptions are allowed for hunting game birds and for research purposes, both of which require licenses or permits. The USFWS is responsible for administering the MBTA.

4.2.1.5 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act was enacted in 1940 to protect the bald eagle, and it was expanded in 1962 to include the golden eagle. The Act makes it illegal to take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald or golden eagle. The Act defines *take* as "to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." *Disturb* as used in the Act means "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle; (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." The USFWS is responsible for administering this Act.

4.2.1.6 Washington Endangered Species Act

Washington Administrative Code (WAC 232-12-297) allows for identification and classification of native wildlife species with a need for protection or management to ensure their survival as free-ranging populations in Washington State and to define the process by which listing, management, recovery, and de-listing of a species can be achieved. *Endangered* means any wildlife species native to Washington State that is seriously threatened with extinction throughout all or a significant portion of its range within the state. *Threatened* means any wildlife species native to Washington State that is likely to become an endangered species in the foreseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats. *Sensitive* means any wildlife species native to Washington State that is vulnerable or declining and is likely to become endangered or threatened in a

3 If the hearing threshold returns to the pre-exposure value, it is called a *temporary threshold shift* (TTS) (Southhall et al. 2007). A human-based example is a temporary reduction in hearing sensitivity (and perhaps ringing in the ears) that may be experienced by a person attending a concert, but hearing sensitivity returns to pre-concert levels in a few hours.

significant portion of its range within the state without cooperative management or removal of threats. While listed, each species is by law under federal and/or state protection.

4.2.2 Marine Mammals

Twenty-nine marine mammal species have the potential to occur in Washington State waters (Table 4.2-1), including 23 cetaceans (whales, dolphins, and porpoises), 5 pinnipeds (seals, sea lions, and walruses), and sea otters. Of these, 16 species have the potential to occur in the study area (Table 4.2-1).

Summary information for each species is provided in Table 4.2-1; these species are more fully discussed in Appendix F. Information was obtained from NMFS North Pacific Marine Mammal Stock Assessment Reports, various recovery plans, technical reports, scientific publications, and the National Marine Mammal Laboratory in Seattle.

4.2.2.1 Habitat Use

The prominent inland water species (i.e., Puget Sound) are the killer whale, harbor seal, and harbor porpoise. Other marine mammal species occur off the coast and rarely, if ever, enter the inland waters of Washington State (Table 4.2-1). Coastal species include the humpback whale, gray whale, harbor porpoise, Dall's porpoise, Pacific white-sided dolphin, northern right whale dolphin, Risso's dolphin, harbor seal, fur seal, and sea otter.

4.2.2.2 Protected Mammal Species

Of the 29 marine mammal species with the potential to occur in Washington State waters, 16 could occur in the study area. Of these, four are listed as endangered or threatened under federal ESA (southern resident killer whale, fin whale, blue whale, and humpback whale), and three are listed under the state ESA (Dall's porpoise, gray whale, and harbor seal). Further information on the life history and occurrence of each of these species in the study area is provided in Appendix F. The draft Biological Evaluation (Appendix G) provides a more thorough discussion of the life history and listing status of each of the federally listed species. All marine mammals listed as threatened or endangered under the ESA are also protected under the MMPA. Under the MMPA, the eastern North Pacific stock[4] of northern fur seal is designated as depleted.

4.2.2.3 Common Marine Mammal Species in Washington Waters

Cetaceans (whales, dolphins, and porpoises) can be broken into two categories based on how they feed: the strainers (i.e., baleen whales) that sift and strain their food, and the biters (i.e., toothed mammals—pinnipeds, dolphins, and porpoises) that bite and gulp their food—as do seals and sea lions.

Eleven commonly observed marine mammals occur in Washington waters (Table 4.2-2). Of these species, six would be expected to occur in the study area: the harbor seal, California sea lion, northern elephant seal, Dall's porpoise, harbor porpoise, and gray whale. The other five species are more common in open water off the Washington coast and would not be expected to occur in the study area.

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[4] As defined by the Marime Mammal Protection Act, the term *stock* means a group of marine mammals of the same species or smaller taxa in a common spatial arrangement that interbreed when mature (http://www.nmfs.noaa.gov/pr/glossary.htm).

Table 4.2-1 Marine Mammals off the Washington Coast

Species	Scientific Name	Relative Abundance	Primary Location[a]	Primary Prey	Season(s) Present	Federal/ State Status	Occurs in Study Area?
Harbor seal	*Phoca vitulina*	Common	Ocean/ inland	Fish	Year-round	State monitored	Yes
California sea lion	*Zalophus californianus*	Common	Ocean/ inland	Fish	Summer/ spring	None	Yes
Steller sea lion (eastern DPS)	*Eumetopias jubatus*	Common	Ocean/ inland	Fish	Year-round	None	Yes
Northern elephant seal	*Mirounga angustirostris*	Common	Ocean/ Inland	Fish/ squid/ crab	Summer/ fall	None	Yes
Northern fur seal	*Callorhinus ursinus*	Common	Ocean	Fish/ squid	Year-round	None	Yes
Dall's porpoise	*Phocoenoides dalli*	Common	Ocean/ inland	Fish	Year-round	State monitored	Yes
Harbor porpoise	*Phocoena phocoena*	Common	Ocean/ inland	Fish/ squid	Year-round	None	Yes
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	Common	Ocean	Fish	Year-round	None	Yes
Northern right whale dolphin	*Lissodelphis borealis*	Common	Ocean	Fish/squid	Year-round	None	Yes
Common dolphin	*Delphinus delphis*	Uncommon	Ocean	Squid/ fish	Unknown	None	No
Striped dolphin	*Stenella coeruleoalba*	Uncommon	Ocean	Fish/squid/ zooplankton	Unknown	None	No
Risso's dolphin	*Grampus griseus*	Common	Ocean	Squid	Year-round	None	Yes
Southern resident killer whale[b]	*Orcinus orca*	Common	Ocean/ inland	Fish/marine mammals	Year-round	Federally and state listed as endangered	Yes
False killer whale	*Pseudorca crassidens*	Uncommon	Ocean	Fish	Unknown	None	No
Pilot whale	*Globicephala macrorhynchus*	Uncommon	Ocean	Fish/octopus	Unknown	None	No
Pygmy sperm whale	*Kogia breviceps*	Uncommon	Ocean	Octopus/ fish/squid	Unknown	None	No
Gray whale	*Eschrichtius robustus*	Common	Ocean/ Inland	Crustaceans	Year-round	State sensitive	Yes
Humpback whale	*Megaptera novaeangliae*	Uncommon	Ocean	Zooplankton/ fish	Spring to fall	Federally and state listed as endangered	Yes

Table 4.2-1 Marine Mammals off the Washington Coast (Continued)

Species	Scientific Name	Relative Abundance	Primary Location[a]	Primary Prey	Season(s) Present	Federal/ State Status	Occurs in Study Area?
Sperm whale	*Physeter catadon*	Uncommon	Ocean	Squid/fish	Spring to fall	Federally and state listed as endangered	No
Minke whale	*Balaenoptera acutorostrata*	Common	Ocean/ inland	Fish/squid	Year-round	None	Yes
Fin whale	*Balaenoptera physalus*	Uncommon	Ocean	Fish/ zooplankton	At least winter	Federally and state listed as endangered	Yes
Blue whale	*Balaenoptera musculus*	Uncommon	Ocean	Zooplankton	Not known	Federally and state listed as endangered	Yes
Sei whale	*Balaenoptera borealis*	Uncommon	Ocean	Zooplankton	Not known	Federally and state listed as endangered	No
Black right whale	*Balaena glacialis*	Rare	Ocean	Zooplankton	At least spring	Federally and state listed as endangered	No
Baird's beaked whale	*Berardius bairdii*	Rare	Ocean	Squid/ octopus/ fish	At least fall	None	No
Curvier beaked whales	*Ziphius cavirostris*	Rare	Ocean	Squid/fish	Unknown	None	No
Hubb's beaked whale	*Mesoplodon carlhubbsi*	Rare	Ocean	Squid/fish	Unknown	None	No
Stejneger's beaked whale	*Mesoplodon stejnegeri*	Rare	Ocean	Squid/fish	Unknown	None	No
Sea otter (Alaska stock)	*Enhydra lutris kenyoni*	Common	Ocean	Sea urchins/ clams	Year-round	State listed as endangered, federal species of concern	No

DPS = distinct population segment

[a] "Ocean" includes all water westward off the Washington coast. "Inland water" includes saltwater between Washington State and British Columbia, including Puget Sound, Strait of Juan de Fuca, Southern Georgia Strait, and the San Juan Islands.

[b] In 2005, the southern resident killer whale population was listed as endangered by the National Marine Fisheries Service. Transient and offshore killer whales are not listed under the Endangered Species Act but are known to occur in the study area.

Sources: Haley 1978; Brueggeman et al. 1992; NMFS 1992; Green et al. 1993; Ferrero et al. 2000; Forney et al. 2000; WDFW 2011.

Table 4.2-2 Common Marine Mammals in Washington Waters

Species	Scientific Name	Relative Abundance	Primary Location[a]	Primary Prey	Season(s) Present	Federal/ State Status	Occurs in Study Area?
Harbor seal	*Phoca vitulina*	Common	Ocean/ inland	Fish	Year-round	State monitored	Yes
California sea lion	*Zalophus californianus*	Common	Ocean/ inland	Fish	Summer/ spring	None	Yes
Northern elephant seal	*Mirounga angustirostris*	Common	Ocean/ inland	Fish/squid/crab	Summer/ fall	None	Yes
Northern fur seal	*Callorhinus ursinus*	Common	Ocean	Fish/squid	Year-round	None	No
Dall's porpoise	*Phocoenoides dalli*	Common	Ocean/ inland	Fish	Year-round	State monitored	Yes
Harbor porpoise	*Phocoena phocoena*	Common	Ocean/ inland	Fish/squid	Year-round	None	Yes
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	Common	Ocean	Fish	Year-round	None	No
Northern right whale dolphin	*Lissodelphis borealis*	Common	Ocean	Fish/squid	Year-round	None	No
Risso's dolphin	*Grampus griseus*	Common	Ocean	Squid	Year-round	None	No
Gray whale	*Eschrichtius robustus*	Common	Ocean/ inland	Crustaceans	Year-round	State sensitive	Yes
Minke whale	*Balaenoptera acutorostrata*	Common	Ocean/ inland	Fish/squid	Year-round	None	No

[a] "Ocean" includes water off the Washington coast. "Inland" includes saltwaterbetween Washington State and British Columbia, including Puget Sound, Strait of Juan de Fuca, Southern Georgia Strait, and the San Juan Islands.

Sources: Haley 1978; Brueggeman et al. 1992; NMFS 1992; Green et al. 1993; Ferrero et al. 2000; Forney et al. 2000; WDFW 2011.

4.2.2.4 Uncommon Marine Mammal Species in Washington Waters

Nine species of marine mammals (not including the ESA-listed species discussed above) are uncommon or rare in Washington waters (Table 4.2-3). These include four species of toothed whales, three species of baleen whales, and two species of dolphins. Most of these species would be expected to occur seasonally, in low numbers, and in deeper offshore waters outside the study area. Brueggeman et al. (1992) observed a small number of false killer whales in spring and beaked whales in fall off the Washington coast. Five groups of Baird's beaked whales (totaling 21 whales) also were observed, but all were off the Oregon coast during spring and summer, suggesting low occurrence of this species in Washington waters. Some limited information is available on this group of uncommon marine mammals, but little is known about their use of waters off the Washington coast. These species would not be expected to occur in the study area.

Table 4.2-3 Marine Mammals Not Expected to Occur in the Study Area

Species	Scientific Name	Relative Abundance	Primary Location[a]	Primary Prey	Season(s) Present	Federal/ State Status
Common dolphin	*Delphinus delphis*	Uncommon	Ocean	Squid/fish	Unknown	None
Striped dolphin	*Stenella coeruleoalba*	Uncommon	Ocean	Fish/squid/ zooplankton	Unknown	None
False killer whale	*Pseudorca crassidens*	Uncommon	Ocean	Fish	Unknown	None
Pilot whale	*Globicephala macrorhynchus*	Uncommon	Ocean	Fish/ octopus	Unknown	None
Pygmy sperm whale	*Kogia breviceps*	Uncommon	Ocean	Octopus/ fish/ squid	Unknown	None
Baird's beaked whale	*Berardius bairdii*	Rare	Ocean	Squid/octop us/ fish	At least fall	None
Curvier beaked whales	*Ziphius cavirostris*	Rare	Ocean	Squid/fish	Unknown	None
Hubb's beaked whale	*Mesoplodon carlhubbsi*	Rare	Ocean	Squid/fish	Unknown	None
Stejneger's beaked whale	*Mesoplodon stejnegeri*	Rare	Ocean	Squid/fish	Unknown	None

[a] "Ocean" includes all water westward off the Washington coast.

Sources: Haley 1978; Brueggeman et al. 1992; NMFS 1992; Green et al. 1993; Ferrero et al. 2000; Forney et al. 2000; WDFW 2011.

4.2.2.5 Vocalizations and Hearing in Marine Mammals

Sound travels much farther underwater than in air, and the sounds produced by many marine mammals can project for miles (DOSITS 2013). Some marine mammals rely on echolocation to aid in navigation and hunting within their environment. *Echolocation* involves the emission of sound and the reception of its echo, which allows the animal to gather information about objects and prey around them, including their range and configuration. Therefore, it is important to understand marine mammal vocalizations and hearing to assess the potential effects on whales and dolphins of vessels traveling to and from the BP Cherry Point dock (Section 6.2).

The most common source of anthropogenic noise in Admiralty Inlet is vessel traffic (Bassett et al. 2012). Based on the size and speed of the vessel, source noise levels for vessel traffic vary significantly—from

150 dB re 1 μPa at 1 meter (3.3 feet) for small fishing vessels up to 195 dB re 1 μPa at 1 meter (3.3 feet) for super tankers (Gray and Greeley1980, Kipple and Gabriele 2003, and Hildebrand 2005 as cited in Bassett et al. 2012). In the absence of vessel traffic, other noise sources, such as distant vessel traffic, wind, and waves, are likely to dominate (Bassett et al. 2012).

Background sound data have not been collected specific to this project; however, noise studies performed by Bassett (2010) estimate permanent noise (the noise present when all identifiable sources have been removed, the lowest level of background recurring noise) as 98 dB re 1 μPa. Although Murray (2007) measured the ambient sound level at ConocoPhillips (in the vicinity of Cherry Point) from 117 to 139 dB re 1 μPa, with a mean of 130 dB re 1 μPa, this ambient sound level included routine activities at the dock and nearby tug traffic.

Given the relatively small contribution oil/chemical carriers made to the energy budget at Admiralty Inlet and assuming that is representative of the study area, the small increase in vessel calls at BP Cherry Point dock would not be expected to increase ambient noise levels. The noise from these vessels would be transient and therefore would not result in long-term effects to biological organisms. Short-term effects due to an increase in noise from close approaches of passing vessels could be experienced by both baleen and toothed whales, and may include temporary call masking and potential changes in diving and foraging behavior (NRC 2005).

Toothed Whales

Toothed whales use echolocation to detect the size and nature of objects in their environment. Killer whales produce a wide variety of clicks, whistles, and pulsed calls. Their clicks are relatively broadband and short (0.1 to 25 milliseconds); the clicks range in frequency from 8 to 80 kiloHertz (kHz), with an average center frequency of 50 kHz and an average bandwidth of 40 kHz (Au et al. 2004). Studies of other toothed whales (dolphins and porpoises) found that the most sensitive frequencies were between 8 and 90 kHz (Richardson et al. 1995).

Most toothed whales hear in a frequency range that extends from 1 to at least 120 kilohertz (kHz), but they are most sensitive in the range of 18 to 42 kHz (Szymanski et al. 1999). The hearing range of most toothed whales is above the frequency of large vessels (Richardson et al. 1995).

Baleen Whales

Unlike toothed whales, baleen whales have not been shown to use echolocation to detect the size and nature of objects. However, baleen whales use sound as a long-range acoustic communication system to facilitate mating and social interactions. Baleen whales are thought to be most sensitive to a range of low-frequency sounds occurring in the 0.01 to 1 kHz range (Merchant et al. 2012). Most industrial sounds, including those from large vessels, fall within the hearing range of baleen whales. However, most baleen whales show no avoidance of vessels, provided they are not directly approached by them (Watkins 1986).

Pinnipeds

Pinnipeds, like toothed whales, are sensitive to noise above 1 kHz. Most pinnipeds hear at frequencies between 1 and 50 kHz, and some can detect intense higher frequencies up to 60 kHz (Richardson et al. 1995; Schusterman 1981; Schusterman et al. 1972). Pinniped hearing ranges occur above frequencies emitted by large vessels, as evidenced by their generally mild or lack of response to large vessels. Pinnipeds commonly approach vessels, indicating their high tolerance for vessel noise and presence (Richardson et al. 1995).

Sea Otters

Little information is available on sea otter hearing sensitivity. Limited studies have documented mother and pup calls ranging from 3 to 5 kHz, with the probability that some calls reach higher frequencies (Sandegren et al. 1973). Sea otters appear to be minimally disturbed by vessel noise and commonly approach vessels.

4.2.3 Marine Turtles

Information on marine turtles was obtained from NOAA, USFWS, and WDFW publications and reports. All sea turtles are listed under the ESA and are under the joint jurisdiction of NOAA and the USFWS. Marine turtles with the potential to occur in the study area include the leatherback, loggerhead, olive ridley, and green sea turtles (Table 4.2-4). The presence of loggerhead, olive ridley, and green sea turtles in the area would be atypical as the study area is beyond the normal range of these species occurrence and contains unsuitable habitat due to cold water temperatures. The leatherback turtle regularly occurs off the coast of Washington and could occur in the study area.

Table 4.2-4 Marine Turtles with the Potential to Occur in the Study Area

Species	Scientific Name	Relative Abundance	Primary Location[a]	Primary Prey	Season(s) Present	Federal/ State Status	Occurs in Study Area?
Leatherback sea turtle	*Dermochelys coriacea*	Common	Ocean	Jellyfish	Summer/ fall	Federally and state listed as endangered	Yes
Loggerhead sea turtle	*Caretta caretta*	Rare	Ocean	Shellfish/ jellyfish	Uncommon	Federally listed as endangered and state listed as threatened	No
Olive ridley sea turtle	*Lepidochelys olivacea*	Rare	Ocean	Fish/ shellfish/ jellyfish/ algae	Uncommon	Federally listed as threatened	No
Green sea turtle	*Chelonia mydas*	Uncommon	Ocean	Seagrass/ algae	Uncommon	Federally and state listed as threatened	No

[a] "Ocean" includes all water westward off the Washington coast.

Source: NMFS 2014

Sea turtles are highly adapted for life in the marine environment with the aid of powerful, modified forelimbs that allow continuous swimming for extended periods. Sea turtles are among the longest and deepest diving of the air-breathing marine vertebrates, with some species spending as little as 3 to 6 percent of their time at the water's surface. Sea turtles often travel thousands of miles between their nesting beaches and feeding grounds.

4.2.3.1 Habitat Use and Species Distribution

Most marine turtle species spend much of their lives in warm temperate and tropical continental shelf waters, where males do not leave the sea and females come ashore only to lay their eggs on sandy beaches during the spring/summer season. During the nesting season, mature males and females migrate from feeding grounds and mate near the beach where the females nest (WWF 2013). Other than the deep oceans, important sea turtle habitat includes protected bays and estuaries, and nearshore waters and seagrass beds.

The distribution of sea turtles in the ocean off the West Coast of the United States is strongly affected by seasonal changes in water temperature. The Pacific Coast experiences cool water temperatures (less than 68°F), where sea turtles are far less abundant compared to warmer waters. Cool water temperatures prevent sea turtles from nesting on U.S. West Coast beaches and may also inhibit reproductive activity, by reducing the quality and availability of food resources in the area. The northernmost known nesting sites of leatherbacks and olive ridley sea turtles in the eastern Pacific Ocean occur along the coast of Baja California. After nesting, female leatherbacks migrate north and can be found in summer and fall off the coast of southern Washington, particularly off the Columbia River mouth, where they feed on jellyfish (WDFW 2012).

As noted, the occurrence of loggerhead, olive ridley, and green sea turtles in Puget Sound would be atypical; however, leatherback turtles could be present. Further information on the life history and occurrence of leatherbacks is provided in Appendix F and Appendix G.

4.2.4 Birds

Approximately 160 species of birds use the coastal and marine resources in the study area during some portion of the year (Paulson 2007; Wahl et al. 2005). In general, the diversity and abundance of birds in the study area are highest during spring and fall migration periods and during winter. Many birds that overwinter south of the study area stop in the study area during migration; they gather energy reserves and nutrients to fuel migration to more southern latitudes where they breed. Many birds overwinter and some birds breed in the study area. Bird populations in the study area are inventoried during both the nesting season and during winter (Mahaffy et al. 1994).

Types of birds occurring in the study area include waterfowl (ducks, geese, and swans), seabirds (loons, grebes, pelicans, cormorants, gulls, terns, auks, and puffins), raptors (eagles, osprey, hawks, merlins, falcons, and vultures), shorebirds (plovers, oystercatchers, sandpipers, and phalaropes), and “other coastal birds” (herons, coots, and songbirds). The variety of birds in the study area reflects the variety of habitats and the contribution of marine-based nutrition. These bird groups, the common species within each group, their population status, and the specific habitats used are described in detail in Appendix F and summarized below.

4.2.4.1 Habitat Use

Waterfowl, seabird, raptor, shorebird and “other coastal birds” may be found within five coastal and marine habitats: coastal dunes and beaches, coastal headlands and inlets, bays and estuaries, inland marine deep waters, and marine nearshore waters (Wahl et al. 2005). Coastal dunes and beaches include sand beaches above the high-tide line, non-forested sand dunes, spits, and berms along the coast. Coastal headlands and islets include shrublands and grasslands that occur on exposed headlands and islands along the outer coast and small islands in inland waters of Puget Sound. Bays and estuaries include areas with significant mixing of saltwater and freshwater, including the lower reaches of rivers, intertidal sand and mud flats, salt and brackish marshes, and open water portions of associated bays. Inland marine deep water includes open waters deeper than 20 meters (66 feet) in Puget Sound, Hood Canal, the Strait of Georgia, around the San Juan Islands, and the Strait of Juan de Fuca east of the Elwha River. Marine nearshore waters includes marine waters that are less than 20 meters (66 feet) deep and the intertidal zone up to the high-tide line (Wahl et al. 2005).

The habitat type used by each group is summarized in Table 4.2-5. Waterfowl primarily use bays and estuaries (93 percent of species) and nearshore marine waters (52 percent of species). Seabirds occur throughout all coastal habitats. Raptors use coastal dunes and beaches and bays and estuaries (78 percent of species) but occur across all habitats. Most shorebirds use bays and estuaries (87 percent of species) and sand beach habitats (74 percent of species). "Other coastal birds," including wading birds and many songbird species, use costal habitats and bays and estuaries; these species rarely occur in marine waters. For all bird species combined, the greatest number of species occur within bays and estuaries (74 percent of species), followed by coastal dunes and beaches (55 percent of species).

Table 4.2-5 Numbers of Bird Species in Study Area Coastal and Marine Habitats

Habitat Type	Bird Groups					All Birds
	Waterfowl	Seabirds	Raptors	Shorebirds	"Other Coastal Birds"	
Coastal dunes and beaches	0	19	7	23	38	87
Coastal headlands and islets	0	25	4	8	25	62
Bays and estuaries	27	33	7	27	24	118
Inland marine deep waters	7	27	1	1	1	37
Marine nearshore	15	37	4	1	4	61
Total species	**29**	**42**	**10**	**31**	**47**	**159**

Note: The numbers in the table represent numbers of bird species from the 159 total species that use coastal and marine resources in the study area during some portion of the year.

Sources: Paulson 2007; Wahl et al. 2005.

Coastal and marine habitats in the study area are used for breeding, overwintering, and stopovers during migration. Most waterfowl that breed in the study area are not as closely associated with marine habitats during breeding as they are during migration, molt, or overwintering. Three national wildlife refuges (NWRs) in the study area support nesting seabird populations: (1) Protection Island NWR, which supports approximately 70 percent of the nesting seabird population of Puget Sound and the Strait of Juan de Fuca; (2) San Juan Islands NWR, which includes 83 rocks, reefs, and islands throughout the San Juan Islands; and (3) Flattery Rocks NWR, which extends from Cape Flattery southward along the outer Washington coast. Dungeness NWR includes one of the world's longest natural sand spits, which is used extensively by staging Brant geese and shorebirds. Raptor nests occur in large trees or cliffs throughout the study area, and many raptors remain year-round. A few shorebirds nest along shorelines in the study area, but their primary use is during migration. Herons nest colonially in trees in the study area; and many songbirds nest in shrubs, trees, cliffs or grasses along shorelines and estuarine riparian areas. Summer bird densities in the study area are highest in bays and estuaries, with moderate density (200-400 birds/km^2) recorded near Cherry Point, as shown in Figure 4.2-1.

During summer surveys, seabirds (primarily gulls and terns) predominate (87 percent), followed by waterfowl (8 percent), and "other coastal birds" (5 percent) (Nysewander et al. 2005). Of the 160 species of birds likely to occur in study area habitats, 48 species are considered to breed in the study area, including 13 seabird species, 4 raptor species, 4 shorebird species, and 27 "other coastal bird" species (Wahl et al. 2005). Total bird densities during summer average approximately an order of magnitude less than total bird densities during winter, based on aerial surveys (Nysewander et al. 2005). During winter, waterfowl predominate (68 percent), followed by seabirds (21 percent), and shorebirds (11 percent) (Nysewander et al. 2005). Winter bird densities in the study area also reach their maximum values within bays and estuaries, with moderate densities (75–400 birds/km^2) near Cherry Point (Figure 4.2-2).

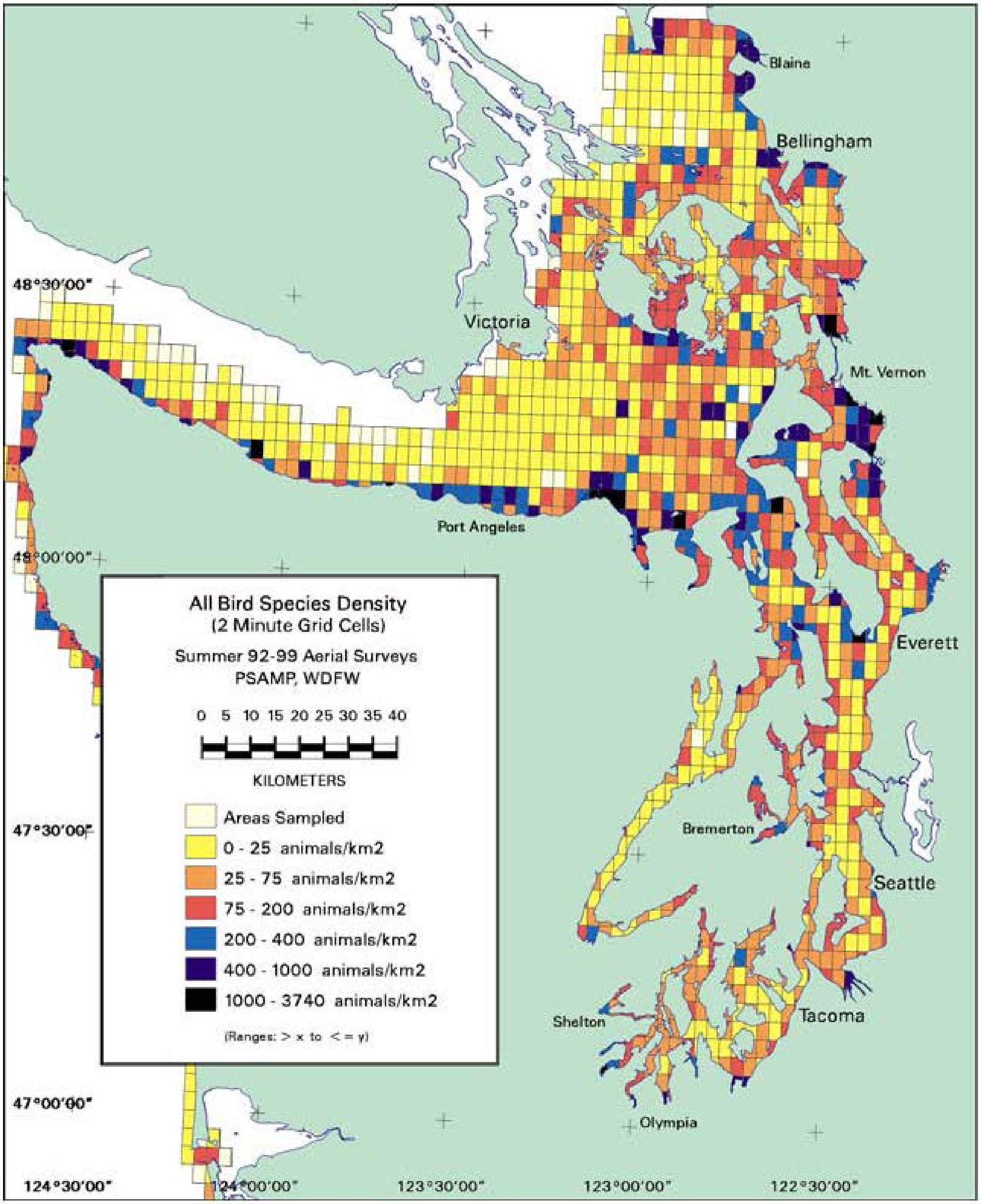

Figure 4.2-1 Summer Bird Density during 1992–1999 Aerial Surveys (July)

Source: Nysewander et al. 2005.

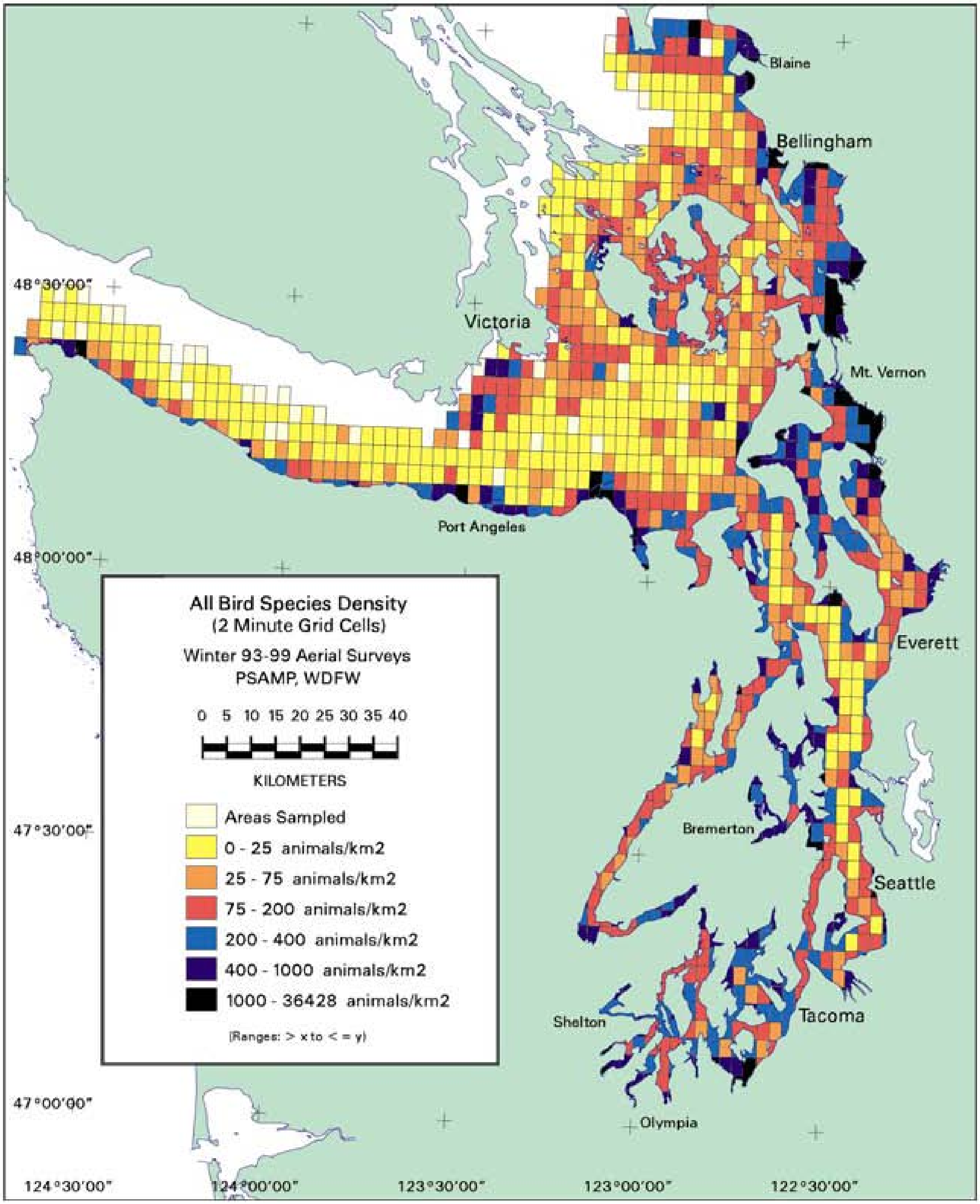

Figure 4.2-2 Winter Bird Density during 1993–1999 Aerial Surveys (December to February)

Source: Nysewander et al. 2005.

4.2.4.2 Protected Bird Species

All birds occurring in the study area are protected by the MBTA. Bald eagles have been de-listed from the ESA but are protected by the Bald and Golden Eagle Protection Act. The marbled murrelet is listed as threatened under both the federal and state ESA. The draft Biological Evaluation, included as Appendix G, provides a more thorough discussion of the life history and listing status of this species. The WDFW has designated special status for 11 bird species under the state ESA. Two bird species are listed as endangered, six bird species are listed as candidates for protection, and three bird species are considered sensitive. Table 4.2-6 shows protected birds and birds of conservation concern with the potential to occur in the study area. A discussion of the life history and listing status of these state-listed species is provided in Appendix F.

Table 4.2-6 Special-Status Birds with the Potential to Occur in the Study Area

	Protection Status			
	Federal Status		State Status	
Species (Scientific Name)	Global Score	Designation	State Score	Designation
Seabirds				
Common loon (*Gavia immer*)	G5	None	S2B/S4N	Sensitive
Western grebe (*Aechmophorus occidentalis*)	G5	None	S3B/S3N	C
Brown pelican (*Pelecanus occidentalis*)	G4	C	S3N	E
Brandt's cormorant (*Phalacrocorax penicillatus*)	G5	None	S3B/S4N	C
Common murre (*Uria aalge)*	G5	None	S4B/S5N	C
Marbled murrelet (*Brachyramphus marmoratus*)	G3	T	S3	T
Cassin's auklet (*Ptychoramphus aleuticus*)	G4	SC	S3	C
Tufted puffin (*Fratercula cirrhata*)	G5	SC	S3S4B/S4N	C
Raptors				
Bald eagle (*Haliaeetus leucocephalus*)	G4	SC	S4B/S4N	Sensitive
Peregrine falcon (*Falco peregrinus*)	G4	SC	S2B/S3N	Sensitive
"Other Coastal Birds"				
Streaked horned lark (*Eremophila alpestris strigata*)	G5T2	C	S1B	E
Purple martin (*Progne subis*)	G5	None	S3B	C

Global Score: G5 = Secure; G4 = Apparently Secure; G5T4 = Apparently Secure (Rounded); G5T2 = Imperiled (Rounded); G3 = Vulnerable

State Score: B = Breeding; N = Non-breeding; S5 = Secure; S4 = Apparently Secure; S3 = Vulnerable; S2 = Imperiled; S1 = Critically Imperiled; SH = Possibly Extirpated; SX = Presumed Extirpated

Designations (federal and state): E = Endangered; T = Threatened; C = Candidate; SC = Species of Concern; D = De-Listed

Sources: NatureServe 2010; WDFW 2011.

4.2.4.3 Bird Groups in the Study Area

Waterfowl

Waterfowl are medium to large plump-bodied birds with long necks and short wings that are commonly found on or near water. Waterfowl feed while on the water by diving completely beneath the water's surface during feeding (diving ducks) or by tilting their bodies so that their heads and necks are submerged (dabbling ducks) to search for fish, plants, and invertebrates.

Most waterfowl are migrants or winter visitors, although non-breeding individuals including sub-adult birds may remain in the study area year-round; some waterfowl may breed in the study area.

All waterfowl are protected by the MBTA, and all waterfowl species occurring in the study area are harvested by sportsmen in Washington (USFWS 2007). The most commonly harvested species (>10,000/year) include Canada goose, snow goose, mallard, wigeon, green-winged teal, and northern pintail (USFWS 2007).

Geese and swans use bays and estuaries for feeding, especially during migration. Snow geese obtain most of their food by grubbing for rhizomes of bulrushes in tidal marshes, while swans feed on eelgrass leaves, grasses, and sedges (Ducks Unlimited 2013). Dabbling ducks generally feed on or near the water's surface in bays and estuaries—although the American wigeon, mallard, and northern pintail also use nearshore habitats. Diving ducks are diverse in their foraging habits.

Seabirds

Seabirds include a diverse assemblage of birds that are tied to marine habitats during at least a portion of their life cycle. Loons, grebes, cormorants, auks, and puffins feed by diving deeply for fish or invertebrates, while gulls and terns feed near the water surface or shoreline. Albatrosses, shearwaters, and petrels spend much of their life at sea, feeding from the water's surface and coming to land only to nest.

Seabirds occurring in the study area generally belong to species that are widely distributed throughout the Pacific coast from Alaska to California. Loons and grebes are generally migrants or winter visitors, as are some of the arctic-breeding gull and tern species. Cormorant, ring-billed gull, glaucous-winged gull, common murre, and pigeon guillemot are common year-round resident seabirds. Caspian tern and rhinoceros auklet move into the study area during spring and summer to nest and rear their young.

Seabirds dominate the birds occurring in the study area during summer but account for less than one-quarter of all birds recorded during winter (Nysewander et al. 2005). Major seabird nesting colonies in the study area occur at Protection Island, at islets within the San Juan Islands, and off Cape Flattery (Figure 4.2-3).

All seabirds are protected by the MBTA. Few seabirds are harvested for food, although historically seabird nesting colonies provided a subsistence food source for humans.

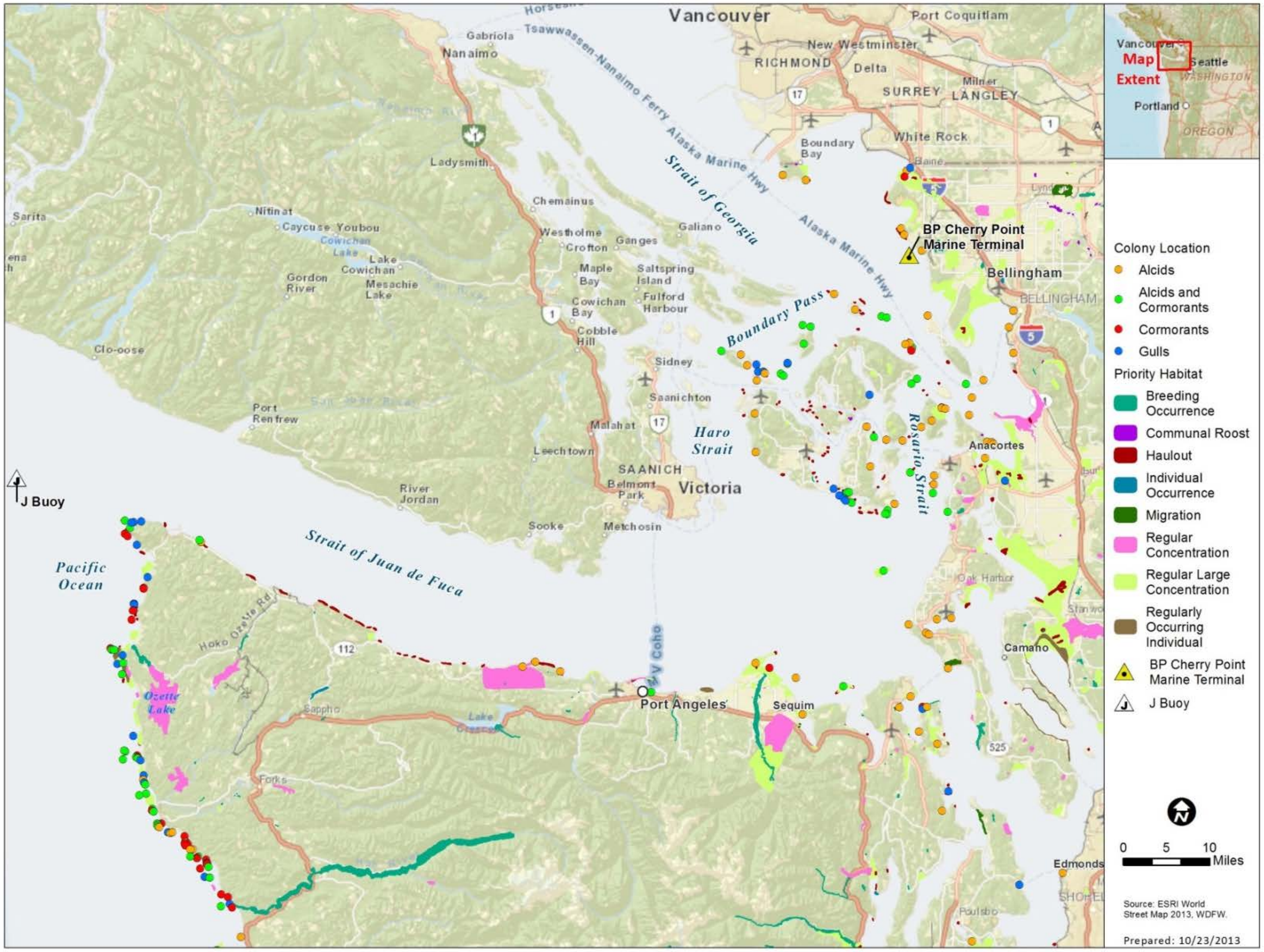

Figure 4.2-3 Seabird Nesting Colonies in the Study Area, Showing Nesting Species and Recent Relative Abundance

Source: Nysewander et al. 2005.

Loons and grebes occur in bays and estuaries and in nearshore marine and inland marine habitats (Wahl et al. 2005). They feed on fish and aquatic insects, and both loons and grebes primarily nest on freshwater and winter on saltwater. Cormorants occur in bays and estuaries, in nearshore marine habitats, and in headlands and islets (Wahl et al. 2005). Cormorants feed on herring, shiner perch, gobies, rockfish, anchovy, plainfin midshipman, saury, sanddab, sole, shrimp, and squid (Vermeer and Ydenberg 1989).

Gulls and terns occur in nearshore marine habitats, dunes and beaches, bays and estuaries, headlands and islets, and inland marine habitats (Wahl et al. 2005). Gull and tern diets vary with the species but include bivalves, barnacles, mussels, sea urchins, limpets, shrimp, crabs, herring and herring spawn, salmon, blennies, lampreys, and sculpins (Vermeer and Ydenberg 1989). Auks and puffins are diving birds that spend most of their time at sea, coming to land primarily for nesting. Auks forage primarily on fish and invertebrates, including herring, sand lance, shiner perch, smelt, rockfish, sculpins, flatfish, squid, shrimp, and crab; but they may feed their chicks primarily fish, and probably feed more on invertebrates during winter (Vermeer and Ydenberg 1989).

Raptors

For the purposes of this discussion, raptors include vultures, osprey, eagles, harriers, kites, hawks, merlins, falcons, and owls. Hawks, eagles, harriers, and falcons are medium to large birds with upright posture and strong, short, hooked beaks. Their acute vision enables them to catch live vertebrate prey. Vultures share these characteristics but feed primarily on carcasses of large animals. Osprey are large diving hawks that subsist on a diet of live fish. Six species of raptors that use shoreline habitats are common or fairly common in the study area. Kites, merlins, and owls do not commonly occur in the study area.

All raptors present in the study area occur throughout North America. Common species are most abundant in the study area either during winter (i.e., northern harrier and rough-legged hawk), nesting (i.e., turkey vulture and osprey), migration (i.e., peregrine falcon), or year-round (i.e., bald eagle). Peregrine falcons also nest in the study area.

The bald eagle is the most common raptor in the study area and occurs throughout the study area (Figure 4.2-4). Bald eagles and osprey nest in large shoreline trees during early spring and summer. Turkey vultures are most common during spring and fall migrations, and northern harriers are a fairly common migrant and resident bird in portions of the study area (Wahl et al. 2005). The rough-legged hawk is a fairly common migrant and winter resident in portions of the study area; peregrine falcons may occur year-round but are most common during fall migrations (Wahl et al. 2005). The distribution of peregrine falcon in the study area is illustrated in Figure 4.2-5.

All raptors are protected by the MBTA, and the bald eagle is also protected by the Bald and Golden Eagle Protection Act. The bald eagle and peregrine falcon were formerly protected under the ESA.

Raptors occur in coastal dunes and beaches, bays and estuary, nearshore marine habitats, headlands and islets, and inland marine habitats (Wahl et al. 2005). Osprey, bald eagle, northern harrier, and peregrine falcon nest in the study area. Osprey nest along shorelines, generally in tall emergent trees, and forage for fish in marine and freshwater habitats. Bald eagles nest near water in large conifers and forage in coastal areas, shifting from marine shorelines to inland rivers when salmon carcasses are abundant (Wahl et al. 2005). Northern harriers nest in marshes and forage in wetlands and tidal flats in the study area (Wahl et al. 2005). The rough-legged hawk forages in estuarine habitats. Peregrine falcons forage and winter on large river deltas, estuaries, and coastal beaches, where they feed on shorebirds and waterfowl (Wahl et al. 2005). Turkey vultures forage along shorelines, scavenging for dead fish, seals, and other animals (Wahl et al. 2005).

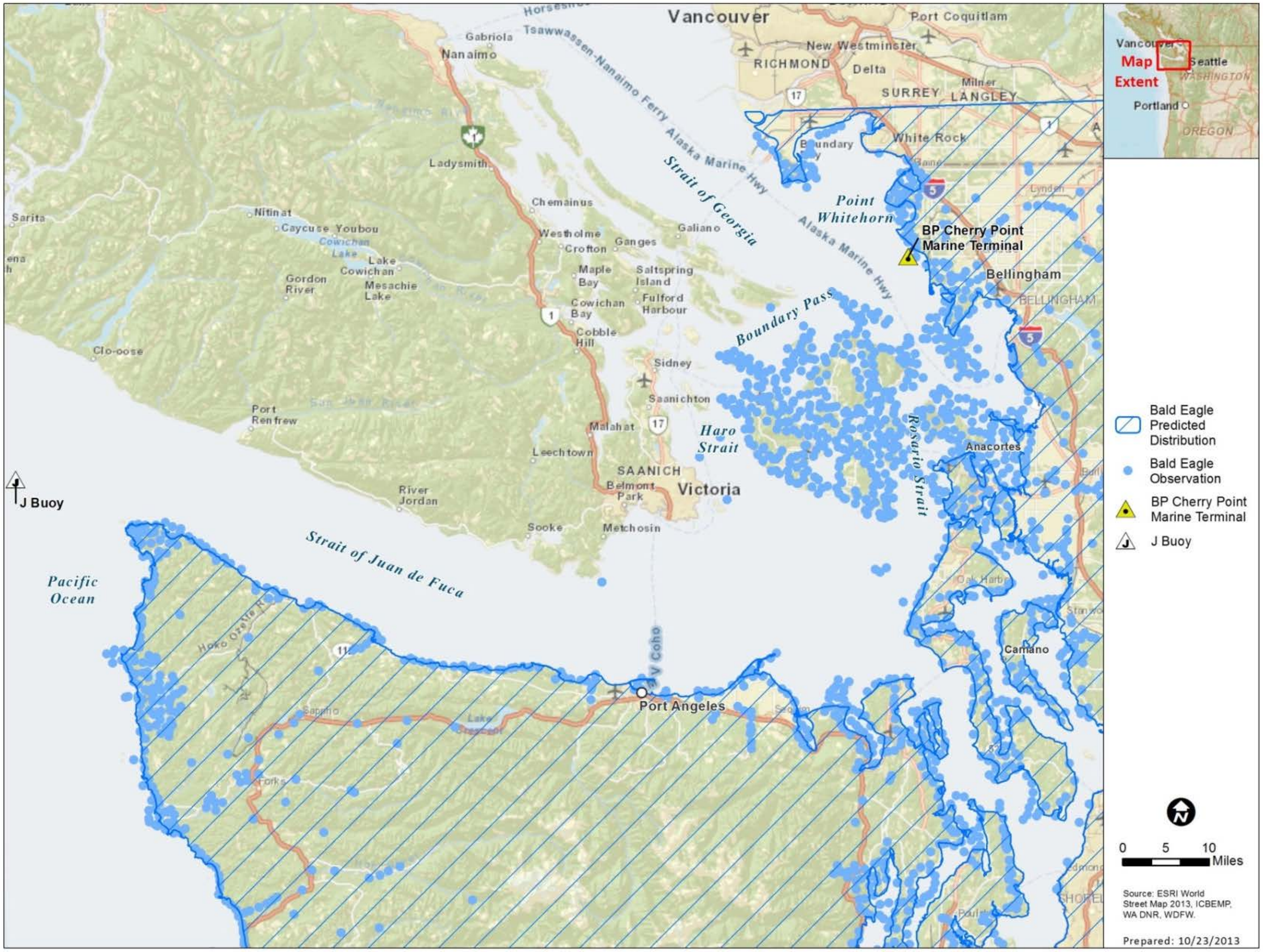

Figure 4.2-4 **Distribution of Bald Eagles in the Study Area**

Source: WDFW 2006.

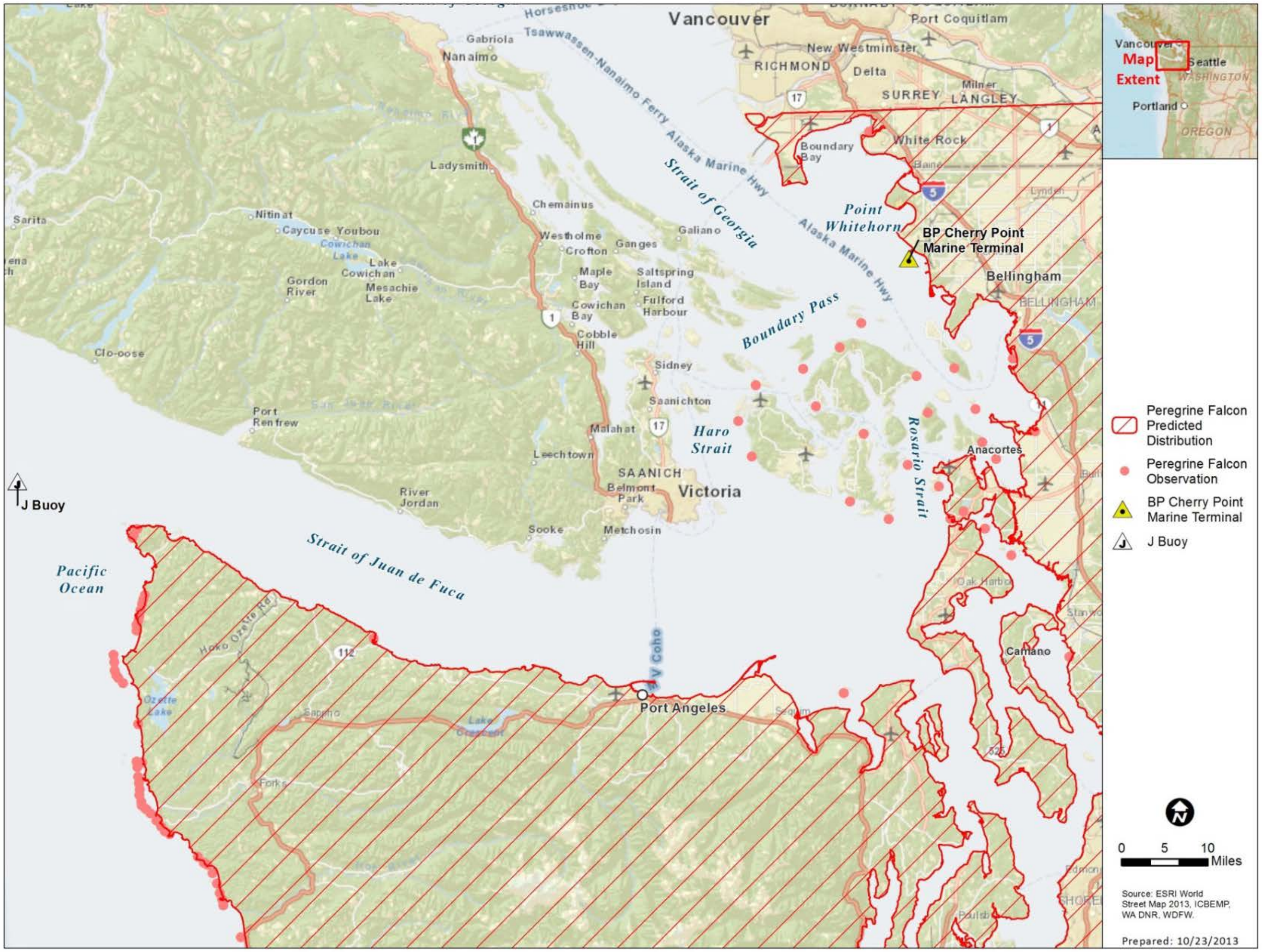

Figure 4.2-5 **Distribution of Peregrine Falcons in the Study Area**

Source: WDFW 2006.

Shorebirds

Shorebirds including plovers, oystercatchers, sandpipers, and phalaropes are a diverse group of birds associated with shorelines that feed primarily on invertebrates or small aquatic creatures. They generally have longish legs and short to long beaks that they use to probe sand or mud substrates, or to pick intertidal invertebrates from rocks. Most species migrate long distances. All but the phalaropes do not generally swim but instead walk along shorelines and beaches.

Most shorebirds occurring in the study area are present only during migration between nesting and overwintering areas. However, some of the more common shorebird species winter in the study area and killdeer, black oystercatcher, and spotted sandpiper nest in the study area.

The shorebirds are common or fairly common in the study area during 2 or more months of the year (Appendix F). Shoreline habitats used by shorebirds in the study area are illustrated in Figure 4.2-6.

Shorebirds primarily occur in bays and estuaries, coastal dunes and beaches, and headlands and islets (Wahl et al. 2005). Phalaropes are the only shorebirds in the study area that use inland marine and marine nearshore waters (Wahl et al. 2005). Sandpipers and plovers forage primarily on benthic invertebrates such as worms, snails, bivalves, crustaceans, and insects. Rocky shoreline foraging shorebirds such as black-bellied plovers, semipalmated plovers, killdeer, black turnstone, and surfbird forage on intertidal invertebrates; these species benefit from kelp beds as they feed on the invertebrates in wind-thrown kelp (Bradley and Bradley 1993). Black oystercatchers consume mussels, limpets, oysters, and other intertidal organisms (Seattle Audubon Society 2008).

All shorebirds are protected by the MBTA. Except for the common snipe, shorebirds are not currently harvested in the Pacific Northwest.

Other Coastal Birds

The “other coastal birds” group is a general grouping for shoreline-associated birds that do not fall within the previous groups. This group includes wading birds and landbirds—such as herons, coots, rails, dippers, and kingfishers—that are tightly associated with water for foraging and other landbirds that are more loosely associated with water—such as crows, swifts, swallows, and wrens. For the purposes of this discussion, “other coastal birds” includes herons, coots, and landbirds that use coastal habitats, in addition to dippers, jays, crows, ravens, swallows, and wrens.

Twenty-seven species of other coastal birds occur commonly in the study area during 3 or more months of the year (see Appendix F). Most other coastal birds are widespread in distribution throughout the Pacific Northwest. Of the 27 common species from this group that occur in the study area, 23 species nest along shoreline habitats, 14 species are year-round residents, and 4 species are winter residents (Appendix F).

Figure 4.2-6 Shorebird Concentration Areas in the Study Area

Source: NOAA Puget Sound ESI Geodatabase.

Shoreline habitats used by other common coastal birds in the study area include coastal dunes and beaches, headlands and islets, and bays and estuaries (Wahl et al. 2005). Herons generally nest colonially near water in deciduous, coniferous, or mixed stands of mature trees and feed along shorelines on fish and intertidal invertebrates. American coots nest on freshwater, using such marine resources as salt marshes and coastal bays during other portions of the year. They feed primarily on vegetation, fish, and invertebrates. The wide array of coastal landbirds in the study area uses a variety of foraging habitats. Crows nesting in coastal areas feed on aquatic creatures including shellfish, fish, seabird eggs, and various aquatic invertebrates (Seattle Audubon Society 2008). Hummingbirds feed on nectar and insects; in the Puget Sound area, they nest in huckleberry bushes, alders, blackberries, or conifer branches (Seattle Audubon Society 2008). Steller's jays feed on both vegetation and animal matter, and prey on the young of other birds. Other common landbirds generally feed on insects and vegetation.

Some other coastal birds are protected by the MBTA. Except for the American coot, no other coastal birds currently are harvested in the Pacific Northwest. Four landbirds commonly occurring in the study area are considered Stewardship Species in the North American Landbird Conservation Plans: the Steller's jay, winter wren, fox sparrow, and golden-crowned sparrow. One landbird commonly occurring in the study area, the rufous hummingbird, is considered a Watch List Species because of a decreasing population trend, vulnerable non-breeding distribution, and threats to coastal and riparian shrublands required by this species (Rich et al. 2004). Two Watch List species, the fox sparrow and golden-crowned sparrow, are also primarily found in shrublands; and significant proportions of their non-breeding populations (52 percent and 85 percent, respectively) occur within these habitats in the Pacific avifaunal biome[5] (Rich et al. 2004). Two Watch List Species, the Steller's jay and winter wren, are primarily associated with coniferous forests; a significant percentage of the breeding population of Steller's jay (54 percent), wintering populations of Steller's jay (54 percent), and winter wren (50 percent) occur within the Pacific avifaunal biome (Rich et al. 2004).

4.2.5 Fish

Nearly 400 species[6] of coastal and inland marine fishes inhabit or visit the study area. Species richness and diversity along the Pacific Coast and Puget Sound is attributed to the complex bathymetry, convergence of major oceanographic circulation systems, abundant food resources, and changeable environmental conditions (Burns 1985). Love et al. (2002) and Pacific Fishery Management Council (PFMC) (2011) classifications were predominantly used for describing fish distribution in the study area. The high diversity of fish species and habitat associations required grouping species according to behavioral and early life history vulnerability to effects (eggs, larvae, and juveniles).

Marine fish exhibit variable spawning tendencies by species; however, these can be generalized. The reproductive cycle of species with northern affinities such as the Pacific hake and some rockfish species in Puget Sound generally peak from winter to spring. Some fish species like the splitnose rockfish, northern anchovy, and surf smelt may spawn throughout the year. Spawning periods also can be governed by lunar and diel (24-hour period) cycles. In addition to spawning, numerous anadromous[7] species also use the study area for rearing and migration. Salmonid[8] species have a diversity of spawning

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[5] The *Pacific avifaunal biome* is a major regional biotic community that is characterized by dominant forms of plant life and the prevailing climate.

[6] Scientific names of species occurring in the study area are presented in tables and Appendix F.

[7] *Anadromous* fish are born in freshwater, spend their life in the sea, and return to freshwater to spawn.

[8] *Salmonid* species include salmon, trout, and char.

habits which, in total, span the year for the catchments relevant to the study area. Other anadromous species spawn throughout winter and spring.

Migrations are common among marine fishes and are usually related to feeding and reproduction. In spring, some anadromous salmonids migrate from freshwater into estuarine and nearshore habitats and the ocean to begin their feeding into adult phase. Some herring stocks appear to have an annual migration from inshore spawning grounds to open ocean feeding areas; while others appear to be more "resident," remaining inside the Puget Sound basin year-round. Dover sole migrate into deep water in winter to spawn and return to shallow water in summer to feed. Scorpionfish migrate offshore to spawning grounds from May through August. In fall, Pacific hake migrate from feeding grounds off the Pacific Northwest to winter spawning grounds off southern California and Baja California.

Fish communities offshore of Washington occur in two main regions: the pelagic (open ocean) zone and the benthic (bottom of the ocean) zone. Although these designations are useful, the regions overlap; and several zones are within each of these regions. For example, the pelagic region is made up of three specific zones: epipelagic (from the water's surface to depths of 183 meters [600 feet]), mesopelagic (depths between approximately 183 and 914 meters [600 and 3,000 feet]), and bathypelagic (depths greater than 914 meters [3,000 feet]). The benthic zone includes soft-bottom habitat, hard-bottom habitat, and low and high relief features—all of which harbor specific species of fish. Demersal fish[9] are strongly associated with specific types of benthic substrates but are generally not in direct contact with the ocean floor, whereas benthal fish species are generally in contact with the bottom substrate.

The epipelagic realm includes the water column covering the shelf and the upper 90 to 183 meters (300 to 600 feet) of water overlying the slope and deep basins. The fish from this zone represent a mix of permanent residents and migratory species. The important pelagic species of Washington include the northern anchovy, albacore tuna, jack mackerel, Pacific mackerel, Pacific sardine, Pacific whiting, Pacific herring, salmon, steelhead trout, and thresher shark.

The epipelagic zone is euphotic,[10] and temperatures fluctuate diurnally and seasonally. Northern anchovy, Pacific sardine, jack mackerel, Pacific mackerel, and Pacific hake are residents of the epipelagic zone of the Washington coast currents: California Current, Davidson Current, and California Undercurrent.

Less is known about the fish in the mesopelagic and bathypelagic zones. Typical mesopelagic species of the area include blacksmelt, northern lampfish, northern smoothtongue, viperfish, daggerfish, and the lanternfish (Abookire 2001). Bathypelagic species of the area include dragonfish and bristlemouth.

Demersal fish distributions are generally based on depth or depth-related factors. As with the epipelagic fishes, the demersal species of concern are those with restricted distributions during a significant part of their life cycle. The species common to the benthic zone are flatfishes, lingcod, some rockfishes, cods, and sablefish. The shallow, rocky bottom benthic environment includes tide pools and subsurface rocky outcrops. Rockfish, lingcod, sculpins, blennies, and eels are typical residents. Common residents of the shallow, sandy bottom benthic environment include skates, rays, smelts, surfperches, and flatfish. Vertical relief benthic areas, including kelp beds and man-made structures with vertically dominated gradients, are inhabited by fish of both pelagic and benthic habitats. Common species include kelp bass,

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9 *Demersal* fish live and feed on or near the seafloor.

10 *Euphotic* refers to the uppermost layer of a body of water with sufficient light for photosynthesis and the growth of green plants.

rockfishes, and surfperches. Estuaries and wetlands, natural and artificial hard-bottom features, kelp beds, and harbors represent important habitat for demersal species.

4.2.5.1 Fish Assemblages and Habitat Associations

A common approach to describing the diversity in community structure of fish assemblages is to categorize species and complexes of species according to ecological zones of occurrence. Embedded within this large-scale template (Puget Sound – Pacific Coast) is a mosaic of typical fish communities that reflect the finer-scale habitats the individual species are associated with by life history stage (e.g., larvae in kelp canopy or eelgrass beds and or fry/larvae).

A shoreline habitat cross-section was developed (Figure 4.2-7) using common aquatic and oceanographic terminology to accommodate:

- The complexities of interaction between fish life history stage/habitat interactions;
- Consistent use of terminology about fish groups; and
- Consideration for categories that would facilitate the impact analysis.

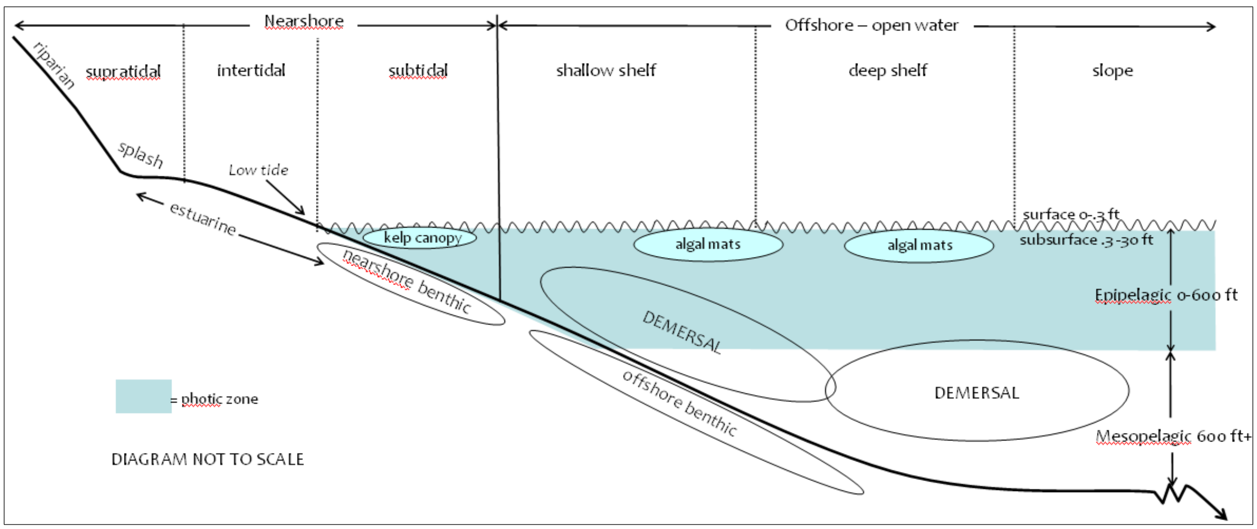

Figure 4.2-7 Cross Section of Physical and Aquatic Habitat Types Showing the Typical Location of Habitat Features or Distribution Characteristics (bubbles)

Estuarine habitats are recognized for their vital role as nurseries and rearing areas; they serve as major contributors to biological productivity at the producer and consumer level. Nearshore canopy includes seagrasses and kelp, and is recognized for its diverse species use for foraging, spawning, and rearing. Floating algal mats, comprised of drift kelp fronds, may support thousands of invertebrate individuals and provides open water cover for foraging fish species. Demersal habitats host ground fish and other deepwater dwellers. Benthic habitats provide for a variety of shellfish and other invertebrates that contribute to food webs and fish communities. The intertidal area-subtidal area hosts the greatest species diversity in the marine environment. The water surface (0 to 0.1 meter [0 to 0.3 foot deep]), or neuston layer, is the highly active interface between water and air environments that is a key habitat to many species. The subsurface habitat (0.1 to 9 meters [0.3 to 30 feet deep]) is a highly productive zone of the water column serving as a key food web resource. These habitats are included in the nearshore and offshore classifications that provide a coarse screen to assess the vulnerability of organisms to the effects of an oil spill using location data.

Physical habitat descriptions are provided at the beginning of this section. The principal habitats in which effects will express themselves distinctly are as follows:

- Water column (0 to 9 meters [0 to 30 feet] deep)
- Water column (9 meters [30 feet] deep to the bottom)
- Rocky subtidal bottom
- Granular bottom (cobble-gravel-sand-shell hash)
- Mud bottom

These habitat associations capture the varying habitat types in which certain life history stages of various species could be affected in the event of an oil spill. Impacts on species would vary dependent on the location of a species within the water column and its life history stage. For example, free-floating larvae that inhabit the upper portion of the water column would more likely be exposed to oil constituents in the event of a spill than juvenile demersal fish or motile invertebrates that are offshore and at depths greater than 100 feet.

The fish species that may be present in the study area were assembled into the following groups: salmonids, rockfish, flatfish, forage fish, roundfish, coastal pelagic, and skate-ray-shark-chimera complex. The habitat association for each fish species was based on either the location of sensitive life history stages (e.g., nearshore), the behavior that predominates the group (e.g., demersal) or the general similarity of a group of species (e.g., cabezon, greenling, lingcod). The resulting groupings are presented in Table 4.2-7. Certainly, there will be exceptions to the generalized group description for each species—either through life history variations or aspects of adaptation. Nonetheless, the groupings serve to facilitate discussions and evaluation of the potential effects of the Project. Details of specific life history stage sensitivities are included below.

Salmon, rockfish, and some other pelagic species that are vital to commercial and recreational fisheries are considered in their own groups (Table 4.2-7). A particular species may fit into more than one habitat association, but if it possesses exceptional commercial or recreational value, that species was assigned to a “complex” made up of species with similar commercial or recreational value. Typically, they share similar life history or habitat use traits.

4.2.5.2 Protected Fish Species

Of the marine fishes occurring in the study area, four species of salmonids are federally listed as threatened, one species of rockfish is federally listed as endangered, and two species of rockfish are federally listed as threatened (Table 4.2-8). In addition, the green sturgeon and eulachon are federally listed as threatened. These species are discussed in more detail in the draft Biological Evaluation, included as Appendix G.

At the state level, 15 fish species are listed that are not listed under the federal ESA; 14 of these may occur or are likely to occur in the study area. A discussion of the life history and listing status of these state-listed species is provided in Appendix F.

The PFMC manages over 90 species of fish under four fishery management plans: the Coastal Pelagic Fishery Management Plan, the Pacific Salmon Fishery Management Plan, the Pacific Groundfish Fishery Management Plan, and the Highly Migratory Species Fishery Management Plan, as shown in Table 4.2-9.

Table 4.2-7 Habitat Associations of Fish Species Groups in the Study Area

Habitat Association Name[a]	Description	Definition	Example Species or Complex
Ff_pelagic	Forage fish pelagic	Species that predominantly associate with open-water habitat above the thermocline[b]	Eulachon, longfin smelt
Ff_nearshore	Forage fish nearshore	Species that associate either juvenile, larvae, and/or egg stages with the estuary or intertidal areas and rooted macrophytes,[c] algae, or seagrass	Herring, sand lance,surf smelt
Sal/neritic	Salmon neritic	Species with direct freshwater to ocean outmigration	Pink salmon, sockeye salmon, coho, steelhead
Sal/nearshore_outmig	Salmon nearshore outmigrant	Species using the nearshore as a transient habitat	Chinook and chum salmon
Sal/nearshore_res	Salmon nearshore resident	Species that do not migrate far from natal estuaries and that associate with the nearshore throughout their life history	Bull trout, Dolly Varden, coastal cutthroat
Gf/flatfish_nearshore	Groundfish flatfish nearshore	Species that associate juvenile, larvae, or egg stages with the estuary or intertidal areas and rooted macrophytes, algae, or seagrass	Most flounder
Gf/flatfish_demersal	Groundfish flatfish demersal	Species at depths with low potential effect from oil spills	Pacific halibut, speckled sanddab
Gf/shr_skt_chim	Groundfish shark-skate-chimera complex	Species complex at depths with low potential effect from oil spills; some live birth species	Spiny dogfish, six-gill shark, big skate
Gf/rndfish_cagrli	Groundfish cabezon-greenling-lingcod complex	Species complex with similar habitat associations that are important to recreational fisheries	Cabezon, greenling, ling cod
Gf/rndfish_cohapo	Groundfish pacific cod-hake-pollock complex	Species complex that is important to commercial fisheries	Pacific cod, hake, pollock
Gf/rndfish_other	Groundfish roundfish other	Other groundfish species with minimal association to nearshore or estuary areas	Sablefishes, toadfishes
Rkf/nearshore	Rockfish nearshore nursery	Species complex that associates juvenile, larvae, or egg stages with the estuary or intertidal areas and rooted macrophytes, algae or seagrass	Copper rockfish, rosy rockfish
Rkf/offshore_subsurf	Rockfish offshore subsurface nursery	Species complex with offshore nurseries	Thornyhead
Rkf/surface veg	Rockfish surface vegetation	Species complex with surface (algal mats, canopy) nurseries	Copper and vermilion rockfish
Ns/rockyns_kelp	Nearshore rocky nearshore kelp	Species that associate juvenile, larvae, or egg stages with the intertidal areas and rooted macrophytes or algae	Blennies, gunnel, sculpins
Ns/eelgr_uncons	Nearshore rocky nearshore unconsolidated	Species that associate juvenile, larvae, or egg stages with the estuary or intertidal areas and seagrass	Seaperch, sculpins
Other/ demersal_offshore	Non-categorized species groups with relatively lower risk	Species whose life history stages are demersal, with minimal nearshore association	Poachers, sea perch

[a] Habitat Association: ff = forage fish; sal = salmon; gf = groundfish; rkf = rockfish; ns = nearshore; other = other fish types

[b] *Thermocline* refers to the transitional layer of water separating warmer upper mixed water from colder deeper waters .

[c] *Macrophytes* refers to an aquatic plant that grows in or near water.

Table 4.2-8 Protected Fish and Habitat in the Study Area

Species	Protection Status		Occurs in Study Area?
	Federal Status	State Status	
Salmonids			
Chinook salmon (*Oncorhynchus tshawytscha*) Chinook salmon (*Oncorhynchus tshawytscha*) PS Columbia run	Threatened	Candidate	Yes
Chum salmon (*Oncorhynchus keta*) Chum salmon (*Oncorhynchus keta*) HC summer run	Threatened	Candidate	Yes
Steelhead (*Oncorhynchus mykiss*) Steelhead (*Oncorhynchus mykiss*) PS	Threatened	None	Yes
Bull trout (*Savelinus confluentus*) Bull trout (*Savelinus confluentus*) Coastal/PS	Threatened	Candidate	Yes
Sockeye salmon (*Oncorhynchus nerka*) Lake Ozette	Threatened	Candidate	Unlikely
Rockfish			
Black rockfish (*Sebastes malanops*)	None	Candidate	May occur
Brown rockfish (*Sebastes auriculatus*)	Species of concern	Candidate	May occur
Bocaccio rockfish (*Sebastes paucispinis*)	Endangered	Candidate	May occur
Canary rockfish (*Sebastes pinniger*)	Threatened	Candidate	Yes
China rockfish (*Sebastes nebulosus*)	None	Candidate	Yes
Copper rockfish (*Sebastes caurinus*)	Species of concern	Candidate	Yes
Greenstriped rockfish (*Sebastes elongates*)	None	Candidate	May occur
Quillback rockfish (*Sebastes maliger*)	Species of concern	Candidate	Yes
Redstripe rockfish (*Sebastes proriger*)	None	Candidate	May occur
Tiger rockfish (*Sebastes nigrocinctus*)	None	Candidate	Yes
Widow rockfish (*Sebastes entomelas*)	None	Candidate	Yes
Yelloweye rockfish (*Sebastes ruberrimus*)	Threatened	Candidate	Yes
Yellowtail rockfish (*Sebastes flavidus*)	None	Candidate	Unlikely
Foragefish			
Pacific herring (*Clupea pallasi*) – CP and DB stock	Species of concern	Candidate	Yes
Eulachon (*Thaleichthys pacificus*)	Threatened	Candidate	May occur
Groundfish			
Pacific cod (*Gadus macrocephalus*) South and Central PS	Species of concern	Candidate	May occur
Lingcod (*Ophiodon elongates*)	Not listed	Not listed	Yes
Pacific sand lance (*Ammodytes hexapterus*)	Not listed	Not listed	Yes
English sole (*Parophyrs vetulus*)	Not listed	Not listed	May occur
Rock sole (*Lepidopsetta bilineata*)	Not listed	Not listed	May occur
Pacific hake (*Merluccius productus*) Central PS	Species of concern	Candidate	May occur
Walleye pollock (*Theragra chalcogramma*) South PS	Species of concern	Candidate	May occur
Green sturgeon (*Acipenser medirostris*)	Threatened	None	Yes
Other			
Pacific lamprey (*Entosphenus tridentatus*)	Species of concern	Candidate	Monitor

PS = Puget Sound; HC = Hood Canal; CP = Cherry Point; DB = Discovery Bay

Source: WDFW 2011.

Table 4.2-9 Fish Species Managed under Fishery Management Plans

Coastal Pelagic Fishery Management Plan	Highly Migratory Species Fishery Management Plan	Pacific Salmon Fishery Management Plan
Northern anchovy	Common thresher shark	Chinook salmon
Pacific sardine	Albacore tuna	Coho salmon
Pacific (chub) mackerel	North Pacific Tuna	Pink salmon
Jack mackerel	Yellowfin tuna	***Pacific Salmon Commission***
Market squid	Bigeye tuna	Sockeye salmon
Pacific herring	Skipjack tuna	Pink salmon
Jacksmelt	Northern bluefin tuna	
Sablefish Management Plan	Striped marlin	
Sablefish	Swordfish	
Pacific Halibut Commission	Dorado or dolphinfish	
Pacific halibut	Common mola	
	Lancetfishes	
	Louvar	
	Pelagic sting ray	
	Wahoo	
	Bigeye thresher shark	
	Escolar	
Pacific Groundfish Fishery Management Plan		
Flatfish	***Rockfish***	**Rockfish (Continued)**
Butter sole	Aurora rockfish	Longspine thornyhead
Curlfin sole	Bank rockfish	Mexican rockfish
Dover sole	Black rockfish	Olive rockfish
English sole	Black and yellow rockfish	Pacific ocean perch
Flathead sole	Blackgill rockfish	Pink rockfish
Petrale sole	Blue rockfish	Pinkrose rockfish
Rex sole	Bocaccio	Pygmy rockfish
Rock sole	Bronzespotted rockfish	Quillback rockfish
Sand sole	Brown rockfish	Redbanded rockfish
Arrowtooth flounder (turbot)	Calico rockfish	Redstripe rockfish
Starry flounder	California scorpionfish	Rosethorn rockfish
Pacific sanddab	Canary rockfish	Rosy rockfish
Roundfish	Chameleon rockfish	Rougheye rockfish
Lingcod	Chilipepper rockfish	Sharpchin rockfish
Cabezon	China rockfish	Shortbelly rockfish
Kelp greenling	Copper rockfish	Shortraker rockfish
Pacific cod	Cowcod	Shortspine thornyhead
Pacific whiting (hake)	Darkblotched rockfish	Silvergray rockfish
Sablefish	Dusky rockfish	Speckled rockfish
Pacific flatnose	Dwarf-red rockfish	Splitnose rockfish
Pacific grenadier	Flag rockfish	Squarespot rockfish
Sharks – Skates – Chimeras	Freckled rockfish	Starry rockfish
Leopard shark	Gopher rockfish	Stripetail rockfish
Soupfin shark	Grass rockfish	Swordspine rockfish
Spiny dogfish	Greenblotched rockfish	Tiger rockfish
Big skate	Greenspotted rockfish	Treefish
California skate	Greenstriped rockfish	Vermilion rockfish
Longnose skate	Halfbanded rockfish	Widow rockfish
Spotted ratfish	Harlequin rockfish	Yelloweye rockfish
	Honeycomb rockfish	Yellowmouth rockfish
	Kelp rockfish	Yellowtail rockfish

Sources: PFMC 2011a, 2011b, 2011c, 2012.

4.2.5.3 Fish Species in the Study Area

Salmonids

Salmonids include salmon, trout, and char and are the most ubiquitous, commercially significant, and ecologically and culturally prominent group of fishes in the Pacific Northwest (Groot and Margolis 1991). Salmon use an extensive network of waterbodies, including small headwater streams; rivers, lakes, wetlands, and floodplain habitats; estuaries; and nearshore, offshore, and open ocean environments.

Nine native anadromous species of Pacific salmon (*Oncorhynchus*) and char (*Salvelinus*) occur regularly in the study area, as presented in Table 4.2-10. Atlantic salmon (*Salmo salar*) are the only non-native species known to occur in the study area because of net pen escapement. The Atlantic salmon is not independently reviewed here because of its non-native status. However, ecological concerns are indirectly addressed in the steelhead section because the life history and habitat requirements for steelhead are similar to those for Atlantic salmon.

Table 4.2-10 Anadromous Salmonidae and their Habitat and Life History Associations in the Study Area

Species	Scientific Name	Habitat Association	Fry Nearshore Outmigrant	YOY/ Subadult Nearshore	YOY/ Subadult Offshore	Adult Nearshore	Adult Offshore
Chinook salmon	*Oncorhynchus tshawytscha*	Nearshore outmigrant	Winter/ spring	Year-round	Year-round	Spring/ fall	Spring/ fall
Chum salmon	*Oncorhynchus keta*	Nearshore outmigrant	Late winter/ spring	Late winter/ spring	Spring/ summer[a]	Summer-winter	Summer-winter
Coho salmon	*Oncorhynchus kisutch*	Neritic	Spring	Year-round	Year-round	Summer/ fall	Summer/ fall
Pink salmon	*Oncorhynchus gorbuscha*	Neritic	Spring	Spring	Spring	Summer	Year-round
Sockeye salmon	*Oncorhynchus nerka*	Neritic	Unknown	Spring/ summer	Spring/ summer	Summer	Year-round
Steelhead	*Oncorhynchus mykiss*	Neritic	Unknown	Spring/ summer	Spring/ summer	Summer – winter	Summer – winter
Coastal cutthroat	*Oncorhynchus clarki clarki*	Nearshore resident	--	Unknown	Unknown	Year-round	Year-round
Bull trout	*Salvelinus confluentus*	Nearshore resident	Unknown	--	--	Year-round	Year-round
Dolly Varden	*Salvelinus malma*	Nearshore resident	--	--	--	--	--

-- = Life history not utilized by species
YOY = young-of-the-year fish

Source: NMFS 2013.

The nine salmonid species described in this report (Chinook, chum, coho, pink, sockeye steelhead, coastal cutthroat, Dolly Varden, and bull trout) have various and complex life cycles. The generalized life history of anadromous Pacific salmon includes freshwater incubation, hatching, and emergence—followed by various periods of instream rearing and migration, or direct migration to estuaries or oceans. Sub-adults disperse and mature in the ocean or inland saltwater bodies and then return to freshwater for completion of maturation and then spawning.

Salmon species can be grouped into *stocks*, which are groups of fish that are genetically self-sustaining and isolated geographically or temporally during reproduction. A population of fish may include a single stock or a mixture of stocks. Under the ESA, stocks of salmonids may be grouped as a distinct population segment (DPS)[11] (as in the case for bull trout under the jurisdiction of the USFWS) or an evolutionarily significant unit (ESU)[12] (as in the case for Pacific salmon under the jurisdiction of NMFS). Salmon in Washington State are co-managed under the Boldt decision between the State of Washington and the Indian tribes who were parties to the Stevens-Palmer Treaties.[13] Critical habitat designations in the study area for ESA-listed species include bull trout, Puget Sound Chinook, and Hood Canal summer chum. The Puget Sound steelhead DPS has been federally listed as threatened, and critical habitat has been proposed but not designated.

Most of the salmonids have both freshwater and anadromous forms; however, only the anadromous forms are specifically addressed in this EIS because of the location of the study area. The importance of estuarine and nearshore marine habitats to the early life history stages of salmonids has become increasingly apparent to regional conservation and recovery efforts. Salmonids use the nearshore for physiological transition (adaptation from freshwater to saltwater), as migration corridors, as nursery areas, for juvenile and adult food production and feeding, and as residence and refuge. All juvenile salmon move along the shallows of estuaries and nearshore areas during their seaward outmigration, but some species have more extensive associations.

The salmonids have been categorized into three subgroups for discussion based on similarities in utilization of surface water and nearshore habitats in the study area by life history stages. The groupings are based on early migrant distribution patterns and include the following:

- Nearshore resident: bull trout, Dolly Varden, coastal cutthroat
- Nearshore outmigrant: chum salmon and Chinook salmon
- Neritic:[14] pink salmon, steelhead, coho salmon, and sockeye salmon

These patterns are important determinants of the population's productivity rates because the early life history stages are generally the most sensitive to natural and anthropogenic changes to surface water and nearshore habitat condition.

Pink, chum, Chinook, and coho salmon are known to have nearshore fry migrants. For all species, the early fry migrant stage is brief (<10 days) and is characterized by close association with the shoreline and the top 1 meter (3 feet) of the water column. Several researchers have referred to these early migrants as *obligate nearshore residents*. The habitat suitability mechanisms for the close associations are believed

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11 A *distinct population segment* (DPS) is a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The Endangered Species Act provides for listing species, subspecies, or distinct population segments of vertebrate species (http://www.nmfs.noaa.gov/pr/glossary.htm.)

12 An *evolutionarily significant unit* (ESU) is a Pacific salmon population or group of populations that is substantially reproductively isolated from other conspecific populations and that represents an important component of the evolutionary legacy of the species. The ESU policy (56 FR 58612) for Pacific salmon defines the criteria for identifying a Pacific salmon population as a distinct population segment (DPS), which can be listed under the Endangered Species Act. (http://www.nmfs.noaa.gov/pr/glossary.htm.)

13 Indian tribes in Washington State who signed treaties with the United States in the mid-1850s retained the right to fish at all "usual and accustomed grounds and stations." These are areas traditionally harvested for water-dwelling animals and plants before the treaty. The U.S. government recognizes 25 Indian tribes as parties to the Stevens-Palmer Treaties, and 24 tribes have usual and accustomed fishing places within the boundaries of the present-day state of Washington (Woods 2005). (See Section 4.9, "Tribal/Subsistence Fishing" for additional information on the Treaty tribes.) For salmon, tribes must adhere to the U.S./Canada Pacific Salmon Treaty (which regulates fisheries on salmon stocks shared by the two countries).

14 The *neritic* zone occurs between low tide and the edge of the continental shelf.

to be lower salinities that support osmoregulatory transition[15] to marine waters, abundant prey, refuge from adverse current speeds and turbulence, and refuge from predators.

The life history stage trajectories beyond this stage vary between the species. Pink and chum salmon undergo a rapid osmoregulatory transition to the marine environment at the fry stage. As the transition occurs, both species move farther from the shoreline and deeper in the water column. Pink salmon juvenile outmigration is very rapid. Within days, they transition and occur primarily in the shallow subsurface and subsurface layers of the epipelagic zone distributed across the shallow and deep shelf ecological regions (Figure 4.2-7). Chinook and coho salmon outmigrants are not capable of the osmoregulatory transition to marine environments at the fry life history stage. To survive, the fry outmigrants entering nearshore environments need to discover and colonize non-natal estuarine habitats along the nearshore. Because their mobility and physical reserves are limited, their successful range is believed to be less than 16 kilometers (km) (10 miles). Little is known of coho salmon fry outmigrant distribution or success. Chum salmon fry outmigration is very rapid. They use their natal estuary for a period of several days to a few weeks. Some migrate into the nearshore quickly and may colonize other estuaries before moving offshore. Although there is significant diversity in distribution patterns, for a spawning aggregation, chum outmigrant residence time in estuarine and nearshore habitats is on the order of a few weeks to a couple of months. At approximately 80 to 100 millimeters in length, juvenile chum salmon move offshore into the subsurface layer of the epipelagic zone of shelf and deep shelf regions. They continue to outmigrate from Puget Sound throughout spring and summer. Small numbers of chum salmon have been documented to reside year-round in Admiralty Inlet and in the Strait of Juan de Fuca. These fish likely have low-density pelagic distribution.

Appendix F describes the three salmonid groupings above: nearshore resident, nearshore outmigrant, and neritic. The known geographic distribution, specific life history stage history, trophic[16] interactions, and population status and trends also are discussed.

Rockfish

The Pacific rockfishes consist of more than 60 species found off the California, Oregon, and Washington coasts; an additional 30 species can be found further north in Canada and Alaska, and 28 additional species in the Northwest Pacific (PFMC 2011c). Rockfish have been commercially harvested since the 1940s along the Washington coast and remain an important recreational fishery. The recreational fishery has emphasized black, blue, and copper rockfish; other closely managed species are bocaccio, canary, china, quillback, tiger, vermillion, yelloweye, and yellowtail rockfish.

On July, 27, 2010, NMFS listed the Puget Sound/Georgia Basin DPSs of yelloweye and canary rockfish as threatened, and listed bocaccio rockfish as endangered under the ESA (July 27, 2010, 75 FR 22276). In August 2013, NMFS proposed designation of critical habitat for yelloweye, canary, and bocaccio rockfish in the Puget Sound/Strait of Georgia basin (78 FR 47635). Proposed protective regulations for yelloweye and canary rockfish under ESA Section 4(d) will be addressed in a separate rulemaking. These species are discussed in more detail in the draft Biological Evaluation, included as Appendix G.

Some rockfish are reported as being ovoviviparous (bearing live young); however, many studies have confirmed that they are a primitive viviparous group and supply nutrition to developing embryos (Parker

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[15] *Osmoregulation* refers to maintaining the mineral and salt content in the blood while transitioning between a freshwater and saltwater environment. When seaward migrants reach the saline water at the mouth of their home stream, they remain there for a period of several days to weeks, gradually moving into saltier water as they acclimate.

[16] *Trophic* refers to a class of organisms that occupy the same position in the food chain.

et al. 2000). Parturition occurs in spring or summer. Many species have sex-specific growth rates, which can result in differential age at maturity and sex-specific natural mortality rates (Parker et al. 2000).

The rockfish are an extremely successful group and are represented in every habitat from Mexico to the Aleutian Islands and from intertidal waters to depths greater than 1,372 meters (4,500 feet). Rockfish are some of the longest-lived fish known in Puget Sound, with some individuals living to beyond 50 years. Some species of rockfish may mature as early as age 2, but it is more common for these species to take from 6 to 11 years to reach sexual maturity; the yelloweye rockfish may not become sexually mature until age 22 (Palsson et al. 2009). Larvae are found in surface waters and may be distributed over a wide area extending several hundred miles offshore. Larvae and small juvenile rockfish may remain in open waters for several months being passively dispersed by ocean currents. Juvenile rockfish "settling-out" or recruiting[17] to nearshore habitats in Puget Sound move along specific recruitment pathways that include many types and a succession of habitats. These recruitment pathways end at specific nursery habitats that are benthic; they are usually composed of rock substrate, with abundant food resources.

A common approach to describing the diversity in community structure of rockfish assemblages is to categorize the species according to habitat water depth and substrate criteria. An example of community grouping of rockfish species by water-depth categories is presented in Table 4.2-11. Shifts in community composition can occur quite regularly along shoreline areas. For instance, at the same depth in the nearshore environment, communities will be vastly different depending on whether boulder habitat, kelp canopy, or unconsolidated bottom is dominant.

Puget Sound rockfish communities have fewer species than those on the open coast. Of the Puget Sound species, only 5 to 10 are common. Most rocky reefs in water less than 60 meters (200 feet) deep are dominated by copper and quillback rockfishes. In heavily fished or low-current water, brown rockfish may be the most common species. High-current and high-relief areas often harbor large schools of Puget Sound, black, and yellowtail rockfishes. Blue, china, and vermilion rockfish are more typical of the outer coast. Splitnose rockfish are found at approximately 180 meters deep (600 feet) in the Hood Canal and in the southwest Strait of Georgia.

Variations and exceptions can occur when creating similar species groups or guilds for analyses. The rockfish community grouping is based on Love et al. (2002) (Table 4.2-12) and EFH general species descriptions and preferred habitat documentation (PFMC 2011c). It is a practical classification approach based on juvenile and larval stage habitat association that fits the goal of understanding the rockfish resource sensitivity to potential effects. The group is separated into the following three subsections for discussion and assessment purposes:

- Nearshore complex: the larval and juvenile life history stages are strongly associated with nearshore habitats
- Nearshore surface vegetation complex: pelagic larvae or juvenile life history stages are strongly associated with algal mats or canopy
- Offshore subsurface complex: larval or juvenile life history stages are associated with offshore and subsurface

[17] *Recruitment* is the time when a young fish enters a fishery (i.e., becomes large enough to be caught) or enters a specific habitat such as juvenile or adult habitat (http://www.nmfs.noaa.gov/pr/glossary.htm).

Table 4.2-11 Community Grouping of Rockfish Species by Water-Depth Categories

Coastal Communities			
Nearshore	Shallow Shelf	Deep Shelf	Slope
Black	Black	Bocaccio	Bocaccio
Blue	Blue	Canary	Darkblotched
Bocaccio (j)	Bocaccio	Darkblotched	Greenstriped
Canary	Canary	Greenstriped	Pacific ocean perch
China	China	Pacific ocean perch	Redbanded
Copper	Copper	Puget Sound	Redstripe
Quillback	Greenstriped	Redbanded	Rosethorn
Yellowtail (YOY)	Quillback	Redstripe	Rougheye
--	Redstripe	Rosethorn	Sharpchin
--	Rosethorn	Rougheye	Silvergray
--	Silvergray	Sharpchin	Splitnose (j)
--	Stripetail (j)	Splitnose (j)	Tiger
--	Tiger	Stripetail	Yelloweye
--	Widow	Tiger	Longspine thornyhead
--	Yelloweye	Widow	Shortspine thornyhead
--	--	Yellowtail	--
--	--	Yelloweye	--
Puget Sound Communities			
Nearshore	Shallow Shelf	Deep Shelf	Slope
Black	Black	Bocaccio	--
Brown	Brown	Greenstriped	--
Copper	Copper	Quillback	--
Quillback	Quillback	Redstripe	--
Puget Sound	Puget Sound	Silvergray	--
Yellowtail (j)	--	Splitnose	--
--	--	Yelloweye	--
--	--	Yellowtail	--
--	--	Widow	--

-- = Water depth category not utilized by species
j = juvenile fish
YOY = young-of-the-year fish

Source: Love et al. 2002.

Table 4.2-12 Pelagic Juvenile Rockfish Habitat Associations

Pelagic Juvenile	Description	Analysis
Limited pelagic phase	At the extreme, a group of inshore demersal species, including gopher, black-and-yellow, kelp, and perhaps copper rockfishes, have a very short juvenile pelagic stage. These species settle in nearshore water at very small sizes, often only 0.6 to 0.8 inches long. Some individuals have the appearance of large larvae.	Nearshore
Shallow-water residents	The pelagic juveniles of most species are found from near the surface to the thermocline (generally the top 100 meters (330 feet) of water, with some seasonal changes). Pelagic juveniles of at least a few of these species may occur at specific depths. For instance, boccacio rockfish usually are found very close to the surface. Bocaccio rockfish also may be found associated with drifting plant debris. On the other hand, pygmy and blue rockfishes are found in the deeper part of this depth range. The average depth of all pelagic juvenile rockfishes may increase as their growing season progresses.	Nearshore
Surface water – drifting mats residents	These species live near the surface and often are associated with drifting kelp mats and other plant debris. In Puget Sound, and off Washington and British Columbia, black, splitnose, and tiger rockfishes have been collected around drifting vegetation. Rockfish are significant benefactors of an algal mat's contribution to the ecosystem. Algal mats not only provide key components of the trophic system (the smaller splitnose rockfish feed on planktonic animals such as copepods while larger pelagic juveniles shifted their diet to an amphipod associated with the vegetation) but also are a shelter source. While clearly associating with the mats, the extent to which any of these species depend on drifting algae during juvenile life history stage is not known because the species also can be found in tows of vegetation-free open water.	Nearshore-surface vegetation
Deepwater dwellers	The pelagic juveniles of a few species spend some or all of their time below the thermocline in relatively deep water. For example, blackgill rockfish pelagic young commonly are found in 200 to 250 meters (660 to 825 feet) of water, which places them near the optimal settling depth of the older stages. The pelagic juvenile of at least a few other species, such as aurora rockfish and some members of the subgenus Sebastomus (most like greenblotched, pink, and pinkrose rockfishes), may share this behavior.	Offshore-subsurface

Source: Adapted from Love et al. 2002.

The larval life history phase is perhaps the most sensitive period to overall productivity because of the naturally high mortality rate. Effects from the Project also could occur during the pelagic juvenile stage. Table 4.2-13 provides a brief overview of the pelagic juvenile habitat association. Because larval habitat use can overlap, the limited pelagic phase and shallow-water resident phase were combined to comprise the most sensitive nearshore category.

Table 4.2-13 Rockfish Groupings Based on Strong Habitat Associations of Larvae and Juveniles

Common Name	Scientific Name	Larvae	Juvenile	Subadult/ Adult	Habitat Association Code[a]
Surface Vegetation					
Black rockfish	*Sebastes melanops*	Nearshore to shallow shelf parademersal	Nearshore to shallow shelf demersal, limited pelagic phase, kelp canopy and eelgrass	Nearshore to shallow shelf	1; 2
Blue rockfish	*Sebastes mystinus*	Subsurface	Nearshore kelp canopy	Nearshore to shallow shelf demersal	2
Bocaccio	*Sebastes paucispinis*	Nearshore	Nearshore parademersal, kelp canopy	Shallow shelf to deep shelf parademersal	2
China rockfish	*Sebastes nubulosus*	Nearshore	Nearshore to shallow shelf kelp canopy	Nearshore to shallow shelf demersal	2; 6
Copper rockfish	*Sebastes caurinus*	Nearshore kelp canopy	Nearshore kelp canopy, estuaries	Nearshore to shallow shelf demersal	2
Quillback rockfish	*Sebastes maliger*	Nearshore	Nearshore kelp canopy	Nearshore to deep shelf	1; 2
Splitnose rockfish	*Sebastes diploproa*	Pelagic	Deep shelf drifting algal mats	Deep shelf demersal	4
Tiger rockfish	*Sebastes nigrocintus*	N/A	Nearshore to continental slope Drifting algal mats	Parademersal, shallow shelf to continental slope	4
Vermilion rockfish	*Sebastes miniatus*	Subsurface	Nearshore to continental slope drifting algal mats	Nearshore to continental slope demersal	4
Widow rockfish	*Sebastes entomelas*	Nearshore	Nearshore to deep shelf YOY kelp canopy	Nearshore to deep shelf	4
Yellowtail rockfish	*Sebastes flavidus*	Nearshore	Nearshore to shelf	Shallow shelf to deep shelf parademersal	1; 6
Nearshore					
Brown rockfish	*Sebastes auriculatus*	Subsurface estuary	Nearshore to shallow shelf demersal	Nearshore to shallow shelf demersal	1; 3; 7
Canary rockfish	*Sebastes pinniger*	Epipelagic	Nearshore to shallow shelf YOY tide pools	Shallow shelf to deep shelf parademersal	1; 6
Puget Sound rockfish	*Sebastes emphaeus*	N/A	Nearshore demersal	Nearshore to shallow shelf demersal	3
Stripetail rockfish	*Sebastes saxicola*	N/A	Nearshore to shallow shelf demersal, kelp canopy	Shallow shelf demersal	2; 3

Table 4.2-13 Rockfish Groupings Based on Strong Habitat Associations of Larvae and Juveniles (Continued)

Common Name	Scientific Name	Larvae	Juvenile	Subadult/ Adult	Habitat Association Code[a]
Offshore Subsurface					
Darkblotched rockfish	*Sebastes crameri*	Mesopelagic	Deep shelf	Deep shelf to continental slope demersal	8
Greenstriped rockfish	*Sebastes elongatus*	N/A	Epipelagic	Shallow shelf to continental slope parademersal	6
Longspine thornyhead	*Sebastolobus altivelis*	Continental slope eggs float	Continental slope demersal	Continental slope demersal	5; 7
Pacific Ocean perch	*Sebastes alutus*	Mesopelagic	Deep shelf demersal	Deep shelf to continental slope demersal	8; 7
Rebanded rockfish	*Sebastes babcocki*	N/A	Epipelagic to mesopelagic	Deep shelf	6
Redstripe rockfish	*Sebastes proriger*	Parademersal	Occasional estuary to shelf epipelagic parademersal	Shallow shelf to continental slope parademersal	3
Rosethorn rockfish	*Sebastes helvomaculatus*	N/A	Epipelagic	Shallow shelf to continental slope demersal	7
Rosy rockfish	*Sebastes rosaceus*	N/A	Shallow shelf to deep shelf demersal	Shallow shelf to deep shelf demersal	7
Rougheye rockfish	*Sebastes aleutianus*	N/A	Mesopelagic	Deep shelf demersal	8
Sharpchin rockfish	*Sebastes zacentrus*	Continental slope	Deep shelf to continental slope demersal	Deep shelf demersal	7
Shortspine thornyhead	*Sebastolobus alascanus*	Continental slope eggs float	Continental slope demersal	Continental slope demersal	5; 7
Silvergray rockfish	*Sebastes brevispinis*	N/A	Epipelagic	Shallow shelf to continental slope	6
Yelloweye rockfish	*Sebastes ruberrimus*	N/A	Shallow shelf	Shallow shelf to continental slope demersal	6

N/A = not applicable
YOY = young-of-the-year fish

[a] Habitat Association Codes: 1 = nearshore; 2 = kelp canopy; 3 = nearshore demersal; 4 = shelf – surface and drifting algal mats; 5 = shelf – subsurface; 6 = shelf – epipelagic; 7 = shelf – demersal; 8 = shelf – mesopelagic

Source: PFMC 2005.

Flatfish

The flatfish are a group of species characterized by a demersal adult life history stage compressed form that orient themselves parallel to the substrate and characterized by both eyes positioned on the same side, facing upwards. Species belong to the family Pleuronectidae, the so called "right-eyed" flounders, and the family Bothidae, referred to as "left-eyed" flounders. While adult flatfish are demersal, some species (such as halibut) can range up into the water column. Flatfish are oviparous,[18] with egg fertilization occurring externally, and reproduce multiple times during their life (Roff 1982).

Flatfishes in the study area are separated into two subsections (complexes) for discussion:

- **English sole complex:** the larval and juvenile life history stages are strongly associated with the water surface and estuarine nursery areas
- **Arrowtooth flounder complex:** fish with epipelagic or pelagic eggs, larvae, and juveniles and distributions of those life history stages farther offshore—in the shallow and deep shelf ecological regions

Both complexes are important commercial and recreational fishery resources. The English sole complex would be expected to occur in the study area. The arrowtooth flounder complex is unlikely to occur in the study area.

Appendix F contains detailed information on these two complexes.

Roundfish

As described by McCain et al. (2005), the members of the roundfish group have varying degrees of similarity, although they all tend to have elongate body forms. All of the species are oviparous, with external fertilization.

Roundfish in the study area are separated into two complexes for discussion:

- **Pacific hake-walleye pollock-Pacific cod-sablefish complex (Complex 1):** species with life history stage associations with surface waters and unconsolidated subtidal and shelf habitats
- **Lingcod-cabezon-greenling complex (Complex 2):** species that are strongly associated with rocky intertidal and subtidal habitats and sensitive early life history stage associations with surface water and nearshore habitats

Both complexes are important commercial and recreational fishery resources. The vertical distribution and ecological zone categories for roundfish species are shown in Table 4.2-14.

These two complexes are described in greater detail in Appendix F.

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[18] *Oviparous* young hatch from eggs.

Table 4.2-14 Vertical Distribution and Ecological Zone Categories for Roundfish Species

Common Name	Scientific Name	Eggs	Larvae	Juvenile	Subadult/ Adult	Complex[a]
Lingcod	*Ophiodon elongates*	Nearshore Benthic	Nearshore to continental shelf Epipelagic	Nearshore to continental shelf SJ epipelagic LJ demersal	Nearshore to continental shelf Demersal	2
Kelp greenling	*Hexagrammos decagrammus*	Nearshore to shallow shelf Benthic	Nearshore to shallow shelf Epipelagic	Nearshore to shallow shelf SJ epipelagic; LJ demersal	Nearshore to shallow shelf Demersal	2
Whitespotted greenling	*Hexagrammos stelleri*	N/A	N/A	N/A	N/A	2
Rock greenling	*Hexagrammos lagocephalus*	N/A	N/A	N/A	N/A	2
Masked greenling	*Hexagrammos octogrammus*	N/A	N/A	N/A	N/A	2
Painted greenling	*Oxylebius pictus*	N/A	N/A	N/A	N/A	2
Pacific cod	*Gadus macrocephalus*	Nearshore to shelf Benthic	Nearshore Epipelagic	Nearshore Parademersal	Nearshore to continental shelf Parademersal	1
Pacific hake	*Merluccius productus*	Epipelagic	Epipelagic	Epipelagic	Estuary	1
Pacific flatnose	*Antimora microlepis*	N/A	N/A	N/A	Mesobenthal	1
Pacific grenadier	*Coryphaenoides acrolepis*	Epipelagic	Epipelagic	Mesobenthal	Mesobenthal	1
Cabezon	*Scorpaenichtys marmoratus*	Nearshore Benthic	Epipelagic	Nearshore SJ epipelagic; LJ demersal	Nearshore Demersal	2
Pacific tomcod	*Microgadus proximus*	N/A	N/A	N/A	N/A	1
Walleye pollock	*Thereagra chalcogramma*	Pelagic	Epipelagic	Epipelagic	Shallow shelf to continental slope Parademersal	1
Sablefish	*Anoplopoma fimbria*	Continental slope Epipelagic	Epipelagic	Shallow shelf to deep shelf Benthopelagic	Deep shelf to continental shelf Benthopelagic	1
Pacific midshipman	*Porichthys notatus*	N/A	N/A	N/A	N/A	1

Notes:

LJ = large juvenile; N/A = Information is not available at this level of detail; SJ = small juvenile

Vertical distribution categories include surface, subsurface, epipelagic, and mesopelagic.
Coastal ecological zones include nearshore, shallow shelf, deep shelf, and continental slope.

[a] *Species complexes* are subgroups of species, with similar distributions and life history patterns.

Sources: McCain et al. 2005; NMFS website (http://www.nmfs.noaa.gov).

Forage Fish

Small, schooling fish species known as *forage fish* play an important ecological role as the link between lower trophic levels (primary and secondary planktonic production) and higher trophic level species (such as salmon, marine mammals, and marine birds). Several forage fish species occur in Puget Sound and in the nearshore waters of Washington State and British Columbia. The three species described in this report, Pacific herring, surf smelt and Pacific sand lance, all spawn on intertidal and shallow subtidal portions of beaches in the study area. These species are described in more detail in Appendix F.

In Washington State, fisheries for forage fish and their roe are managed by the WDFW under the Forage Fish Management Plan. Because population sizes are known to fluctuate widely, fisheries are primarily regulated through time/area/gear restrictions meant to limit fishing effort rather than by setting defined catch limits.

Coastal Pelagic Species

Coastal pelagic species (CPS) include northern anchovy, jack mackerel, Pacific sardine, Pacific (chub or blue) mackerel, and market squid. These species groups are discussed briefly (except northern anchovy) because their members have limited associations with habitats or locations with a high probability of oil exposure. CPS can occur in shallow embayments or brackish water, but not to a significant degree. These water-column dwellers can generally be found anywhere from the surface to 1,006 meters (3,300 feet) deep and at significant distances offshore. Species descriptions for CPS are provided in Appendix F.

Jack mackerel and northern anchovy are part of the CPS Fisheries Management Plan. Along with market squid, they are considered monitored species (they do not need management by harvest guidelines or quotas according to the provisions of the management plan). Jack mackerel and northern anchovy are actively monitored by the California Department of Fish and Wildlife.

Puget Sound and nearshore coastal areas, bays, estuaries, and river mouths of Washington and British Columbia generally do not experience extensive use by these pelagic species, except for northern anchovy. Northern anchovy of all life history stages are found in these areas and can be abundant, particularly during periods of warmer water in summer and fall. Increasing sea surface temperatures related to climate change may shift the northern distribution of the spawning areas for the CPS, resulting in increasing frequency and abundances in juvenile use of Puget Sound and nearshore coastal areas of Washington, or increased abundance in the offshore areas. Recent nearshore surveys have documented increased abundances of larval and juvenile anchovies in the study area and in other areas within Puget Sound. Table 4.2-15 presents the summary of distribution and EFH for CPS.

CPS are most common in the upper mixed layer of the ocean (above the thermocline) in a broad band (up to hundreds of miles wide) along the coast. CPS may occur in shallow embayments and brackish water but do not depend on these habitats to any significant degree. In general, older and larger individuals occur farther north and offshore. The northern extent of the distribution and EFH for CPS depends on temperature and biomass.

Table 4.2-15 Essential Fish Habitat for Coastal Pelagic Species

Scientific Name	Lifestage	Present at Cape Blanco – Queen Charlotte Islands?	Benthic Association?
Northern Anchovy			
Engraulis mordax	Eggs/larvae/juveniles	Yes	No
	Adults	Yes	No
Pacific Sardine			
Sardinops sagax	Eggs/larvae/juveniles	Yes (warm environment/ high abundance)	No
	Adults	Yes (warm environment/ high abundance)	No
Pacific (Chub) Mackerel			
Scomber Japonicus	Eggs/larvae/juveniles	Yes (warm environment/ high abundance)	No
	Adults	Yes (warm environment/ high abundance)	No
Jack Mackerel			
Trachurus declivis	Eggs/larvae/juveniles	No	No
	Adults	Yes	No
Market Squid			
Loligo opalescens	Eggs/larvae/juveniles	No information available	Yes
	Adults	Yes	Yes

Source: PFMC 2011a.

Sharks, Skates, and Chimaeras

This group includes sharks, skates, and chimaeras. Habitat associations are presented in Table 4.2-16.

Soupfin sharks form dense shoals and have a coastwide movement that is not completely understood. The soupfin migrates north in summer and southward in winter. During the late 1930s and the 1940s, the soupfin shark was one of the most economically important of the sharks on the West Coast. Currently, most catches are made as bycatch in other commercial fisheries or by recreational fishers.

Dogfish often migrate in large schools and feed avidly on their journeys. Dogfish undertake seasonal migrations to stay in the preferred temperature range. Schooling behavior occurs with inshore populations and with migratory offshore populations. Spiny dogfish are currently the most abundant and economically important shark off North American coasts. Big skates can be found in waters from the intertidal range to depths of 120 meters (394 feet), inhabiting the coast in estuaries, bays, and over the continental shelf. Big skates are commonly found on sandy and muddy bottoms where they hide with only eyes protruding, although they are also sometimes observed in low stands of kelp. Big skates are generally taken as bycatch in other fisheries and occasionally are taken by recreational fishers.

The spotted ratfish makes significant seasonal migrations. In winter, spotted ratfish move into shallow nearshore waters and estuaries, probably for feeding and pre-spawn mate selection. In Puget Sound and other estuaries, spotted ratfish move from deep water, where they reside during the day, to much shallower water at night (Andrews and Quinn 2012). There is no directed fishery for spotted ratfish in the northeast Pacific, but they are taken quite often as bycatch in bottom trawls. Spotted ratfish are not sought by recreational fishers but are caught occasionally while fishing for other demersal species (PFMC 2005).

Table 4.2-16 Vertical Distribution and Ecological Zone Categories for Sharks, Skates, and Chimaeras

Common Name	Scientific Name	Larvae	Juvenile	Subadult/ Adult	Complex[a]
Soupfin	*Galeorhinus galeus*	Nearshore	Nearshore to deep shelf Benthopelagic	Nearshore to deep shelf Benthopelagic	Shark
Spiny dogfish	*Squalus acanthias*	Nearshore	Nearshore to deep shelf Benthopelagic	Nearshore to deep shelf Benthopelagic	Shark
California skate	*Raja inornata*	Egg: estuary and deep shelf Demersal	Estuary and deep shelf Demersal	Estuary and deep shelf Demersal	Skate
Longnose skate	*Raja rhina*	Egg: Demersal	Nearshore to deep shelf Demersal	Nearshore to deep shelf Demersal	Skate
Big skate	*Raja binoculata*	Egg: Shallow shelf Demersal	Shallow shelf to continental slope Demersal	Shallow shelf to continental slope Demersal	Skate
Spotted ratfish	*Hydrolagus colliei*	None	Nearshore to deep shelf Demersal	Nearshore to deep shelf Demersal	Chimaera

Notes:

Vertical distribution categories include surface, subsurface, epipelagic, and mesopelagic.
Coastal ecological zones include nearshore, shallow shelf, deep shelf, and continental slope.

[a] Species complexes are subgroups of species with similar distributions and life history patterns.

Sources: McCain et al. 2005; NMFS website (http://www.nmfs.noaa.gov).

Other Fish

Species with the potential to occur in the study area that do not fit within the above groups include Pacific lamprey and green sturgeon. Both of these species are federally or state listed. . Their listing status and information on their distribution in the study area and can be found in Appendix F.

4.2.6 Invertebrates

Marine invertebrates are organisms without backbones, such as shrimps, crabs, sponges, corals, worms, jellyfishes, snails, and squids. In many, but not all cases, marine invertebrates possess a shell or hard exoskeleton that protects their generally soft bodies. Crustaceans, of which nearly all are marine invertebrates, make up the greatest biomass of any marine animal group. These include economically valuable species such as crabs and shrimps.

The life cycles of most marine invertebrates include a demersal adult and pelagic larval stage. Many adult marine invertebrates are either sessile (immobile) or sedentary; as a result, they have adapted specialized mechanisms for feeding and reproduction (Strathmann 1985). For example, barnacles have feathery legs that strain food out of moving ocean currents, mussels have gills that act as a net for filtering food, and tube worms spin a mucous net across underground tunnels to capture food. Relatively mobile marine invertebrates, such as clams, bury themselves in the sediments of bays and extend an incurrent siphon[19] just above the surface of the sediment to filter food. Limpets and other marine snails graze on seaweeds, while sea anemones have stinging cells to capture and subdue small creatures.

During reproduction, many marine invertebrates release large numbers of larvae into the water column (Thorson 1950). The larvae grow for a certain period of time (variable among species) before metamorphosing into adults. Probably the most widely accepted theory explaining the function of a larval stage is that it provides the ability for individuals to be dispersed over long distances (Caley et al. 1996). Sessile organisms (such as barnacles) as well as sedentary species (such as mussels, clams, and crabs) need some mechanism to move their young into new territory because the adults cannot move long distances. Many species have relatively long pelagic larval durations (the amount of time a larva is in the water column before it is competent to settle)—on the order of weeks or months. During this time, free-floating larvae feed and grow, while many species transition through several stages of development (Brothers et al. 1983; Scheltema 1986). This allows the larvae to utilize different food resources than the adults and gives them time to disperse.

Three physical factors—salinity, wind and wave energy, and substrate—largely determine the plant and animal complement of marine habitats. As mentioned previously, ocean currents and wave energy are primarily responsible for the dispersal of marine invertebrates. The ocean currents and duration of larval life history stages determine where individuals will settle and mature into adults. In general, substrates associated with high energy beaches along the Strait of Juan de Fuca consist of rocky, sandy, or gravelly habitat. Similar habitats occur along the San Juan Archipelago but within more quiet and protected areas. In addition to physical factors, nitrogen-rich waters from the Pacific and Strait of Juan de Fuca enter Puget Sound, providing a nutrient base for the formation and development of new marine life.

Invertebrates are integral in the structure, health, and functioning of intertidal habitats of Puget Sound and the Strait of Juan de Fuca. For example, some intertidal invertebrates hold important positions in detrital food chains.[20] In processing detritus, invertebrates also play a role in carbon and nutrient cycling, and in the transfer of energy to higher trophic levels. Their feces can also support coprophagous (feces-based) food chains that may extend to coastal waters. In addition, burrowing by intertidal invertebrates locally aerates the sediment and creates conduits for water and nutrient exchange. These effects play an important role in nutrient recycling and habitat productivity.

Marine invertebrates that are present in the study area provide important commercial, recreational, and tribal fisheries. According to NMFS (2008), the combined value of commercial marine invertebrate landings from all of Washington State fisheries in 2006 amounted to $147,931,306 (Table 4.2-17).

In addition to naturally occurring marine invertebrates and shellfish, the past few decades have seen a rapid expansion of alternative and innovative methods for cultivation of oysters and hard-shell clams. Marine aquaculture in the study area is primarily limited to Drayton Harbor. In general, Washington's fish and shellfish farms are among the most technologically advanced in the world; it is the largest producer of farmed clams, oysters, and mussels in the United States (Washington Sea Grant Program 2013). In 2003, the total shellfish aquaculture production amounted to 6.062 million pounds, valued at $76.166 million (The Research Group 2008). However, the production is not without challenges: Washington aquaculture is highly regulated and "vulnerable to water-borne disease, pollution, and toxic algae blooms" (Washington Sea Grant Program 2004). Large-scale aquaculture of marine invertebrates in Washington is primarily limited to bivalve mollusks, particularly oysters.

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[19] An *incurrent siphon* is a tube-like structure used for inhalation.

[20] A *detrital food chain* is based on detritus (dead organic matter).

Table 4.2-17 Commercial Invertebrate Fishery Landings (2006)

Common Name	Scientific Name	Pounds (lbs)	Dollars ($)	Price/Pound ($)
Mollusks				
Butter clam	*Saxidomus giganteus*	11,900	12,790	1.07
Manila clam	*Tapes philippinarum*	1,871,134	30,818,049	16.47
Pacific geoduck	*Panopea abrupta*	2,176,000	23,326,603	10.72
Native littleneck clam	*Protothaca staminea*	35,124	98,457	2.8
Pacific razor clam	*Siliqua patula*	58,715	199,469	3.4
Pacific gaper clam	*Tresus nuttallii*[a]	1,186	1,899	1.6
Softshell clam	*Mya arenaria*	380,819	331,348	0.87
Heart cockle	*Clinocardium nuttallii*	478	238	0.5
Blue mussel	*Mytilus edulis*[a]	774,349	6,564,177	8.48
Eastern oyster	*Crassostrea virginica**	33,111	159,562	4.82
European flat oyster	*Ostrea edulis*[a]	13,533	251,491	18.58
Olympia oyster	*Ostreola conchaphila*[a]	17,909	884,826	49.41
Giant pacific oyster	*Crassostrea gigas*	12,216,447	36,806,383	3.01
Squids	*Loligo* spp.	921	231	0.25
Octopus	*Enteroctopus* spp.	4,834	2,463	0.51
Crustaceans				
Dungeness crab	Cancer magister	24,580,629	43,380,090	1.76
Brine shrimp	*Artemia* spp.	168,783	192,020	1.14
Ocean shrimp	various	6,453,113	2,097,203	0.32
Penaid shrimp	*Penaeus* spp.	304,064	1,313,039	4.32
Echinoderms				
Sea cucumber	*Strongylocentrotus* spp.	641,042	1,108,186	1.73
Sea urchins	*Parastichopus* spp.	396,106	382,782	0.97
Total		**50,140,197**	**$147,931,306**	

spp. = species

[a] Species are not present in the study area (NMFS 2008).

Source: NMFS (2008).

4.2.6.1 Prominent Shellfish Species by Region

Strait of Juan de Fuca

The nearshore of the Strait of Juan de Fuca is home to diverse and extensive shellfish populations. The most economically important of these shellfish resources include Dungeness crab; geoduck clams; and through a recent reintroduction program, the native Olympia oyster. The nearshore of the Strait of Juan de Fuca also provides habitat for sea stars, sea cucumbers, anemones, and numerous other invertebrate species. The Puget Sound Coastal Atlas shows that the Strait of Juan de Fuca is characterized by patchy surfgrass and kelp forest communities, with the kelp forest communities becoming increasingly dense in the eastern strait. Approved commercial shellfish beds are located in the eastern Strait of Juan de Fuca, with small prohibited harvest areas to the west.

The eastern Strait of Juan de Fuca contains many Puget Sound Marine Conservation Priority Areas with substantial marine invertebrate populations (Palazzi and Bloch 2006). In a stock assessment conducted by the WDFW in 2000, one station sampled in the eastern Strait of Juan de Fuca (Dallas Bank) revealed the presence of geoducks. Smith Island has highly diverse flora and fauna in intertidal and benthic areas; Discovery Bay provides mud-gravel intertidal and shallow subtidal habitats with a diverse invertebrate community, including high clam abundance. Sequim Bay provides extensive intertidal and sand/mud flats with high abundances of Dungeness crabs and other invertebrates.

In the western Strait of Juan de Fuca, priority habitats that support invertebrate populations include Freshwater Bay, Slip Point to Pillar Point, and the mouth of the Sekiu River (Palazzi and Bloch 2006). Freshwater Bay is an important rocky intertidal region with populations of three species of sea urchins and, historically, abalones. The nearshore between Slip Point and Pillar Point contains a steep rocky intertidal area that also supports populations of sea urchins, particularly purple sea urchins. Extensive kelp forests in the area provide habitat for a high diversity of invertebrate species. At the mouth of the Sekiu River, a transition area between coastal and estuarine regimes provides mudflat and sandy substrate habitat for clam beds. In the offshore portion of the same area, rocky habitats support invertebrate populations that may include abalones.

Haro Strait

The subtidal habitats of Haro Strait include nearshore steep, rocky slopes and several shallow bays composed of sand and mud. The nearshore habitat contains steep walls composed of bedrock, steep slopes composed of boulders, sand and gravel beaches and slopes in more protected areas, and embayments of finer sand and mud like Parks Bay and Friday Harbor. Much of the deep channel contains coarse sediments such as gravel and cobble interrupted by rocky ridges, pinnacles, and outcroppings. This diversity of habitat supports valuable macro-invertebrate communities, including red and green sea urchins, red sea cucumbers, spotted prawns, dock and other shrimp, scallops, northern horse mussels, sea stars, northern abalone, and Puget Sound king crabs. The Puget Sound Coastal Atlas shows that, within Haro Strait, the southern portion of San Juan Island is characterized by seagrass habitat, while the area to the north provides a kelp forest community. There are no commercial shellfish beds in Haro Strait.

A portion of Haro Strait south of Lime Kiln Lighthouse is included in the San Juan Channel Urchin and Cucumber Reserve. The reserve is bound on the west by the east shore of San Juan Island and on the east by the west shore of Shaw Island. The southern portion of the reserve includes the town of Friday Harbor. Regulations for the commercial non-tribal sea urchin and sea cucumber fisheries prohibit harvest of sea urchins and sea cucumbers within the reserve. The purpose of the urchin and cucumber reserve is to ensure that a significant portion of the resource has the potential to exhibit natural characteristics in terms of density, distribution, size, and age.

Rosario Strait

Rosario Strait runs north/south between Lopez, Decatur, Blakely, and Orcas Islands on the west and Fidalgo, Cypress, Sinclair, and Lummi Islands on the east. Little information is readily available regarding shellfish and other marine invertebrates in Rosario Strait. The Puget Sound Coastal Atlas shows that the west side of Rosario Strait provides patchy eelgrass, which generally provides habitat for invertebrate species such as Dungeness crab. The southern portion of the west side of the strait also has some patches of surfgrass, which provides specialized habitats for many species of marine snails. On the east side of Rosario Strait, the shoreline of Fidalgo Bay is diverse, including surfgrass, eelgrass, and kelp bed habitats. This diversity is consistent moving north through the strait along Cypress, Sinclair, and Lummi Islands. The Puget Sound Coastal Atlas maps indicate that shellfish habitat occurs on the north side of Sinclair Island, the west side of Lummi Island, and north of the Lummi Peninsula on the mainland.

Puget Sound (North of Admiralty Inlet)

During summer 1995, the WSDNR Nearshore Habitat Program surveyed 177 km (110 miles) of Whatcom County shoreline from Point Whitehorn southward to the Skagit County border. The study revealed that the region supports a range of intertidal habitat types, including rocky and mixed coarse sediment beaches with relatively high wave energy, as well as sheltered sand and mud flats. Representative invertebrate species supported by the region include Dungeness crabs, sea urchins, and clams. The Puget Sound Coastal Atlas shows that much of the northern Puget Sound shoreline is lined with continuous or patchy eelgrass fringe, with very few kelp forest or seagrass communities. Kelp forest and seagrass are more prevalent along the western coast of Whidbey Island and along the smaller San Juan Islands. Documented shellfish harvest beds occur in Birch Bay, Lummi Bay, Bellingham Bay, and Padilla Bay.

4.2.6.2 Protected and Important Marine Invertebrates

This section describes marine invertebrates protected under the ESA and those that may be important for commercial, recreational, or tribal fisheries.

The pinto abalone and Newcomb's littorine snail are federally listed as a species of concern and are listed by the State of Washington as candidates for protection. A discussion of the life history and listing status of these species is provided in Appendix F.

Mollusks

The study area provides habitat for a wide variety of mollusks. Mollusks have soft bodies with a mantel, head, foot for locomotion, radula for feeding (except bivalves), and a fully developed digestive tract. Many species' mantels secrete the calcium carbonate that makes up their shells. Ecological benefits of mollusks include their value as a food source for many species and, for filter feeders like bivalves, their ability to improve water quality by removing suspended materials from the water. Bivalves, particularly California mussels, tend to accumulate toxins that they filter out of the water column. As a result, scientists often use mollusks to monitor and analyze the water quality of an area.

Many species of mollusks, collectively referred to as *game fisheries*, have been important to commercial, tribal, and recreational fisheries throughout history. Table 4.2-18 provides a summary of priority mollusks found in the study area. The most productive of the game fisheries are geoduck clams, native littlenecks, and manila clams. Significant commercially harvested species regulated by the WDFW include the giant Pacific oyster and the butter clam. For recreational fishing, both spiny and pink scallops are regulated under the statewide harvest rules by the WDFW. A substantial recreational fishery also exists for the Pacific razor clam. Appendix F provides information on these species.

Echinoderms

Echinoderms include sea stars, starfish, brittle stars, sea urchins, sand dollars, sea cucumbers, and others. Echinoderms contribute their ossified skeletons to many limestone formations; and in places where limestone is unavailable, the calcium-based plates and spines of echinoderms are used by farmers as a source of lime to reduce soil acidity.

Echinoderms present in the study area and noted for their value to commercial and recreational fisheries include California sea cucumber, green sea urchin, and red sea urchin (Table 4.2-19).

Crustaceans

Crabs, shrimp, and barnacles are all crustaceans. A detailed list of priority arthropods and their typical habitat associations in the study area is presented in Table 4.2-20.

Crustaceans are harvested recreationally and commercially, and are an important source of food to other marine species. This makes them both ecologically and economically important. Species such as the Dungeness crab and the Alaska prawn are categorized by the WDFW as being species of commercial, tribal, and recreational importance (Table 4.2-21). Both species support large commercial, tribal, and recreational fisheries.

Other Nearshore Species

In addition to the marine invertebrates protected by the ESA or important for commercial, recreational, or tribal fisheries, many other species are critical to the trophic system, provide limited recreational value, or are edible and may support a fishery in the future. Such nearshore species that may be found in the study area are listed in Table 4.2-21.

Other Demersal Species

The majority of important marine invertebrate species are demersal (bottom dwelling) and live in the nearshore environment. Many are associated with marine algal communities and substrates on or extending from the bottom. Such demersal species that may be found in the study area are listed in Table 4.2-22.

Table 4.2-18 Priority Mollusks Found in the Study Area

Phylum	Class	Common Name	Scientific Name	Species Habitat Associations[a]								Federal Status	State Status/ Other Values
				i	s	sb	sd	r	K	e	o		
Mollusca	*Bivalvia*	Spiny scallop	*Chlamys hastata*	x		x	x	x				None	Formerly commercially harvested; closed until more information is known; recreational fishery open
Mollusca	*Bivalvia*	Pink scallop	*Chlamys rubida*		x	x						None	Formerly commercially harvested; closed until more information is known; recreational fishery open
Mollusca	*Bivalvia*	Giant pacific oyster	*Crassostrea gigas*	x	x	x		x				None	PHS;[b] important commercial shellfish species
Mollusca	*Bivalvia*	Geoduck clam	*Panopea abrupta*	x	x	x						None	PHS;[b] commercial, tribal, and recreational fishery
Mollusca	*Bivalvia*	Native littleneck	*Protothaca staminea*	x		x						None	PHS;[b] commercial, tribal, and recreational fishery
Mollusca	*Bivalvia*	Butter clam	*Saxidomus giganteus*	x	x	x	x	x	x	x		None	PHS;[b] commercial fishery
Mollusca	*Bivalvia*	Pacific razor clam	*Siliqua patula*	x	x		x					None	Commercial, tribal, and recreational fishery
Mollusca	*Bivalvia*	Manila clam	*Tapes philippinarum*	x		x	x					None	PHS;[b] commercial, tribal, and recreational fishery
Mollusca	*Bivalvia*	Pacific gaper	*Tresus nuttallii*	x	x	x	x					None	Commercial, tribal, and recreational fishery
Mollusca	*Gastropoda*	Newcomb's littorine snail	*Algamorda subrotundata*	x				x				Species of Concern	State-listed candidate species
Mollusca	*Gastropoda*	Pinto abalone	*Haliotis kamtschatkana*	x	x				x			Species of Concern	State-listed candidate species; recreational fishery closed in 1994 (declining population)

[a] Species habitat associations are categorized as intertidal (i), subtidal (s), soft-bottomed (sb), sandy-bottomed (sd), rocky (r), kelp (k), eelgrass (e), or other (o).

[b] The Washington Department of Fish and Wildlife has identified priority habitat and species (PHS) of recreational, commercial, or tribal importance.

Sources: NMFS 2008; Onthank 2007; WDFW 2013; Battelle et al. 2001; WDFW 2008a, 2008b; Kegel 1998; ODFW 2008; FAD 2008; AFSC 2008; WSU Beach Watchers 2007.

Table 4.2-19 Priority Echinoderms Found in the Study Area

Phylum	Class	Common Name	Scientific Name	Species Habitat Associations[a]								Federal Status	State Status/ Other Values
				i	s	sb	sd	r	k	e	o		
Echinodermata	*Eleutherozoa*	California sea cucumber	*Parastichopus californicus*	x	x			x				None	Commercial fishery (3 weeks during fall or winter); recreational fishery open
Echinodermata	*Eleutherozoa*	Green sea urchin	*Strongylocentrotus droebachiensis*	x	x			x		x		None	Commercial fishery (roe fishery), small; recreational fishery open
Echinodermata	*Eleutherozoa*	Red sea urchin	*Strongylocentrotus franciscanus*	x	x			x				None	PHS;[b] commercial fishery, small; recreational fishery open

[a] Species habitat associations are categorized as intertidal (i), subtidal (s), soft-bottomed (sb), sandy-bottomed (sd), rocky (r), kelp (k), eelgrass (e), or other (o).

[b] The Washington Department of Fish and Wildlife has identified priority habitat and species (PHS) of recreational, commercial, or tribal importance.

Sources: NMFS 2008; Onthank 2007; WDFW 2013; Battelle et al. 2001; WDFW 2008a, 2008b; Kegel 1998; ODFW 2008; FAD 2008; AFSC 2008; WSU Beach Watchers 2007.

Table 4.2-20 Priority Crustaceans Found in the Study Area

Phylum	Class	Common Name	Scientific Name	Species Habitat Associations[a]								Federal Status	State Status/ Other Values
				i	s	sb	sd	r	k	e	o		
Arthropoda	*Crustacea*	Dungeness crab	*Cancer magister*	x	x	x				x		None	PHS;[b] commercial, tribal, and recreational fishery
Arthropoda	*Crustacea*	Red rock crab	*Cancer productus*	x	x	x	x	x				None	Commercial and recreational fishery
Arthropoda	*Crustacea*	Spot prawn/ Alaska prawn	*Pandalus platyceros*	x	x		x	x				None	PHS;[b] commercial, tribal, and recreational fishery
Arthropoda	*Crustacea*	Goose barnacle	*Pollicipes polymerus*	x				x				None	Formerly commercially harvested (market: Spain, Portugal, and France); closed until more information is known

[a] Species habitat associations are categorized as intertidal (i), subtidal (s), soft-bottomed (sb), sandy-bottomed (sd), rocky (r), kelp (k), eelgrass (e), or other (o).

[b] The Washington Department of Fish and Wildlife has identified priority habitat and species (PHS) of recreational, commercial, or tribal importance.

Sources: NMFS 2008; Onthank 2007; WDFW 2013; Battelle et al. 2001; WDFW 2008a, 2008b; Kegel 1998; ODFW 2008; FAD 2008; AFSC 2008; WSU Beach Watchers 2007.

Table 4.2-21 Other Nearshore Species in the Study Area

Phylum	Class	Common Name	Scientific Name	Species Habitat Associations[a]								State Status/ Other Values
				i	s	sb	sd	r	k	e	o	
Arthropoda	*Crustacea*	Pygmy rock crab	*Cancer oregonensis*	x	x	x		x				Small recreational fishery
Arthropoda	*Crustacea*	Brown box crab	*Lopholithodes foraminatus*	x	x	x						Closed recreational fishery (potential commercial fishery)
Arthropoda	*Crustacea*	Ghost shrimp	*Neotrypaea californiensis*	x	x			x				Prey item for California gray whales
Arthropoda	*Crustacea*	Northern kelp crab	*Pugettia producta*									Recreational fishery
Echinodermata	*Eleutherozoa*	Purple sea urchin	*Strongylocentrotus purpuratus*	x			x	x				Recreational fishery open
Mollusca	*Bivalvia*	Heart cockle	*Clinocardium nuttallii*	x		x						Recreational fishery
Mollusca	*Bivalvia*	Purple hinged rock scallop	*Crassadoma gigantea*	x	x	x	x					Recreational fishery
Mollusca	*Bivalvia*	Northwest ugly clam	*Entodesma saxicola*	x				x				Edible, potential fishery
Mollusca	*Bivalvia*	Baltic macoma	*Macoma balthica*	x		x		x				Edible, potential fishery
Mollusca	*Bivalvia*	Pointed macoma	*Macoma inquinata*	x	x	x		x				Edible, potential fishery
Mollusca	*Bivalvia*	Bent-nosed macoma	*Macoma nasuta*	x		x		x				Edible, potential fishery
Mollusca	*Bivalvia*	Sand clam	*Macoma secta*	x	x							Edible, potential fishery
Mollusca	*Bivalvia*	Soft-shelled clam	*Mya arenaria*	x		x						Recreational fishery
Mollusca	*Bivalvia*	Truncated mya	*Mya truncata*	x		x						Potential recreational fishery
Mollusca	*Bivalvia*	California mussel	*Mytilus californianus*		x	x		x				Recreational fishery
Mollusca	*Bivalvia*	Bay mussel	*Mytilus trossulus*	x	x		x					Recreational fishery
Mollusca	*Bivalvia*	Pacific rock oyster	*Pododesmus macroschisma*	x				x				Food for sea otters
Mollusca	*Bivalvia*	Jacknife clam	*Solen sicarius*	x								Important bait species; edible, potential fishery
Mollusca	*Bivalvia*	Manilla littleneck clam	*Tapes japonica*	x	x							Recreational fishery
Mollusca	*Bivalvia*	Gaper clam	*Tresus capax*	x	x	x						Recreational fishery
Mollusca	*Bivalvia*	Rough piddock	*Zirfaea pilsbryii*	x				x				Recreational fishery

[a] Species habitat associations are categorized as intertidal (i), subtidal (s), soft-bottomed (sb), sandy-bottomed (sd), rocky (r), kelp (k), eelgrass (e), or other (o).

Sources: NMFS 2008; Onthank 2007; WDFW 2013; Battelle et al. 2001; WDFW 2008a, 2008b; Kegel 1998; ODFW 2008; FAD 2008; AFSC 2008; WSU Beach Watchers 2007.

Table 4.2-22 Other Demersal Species with Potential to Occur in the Study Area

Phylum	Class	Common name	Scientific Name	Species Habitat Associations[a]								State Status/ Other Values
				i	s	sb	sd	r	k	e	o	
Arthropoda	*Crustacea*	Puget Sound king crab	*Lopholithodes mandtii*		x			x				Closed recreational fishery
Arthropoda	*Crustacea*	Graceful kelp crab	*Pugettia gracilis*					x				Small recreational fishery
Mollusca	*Bivalvia*	Horse mussel	*Modiolus modiolus*		x							Recreational fishery
Mollusca	*Bivalvia*	Purple varnish clam	*Nuttallia obscuata*					x				Invasive species, recreational fishery
Mollusca	*Bivalvia*	Weathervane Scallop	*Patinopecten caurinus*		x	x						Former small commercial harvest, open recreational harvest; food for fishes, crabs, and other inverts
Mollusca	*Bivalvia*	The Jingle Shell	*Pododesmus cepio*					x				Edible, potential fishery
Mollusca	*Bivalvia*	The Butternut Clam	*Saxidomus nuttalli*		x			x	x	x		Commercial fishery

[a] Species habitat associations are categorized as intertidal (i), subtidal (s), soft-bottomed (sb), sandy-bottomed (sd), rocky (r), kelp (k), eelgrass (e), or other (o).

Sources: NMFS 2008; Onthank 2007; WDFW 2013; Battelle et al. 2001; WDFW 2008a, 2008b; Kegel 1998; ODFW 2008; FAD 2008; AFSC 2008; WSU Beach Watchers 2007

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4.3 NEARSHORE AND MARINE HABITATS

The study area for nearshore and marine habitats is shown in Figure 2-1. Nearshore and marine habitats are a function of their physical features: substrate (mud, sand, gravel, and rock), exposure to wave and tidal energy, topographic relief, proximity to freshwater inputs, and water depth. The study area for nearshore and marine habitats includes the areas between mean high water (MHW) to approximately <18 meters (60 feet) below mean lower low water (MLLW) within the general Project area (Figure 2-1). Figure 4.3-1 shows a cross-section of the nearshore and marine habitats described within this section.

A wide variety of nearshore and marine habitats are located in the study area. Key habitat mapping and classification schemes used for this analysis include the following:

- *A Marine and Estuarine Habitat Classification System for Washington State* (Dethier 1990).
- The Washington State ShoreZone Inventory (WSDNR n.d.) and *The Washington State ShoreZone Inventory User's Manual* (Berry et al. n.d.).
- *Sensitivity of Coastal Environments and Wildlife to Spilled Oil: Puget Sound and Strait of Juan de Fuca, Washington (USA) – Management Areas* (NOAA 2006). (These are more generally known as the *NOAA* Environmental *Sensitivity Index (ESI) maps.*)

The habitat descriptions provided in this section are based primarily on the above sources. Habitats can be grouped based on their location within the marine environment and how they are affected by an oil spill. These include (1) marine and estuarine habitats in the area between mean low water (MLW) and MHW that are typically the most exposed to and affected by oil spills; (2) marine and estuarine habitats below the MLW mark potentially affected by sinking or dispersed oil; and (3) habitats above the MHW mark that might be affected by oil spill clean-up operations.

The following nearshore and marine habitats occur within the study area:

- Eelgrass beds or meadows
- Kelp beds
- Rocky (consolidated) shores (cliffs and platforms)
- Sedimentary (unconsolidated) shores (sand, gravel, cobble, boulder)
- Sandflats and mudflats
- Major estuaries
- Sub-estuaries (pocket estuaries)
- Rocky subtidal
- Unconsolidated subtidal
- Water column
- Salt marshes
- Nearshore riparian areas
- Backshore spray and storm debris zone
- Manmade structures
- Cherry Point area

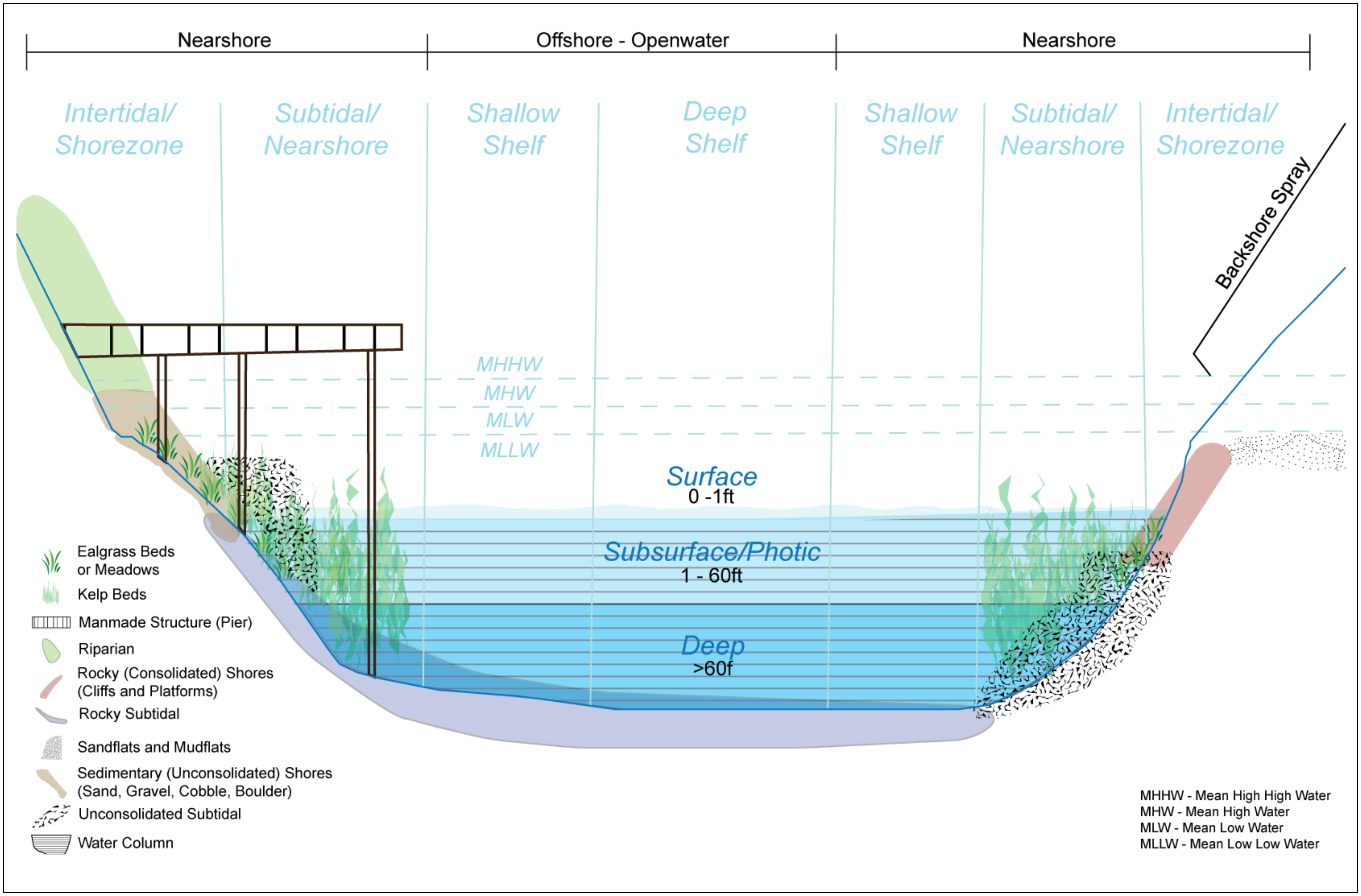

Figure 4.3-1 Nearshore and Marine Habitats in the Study Area

4.3.1 Eelgrass Meadows

Eelgrass is a marine grass that grows in unconsolidated (loose) mixed sediments composed of mud, sand, gravel, and/or shell fragments. It grows in estuarine to marine waters but typically not in areas of constant low salinity. Where it is abundant and covers large areas, eelgrass stabilizes the sea/estuary floor that is habitat for numerous benthic organisms such as worms, clams, and burrowing shrimp. Eelgrass meadows constitute a "habitat" in that they provide shelter, food, and other necessities to a large number of important marine and estuarine species. Herring spawn on the leaves; outmigrating juvenile salmonids use eelgrass as shelter and food as they migrate to the ocean. Numerous water birds and fish feed in eelgrass beds. Many species of fish, crustaceans, and other motile invertebrates use eelgrass meadows as nursery areas. Eelgrass tends to die back in winter, thus contributing a large amount of organic detritus and energy to the nearby biological community.

Eelgrass ranges from approximately mid-intertidal to -11 meters (-35 feet) MLLW and is densest from MLLW to -8 meters (-25 feet) MLLW. The lower boundary is heavily influenced by turbidity, overhead structures (natural and manmade such as docks), and anything else that reduces light levels and penetration into the water. In many of the larger meadows, the lower intertidal area is covered with eelgrass at low tide. The shallower edges of eelgrass are controlled by factors other than light, such as disturbance and water quality.

The seagrasses in the study area consists of eelgrass (native *Zostera marina* and the introduced *Z. japonica*) and three species of surfgrass (*Phyllospadix* spp.). Surfgrass is one of many species found in the intertidal and shallow subtidal zones of exposed, rocky shores—primarily on the west coast of Washington and Vancouver Island, and on the islands in the San Juan/Gulf Island archipelago. For purposes of this analysis, surfgrass is not considered a distinct habitat but is incorporated into the discussion of eelgrass habitat.

As shown in Figure 4.3-2, eelgrass is most abundant in relatively sheltered areas (i.e., low wave and current energy) in Willapa Bay, bays and coves around the San Juan Islands, and on the mainland coast from approximately Deception Pass to the Canadian border.

The approximately 49,500 acres of eelgrass in the Puget Sound area are evenly divided between extensive meadows growing on extensive sand/mud flats and fringe beds (Gaeckle et al. 2007). The largest meadows occur in sheltered bays such as Willapa Bay, Grays Harbor, Padilla Bay, Samish Bay, Fidalgo Bay, Birch Bay, Lummi Bay, and numerous smaller bays on the San Juan Islands. Fringing eelgrass beds are present in smaller, sheltered bays and coves on the Straits of Jan de Fuca, western (and exposed) shores of Whidbey Island and the San Juan Islands, and westerly facing shores north of Cherry Point.

The change in eelgrass abundance and spatial distribution has been monitored by Gaeckle et al. (2007) and Wylie-Echeverria et al (2005a, 2005b). According to Gaeckle et al. (2007), the overall amount of eelgrass appears to be relatively stable over the past few years, with declines in localized areas such as Hood Canal and the San Juan Islands. The cause of these declines is still under investigation. The biology, ecology, and ecological community significance of eelgrass meadows in the study area has been extensively studied at numerous sites and is summarized in several documents, including Phillips (1984) and Gaeckle et al. (2007).

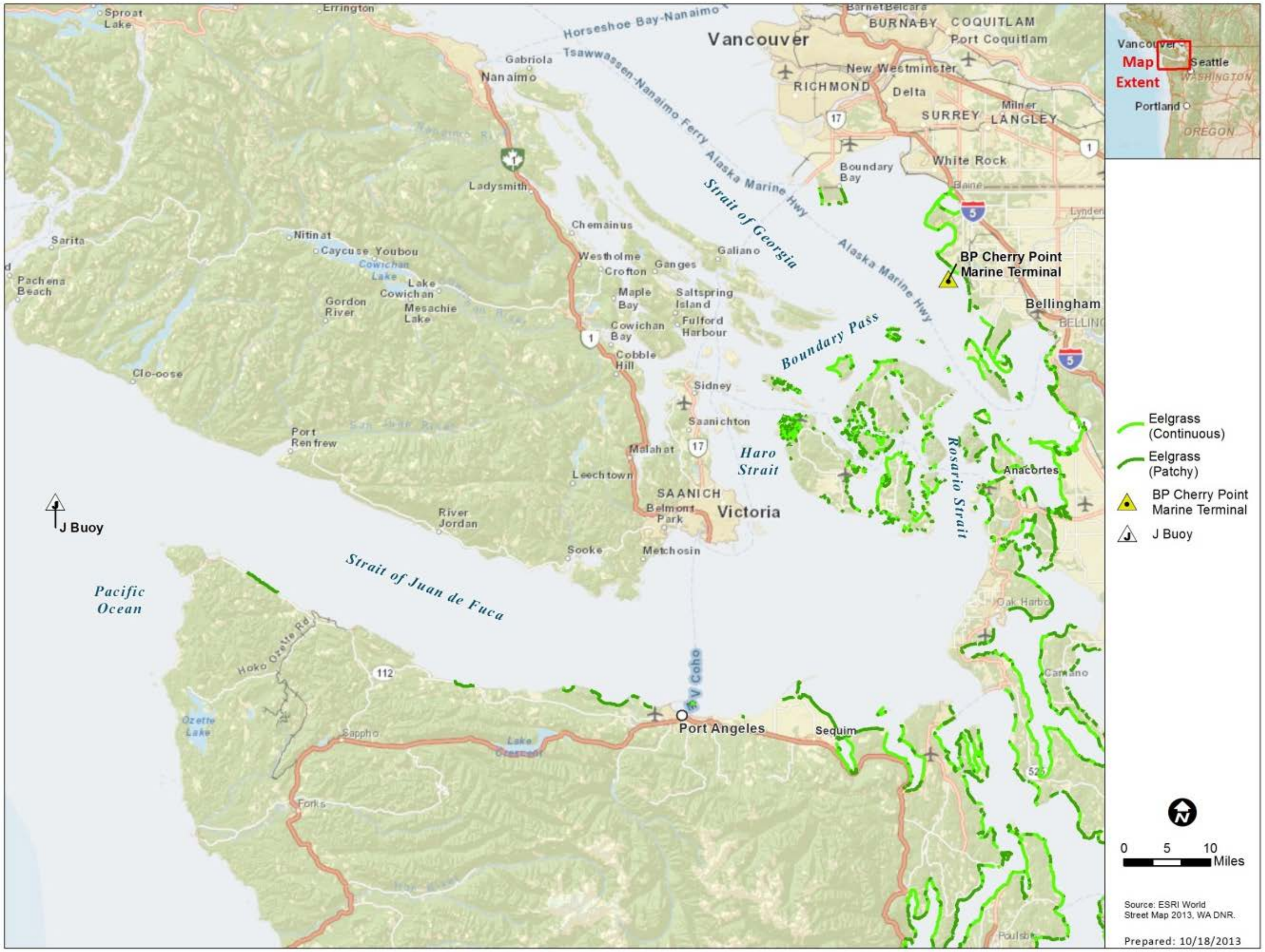

Figure 4.3-2 Eelgrass Distribution on the West Coast and the Strait of Juan de Fuca Coastal Zone

Source: Ecology n.d.

4.3.2 Kelp Beds

Kelp is a general term for brown and some red algae (seaweeds) that are large, occur primarily in low intertidal to subtidal zones, and are attached to rock substrates. They are characterized as "floating" and "non-floating" based on whether the mature individuals form canopies on the water surface at high tides.

Floating Kelp

Floating kelp is typically indicated by a large brown to yellowish brown canopy of bull kelp (*Nereocystis lutkeana*) or giant perennial kelp (*Macrocystis* spp.) floating at the water surface over rocky or large boulder substrates. It is most abundant in water depths from -8 meters (-25 feet) MLLW to approximately -15 meters (-50 feet) MLLW, depending on water clarity and exposures to high to moderate levels of wave action or currents. Within the study area, large beds of floating kelp are formed in the San Juan and Gulf Islands, and along the western shore of Whidbey Island, off the rocky shores of the Strait of Juan de Fuca. Floating kelp is most abundant in marine and higher salinity estuarine waters; it is generally not found in low-salinity areas (Figure 4.3-3).

Both bull kelp and giant perennial kelp are torn loose in storms, especially in winter, to drift on the surface and be deposited in the upper intertidal zone. Because floating kelp is composed of large plants that may cover many acres in what amounts to a densely packed marine forest, it provides habitat, food, and shelter for a wide variety of species. Organisms that use floating kelp as habitat include fish (larval to adult and demersal/benthic to pelagic); benthic macroinvertebrates (such as sea urchins, mollusks, crabs, shrimp, and worms); other algae and macroinvertebrates living on the kelp stems and fronds, or holdfasts on the bottom; sea otters in the outer coast kelp beds; and sea birds. Many of these species are opportunistic users of the kelp habitat (i.e., kelp is not essential to their survival); however, some are largely dependent on kelp for at least part of their life cycle. Floating kelp also breaks up to form organic detritus that enters the marine food web as nutrients.

Non-Floating Kelp

Non-floating kelp is composed of a variety of mostly brown and some red algal species that are large, perennial, and densely packed and that occur on rocky or large boulder substrates. It is often found in association with floating kelp, where it forms an understory canopy. Non-floating kelp is most abundant between the lower intertidal zone and depths to -30 meters (-100 feet) MLLW, depending on water clarity. Non-floating kelp beds occur in a range of areas—from areas with high levels of wave action and currents to sheltered coves and bays. Within the study area, non-floating kelp forms large beds in the San Juan and Gulf Islands, along the western shore of Whidbey Island, and off the rocky shores of the Strait of Juan de Fuca (Figure 4.3-4). Non-floating kelp is most abundant in marine and higher salinity estuarine waters; however, it is also in lower salinity estuarine areas where the deeper water column is more saline than the surface. Non-floating kelp is largely protected from storms because it is found beneath the surface. However, fierce winter storms may tear loose plants that may be deposited in the upper intertidal zone.

Figure 4.3-3 Distribution of Floating Kelp in the Study Area

Source: Ecology n.d.

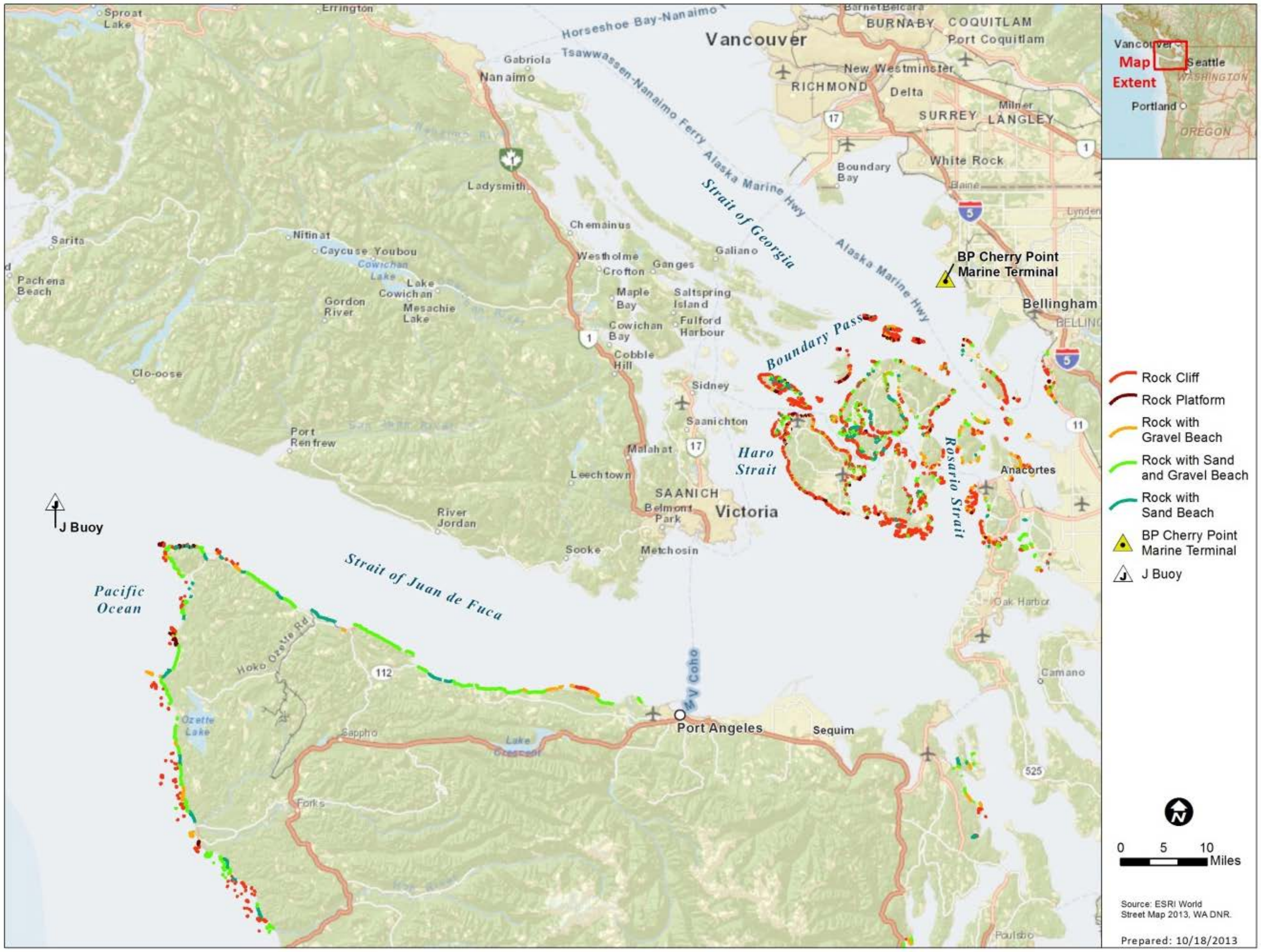

Figure 4.3-4 Rocky Shore Habitats in the Study Area

Source: Ecology n.d.

Like floating kelp, non-floating kelp is composed of large plants that may cover many acres—in what amounts to a densely packed, 1- to 3-meter (3- to 10-foot) tall marine forest. It provides food, habitat, and shelter for a wide variety of species. Organisms that use non-floating kelp as habitat include fish (demersal/benthic larval to adult); benthic macroinvertebrates (such as sea urchins, mollusks, crabs and shrimp, and worms); and other algae and macroinvertebrates living on the kelp stems and fronds, or holdfasts on the bottom. Many of these species are opportunistic users of the kelp habitat (i.e., kelp is not essential to their survival); however, some are largely dependent on kelp for at least part of their life cycle. The total contribution of non-floating kelp to the food web through direct consumption, detritus, and dissolved organic carbon is probably larger than the contribution from the floating species (WSDNR 2007).

4.3.3 Rocky (Consolidated) Shores

Rocky (or consolidated) habitats are a common and often dominant feature of the intertidal shorezone between mean lower low water spring (MLLWS), the average height of low waters occurring during spring tide, and mean higher high water (MHHW), the average elevation of higher high waters of a mixed tide over a specific period of time. In the study area, rocky shore habitat includes much of the Strait of Juan de Fuca on both the Canadian and U.S. sides; much of the San Juan and Gulf Island archipelagos; and portions of the shores along the eastern end of the study area, including the southern Straits of Georgia (Figure 4.3-4). Rocky shores are an intertidal area that consists of solid rocks and can include many different habitat types, such as steep rocky cliffs, platforms, rock pools, and boulder fields. Large boulders singly or in boulder fields may be present on rock platforms or on sedimentary beaches.

Rock can be relatively smooth, especially on shores with sand/gravel beaches and exposure to high wave energy. These rocks, especially large isolated boulders and cobbles, are essentially “sand blasted” by the constant scouring of wave-borne sand, gravel, and small cobble. In lower wave energy areas, such as protected areas, rocky habitats tend to be rough—with numerous crevices, overhangs, holes, and channels that provide habitat for a wide variety of plant and animal species. A biological feature of rocky shores is the dominant presence of algae and macroinvertebrates. These provide food, breeding/spawning areas, and shelter for a wide variety of seaside, sedimentary, and motile species that cannot survive direct exposure to wave energy, especially in exposed areas.

Rocky shore habitats in the study area express a wide range of physical and chemical characteristics—from relatively protected and low-salinity estuaries to exposed oceanic marine habitats. The rocky habitats of the high-salinity, high-wave-energy outer coast of Washington, British Columbia, and eastern portions of the Strait of Juan de Fuca are dominated by hardy seaside algae such as sea palms, coralline algae, and kelp, in addition to macroinvertebrates, gooseneck barnacles, California mussels, and acorn barnacles (Dethier 1990). These species are adapted to withstand the tremendous power and energy associated with greater than 20-foot ocean swells and larger winter storm waves. Living amongst these large algae and invertebrates are surfgrass, dozens of species of smaller algae, and hundreds of species of macroinvertebrates (e.g., anemones, sponges, crabs, clams, worms, limpets, chitons, snails, barnacles, starfish, sea urchins, and nudibranchs). At high tide, several species of fish forage in rocky habitats, including sculpins, greenlings, rockfish, perch, and blennies. Tide pools harbor numerous typically shallow subtidal algae, macroinvertebrates, and fish, as well as numerous intertidal species. Tide and surf rips immediately adjacent to rocky habitats serve as foraging and refuge areas commonly occupied by a large variety of schooling fish; these include both juvenile and adult life stages of herring, sand lance, Chinook salmon, and various species of rockfish and perch.

Within Puget Sound (eastern Strait of Juan de Fuca and the west/south shores of the San Juan Islands and Whidbey Islands), wave energy is reduced and rocky shores tend to be dominated by several species of non-floating kelp, surfgrass, folione red algae, and corraline algae, in addition to several characteristic macroinvertebrates (e.g., California edible mussels, barnacles, starfish, snails, and limpets).

In protected areas where wave energy is low, rocky shores may be dominated by rock weed, leafy red and brown algae, barnacles, edible mussels, periwinkle snails, small crabs, chitons, starfish, and numerous species of small fish that live in crevices and under cobbles.

4.3.4 Sedimentary (Unconsolidated) Shores

Sedimentary (or unconsolidated, loose substrate) habitats are a common feature of the intertidal shorezone between MLLW and MHHW in the study area. This includes the Strait of Juan de Fuca, numerous bays in the San Juan and Gulf Islands archipelagos, and most of the eastern portion of the study area to the southern Strait of Georgia (Figure 4.3-5). Several habitats described as rocky shores also have a substantial sedimentary component. Most sedimentary shores are composed of a mixture of grain sizes; typically, the visible surface layer material is a coarse veneer overlying a mixed grain size subsurface layer (Dethier 1990). The subsurface layer is often more physically stable than the surface layer. Sedimentary shores are more common in areas that receive slower wave energy, simply because high waves and strong currents tend to move sediment particles and associated biota to lower energy areas, typically to deeper water or sheltered bays.

Sedimentary shore habitats within the marine environment include salinity of 30 parts per trillion (ppt), high dissolved oxygen (DO), small range in temperature (cold), low turbidity, and high wave energy. In estuarine environments they include low salinity of 1ppt, low DO, large range in temperatures, high turbidity, and low wave energy. For many of the sedimentary habitats, especially those in exposed wave regimes, instability of the substratum is a constant factor controlling the biological community structure. There are few sessile species in these habitats unless they live in burrows. In cobble habitats in exposed areas, virtually no macro-organisms, algae, or macroinvertebrates living on or among the cobbles in the surface layers of cobble. The same holds true for gravel and sand beach habitats. Extensive sand beaches may support large populations of burrowing macroinvertebrates (such as polychaetes, amphipods, small clams, and razor clams) and motile forms that live in the swash zone[21] (such as mole or sand crabs). Other sedimentary habitats may support a wide variety of crustaceans, polychaete worms, bivalves, snails, small starfish, chitons, sponges, anemones, and other macroinvertebrates. The species, abundance, and life history stage vary primarily with salinity, wave exposure, and sediment grain sizes. Other physical or chemical factors (such as turbidity, pollutants, and shading by man-made structures.) may have locally important effects.

4.3.5 Sandflats and Mudflats

Sandflat and mudflat habitats are primarily located in major estuaries (such as Willapa Bay, Grays Harbor, Dungeness Bay, and the Nooksack delta), bays (such as False Bay and Birch Bay), and similar areas that are protected from wave energy. They generally have a gentle slope and are adjacent to large volume sources of fine grain sediments, usually rivers. Sand and mud flats tend to be physically stable and provide habitat to numerous burrowing and epibenthic species (organisms living at the surface of the sea floor).

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[21] The *swash zone* is the upper part of a beach, between the the nearshore zone and backbeach, where intense eroision occurs during storms.

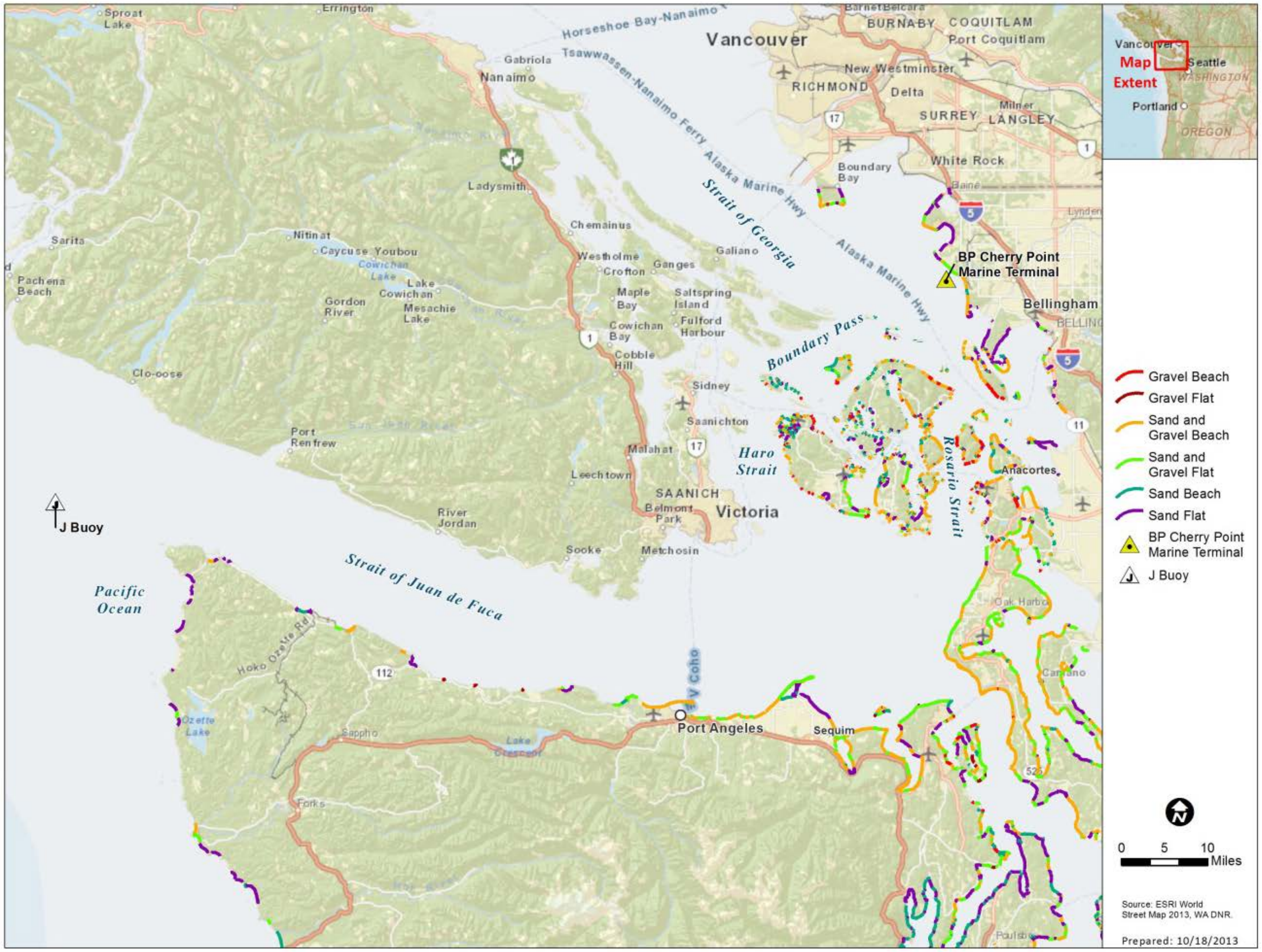

Figure 4.3-5 Sedimentary Shore Habitats in Puget Sound

Source: Ecology n.d.

In general, mudflats are biologically more diverse and productive than sandflats because they provide more organic material. Beaches adjacent to sand and mud flats often are suitable spawning habitats for rock sole, sand lance, and surf smelt.

Sandflats

Sandflats are composed primarily of sand, but may contain silt, clay, mud and small amounts of organic material. Dominant sandflats often have tidal marshes in the upper edges (Dethias 1990). Burrowing and tube dwelling macroinvertebrates dominate the benthic community and include several species of clams, polychaete worms, sea cucumbers, amphipods, and ghost shrimp. Common epibenthic macroinvertebrates include sand dollars, moon snails and other snails, Dungeness crabs, small crangonid shrimp, mysids, and several species of worms. Sole, flounder, sculpins, smelt, sand lance, juvenile salmonids and perch feed over/on sandflats. Sandflats in the study area occur along numerous bays in the San Juan and Gulf Islands archipelagos, and in Dungeness, Bellingham, Lummi and Birch Bays (Figure 4.3-5).

Mudflats

Mudflats are composed of very fine sand, silt, and clay and may contain substantial organic material. Mudflats are limited to bays and inlets where there is essentially no wave action or strong currents that would transport the fine silt and detrital particles away. Burrowing macroinvertebrates are diverse, abundant and productive in mud flats and are dominated by worms, mud shrimp, and other small crustaceans. Epibenthic invertebrates and macroinvertebrates include opisthobranches, snails, crabs, and shrimp. Numerous fish (such as starry flounder, sand dabs, shiner perch, gunnels, sculpins, and some smelt species) spend part to all of their lives on mud flats. Others live and feed on mud flats, especially in the juvenile stages (such as English sole, various perch species, salmonids, sand lance, herring, and surf smelt). Mud flats may also support extensive, dense eelgrass meadows. Mudflats in the study area occur in Wescott, Fidalgo, Padilla, Dungeness, and Willapa Bays (Figure 4.3-5).

4.3.6 Major Estuaries

Estuaries consist of intertidal and subtidal areas resulting from the union of rivers with the sea. Combined with inputs of sediment, nutrients, and organic materials from up-river sources, these waters provide highly productive ecosystems that have many functions and values. Estuaries support biodiversity and high species richness, provide areas for fish and wildlife to reproduce and rear, and act as important migratory corridors for multiple terrestrial and aquatic species (Hruby 2004).

Estuaries and associated wetlands protect the nearshore from erosion by buffering the coast from storm surges and wave energy. Estuaries also improve water quality by providing flood storage during high water events. As runoff inundates estuarine wetlands, the dense vegetation slows water velocity, causing sediments in the water column to settle out (Ecology n.d.).

Major estuaries found in the Puget Sound include:

- The Dungeness River Delta Estuary is located in the eastern Strait of Juan de Fuca at the mouth of the Dungeness River (Figure 4.3-6). This estuary is protected from strong wind-driven currents by Dungeness Bay to the west and contains many tidal creeks, distributary channels, and blind channels. The vegetation of the delta is predominantly emergent tidal marsh species, with some areas on the tidal creek levees exhibiting scrub-shrub vegetation (Redman et al. 2005).

- The Elwha River Delta Estuary is located at the mouth of the Elwha River just to the west of Lower Elwha, Washington (Figure 4.3-6). Sediment is comprised of cobbles and small boulders, and extensive kelp beds are present. Estuarine plant communities are comprised of emergent and scrub-shrub vegetation. Tidal creeks and side channels are not extensive or abundant, due in part to the high sandy bluffs just east of the estuary (Redman et al. 2005).
- The delta of the Skagit River Estuary has many distributary channels (Figure 4.3-6); the North Fork of the Skagit River empties into the bay south of LaConner, and the South Fork drains into the southern extent of the bay near Camano Island. Emergent and scrub-shrub marshes extend between the two river mouths, with riverine tidal marsh habitat extending up the north and south forks of the Skagit River.
- The Swinomish Channel is currently channelized and fragmented with few emergent marshes, substantially impeding fish migration (Figure 4.3-6).
- Padilla Bay extends from Samish Island south to the Swinomish Channel; it is approximately 8 miles long and 3 miles wide (Figure 4.3-6). Padilla Bay is an enclosed coastal embayment consisting of many tidal creeks and distributary and blind channels. The bottom of the bay is shallow, flat, and mucky from historical deposition of sediment from the Skagit River. At low tide, miles of mudflats are exposed across the bay. The large area of mudflats has led to extensive meadows of eelgrass (approximately 8,000 acres), a valuable food and refuge source for many different marine species, which have increased the habitat functions and values of Padilla Bay. The bay also contains pockets of salt marsh near the Swinomish Channel and intertidal sand and mudflats along the eastern extent of the bay (Ecology and NOAA n.d.).
- The Samish Bay Estuary extends from Samish, Washington south to Samish Island. It contains many tidal creeks and distributary and blind channels, as well as extensive mudflats (Figure 4.3-6). The Samish River is the largest freshwater system that drains directly into the bay and decreases salinity levels locally (Jones and Ross 1979).
- The Lummi Estuary is a delta that begins just south of Neptune beach and extends south to the eastern edge of Lummi Island (Figure 4.3-6). It is an enclosed coastal embayment consisting of many tidal creeks and distributary and blind channels. Mudflats occur at low tide, with patchy to continuous meadows of eelgrass and some areas of floating kelp.
- The Nooksack Estuary is located at the mouth of the Nooksack River in Bellingham Bay (Figure 4.3-6). Active deposition of sediment from the Nooksack River lead to changes in delta and emergent marsh areas, and conditions similar to the Lummi Estuary are found within this area.

Figure 4.3-6 Estuaries in the Study Area

Source: Ecology n.d.

4.3.6.1 Sub-Estuaries

Sub-estuaries occur at the mouths of minor rivers and streams. They provide many of the same ecosystem functions and values as larger estuaries, but on a smaller scale. Sub-estuaries provide critical habitat for juvenile salmonids that depend on sub-estuarine habitat for foraging and growth, shelter from predation, migratory corridors, and areas for physical transition from freshwater to saltwater (Beamer 2005). Sub-estuaries are also referred to as lagoons, pocket estuaries, or small river deltas. Select sub-estuaries of noted importance in the study area are described as follows:

- Channels and protected open waters in the Jimmy-Come-Lately sub-estuary (located at the head of Sequim Bay in the eastern Strait of Juan de Fuca) provide refuge for aquatic organisms during storms and from consistent wave energy. The proximity of uplands with riparian vegetation, mud and sand flats, and emergent marshes leads to complex food webs.
- The Padden Creek sub-estuary located in the southeast corner of Bellingham Bay and adjacent to the South Georgia Strait has few meandering channels and limited protected open water. Nevertheless, these limited habitat features provide some refuge for aquatic organisms during storms and from consistent wave energy. The proximity of uplands with riparian vegetation and emergent marshes leads to a varied prey base for salmonids.
- The Snow Creek sub-estuary located at the head of Discovery Bay in the eastern Strait of Juan de Fuca has channels and protected open waters that provide refuge for aquatic organisms during storms and from consistent wave energy. The proximity of uplands with riparian vegetation, mudflats and sand flats, and emergent marshes leads to complex food webs.
- The Hoko River sub-estuary located in the western Strait of Juan de Fuca contains well mixed, clear waters that support osmoregulation of juvenile salmonids. The estuary has an oxbow[22] channel and protected open waters that provide refuge for aquatic organisms during storms and from consistent wave energy. Furthermore, sub tidal and intertidal areas, patchy kelp and surf grass, and emergent marshes add habitat value to this estuary by increasing niche space for fish and wildlife.

4.3.7 Rocky Subtidal Habitat

Rocky subtidal habitat is composed of bedrock and other consolidated substrates that comprise steep walls, reefs, benches, pinnacles, large boulders, and similar structures below the MLLW level and down to the deepest waters in the study area. The shallow subtidal area includes the area from MLLW down to approximately -18 meters (-60 feet) MLLW, and the deep subtidal is the area below that. Rocky subtidal habitats generally are located adjacent to the rocky (consolidated) shorezone and occur under kelp beds. Rocky subtidal habitats cover all salinity regimes, although most are in marine and higher-salinity estuarine waters. In addition, they are exposed to the entire spectrum of wave and current regimes from the high-energy open coast (such as Tatoosh Island) to the lowest-energy sheltered coves and bays (such as East or West Sound on Orcas Island). Solid rock subtidal habitats tend to be rough-textured, providing numerous micro-habitats for a wide variety of organisms. Many areas also have an extensive veneer of boulders and large cobble that is physically stable, even under high wave regimes, and that provides extensive habitat in openings under, on, and around the cobble/boulders.

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[22] An *oxbow* is a section of a river channel fully or partially separated from the river.

Shallow Subtidal Rocky Habitat

Shallow subtidal rocky habitat is often dominated by algae, including floating and non-floating kelp and numerous other smaller species of algae and surfgrass in exposed areas. The dominant sedentary organisms on deep rocky substrates tend to be sponges, bivalves, worms, hydroids, and sea anemones. Motile species tend to be shrimp, crabs, pectens, starfish, sea urchins, various mollusks (chitons, octopus, nudibranchs, and snails), worms, and other crustaceans. Fish include demersal and benthic species such as greenling, cabezon, lingcod, sculpins, pricklebacks, and some rockfish. This habitat also supports a wide variety of eggs, larvae, and juveniles of all the above groups and of numerous pelagic fish species. Herring, sand lance, and smelt juveniles and adults frequently utilize the associated water column habitats as refuge from pelagic predators. However, salmonids, black rockfish, and other pelagic species frequently pursue forage fish well into shallow habitats.

The shallow subtidal rocky habitat is biologically productive, partly because the algal cover provides a large amount of energy through primary production to the nearshore community. It also provides shelter; food; fish migration corridors; juvenile fish and macroinvertebrate rearing areas; food sources for sea birds, sea otters, and pinnipeds; and substrate for a wide variety of species, many of which are dependent on the algal community.

Deep Subtidal Rocky Habitat

Deep subtidal habitat typically has less algal cover, and the amount decreases as depth increases and light availability decreases. The dominant sedentary organisms on deep rocky substrates tend to be barnacles, hydroids, worms, sponges, sea anemones, bivalves, and other large macroinvertebrates. Motile species tend to be crustaceans, starfish and urchins, snails, and numerous smaller worms and other species. Fish include species of sculpins, lingcod, cabezon, greenlings, perch, gobies, and other demersal fish. Diverse communities of rockfish species of various life stages and degrees of demersal and pelagic behaviors are typically present. Number of species and community diversity vary with depth and other characteristics of the deep subtidal rocky habitats. As depth increases, deeper water species (such as deep water-dwelling rockfish, lingcod, and halibut) replace the above nearshore communities. As with the shallow subtidal rocky habitats, pelagic forage fish and predators are frequently found in association with deep subtidal rocky habitats. The separation between pelagic and demersal communities becomes more distinct as depth increases beyond the nearshore zone. The deep subtidal rocky habitat provides many of the same ecological benefits as shallow subtidal rocky habitat though the provision of energy; however, algal primary production is lower than in shallower areas due to decreased light.

4.3.8 Unconsolidated Subtidal Habitat

Unconsolidated subtidal habitat is composed of one or more substrates of mud, sand, gravel, shell fragments, pebble, and small cobble substrates. This habitat is generally found in channels between reefs and islands, gently sloped bottoms offshore of beaches, and in coves and bays below the MLLW level and down to the deepest water in the study area. Unconsolidated subtidal habitats are generally located: offshore of the unconsolidated shorezone areas; on the flat to gently sloped bottoms between islands, reefs, pinnacles, and similar rocky structures; in the deep subtidal habitat offshore of the rocky (consolidated) shorezone; at the bottom of the straits and offshore of the outer coast; and in coves, bays, estuaries, and similar flat to gently sloped low-energy areas. Unconsolidated subtidal habitats cover all salinity regimes from marine waters to low-salinity estuarine waters. They tend to be dominant in areas of lower energy wave and current regimes, such as the deep areas of the Strait of Juan de Fuca and Georgia Strait and of the numerous coves, bays, and inlets in the study area. High-energy regimes, especially from waves, tend to mobilize the sedimentary particles and move them to lower energy areas.

Unconsolidated sediment habitats provide opportunity for numerous species of worms, bivalves, sea cucumbers, fish, crustaceans, and many other species to live beneath the surface in burrows, tubes, or depressions. Many other species such as star fish, sea urchins, worms, crabs, shrimp, and snails live on the surface of the sedimentary habitat. Where there are cobbles, there may be large numbers of bivalves, worms, hydroids, sponges, and other species that are also found in the rocky subtidal habitat. Numerous fish live in or on (benthic) or just above (demersal) the unconsolidated subtidal habitats; these include numerous sport and commercial species such as halibut, sole, flounder, rockfish, and Chinook salmon. Cobble habitats are important demersal rockfish juvenile recruitment areas. Sand lance is known to burrow into finer substrates. Although the purpose of the behavior remains unclear, it is known that these concentrations of sand lance attract a wide range of demersal and pelagic predators such as Chinook salmon, sharks, skates and rays, halibut and other flatfish, rockfish species, lingcod, cod, hake, and pollack.

Shallow Subtidal Unconsolidated Habitat

Shallow subtidal unconsolidated habitat in higher-energy wave and current regimes are found in the Strait of Juan de Fuca and the western-facing shores of Whidbey, San Juan, and Lopez Islands. These habitats are often dominated by coarser particles (such as cobble to coarse sand) while mud and fine sand shallow subtidal habitats dominate in low-energy areas such as coves and bay (such as Dungeness Bay, Willapa Bay, Sooke Basin, Griffin Bay, and Bellingham Bay). Although eelgrass beds are present in many of these areas, algae are either not present or they are small forms and generally not abundant. Several important commercial and recreational shellfish species occupy these habitats; they include geoducks, other clams, Dungeness and rock crabs, weathervane scallops, and sea cucumbers. Commercially or recreationally important fish species found in these shallow-water habitats include starry flounder; sand, rock, and butter sole; and other flatfish. The shallow unconsolidated habitat is biologically productive and provides shelter, food, and breeding areas for numerous fish and macroinvertebrates. These habitats, along with estuaries, are important nursery areas to many species of flatfish.

Deep Subtidal Unconsolidated Habitat

Deep subtidal unconsolidated habitat is often dominated by sand or mud, especially in the deep channels or in deep, protected inlets and bays. Varying amounts of gravel and shell fragments are found in some higher-current energy areas such as Haro Strait and the San Juan Channel. This habitat typically has little to no algal cover. The dominant sedentary organisms tend to be burrowing worms, crustaceans, bivalves (including geoducks), and other large macroinvertebrates. Motile species include crabs, shrimp, and other crustaceans; starfish and urchins; and snails. Fish include several species of juvenile rockfish; halibut; starry flounder; sand, rock, and butter sole; sculpins; and other demersal fish. The deep subtidal unconsolidated habitat provides many of the same ecological benefits as shallow subtidal unconsolidated habitat, although it generally is not as productive as the shallower areas.

4.3.9 Water Column

The water column is the largest habitat in both areal extent and volume in the study area, and it essentially defines the study area. For this assessment, the water column is divided into the surface (0 to 0.3 meter [1foot]), subsurface layer (0.3 to 18 meters [1 to 60 feet] below the surface), and the deep layer (everything below 18 meters [60 feet]).

The majority of the water column habitat is marine (i.e., ~30 ppt salt) with lower salinities in the eastern portions of the study area, especially in estuaries; in the southern Strait of Georgia that is heavily influenced by the Fraser River discharge; and in Sooke Bay, Port Renfrew, and similar large bays with major rivers flowing into them. The surface layer, at the air-water interface, is typically more turbulent and well-oxygenated by wind compared to the lower sub-surface and the bottom layers. Floating material (such as oil), even under heavy wave action, typically mixes only into the surface and upper portion of the sub-surface layer.

Surface Layer

The surface layer is habitat for a diverse and productive community of organisms that lives right at the surface (i.e., in the top inch or so) and is composed of phytoplankton[23], permanent zooplankton[24], and eggs and larvae of numerous fish and macroinvertebrate species. Many of these species are also found in the rest of the surface layer along with other larger plankton, surface-feeding fish, and pelagic macroinvertebrates. Sea birds, waterfowl, and sea otters spend a substantial portion of their time feeding and resting on the surface layer. All marine mammals pass through the surface layer to breathe during feeding, breeding, resting, and sleeping. The species composition, diversity, and biological productivity of the surface layer changes as the overall water depth, distance from shore, and location relative to the eastern portion of the study area decreases. That is, the composition of the biological community in the surface layer is different in the area offshore “J” Buoy from that in the embayments of the southern Strait of Georgia.

Subsurface Layer

The subsurface layer (0.3 to 18 meters below the surface) is in the productive photic zone, where phytoplankton is a major contributor to the primary production and thus the energy source for this habitat. The biological community is dominated by plankton and pelagic eggs and larvae of macroinvertebrates and fish including herring, flatfish, cod, smelt, and halibut. Juvenile fish such as herring, salmon, and other pelagic species feed in the subsurface layer. Numerous larger fish species (salmon, herring, dogfish, pollock, sand lance, and rockfish) also are present—many of them in large numbers—in this layer. Sea birds and many of the marine mammals feed at least some of the time in the subsurface layer—primarily on fish and crustaceans that school there.

Deep Layer

The deep layer (from approximately 18 meters to the bottom) covers a large range in productivity, biomass, and species diversity and composition. In the offshore area (such as J Buoy, the middle of Strait of Juan de Fuca, and Haro Strait), water depths may reach from 91 to over 213 meters (300 to over 700 feet), whereas in the areas nearer shore and much of the eastern portion of the study area, water depths range from 18 to 46 meters (60 to 150 feet). The offshore and deep water portion of the bottom layer is generally less productive because much of it is below the photic zone where phytoplankton can survive. This area is also less species diverse and is dominated by larger zooplankton and pelagic and demersal fish. Only the deepest diving sea birds and many of the marine mammals feed in this zone.

4.3.10 Salt Marshes

Salt marshes occur commonly in estuaries and are of particular importance because they are extremely productive habitats and are home to a wealth of plant and wildlife species. Nearly all of the larger bays and river mouths on the Pacific coast are bordered by salt marshes. In general, more than one-half the sediment in a salt marsh consists of particles less than 0.004 mm in diameter, resulting in soil with a consistency of clay. The roots of salt marsh plants, along with fragments of decaying vegetation, help to

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[23] *Phytoplankton* are plankton consisting of microscopic plants.

[24] *Zooplankton* are tiny animals (e.g., diatoms, krill, and copeopods) found on the waters surface

stabilize the sediment. Salt marsh plants are adapted to high salinity levels and frequent anaerobic conditions (Heatwole 2004). The salinity of the soil in a salt marsh varies according to the amount of tidal flooding, rainfall, fresh water runoff, and evaporation that occurs (Northern Puget Sound Ecological Characterization 2011).

Little is known about the animal communities utilizing salt marshes in Puget Sound (Heatwole 2004). Grasses provide ladders above the tide for those animals that inhabit dry areas (such as some snails and insects), and roots retain moisture for species that thrive in wet environments (such as shore crabs and certain shrimp). Many insects inhabit salt marshes (Heatwole 2004), which are an important food source for many fishes, particularly salmon.

4.3.11 Nearshore Riparian Areas

Nearshore riparian areas are the lands adjacent to marine shorelines and constitute the interface between terrestrial and aquatic ecosystems. A variety of important ecological functions are carried out by riparian vegetation along marine shorelines. Riparian vegetation helps to stabilize the soil, control pollution entering marine waters, and provide fish and wildlife habitats (Brennan 2007). Riparian areas are transitional, providing connections between and affecting both adjacent aquatic and terrestrial systems. Riparian nearshore areas also provide the ability to absorb the impacts of storm surges and other natural, physical assaults on shorelines. Riparian plant and animal communities are greatly affected by temperature and moisture, tidal inundation, wind exposure, and salt spray (Brennan 2007). Specialized riparian communities include prairies, dune-grass associations, salt marshes, and tidal or surge-plain communities.

Riparian nearshore areas provide important nutrients in the form of organic debris that support the marine food web. Riparian vegetation also supports insects and other prey resources, which are eaten by juvenile salmon and other fish and wildlife. Cutthroat trout, Chinook and chum salmon, and many other fish species feed on insects from marine riparian areas and on forage fry and adults that reside there. Overhanging vegetation and tall trees provide shade along shorelines which protects shellfish and other forms of intertidal life from the heat of the sun.

4.3.12 Backshore Spray and Storm Debris Zone

Between the typical upland terrestrial habitat and the MHHW line (characterized by recent deposits of logs, kelp, and jetsam), there may be a zone characterized by flat to gently sloped topography, sand/gravel substrate, and weathered log debris. This backshore habitat is usually adjacent to unconsolidated intertidal habitats. Examples include substantial sections of the open coast from about La Push to the Columbia River (such as Sekiu to Hoko River, Clallum Bay, Crescent Bay, and Dungeness Spit). Typically, these areas receive salt spray from large waves but are rarely inundated except when extreme spring tides coincide with major ocean swells and storm-driven wind waves. The salt spray prevents most of the true upland terrestrial species from living in this zone. Because the backshore area is often low relief, it is suitable for development for camping areas, parks, housing, tourist developments, and commercial and industrial facilities. The biological community is dominated by a few plant species, primarily dune grasses and other salt-tolerant shrubs, forbs, and trees.

4.3.13 Man-Made Structures

Man-made structures include bulkheads, piers, pilings, oyster and mussel pens, riprap, marinas, building foundations, dredged material islands, and numerous other smaller structures, including tribal fishing weirs, placed in the study area by human activities. Man-made structures are most common in the eastern portion of the study area, especially on the western shores of Whidbey and Fidalgo Islands and on the mainland coast from Anacortes to the Canadian border. Man-made structures are less common around the San Juan Archipelago and from Port Townsend to Neah Bay.

Most man-made structures are at or above MLLW; but many of the docks, piers, and breakwaters extend below MLLW or extend out over the water surface (such as piers and marina floating docks) to shade areas of the shallow subtidal habitats. Man-made structures are found in all salinity regimes but are less common in fully marine environments than in the sheltered lower salinity areas. They also tend to be more common in lower energy areas. However, some of the larger structures, such as breakwaters, bulkheads, and shoreline riprap, are placed in high-energy wave environments to protect such areas from high waves.

Most man-made structures are "hard"; that is, the substratum is similar to rocky or consolidated habitat and they tend to support similar biological communities. On wharves, docks, floats, aquaculture pens, and similar structures, the biological community is commonly categorized as the "fouling community."

4.3.14 Cherry Point Area and Cherry Point Aquatic Reserve

For purposes of this analysis, the Cherry Point area is described as a community of habitats because it is a relatively small area close to the BP Cherry Point dock that could potentially be affected by operations associated with the Project. The Cherry Point area extends from the MHW datum to approximately 2 nmi offshore and from Birch Point in the north to Sandy Point in the south. It encompasses the Cherry Point Aquatic Reserve including Birch Bay and Lummi Bay (Figure 4.3-7).

This area is composed of eelgrass beds, kelp beds, rocky and unconsolidated shores, estuaries and mudflats, rocky and unconsolidated subtidal habitats, the water column, and man-made structures. Descriptions of these habitats specific to the Cherry Point area are provided below.

Eelgrass Meadows

The more protected, shallower areas in the Cherry Point area tend to accumulate more smaller-grained substrates that are favored by eelgrass, allowing this area to consistently support larger eelgrass beds. In addition, both Lummi Bay and Birch Bay provide large areas that are relatively protected from storms and long-shore currents, allowing large eelgrass beds to develop. The reach of shoreline between the two bays is lined with patches of eelgrass on the north and south ends, with a more continuous distribution along the center (Ecology n.d.). This middle segment is largely comprised of sandy substrate, which is too mobile to support eelgrass growth. The eelgrass has successfully colonized in depressions surrounded and stabilized by cobbles and boulders (Berger 2000).

Eelgrass along this reach can be found in the lower intertidal and upper subtidal zones between 0 and -4 meters (0 and -13 feet) MLLW (Shapiro 1994). The intertidal zone along the Cherry Point area is a relatively exposed, high-energy area, with the shoreline exposed to strong wave energy. The subtidal zone (8–9 meters [15–30 feet] MLLW) is subject to low to moderate tidal currents (ENSR 1992). Waves along the reach are generally from the south, southwest, west, and northwest and are generated by winds in the Strait of Georgia (EVS 1999). Near Cherry Point, below approximately +1 meter (+3 foot) MLLW, the beach grades into a bench with a relatively flat gradient that extends approximately 305 meters (1,000 feet) seaward to approximately -9 meters (-30 feet) MLLW, where the slope again steepens (Berger 2000). This relatively flat bench provides the appropriate amount of light, diverse substrate types, and consistent flushing by long-shore currents to support subtidal vegetation.

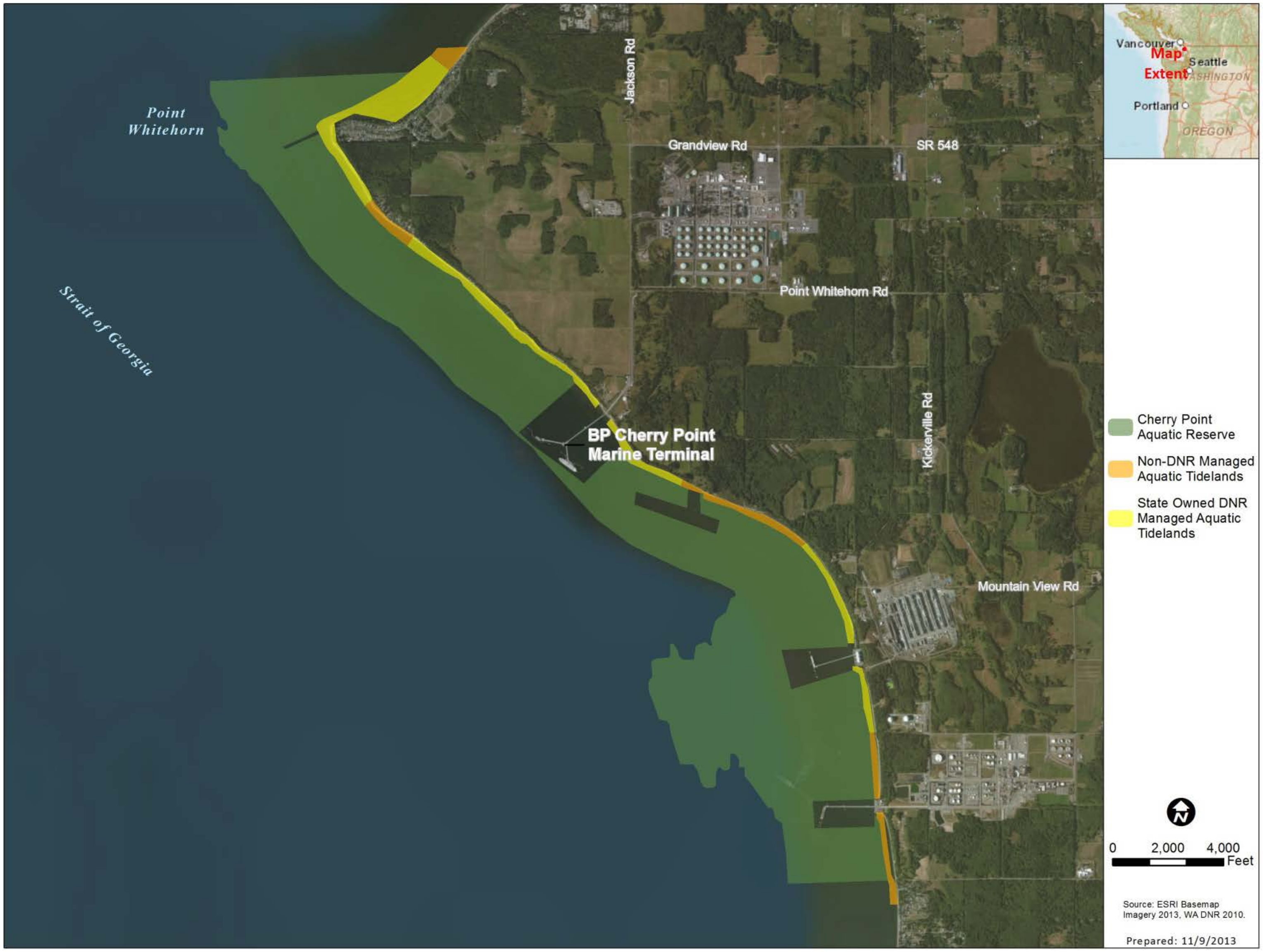

Figure 4.3-7 Cherry Point Aquatic Reserve

Source: WSDNR 2010.

The dominant eelgrass species in this area is *Zostra marina*. The local populations are currently threatened by an invasive species, *Sargassum mutcum.* This brown algae first invaded Washington waters in the early 1990s. By 1997, it was estimated that Sargassum inhabited 34 percent of the shoreline of Whatcom County, where Cherry Point is located. The algae can be found in cobble and shallow subtidal habitats, making it a competitor with eelgrass. When distribution overlaps with native eelgrass, kelp, and algae, the aggressive colonization by Sargassum dominates and shades out the native species. The ecological impact of Sargassum is not fully known because it offers habitat and food to other organisms but also disrupts the native balance.

Eelgrass beds are a preferred spawning substrate for Pacific herring, who deposit their eggs on the blades. Herring spawning has been documented along the entire Cherry Point reach, from inside of Birch Bay to Lummi Bay (WSDNR 2007). The large presence of fish in the eelgrass beds surrounding Cherry Point attracts piscivorous[25] marine birds. Common species found in the area include loons, grebes, cormorants, mergansers, terns, and alcids. Many omnivorous bird species, including many types of diving ducks, also are attracted to the area. Most of these species, especially the piscivorous ones, depart for their breeding grounds after the herring spawning period is completed (ENSR 1992).

Kelp Beds

Kelp is most common in rocky, high-energy environments—which are not characteristic of the Cherry Point area. While the stretches of shoreline between Birch and Lummi Bays are high energy, they are typically sand and cobble environments. Patchy sections of kelp beds are located along the coast; however, they usually are found attached to the pilings of marine terminals. Large boulders that support macroalgae assemblages are prevalent north of Cherry Point, near the Intalco marine facility, and immediately south of the Tosco Ferndale Refinery (EVS 1999).

Marine vegetation can be found from 0 to -9 meters (0 to -30 feet) MLLW along the reach (Shapiro 1994). Green algae (e.g., *Enteromorpha*, *Monostroma*, and *Ulva*) tend to dominate in the lower intertidal zone, brown algae (e.g., *Laminaria*, *Nereocystis*, *Sargassum* and *Costaria*) in the upper subtidal zone, and red algae (e.g., *Gelidium*, *Gigartina*, *Irridaea*, *Porphyra*) in the lower subtidal zone. Subtidal kelp beds provide habitat for a variety of invertebrate fauna, including sea stars, red rock crabs, small shrimp, and a variety of polychaete worms and small bivalves (EVS 1999).

Rocky (Consolidated) Shores

Rocky shores are fairly sparse in the Cherry Point area. Some isolated patches of exposed or sheltered rocky shores are located on the southern tip of Sandy Point and in Birch Bay.

Harbor seals use the rocky beaches for hauling out and pupping from Point Whitehorn south to within approximately 1 mile north of the Cherry Point pier. The Cherry Point shoreline is generally unsuitable for sea lion haulout or use by whales because of the large areas of shallow water near shore (Ecology 2012a).

Sedimentary (Unconsolidated) Shores

Sedimentary beaches comprise most of the shoreline in the Cherry Point area. Areas of sandy gravel are present as berms along the high tide line, as are patches of medium to coarse sand. The substrate distribution is dynamic, depending on the frequency and magnitude of storms and currents. Winds,

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[25] *Piscivorous* birds are fish-eating birds.

waves, and currents associated with storms can relocate smaller-grained substrates, move cobbles and small boulders, and remove vegetation by tearing it from its substrate.

Sedimentary beaches in the Cherry Point area are important spawning habitat for surf smelt from June through August. The fish deposit their eggs near the water's edge on beaches with a specific mixture of coarse sand and pea gravel. Another important forage fish species, Pacific sand lance, is not known to use the Cherry Point area for spawning.

Estuaries and Mudflats

The major estuaries in the Cherry Point area include Birch Bay and Lummi Bay. Birch Bay is a headland bay created by the refraction of incoming waves on the headlands that lie on either side of the bay. Terrell Creek runs parallel along a section of the beach and eventually flows into the bay. Lummi Bay is formed by the Lummi River Delta. The large intertidal shelf provides for an extensive sheltered mudflat and eelgrass bed. Both bays are supportive of typical estuarine species, including algae, eelgrass, crabs, shellfish, and various marine birds. The protected eelgrass beds are also used by juvenile pink, coho, and Chinook salmon (Ecology n.d.).

Most of the area in Lummi Bay and the inland portion of Birch Bay consists of large tidal mudflats that support continuous eelgrass beds and the species that typically occupy them. Many marine birds, gulls, scaup, waterfowl, scoters, and bufflehead are attracted to these mudflats because of the wealth of food available.

The mud and sandflats in Lummi Bay support herring spawning and commercial demersal groundfish fishing. The Bay also includes the Lummi Indian Nation hatchery, which releases coho and fall Chinook salmon; however, no salmon fishing occurs within the bay. The hatchery also takes advantage of the naturally nutrient rich mudflat to support a shellfish hatchery. Major shellfish raised by the tribe includes oysters, manila clams, geoducks, mussels, basket cockles, and European flat oyster. Recreational shellfish harvesting in Birch Bay includes various hardshell clams and Pacific oyster. Both bays are habitat for the Dungeness crab.

Rocky Subtidal Habitat

Loose gravel and large boulders characterize the upper intertidal zone; however, sand becomes more prevalent at lower elevations. Therefore, rocky subtidal habitats are sparse in the Cherry Point area and are limited to isolated patches protected by large boulders.

Unconsolidated Subtidal Habitat

The subtidal zone throughout the Cherry Point area is generally depositional, with finer sediments, fine sand, silt, and muds prevailing. Sediments in the upper subtidal zone immediately below the intertidal zone are generally sandy and muddy (EVS 1999). Below approximately -3 meters (-10 feet) MLLW, the sediments become more uniformly sandy, with patches of gravel and occasional boulders (Berger 2000). Medium to coarse sand is present throughout the area in the lower intertidal and uppermost subtidal zones (ENSR 1992).

The sedimentary subtidal habitat along Cherry Point and the surrounding area provides important habitat for several commercially important fishery species, including Pacific herring, multiple species of salmon, groundfish, Dungeness crab, and geoduck clams (ENSR 1992). Relatively little is known of the groundfish populations along Cherry Point. English sole and starry flounder are potentially the only common groundfish that occur along the subtidal reach (EVS 1999).

Adult Dungeness crabs are common along the Cherry Point shoreline and support recreational and commercial fisheries in the area. Studies have revealed a cyclic pattern in the population abundance through the year (ENTRIX 2006). The crabs move offshore in fall and winter, and back inshore in spring and summer to lay eggs and molt. Trawl catch data show that the highest abundance is in spring, with April yielding the highest catch (ENTRIX 2006).

Water Column

Approximately 305 meters (1,000 feet) seaward of Cherry Point, the subtidal shelf slopes downward to an approximate depth of 46 meters (150 feet). Tidal currents in this deeper water area are on the order of 0.7 to 1.0 ft/second and are directed to the northwest (flood tide) or the southeast (ebb tide) (EVS 1999). Wind-induced currents are present near the water surface and may become significant during high winds. Wave-induced currents include a drift current in the wave direction, which is usually the wind direction.

This offshore area provides a large area utilized for herring holding. The north end of this area, offshore of Birch Bay, is used for commercial demersal and pelagic groundfish fishing. The south end near Lummi Bay is used for recreational salmon fishing in addition to the commercial groundfish. Dominant groundfish species for both commercial and recreational uses include Pacific cod and English sole.

Man-Made Structures

The Cherry Point area is moderately developed and supports three major industrial facilities. The BP Cherry Point dock is located 5.2 miles northwest of Sandy Point. Industrial marine terminals are located 3.7 miles north of Sandy Point (Alcoa Intalco Works) and 2.8 miles north of Sandy Point (Tosco Ferndale Refinery).

The piers associated with these facilities provide hard surfaces that attract algae, barnacles, mussels, and other sessile organisms. The fauna species diversity and abundance on the pilings is largely controlled by invertebrate predators, including seastars and snails. Adult and juvenile salmon, Pacific herring and various demersal species such as sculpins and flatfish also have been observed associated with pier pilings (Berger 2000). Juvenile outmigrating salmon use the piers and their shadow for temporary shelter, and feed on the abundant organisms associated with the piers.

Lummi Bay is home to the Lummi Indian Nation shellfish hatchery. The tribe has more than 7,000 acres of tidelands, including a 700-acre seapond constructed in the Bay. The hard surface of the bordering seapond provides a stable attachment platform for macroalgae. Tribal fishing weirs located in this area historically were an important part of the Lummi Nation treaty rights fishery.

The Sandy Point Marina is located at the north entrance of Lummi Bay. The marina provides boat moorage and a launching ramp. These physical structures can provide habitat for small invertebrates and algae, as well as juvenile fish.

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4.4 WATER QUALITY

The water quality study area encompasses six counties in the state of Washington: Whatcom, San Juan, Skagit, Snohomish, Island, Clallam, and Jefferson. Waterbodies in the study area are associated with the San Juan Islands, the northern Olympic Peninsula, Birch Point to Samish Island, and Padilla Bay to Keystone Harbor (Figure 4.4-1). This section provides the context necessary to understand water quality in the study area. Operation of marine vessels that are powered by diesel internal combustion engines and carry crude oil or refined petroleum products has the potential to release water pollutants via several routes. These releases can cause deterioration of water quality and can affect sensitive wildlife.

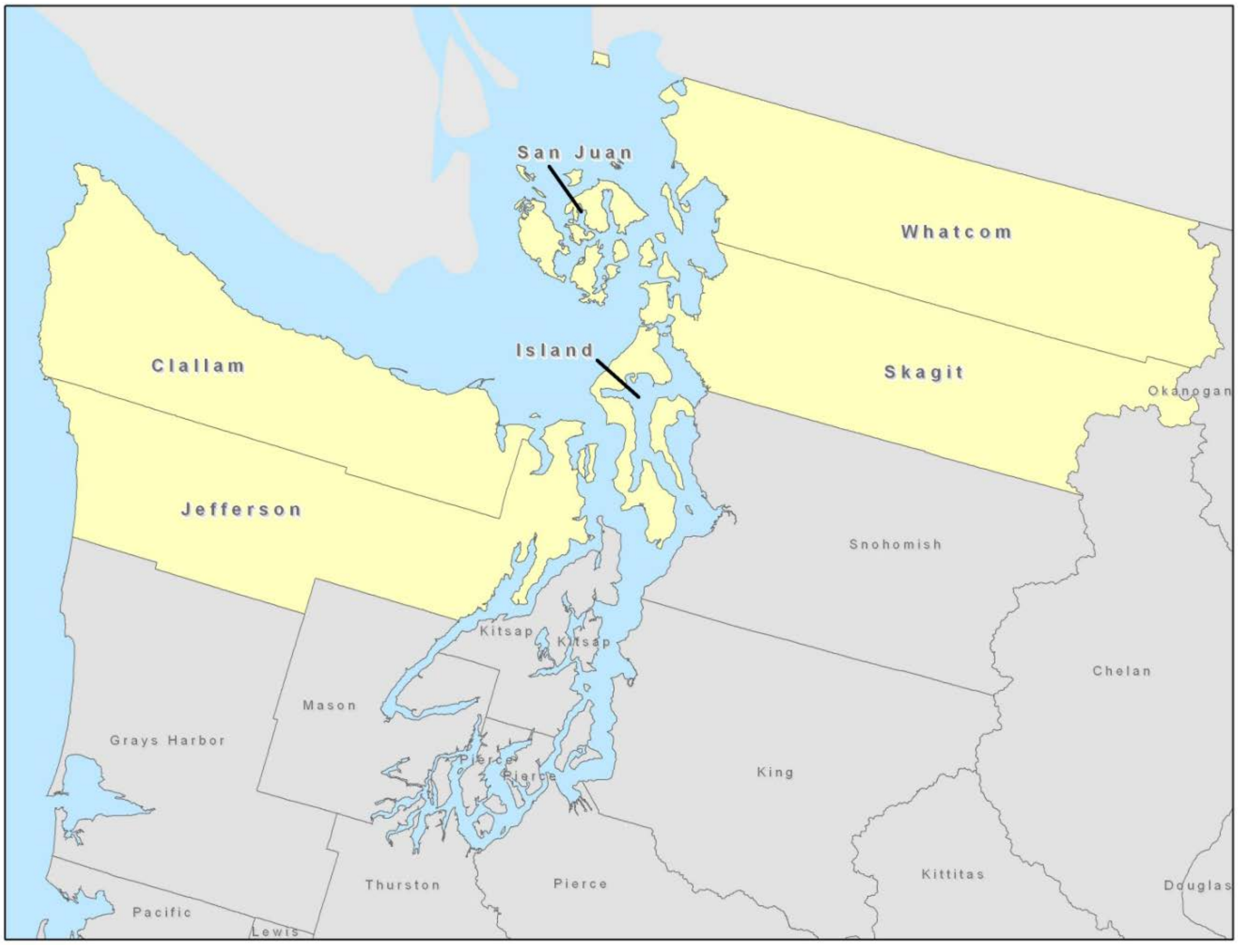

Figure 4.4-1 Map of Counties in the Study Area

This section focuses on existing water quality conditions in the study area and the potential effects of releases associated with operation of diesel-powered vessels carrying crude oil or refined petroleum products. Information used in preparation of this section came from a variety of sources, including the U.S. Environmental Protection Agency (EPA), Ecology, and the Puget Sound Partnership.

4.4.1 Regulatory Setting

This section describes the regulatory framework for the study area and the standards that will be used to determine whether implementation of the Project would result in potential adverse effects on water quality.

4.4.1.1 Federal Regulations

EPA's authority over regulations regarding marine environments is limited to a coastal zone located from 3 to 200 nmi offshore (Craig and Miller 2001). Individual states hold jurisdiction over coastal waters from the state's coastline to 3 miles out to sea. The *marine environment* is defined as:

> *Those areas of coastal and ocean waters, the Great Lakes and their connecting waters, and Submerged Lands thereunder, over which the United States exercises jurisdiction, consistent with international law* (Craig and Miller 2001).

The Puget Sound Partnership was created in 2007 by the Washington State legislature to help restore and protect Puget Sound. The Partnership's Action Agenda is a roadmap for managing the health of Puget Sound and has been approved by the EPA as the Comprehensive Conservation and Management Plan for Puget Sound under the EPA's National Estuary Program (EPA 2013a).

4.4.1.2 State Regulations

In Washington State, Ecology is a member of the Puget Sound Partnership. The agency is responsible for monitoring and controlling toxic chemicals and DO, among other important indicators, in an effort to improve the health of the Puget Sound ecosystem (Ecology 2013a).

Compliance with the surface water quality standards of the State of Washington requires compliance with Chapter 173- 201A WAC, "Water Quality Standards for Surface Waters of the State of Washington," and Chapter 173-204 WAC, "Sediment Management Standards."

Ecology develops water quality criteria for fresh and marine waters to protect designated uses, such as public water supply; fish, shellfish, and wildlife; and recreational, agricultural, industrial, navigational, and aesthetic purposes (Ecology 2013b). Criteria may be numeric (i.e., not to exceed some concentration) or narrative. Narrative criteria are statements that describe the desired water quality goal, such as color and odor, and waters being "free from" pollutants such as oil (Ecology 2011a). Water quality criteria are applied alongside the designated use associated with every waterbody in the state (Ecology 2011a), including marine areas. Numeric criteria have been developed to protect designated uses. In addition, Washington State adopted narrative criteria to address pollutants for which numeric criteria are difficult to specify (Ecology 2012b).

Individual numeric criteria are based on specific data and scientific assessment of adverse effects. The numeric criteria specify limits or ranges of chemical concentrations (e.g., concentrations of ammonia or mercury) or physical conditions (e.g., water temperature and DO). A typical numeric criterion for aquatic life protection is usually reported as a concentration (e.g., 5 milligrams per liter [mg/L]) over a specified period of time. The toxicity of chemicals generally is measured over a short-term (acute) time frame of 1 hour and over a long-term (chronic) time frame that is generally 4 days. The duration of exposure that is considered "acute" or "chronic" varies somewhat, depending on the type of organism exposed and the specific chemical (Ecology 2012b).

4.4.2 General Water Use and Criteria Classes

Washington State has established water quality standards for surface water to protect public health and public enjoyment, and to propagate and protect fish, shellfish, and wildlife, pursuant to Chapter 90.48 of the RCW (Ecology 2012b). The State has established four criteria classes for surface waters that pertain to marine areas: Class AA Extraordinary, Class A Excellent, Class B Good, and Class C Fair. The criteria shown in Table 4.4-1 apply to the various classes of surface waters in Washington (WAC 173-201A-030).

Table 4.4-1 General Water Use and Surface Water Criteria Classes

Parameter or Type	Marine Criteria
Temperature[a]	Class AA: Extraordinary quality 13°C (55.4°F) Class A: Excellent quality 16°C (60.8°F) Class B: Good quality 19°C (66.2°F) Class C: Fair quality 22°C (71.6°F)
Dissolved oxygen[b]	Class AA: Extraordinary quality 7.0 mg/L Class A: Excellent quality 6.0 mg/L Class B: Good quality 5.0 mg/L Class C: Fair quality 4.0 mg/L
Ph[c]	Class AA: Extraordinary quality pH must be within the range of 7.0 to 8.5, with a human-caused variation within the above range of less than 0.2 units. Class A: Excellent quality pH must be within the range of 7.0 to 8.5, with a human-caused variation within the above range of less than 0.5 units. Class B: Good quality. Same as above. Class C: Fair quality pH must be within the range of 6.5 to 9.0.
Turbidity[d]	Class AA: Extraordinary quality turbidity must not exceed: 5 NTUs over background when the background is 50 NTU or less, or a 10 percent increase in turbidity when the background turbidity is more than 50 NTUs. Class A: Excellent quality. Same as above. Class B: Good quality Turbidity must not exceed 10 NTUs over background when the background is 50 NTUs or less, or a 20-percent increase in turbidity when the background turbidity is more than 50 NTUs. Class C: Fair quality. Same as above.
Bacteria	Primary contact recreation fecal coliform organism levels must not exceed a geometric mean value of 14 colonies/100 milliliters (mL), with not more than 10 percent of all samples (or any single sample when less than 10 sample points exist) obtained for calculating the geometric mean value exceeding 43 colonies /100 mL. Secondary contact recreation enterococci organism levels must not exceed a geometric mean value of 70 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than 10 sample points exist) obtained for calculating the geometric mean value exceeding 208 colonies/100 mL.
Natural conditions and narrative criteria	Toxic, radioactive, or deleterious material concentrations must be below those with the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent on those waters, or adversely affect public health. Aesthetic values must not be impaired by the presence of materials or their effects, excluding those of natural origin, that offend the senses of sight, smell, touch, or taste.

[a] Temperature is measured as a 1-day maximum temperature (1-DMax).

[b] Dissolved oxygen concentrations are measured as a 1-day minimum in milligrams per liter (mg/L).

[c] Aquatic life pH criteria in fresh water.

[d] Turbidity is measured in nephelometric turbidity units (NTUs). 1-day maximum turbidity is allowed as a result of human actions for each of the aquatic life use categories.

4.4.3 Water Quality in the Study Area

The waters of the study area are classified as Class A Excellent or Class AA Extraordinary for aquatic life uses in Chapter 173-201A-612 (Ecology 2012b). Specific classifications of marine surface waters of Washington State within the study area are identified in Table 4.4-2.

Table 4.4-2 Water Quality Classifications in the Study Area

Area Description	Class
Guemes Channel, Padilla, Samish, and Bellingham Bays east of longitude 122°39'W and north of latitude 48°27'20"N	Class A Excellent
Mukilteo and all North Puget Sound west of longitude 122°39' W (Whidbey, Fidalgo, Guemes, and Lummi Islands and State Highway 20 Bridge at Deception Pass), except as otherwise noted	Class AA Extraordinary
Puget Sound through Admiralty Inlet and South Puget Sound, south and west to longitude 122°52'30"W (Brisco Point) and longitude 122°51'W (northern tip of Hartstene Island)	Class AA Extraordinary
Strait of Juan de Fuca	Class AA Extraordinary

4.5 CULTURAL RESOURCES

The study area for cultural resources includes the Project area plus an additional 150 feet inland of the Washington State coastline. The additional 150 feet inland was used as a conservative distance from which effects from a potential crude or bunker oil spill could be observed.

This section addresses existing known archaeological sites and historic resources located in the study area. The section also addresses the potential for encountering additional archaeological sites and historic resources in the study area.

4.5.1 Regulatory Context

Under NEPA, federal agencies must evaluate impacts on all cultural resources and those archaeological sites and historic resources that are eligible for, or listed in, the National Register of Historic Places (NRHP) before a project is approved.

The NRHP, created under the National Historic Preservation Act (NHPA), is the federal list of historic, archaeological, and cultural resources worthy of preservation. Historic properties listed in the NHRP include districts, sites, buildings, structures, and objects that are significant in American history, prehistory, architecture, archaeology, engineering, and culture. On behalf of the Secretary of the Interior, the National Park Service (NPS) maintains the NRHP. The Department of Archaeology and Historic Preservation (DAHP) in Olympia, Washington administers the statewide NRHP program under the direction of the State Historic Preservation Officer (SHPO). The NPS developed the NRHP Criteria for Evaluation to guide selection of properties, and determination of their eligibility, for listing in the NRHP. The following criteria are standards by which every property that is considered for listing in the NRHP is evaluated (36 CFR 60.4):

"The quality of significance in American history, architecture, archaeology, engineering and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and

> (a) that are associated with events that have made a significant contribution to the broad patterns of our history [Criterion A]; or
>
> (b) that are associated with the lives of persons significant in our past [Criterion B]; or
>
> (c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction [Criterion C]; or
>
> (d) that has yielded, or may be likely to yield, information important in prehistory or history [Criterion D]."

Archaeological sites are primarily assessed under Criterion D. Buildings less than 50 years old do not meet the NRHP criteria unless they are of exceptional importance, as described in Criteria Considerations (g) (36 CFR § 60.4) and the NPS Bulletin No. 22, "Guidelines for Evaluating and Nominating Properties That Have Achieved Significance within the Past Fifty Years."

The Washington State Environmental Policy Act (SEPA) (RCW 43.21C) and implementing rules in the WAC (WAC 197-11) also apply to this Project. These rules require identification of archaeological sites, historic resources, and properties of religious and cultural significance (including traditional cultural properties [TCPs]) listed in or eligible for listing in the national, state, or local registers. Measures must be considered to reduce or control impacts on identified historic properties affected by a proposed project.

4.5.2 Research Methodology

Information presented in this section is based on a screening-level evaluation of resource types within the cultural resources study area. A literature review of the types of cultural resources commonly found in the study area was completed. Information was obtained from repositories, including the University of Washington, the University of Oregon, the Seattle Public Library, and data available on the internet.

Researchers then obtained data on previously documented resources from the Washington Information System for Architectural and Archaeological Records Data (WISAARD), which is maintained by the DAHP. Architectural historians and archaeologists conducted a records search of all previously documented archaeological sites and historic resources within 150 feet of the Washington State coastline for the study area, including all peninsulas and islands. Archaeological sites include all documented NRHP-eligible and NRHP-unevaluated pre-contact and historic sites, including some historic structures that originally were recorded as archaeological sites. Historic resources include all documented NRHP-eligible buildings, structures, objects, and districts. Properties of religious and cultural significance, including TCPs, may also be present within the study area; however, these resources were not included in these analyses because of restricted location information.

Researchers reviewed the results of previous historic property and cultural resource studies in the study area. Researchers obtained counts and site forms for all NRHP-eligible and NRHP-unevaluated archaeological sites within the study area. Researchers obtained reports from these studies, including site records and NRHP and/or Washington Heritage Register (WHR) nomination forms for all historic resources. All inventory forms were reviewed for historic resources within the study area. Resources that had been recommended as eligible by the person recording the resource were included in the counts. Information concerning site type, location, age, and integrity for all archaeological sites and historic resources were gathered from site records and inventory forms.

Researchers superimposed consecutive 1-mile grids within the study area to perform a site count within each grid unit. The total counts for each 1-mile grid unit were documented in an Excel database. Site counts included any portion of a site within a grid unit. Because of the high number of sites and the extent of the study area, a density gradient was developed to present the concentrations of resources visually. The density gradient is based on an ordinal scale; areas with fewer than five resources are designated as low density, areas with five to ten resources as medium density, and areas with ten or more resources as high density. A GIS specialist then created a series of maps displaying the site density-based gradient for the study area (Figures 4.5-1 to 4.5-10 [at the end of this section]).

The cultural resources study area included the following geographic locations:

- Western extent: Carmanah Point-Tatoosh Island-Cape Flattery
- Southern extent: Port Hudson-Admiralty Head

- Northwest extent: Northern tip of Saanich Peninsula-Beaver Point-northern tip of North Pender Island-northern tip of Saturna Island
- Northern extent: East Point (Saturna Island)-Rosenfeld Rock-Birch Point

4.5.3 Previously Recorded NRHP-Eligible Archaeological Sites

4.5.3.1 Archaeological Site Density

Figures 4.5-1 to 4.5-5 display the density of all previously recorded archaeological sites in the study area that are eligible or unevaluated for listing in the NRHP. The density of archaeological sites within major geographical areas comprising the study area is summarized below.

- Olympic Peninsula – low density
- Whidbey Island/Fidalgo Island/Padilla Bay/Samish Bay – medium density
- Bellingham Bay/Hale Passage/Lummi Island – high density
- Birch Bay/Cherry Point/Lummi Bay – medium density
- San Juan Islands – high density

4.5.3.2 Types of Archaeological Sites

Archaeological sites present in the study area are characterized temporally as pre-contact or historic period. Pre-contact site types primarily comprise shell midden, including fire-modified rock (FMR) and other associated artifacts, lithic scatter, fishing weirs, and petroglyphs.

Shell middens are deposits of non-edible portions of shellfish species that are almost always located along marine water sources. These deposits can occur within village sites next to or below longhouses, as well as at more temporary sites used for hunting and gathering resources. Shell middens often represent extended occupations and commonly contain FMR, lithics, groundstone, faunal remains, botanical species, and/or human and animal burials. Study of shell middens can provide important data on diet, burial practices, trade, and spatial organization.

Lithics are chipped stone artifacts manufactured with percussion and pressure techniques. Projectile points (or fragments), bifaces, flake tools, cores, and debitage are all common lithic artifacts found in archaeological sites throughout the study area. *Groundstone artifacts* are stone artifacts produced by grinding and include mortars, pestles, and adze blades, among other types within the study area. *Fish weirs* are structures typically built of stone, wooden posts, or reeds and placed within the nearshore to catch fish as they swim along with the current. *Petroglyphs* are a form of rock art where the surface of the rock has been carved, etched, incised, rubbed, and/or pounded to create images.

Historic period archaeological sites located in the study area include docks, wharfs, sunken vessels, piers, railroads, forts, logging camps, and early Euro-American settlements.

Shell middens represent the highest number of sites. Shell middens containing only shell or shell and FMR are the most prevalent archaeological site type in the study area. Sites containing shell middens and associated artifacts, such as lithics, faunal remains, and burials, represent the second most prevalent archaeological site type in the study area. Lithic scatters are the third most common archaeological site type in the study area. Historic period resources, fish weirs, and petroglyphs constitute some of the least numerous of the archaeological site types.

The prevalence of archaeological site types in the study area is summarized below.

- Shell midden (including FMR) – high number
- Shell midden with associated artifacts (lithics) – moderate number
- Lithic scatters (without shell midden) – low number
- Historic resources – low number
- Fish Weirs – low number
- Petroglyphs – low number

4.5.3.3 Age of Archaeological Sites

The determination of site antiquity is often very difficult, and estimates commonly represent a broad time range. Identified shell midden sites range in age from 3,500 to 500 years before present (B.P.). Lithic scatters in the study area range in age from 5500 to 500 B.P. The date for historic period archaeological sites ranges from 1792 to 1946.

4.5.3.4 Cultural Affiliation

Almost all of the pre-contact archaeological sites identified in the study area are associated with present-day Indian tribes living in the area or their antecedents (generalized Salish). Cultural associations with the historic period archaeological sites include Captain Vancouver/early British explorers, U.S. Army, railroad companies, and logging companies. The following cultural affiliations are present in the study area:

- Tribes, including Lummi Nation, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, and Makah Tribe
- Generalized Salish antecedents
- U.S. Army, U.S. railroad companies, U.S. logging companies, and Captain Vancouver /early British explorers

4.5.4 Previously Recorded NRHP- and WHR-Eligible Historic Resources

4.5.4.1 Historic Resources Site Density

Figures 4.5-6 to 4.5-10 display the density of all previously recorded NRHP and WHR-eligible historic resources within the study area. Site densities of historic resources per geographic area are summarized below.

- Olympic Peninsula – medium density
- Whidbey Island/Fidalgo Island/Pt. Townsend – medium density
- Bellingham Bay/Bellingham – medium/high density
- Birch Bay/Cherry Point/Lummi Bay – low density
- San Juan Islands – high density

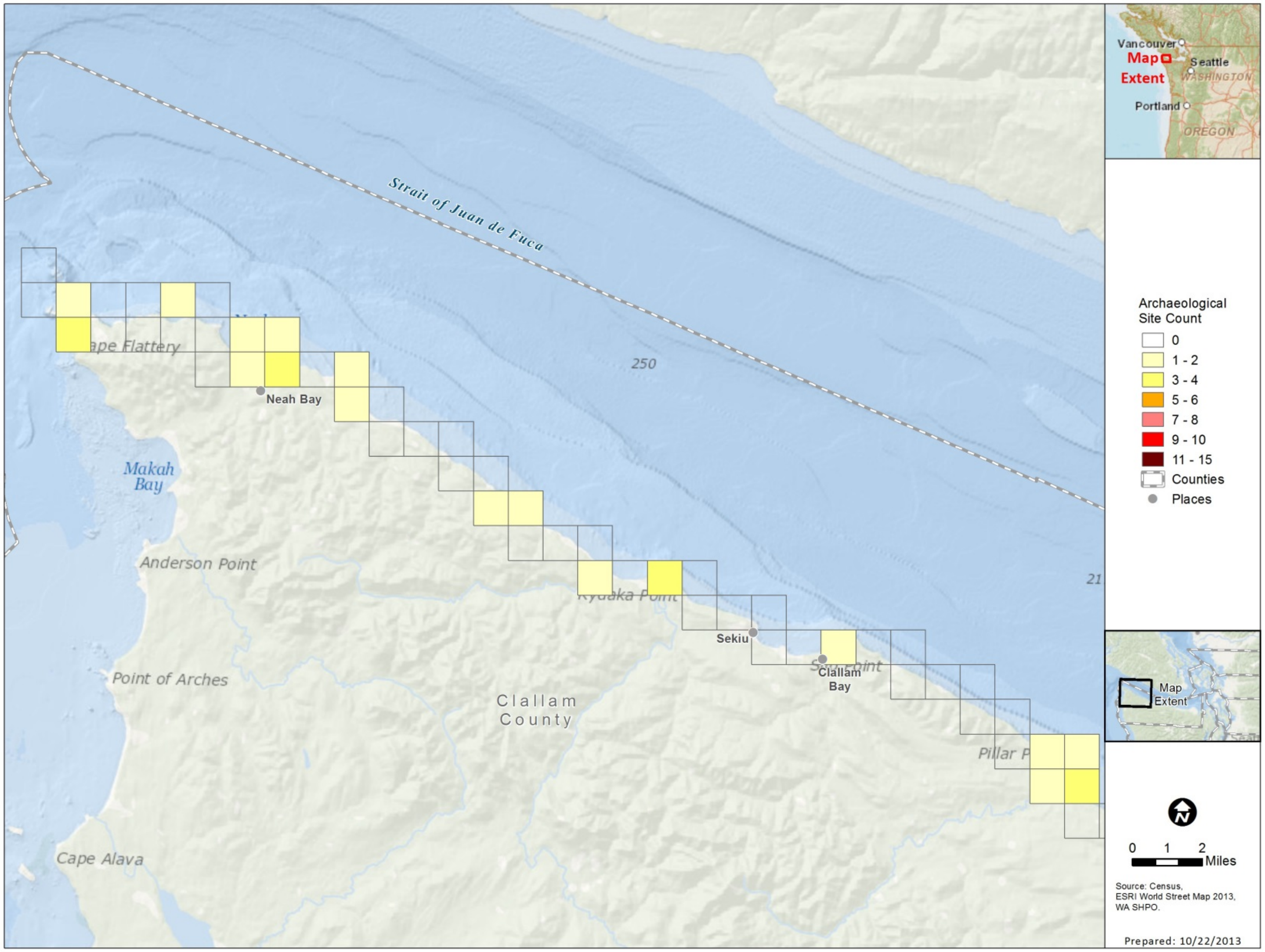

Figure 4.5-1 Previously Recorded Archaeological Sites on Olympic Peninsula – Map 1

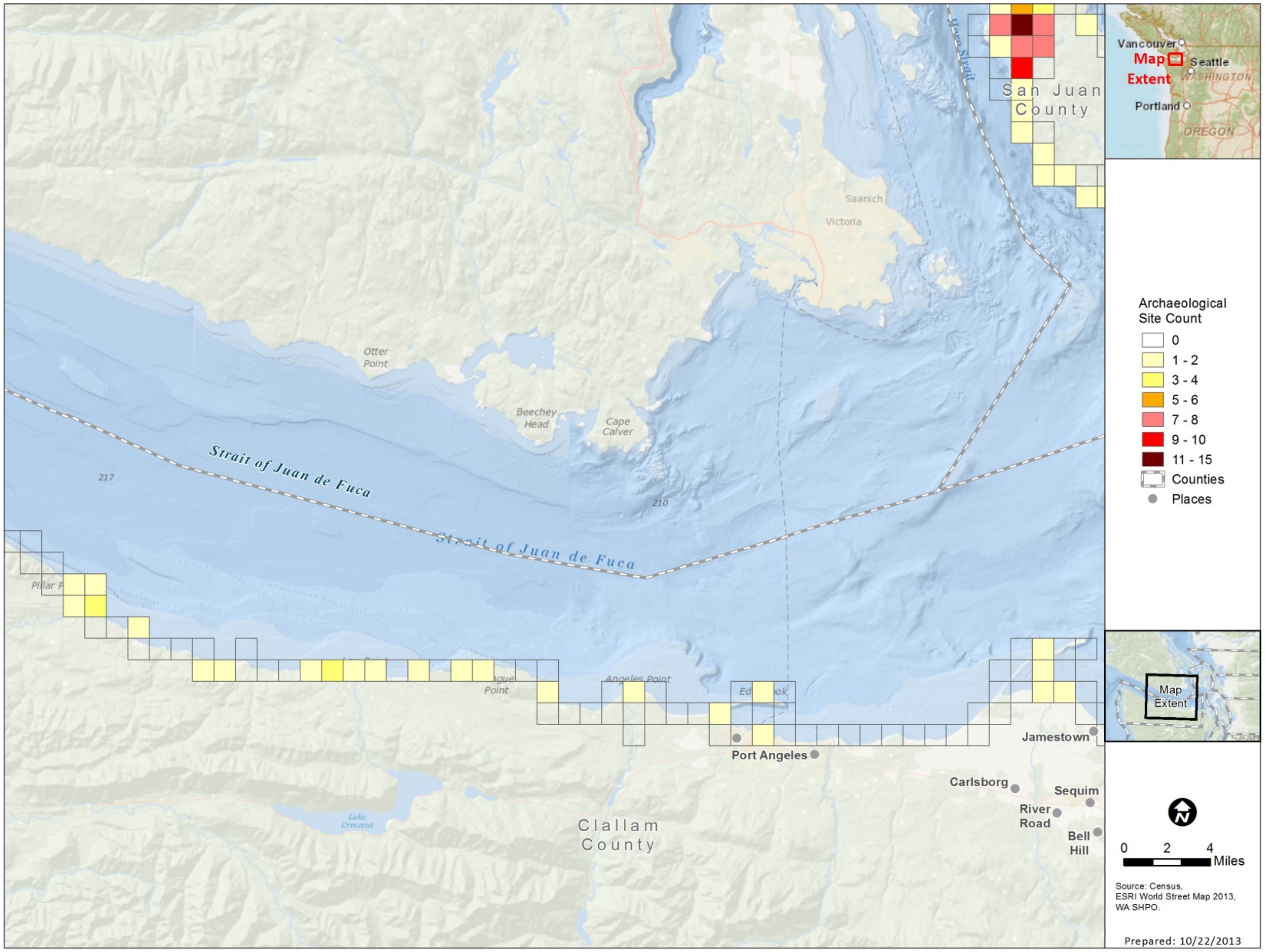

Figure 4.5-2 Previously Recorded Archaeological Sites on Olympic Peninsula – Map 2

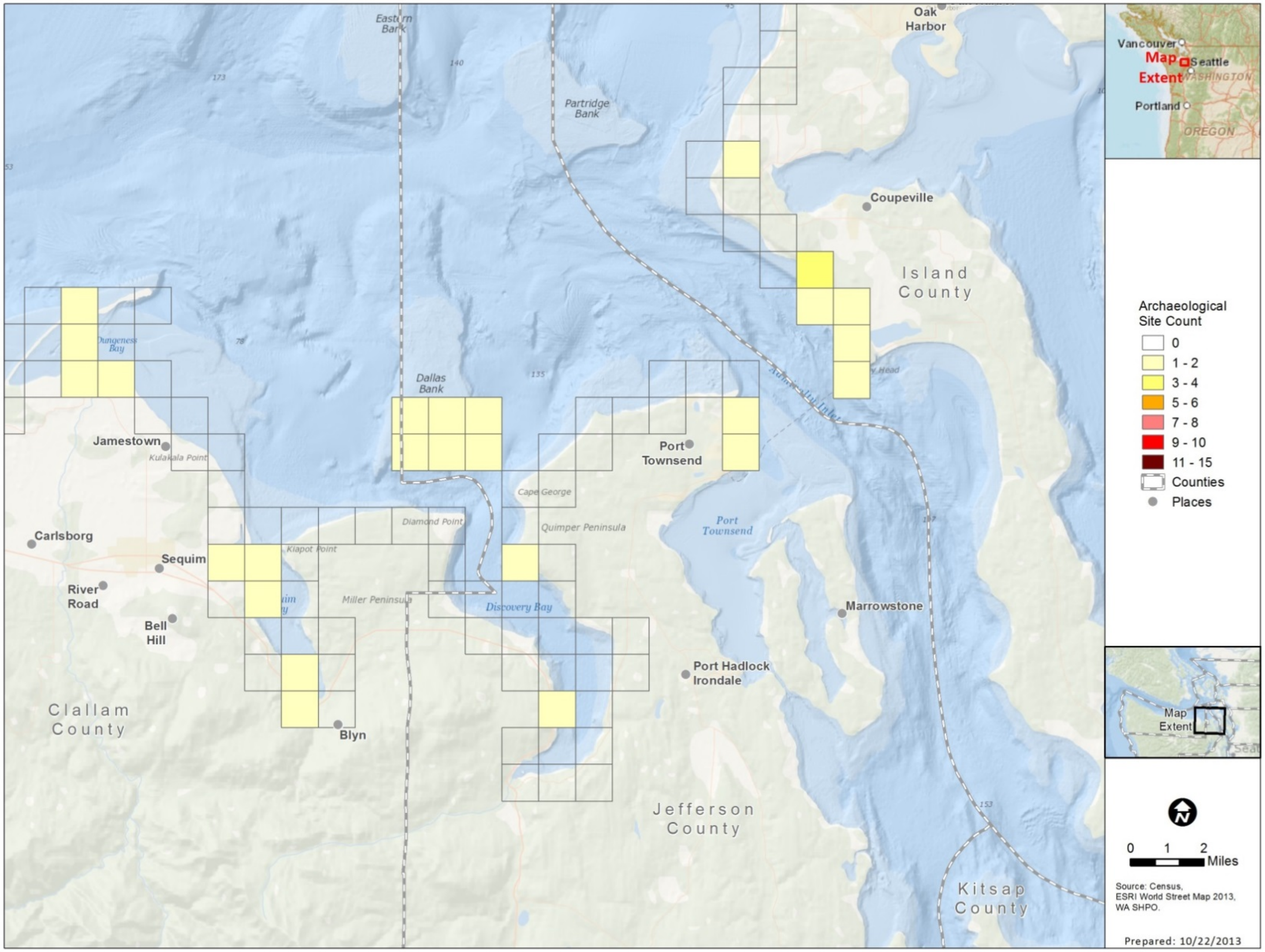

Figure 4.5-3 Previously Recorded Archaeological Sites on Olympic Peninsula and Whidbey Island/Fidalgo Island/Padilla Bay/Samish Bay – Map 3

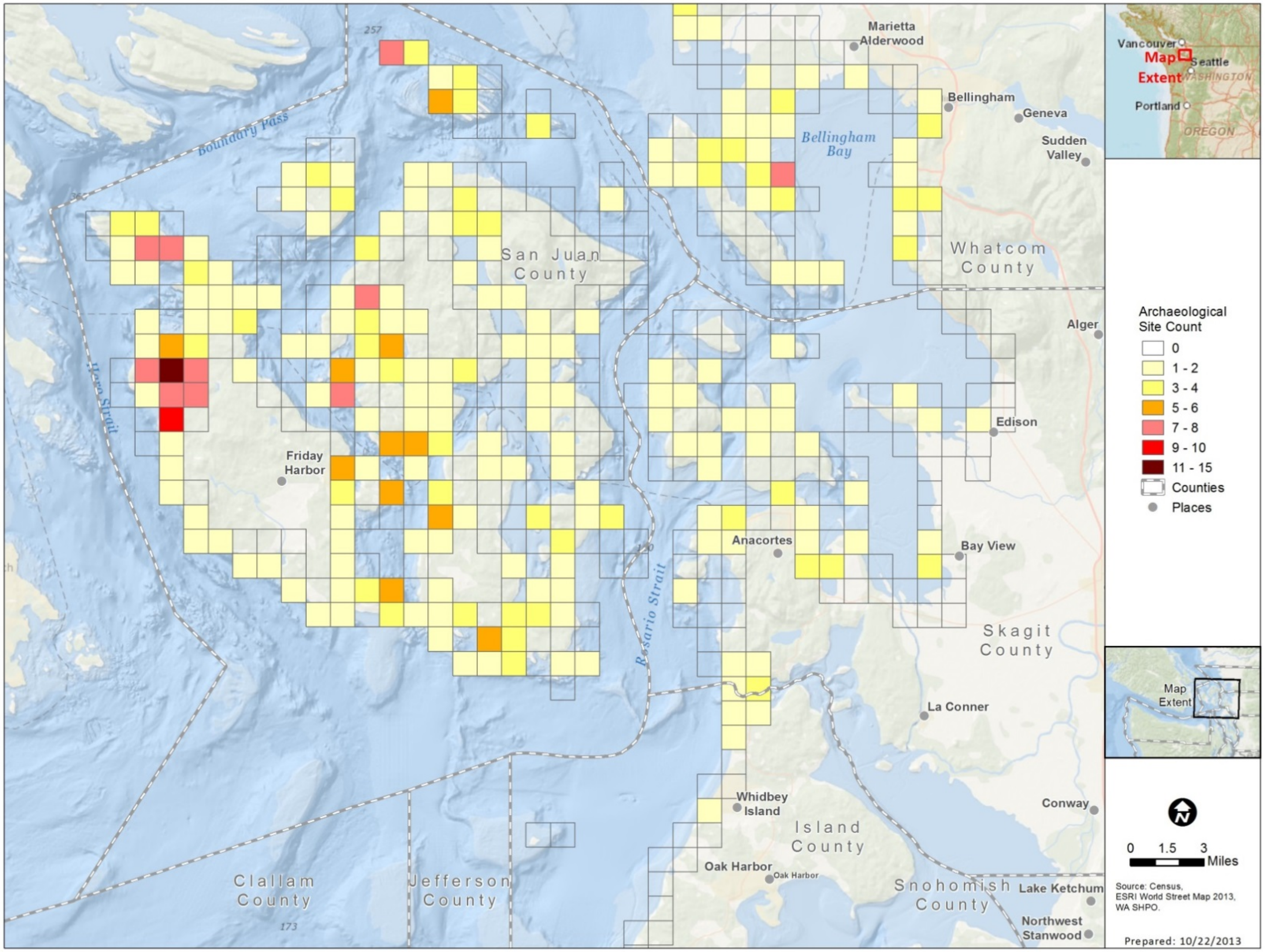

Figure 4.5-4 Previously Recorded Archaeological Sites on Whidbey Island/Fidalgo Island/Padilla Bay/Samish Bay, Bellingham Bay/Hale Passage, Lummi Island, and San Juan Islands – Map 4

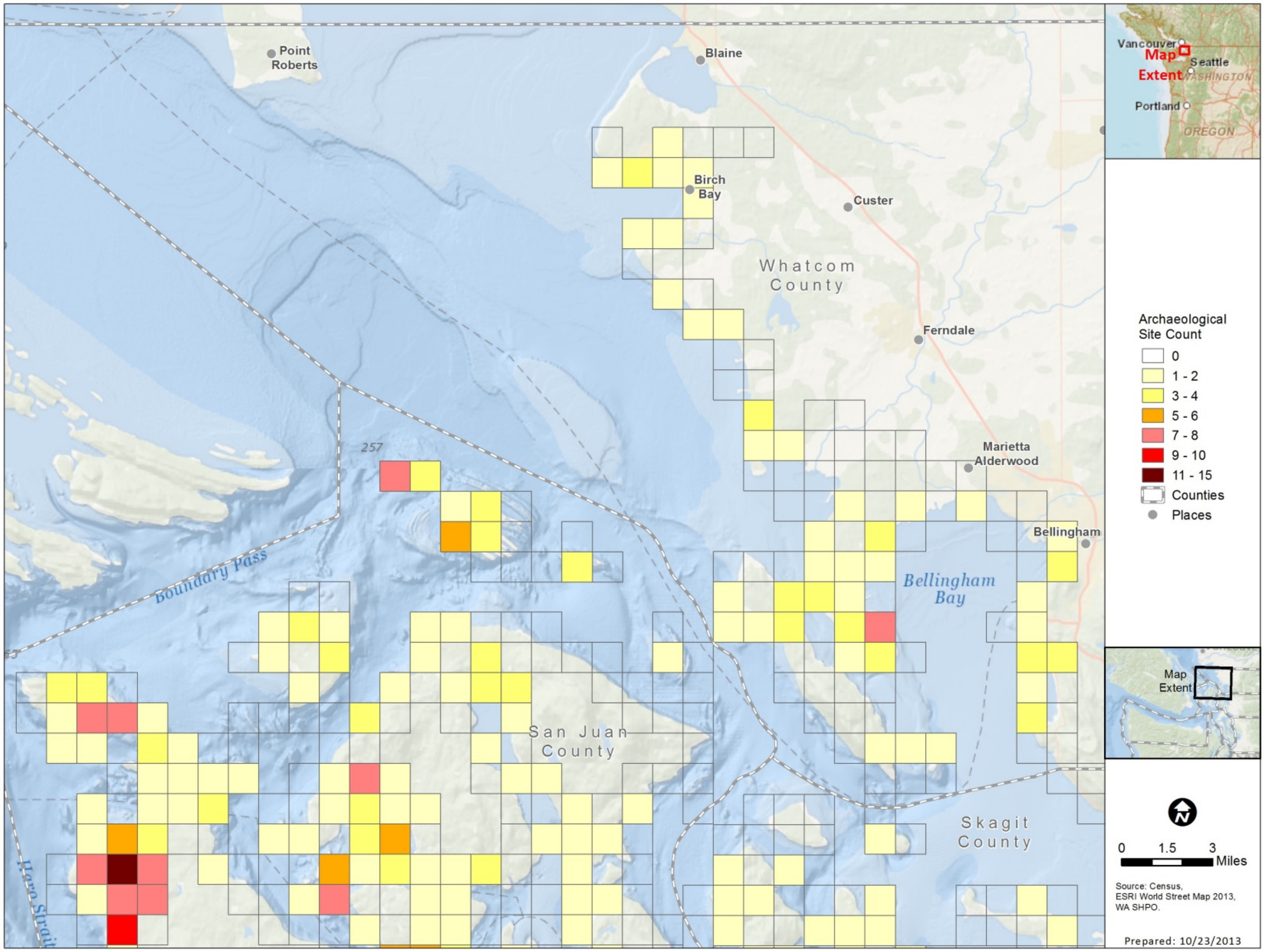

Figure 4.5-5 Previously Recorded Archaeological Sites in Birch Bay/Cherry Point/Lummi Bay – Map 5

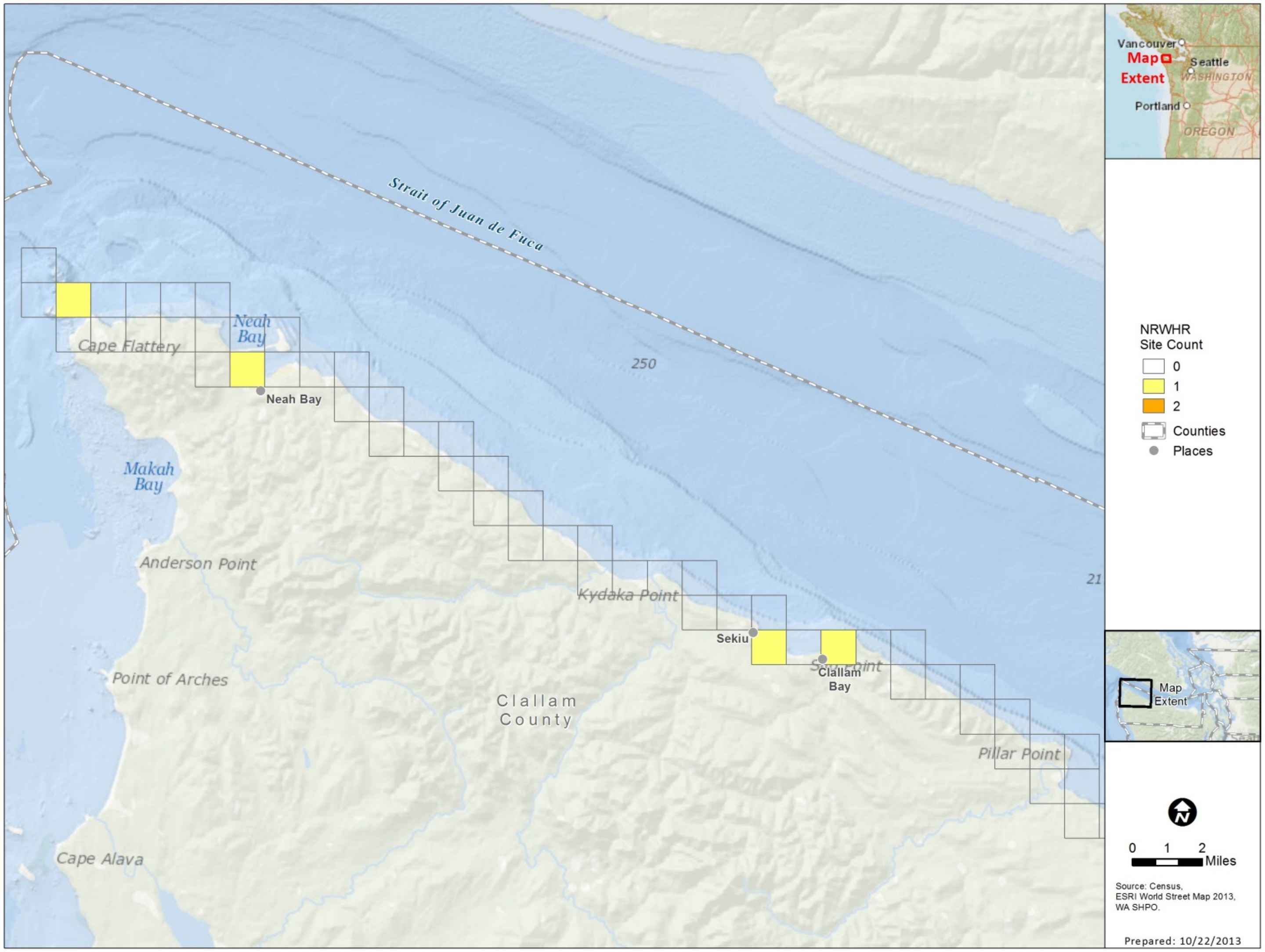

Figure 4.5-6 Previously Recorded Historic Resources on Olympic Peninsula – Map 1

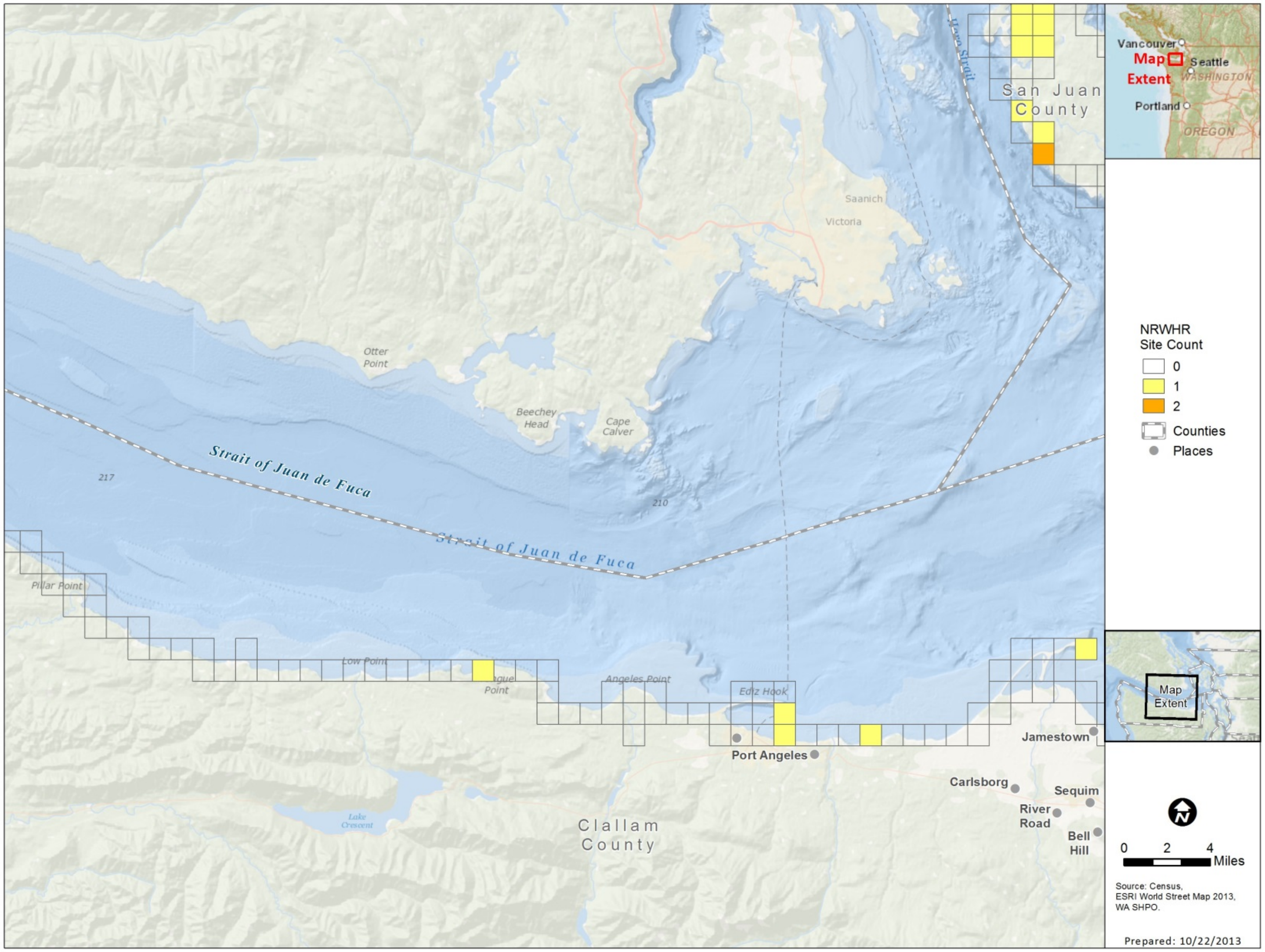

Figure 4.5-7 Previously Recorded Historic Resources on Olympic Peninsula – Map 2

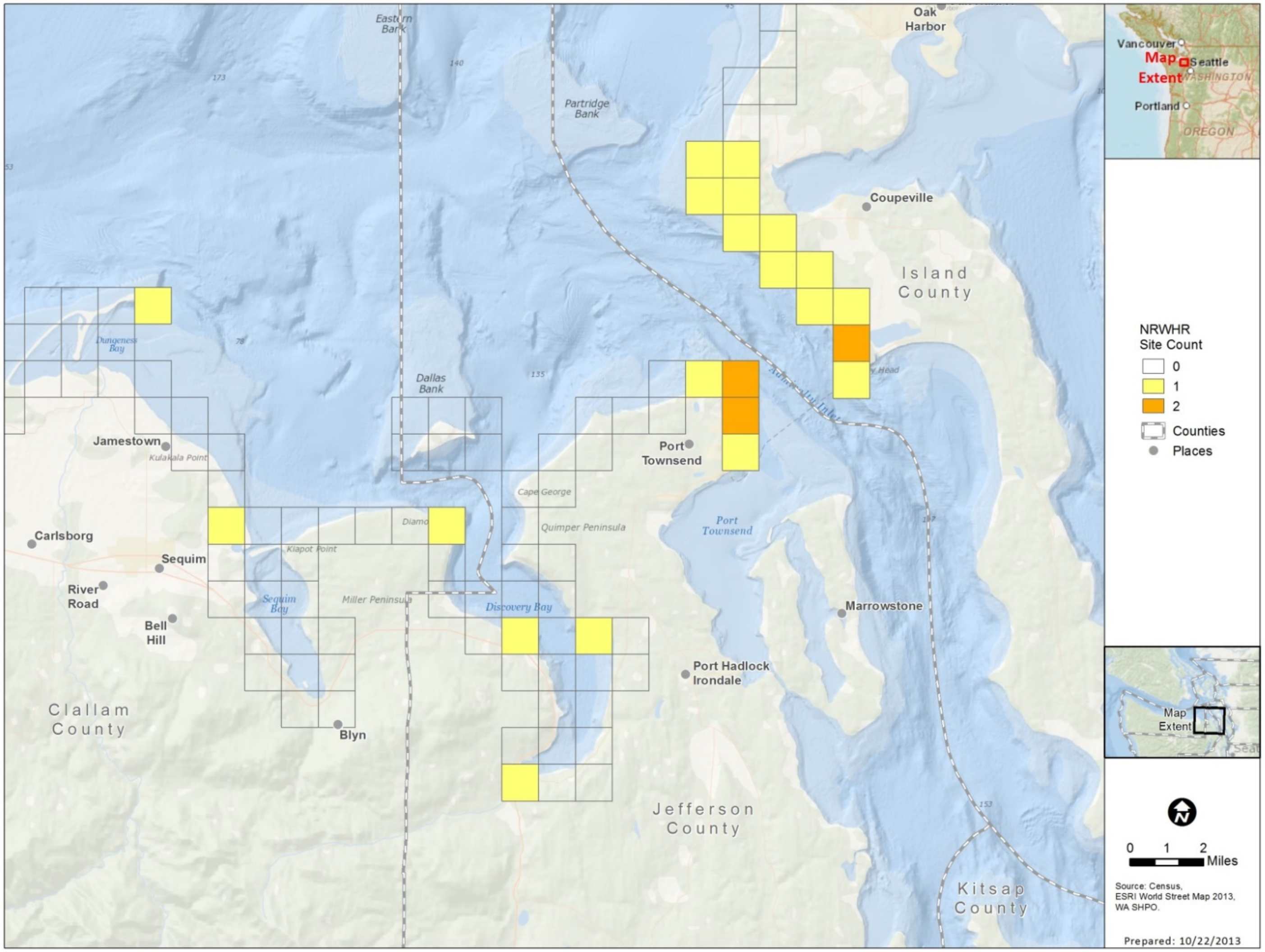

Figure 4.5-8 Previously Recorded Historic Resources on Olympic Peninsula and Whidbey Island/Fidalgo Island/Padilla Bay/Samish Bay – Map 3

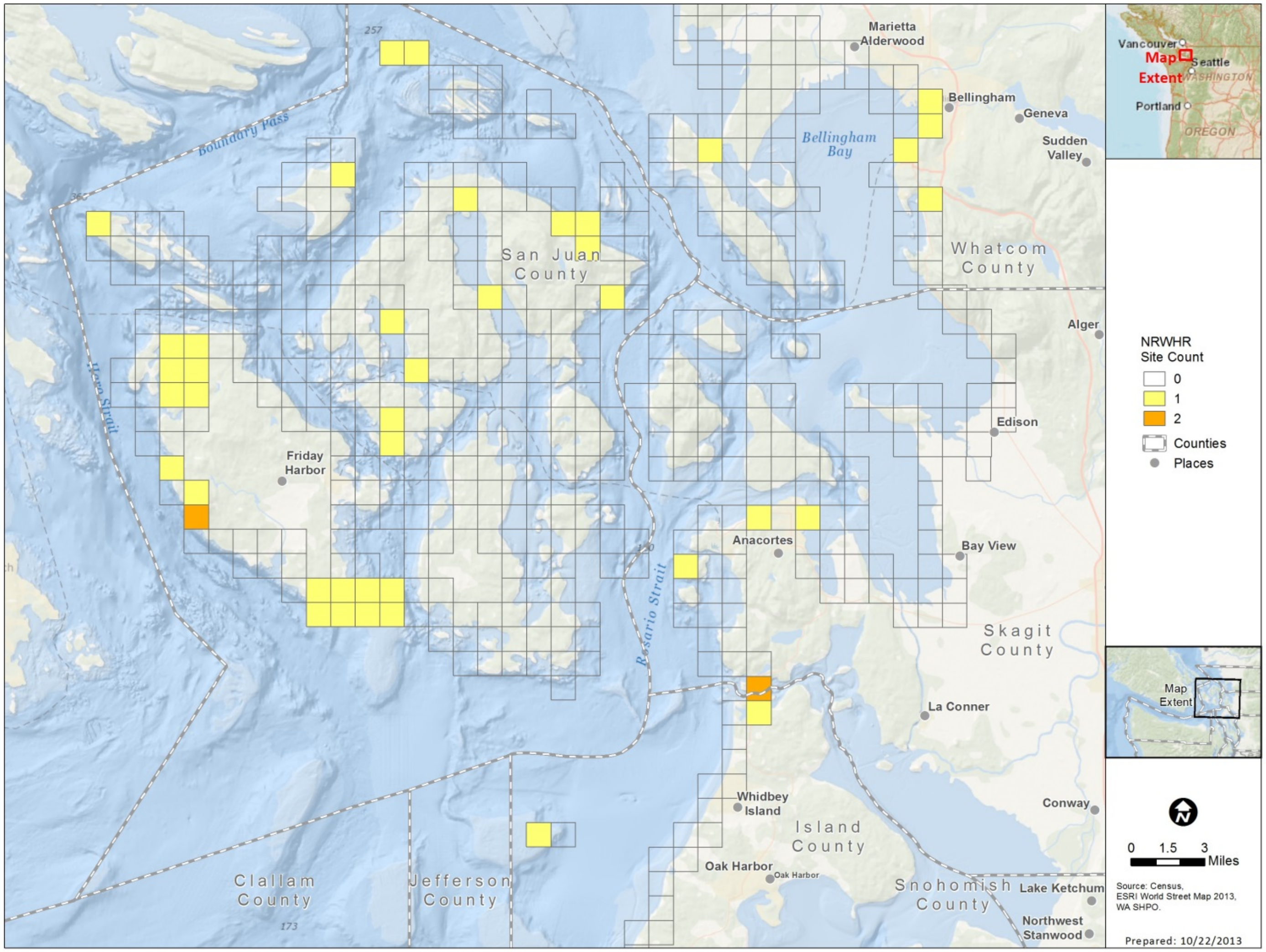

Figure 4.5-9 **Previously Recorded Historic Resources on Whidbey Island/Fidalgo Island/ Padilla Bay/Samish Bay, Bellingham Bay/Hale Passage, Lummi Island, and San Juan Islands – Map 4**

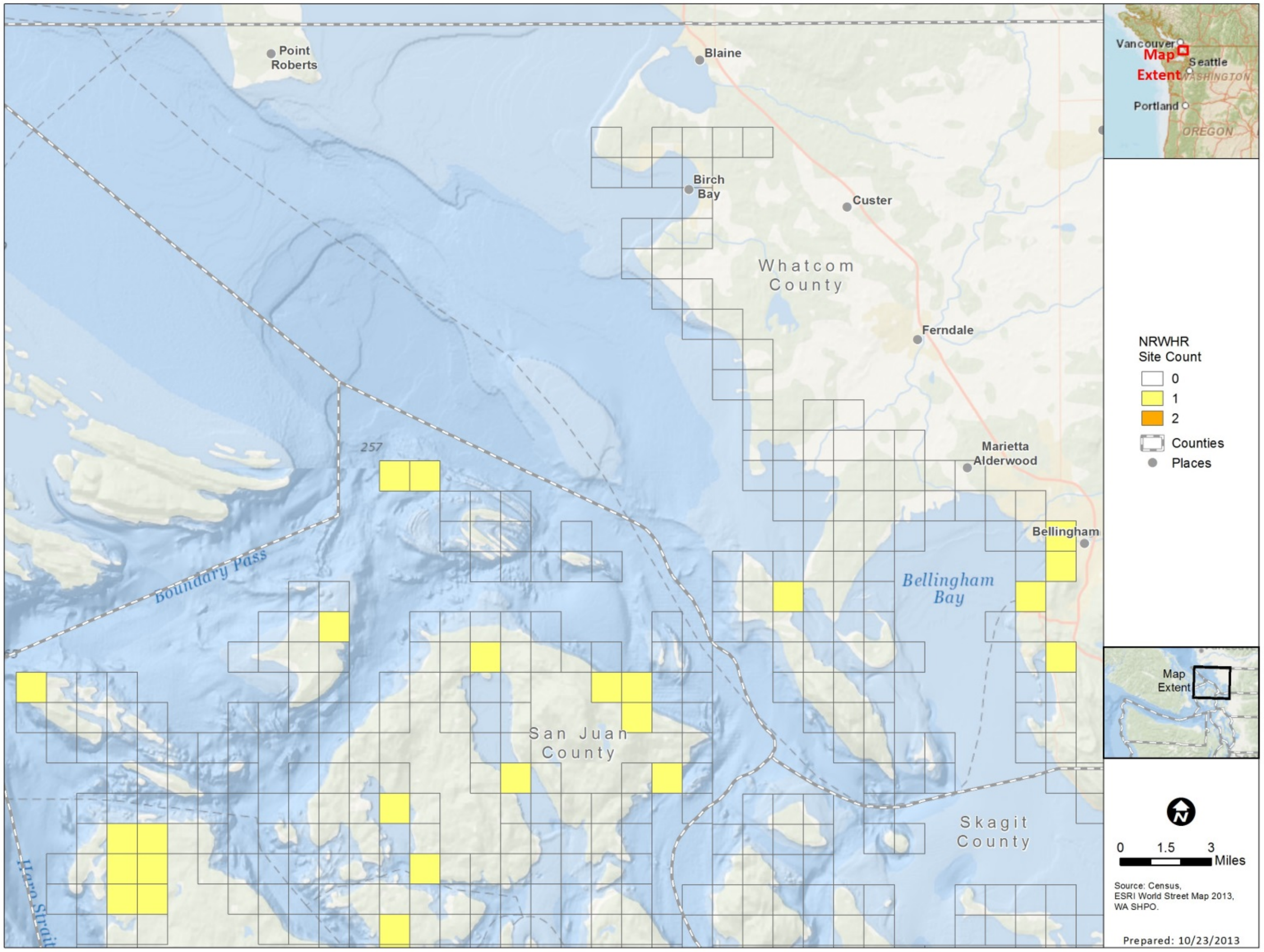

Figure 4.5-10 Previously Recorded Historic Resources in Birch Bay/Cherry Point/Lummi Bay – Map 5

4.5.4.2 Types of Historic Resources

Documented NRHP historic properties and WHR historic resources in the study area fall into six general categories: (1) lightstation/lighthouse; (2) U.S. government installations; (3) towns/districts; (4) homesteads/private individual structures; (5) bridges; and (6) vessels. For some resources, the primary building or structure lies outside the study area, but the boundary of the historic property encompasses the beach or other areas within the study area and must be considered in this discussion.

Lightstations and lighthouses are situated at important nautical navigation locations in order to assist vessels in their transit. In addition to the structure containing the signal or beacon, these properties often include ancillary buildings, such as a dwelling for the keeper and storage buildings.

Historic U.S. government installation sites in the study area include several forts and one quarantine station. In the late nineteenth and early twentieth centuries, Fort Townsend, Fort Worden, Fort Hayden, and other U.S. Army forts provided oversight of the boat traffic in the region. Soldiers were stationed at the forts to protect nearby settlers from attacks by Native Americans or by European powers. Extant resources at these historic properties include docks, housing, officer’s quarters, schoolhouses, and outbuildings. Also associated with U.S. government installation sites are the American and English Camps on San Juan Island.

Historic towns and associated districts, including Bellingham, Port Townsend, Irondale, and Roche Harbor, remain intact throughout the study area. The extant resources in these historic districts range from individual single-family residences to warehouses, processing facilities, and docks associated with the growth of maritime trade on Puget Sound in the late nineteenth-early twentieth centuries.

Scattered across the Puget Sound coastline are complexes and structures associated with settlement of the region by Euro-Americans. Resources include location markers for landings by European explorers, log cabins built by early homesteaders, a tunnel used to drain excess water from farmland to Puget Sound, and remnants of towns and settlements.

The study area also includes unique resources that reflect the twentieth century development of the region, including vessels and bridges. A common vessel type of the late nineteenth century and early twentieth century, the four-masted schooner, *La Merced*, lies on the shore of Fidalgo Island. Initially part of the Standard Oil fleet, the ship was later used as a cannery in Alaska and now functions as a breakwater for a ship building yard. The *W.T. Preston*, a sternwheeler, operated as a snagboat and is now located near Anacortes. Another type of unique resource in the study area is the Portage Canal Bridge, constructed in 1952, which connects Indian and Marrowstone Island to the mainland near the town of Hadlock.

The relative quantities of historic resources in the study area are summarized below.

- Lightstation/lighthouse – high number
- U.S. government installations (quarantine station, forts) – moderate/high number
- Towns/districts/historical events – moderate number
- Homesteads/individual structures – moderate/low number
- Bridges – low number
- Vessels – low number

4.5.4.3 Age of Historic Resources

The ages of cultural resources in the study area are summarized below.

- Pre-1800 – very low number
- 1800–1850 – very low number
- 1850–1900 – moderate/high number
- 1900–1930 – moderate/high number
- 1930 – low number

4.5.5 Additional Resources

This screening level survey identified known archaeological sites and historic resources previously designated as eligible for listing in the WHR or NRHP. The categories discussed above represent the types of cultural resources that could be encountered throughout the study area, many of which may be eligible for listing in the NRHP but have not yet been identified as such.

4.6 LAND USE

This section describes the types of land uses in the study area, and provides a quantitative evaluation of land use along the study area shoreline. The study area for land use includes the San Juan Islands, the Northern Coast of the Olympic Peninsula, Birch Point to Samish Island, and Padilla Bay to Keystone Harbor. In general, across the study area, approximately 50 percent of shoreline areas are classified by the counties as residential; 10 percent are commercial or industrial; and the remaining 40 percent are forested, agricultural, or natural, undeveloped lands.

4.6.1 Overview of Land Uses in the Study Area

The Shoreline Management Act (SMA) of 1972 identifies 12 possible land uses for shorelines in Washington State. Each county produces a local Shoreline Management Program that may name or group the categories differently. In this analysis, land use data from the six counties in the study area (Clallam, Island, Jefferson, San Juan, Skagit, and Whatcom) were collected and aggregated into seven categories: agriculture, aquaculture, commercial, forest, industry, residential, and natural. Each of the 12 SMA land uses is described below, grouped into the seven categories utilized in this chapter. It should be noted that some of the counties in the study area did not classify lands according to the land classes identified in the SMA.

Agriculture: Includes agricultural activities, agricultural products, agricultural equipment and facilities, and agricultural land.

Aquaculture: Defined as the culture or farming of food fish, shellfish, or other aquatic plants and animals.

Commercial: Includes restaurants, retail, and offices. Water-dependent commercial uses have preference over nonwater-dependent commercial uses, and water-related and water-enjoyment commercial uses have preference over nonwater-oriented commercial uses.

- **Boating facilities –** Includes marinas, launch ramps, and moorage but excludes docks serving four or fewer single-family residences.
- **Recreational development –** Includes commercial and public facilities designed and used to provide recreational opportunities to the public, such as parks, trails, and golf courses (excludes boating).

Forest practices: Adequate management of commercial forest uses within shoreline jurisdiction, as defined by the Forest Practices Act and the Forest and Fish Report. This includes land designated as either “natural” or “rural conservancy.”

Industry: Includes manufacturing, shipbuilding, wholesale warehousing, cargo transfer, and construction yards. Water-dependent industrial uses have preference over nonwater-dependent industrial uses, and water-related industrial uses have preference over nonwater-oriented industrial uses.

- **In-stream structural uses –** A structure placed by humans within a stream or river waterward of the ordinary high water (OHW) mark that causes or has the potential to cause water impoundment or diversion, obstruction, or modification of water flow. In-stream structures may include those for hydroelectric generation, irrigation, water supply, flood control, transportation, utility service transmission, fish habitat enhancement, or other purpose.

- **Mining –** The removal of sand, gravel, soil, minerals, and other earth materials for commercial and other uses. Historically, the most common form of mining in shoreline areas has been for sand and gravel because of the geomorphic association of rivers and sand and gravel deposits.

- **Transportation and parking –** Includes roads, ferries, private air strips, and helipads.

- **Utilities –** Includes services and facilities that produce, convey, store, or process power, gas, sewage, communications, oil, waste, and the like.

Residential development: Includes single-family residences as the most common form of shoreline development, but also includes multi-family development and the creation of new residential lots through land division.

Natural: Although not a land use classification in the SMA, a common classification used by the counties in the study area. Natural areas are undeveloped areas, not converted to an alternate land use.

The SMA also designates specific shorelines as lands of "statewide significance." The land uses in these shorelines are constrained by the following: the statewide interest should be recognized and protected over the local interest; the natural character of these shorelines should be preserved; uses of these shorelines should result in long-term benefits to the people of the state; resources and ecological systems of these shorelines should be protected; and public access to publicly owned areas in these shorelines should be increased.

RCW 90.58.030 identifies the following marine areas of statewide significance in the study area:

- Skagit Bay and adjacent area – from Brown Point to Yokeko Point
- Padilla Bay – from March Point to William Point
- Those areas of Puget Sound and the Strait of Juan de Fuca and adjacent salt waters north to the Canadian line and lying seaward from the line of extreme low tide

State parks are addressed in Sections 4.7 and 5.6.

4.6.2 Land Use by Shoreline Area

This section describes the shoreline land use in the study area, organized by four subareas: San Juan Islands, northern coast of the Olympic Peninsula, Birch Point to Samish Island, and Padilla Bay to Keystone Harbor. The shoreline land use data for each subarea are presented in maps and in tables summarizing the miles of shoreline in each land use. Particularly prominent urban areas and land uses also are noted in each section. Although land use information presented in this section is based on data from 2004 to 2008, communication with the counties confirmed that the land use classification has not substantially changed in the study area counties since that time.

4.6.2.1 San Juan Islands

The majority of the shoreline in the San Juan Islands is classified as natural or forest lands; Island County has classified 71 percent of the shoreline in the islands into these two categories of land use. Natural areas are primarily conservation areas protected by state law. While a small proportion of the forest areas are managed for forest resources, the majority of shoreline forest lands are in rural, forested farms. The San Juan Islands have very few urban areas with commercial or industrial land uses, and the majority of the private residential shoreline is rural. Shoreline land use in the San Juan Islands is presented in Table 4.6-1 and in Figure 4.6-1.

Table 4.6-1 Shoreline Land Use in the San Juan Islands

Land Use Type	Miles	Percent
Agricultural	3	1
Commercial	8.3	2
Forest lands	155.5	38
Industrial	0.3	0
Natural	135.4	33
Residential rural	96.5	24
Residential urban	7.7	2
Total	**406.7**	**100**

4.6.2.2 Northern Coast of the Olympic Peninsula

The northern coast of the Olympic Peninsula is in Clallam and Jefferson Counties and is fairly evenly distributed between residential (27 percent), natural (23 percent), forest (20 percent), and commercial land uses (19 percent). Residential areas are primarily rural residences scattered along the coastline. Natural lands along the shoreline mainly consist of conserved rural areas, while some of the natural lands—particularly in the eastern part of the shoreline—are located in state parks. Forest lands are concentrated along the shoreline between Joyce and Clallam Bay. Commercial lands, which constitute 19 percent of all shoreline land uses, include the areas in and surrounding Port Townsend, Port Hadock, Bryn, Sequim, Port Angeles, Joyce, Clallam Bay, and Neah Bay. Indigenous lands of the S'Klallam and Makah Tribes (8 percent) at the northwestern tip of the peninsula constitute the remainder of the shoreline. Shoreline land use along the northern coast of the Olympic Peninsula is presented in Table 4.6-2 and in Figure 4.6-2.

Table 4.6-2 Shoreline Land Use along the Northern Coast of the Olympic Peninsula

Land Use Type	Miles	Percent
Agricultural	6.1	3
Commercial	35.5	19
Forest lands	37.4	20
Indigenous land	14.1	8
Natural	43.2	23
Residential	50.8	27
Total	**187.0**	**100**

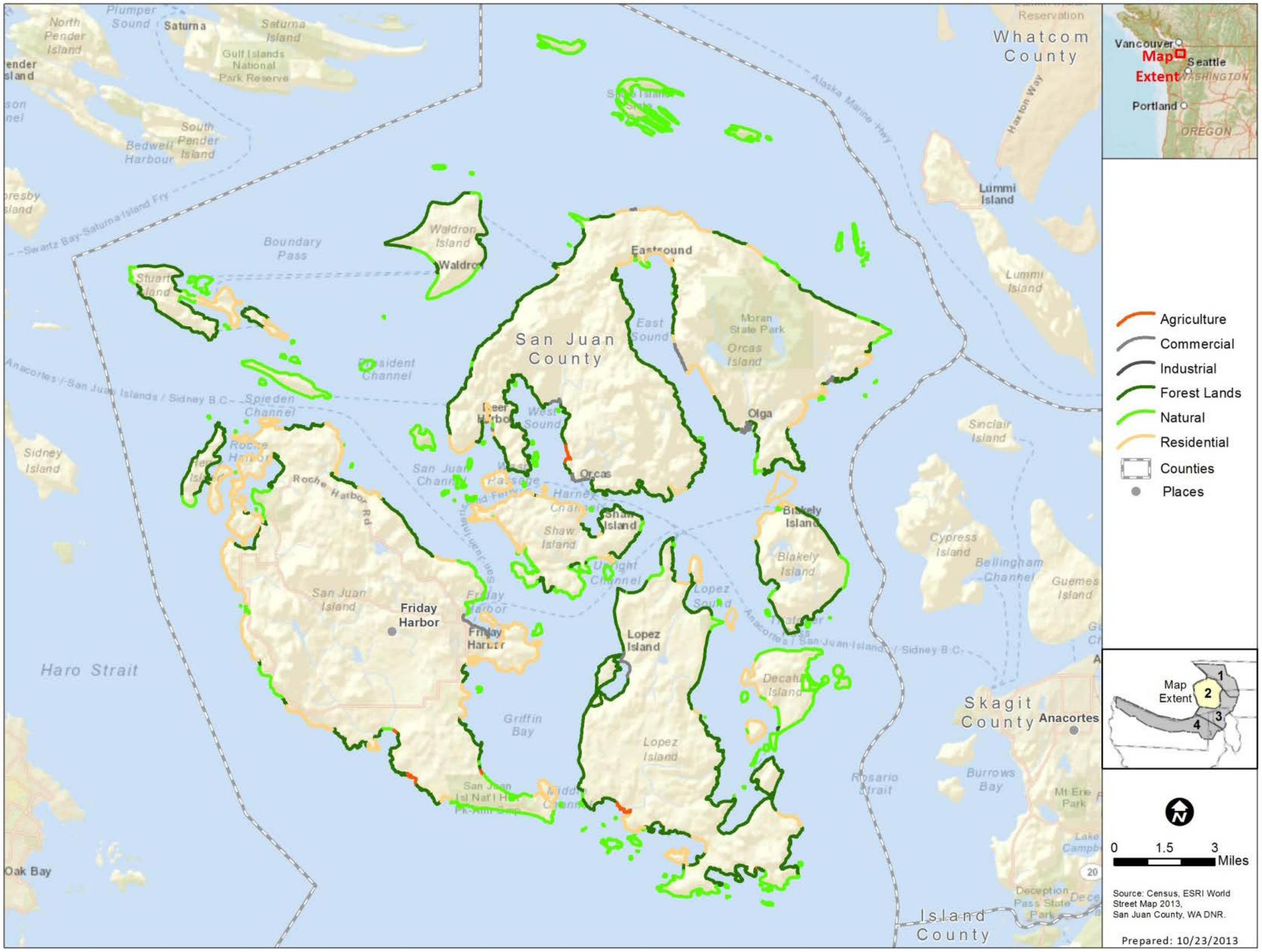

Figure 4.6-1 Shoreline Land Use in the San Juan Islands

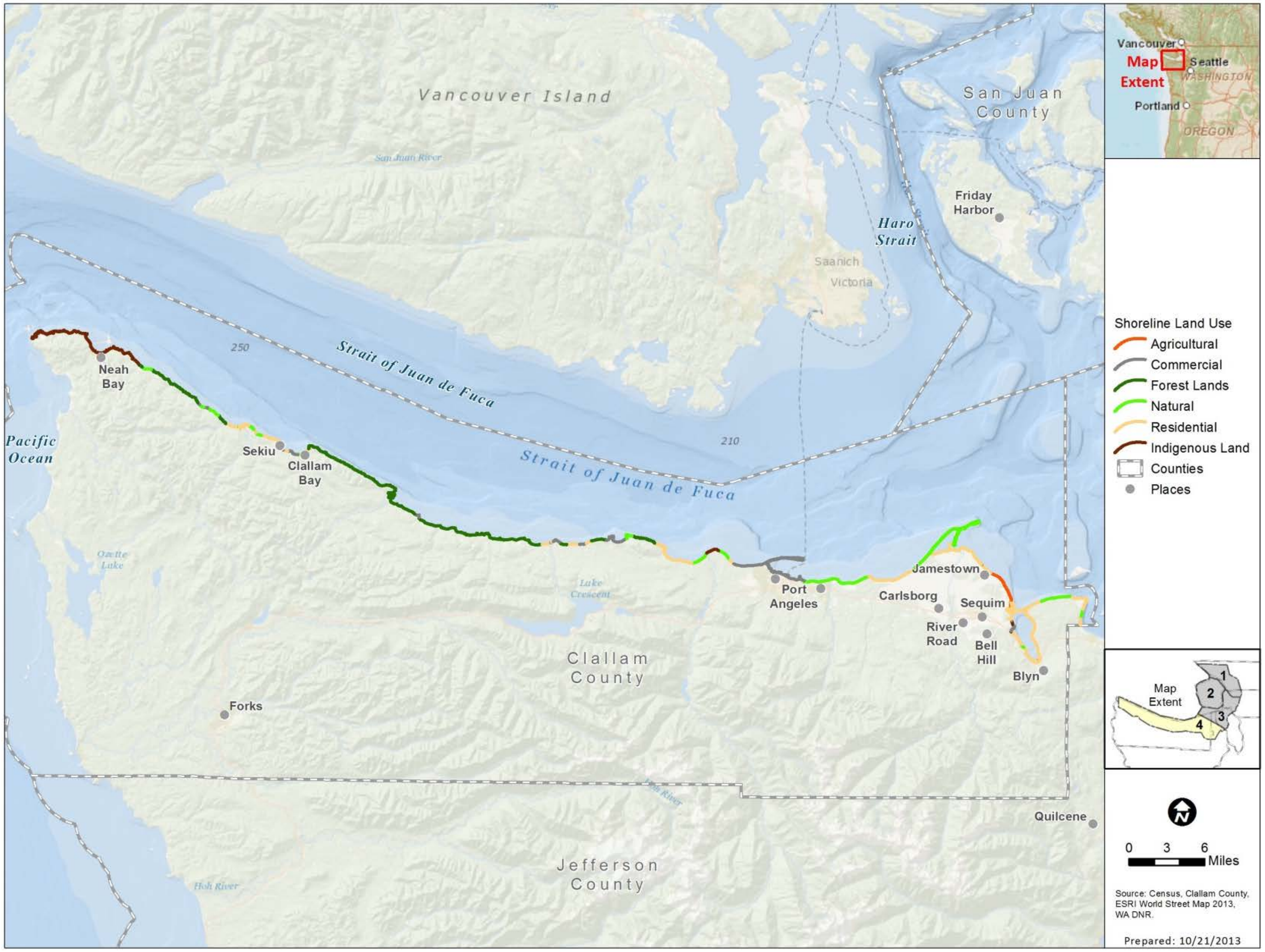

Figure 4.6-2 Shoreline Land Use along the Northern Coast of the Olympic Peninsula

4.6.2.3 Birch Point to Samish Island

The shoreline from Birch Point south to Samish Island is in Skagit and Whatcom Counties and is primarily residential (44 percent) and forest lands (19 percent). Agriculture and commercial lands are also substantial land uses, accounting for 14 percent and 13 percent of the shoreline, respectively. The remainder of shoreline is classified as industrial (5 percent) and natural (4 percent). Residential land use is concentrated around Birch Bay, Lummi Peninsula and Island, and Samish Island. Most of the residential land use is in rural areas with a maximum of three units per acre. Forest lands are primarily located on Lummi Island and at the northern ends of Bellingham Bay and Samish Bay. Agricultural land use is concentrated at Lummi Bay and the southern section of Samish Bay, while commercial land use is concentrated at Bellingham, south of Bellingham, and at the town of Birch Bay. Industrial land use is primarily located south of Cherry Point. Shoreline land use from Birch Point to Samish Island is presented in Table 4.6-3 and in Figure 4.6-3.

Table 4.6-3 Shoreline Land Use from Birch Point to Samish Island

Land Use Type	Miles	Percent
Agricultural	19.4	14
Commercial	17.8	13
Forest lands	26.4	19
Industrial	7.3	5
Natural	4.8	4
Residential	60	44
Total	**135.7**	**100**

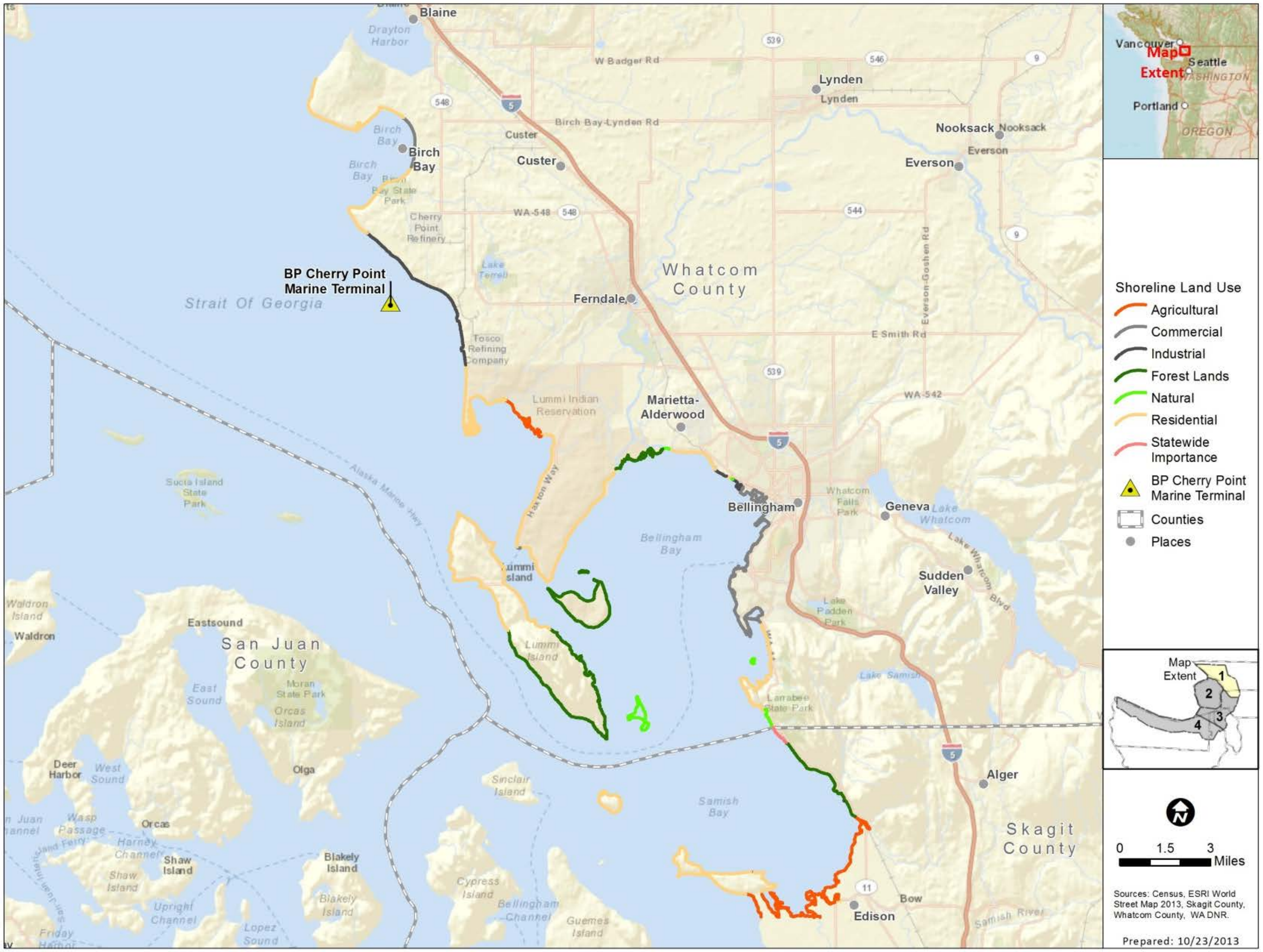

Figure 4.6-3 Shoreline Land Use from Birch Point to Samish Island

4.6.2.4 Padilla Bay to Keystone Harbor

The shoreline from Padilla Bay to Keystone Harbor is located in Island and Skagit Counties and is characterized by a diverse mixture of land uses. Residential is the most common land use, representing 35 percent of the shoreline and primarily concentrated on Fidalgo, Guemes, and Urban Islands. Commercial land uses (19 percent) and areas reserved for urban growth or rural commercial uses dominate the shoreline around Anacortes and from La Conner to Snee Oosh. Agricultural lands (17 percent) are located along the Swinomish Channel and Padilla Bay, while lands of statewide significance (15 percent) are located along the coasts of Cypress and Burrows Islands and at several points inland from Deception Pass. Natural lands (12 percent) are primarily located on the west coast of Whidbey Island. Very few shoreline areas are classified as industrial or forest land by Island or Skagit Counties. Shoreline land use from Padilla Bay to Keystone Harbor is presented in Table 4.6-4 and in Figure 4.6 -4.

Table 4.6-4 Shoreline Land Use from Padilla Bay to Keystone Harbor

Land Use Type	Miles	Percent
Agricultural	33.4	17
Commercial	36.4	19
Forest lands	1.4	1
Industrial	1	1
Natural	23.9	12
Residential	69.3	35
Statewide significance	29.9	15
Total	**195.3**	**100**

Figure 4.6-4 Shoreline Land Use from Padilla Bay to Keystone Harbor

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4.7 RECREATION RESOURCES

The study area for the recreation resources analysis is shown in Figure 4.7-1. Resources important to recreation in the Project area include natural shoreline features, biological resources, and man-made facilities such as parks and campgrounds. The description of recreation resources has two main components. The first is an overview of each of the primary recreation activities and associated level of use throughout the study area. The second is an overview of recreational resources specific to the shoreline and offshore areas located in each of four subareas: the San Juan Islands, the Northern Coast of the Olympic Peninsula, Birch Point to Samish Island, and Padilla Bay to Keystone Harbor. In addition, the offshore recreational resources in Canadian waters near Vancouver Island and the Gulf Islands are described.

4.7.1 Regulatory Context

Aquatic lands are part of the public lands of the State of Washington and include many public places, waterways, bar islands, abandoned river beds, and channels of navigable water (RCW 79.105.060). These are managed by the WSDNR directly or indirectly through management agreements with other governmental entities.

WSDNR’s proprietary management of state-owned aquatic lands is governed by RCW Chapter 79.105.140 and WAC Chapter 332-30. In addition, federal laws, treaties, intergovernmental agreements, and court decisions affect WSDNR’s management activities. Other entities, such as the USACE and the WDFW are responsible for regulating certain activities on both privately and publicly owned aquatic lands. The Public Trust Doctrine also applies to WSDNR managed lands. This common-law principle protects public use and access to navigable waters for navigation, fishing, and recreational activities.

The Washington State Department of Health regulates opening and closing of beaches and waterways, including recreational and commercial shellfish zones. The Washington State Parks and Recreation Commission (Parks Commission) plays a vital role in educating the public regarding appropriate recreation (RCW Chapter 79A.05). WAC 332-30-151 directs WSDNR to consider lands with educational, scientific, and environmental values for aquatic reserve status and identifies management guidelines for aquatic reserves. The Cherry Point Aquatic Reserve falls within the Project area. The state-owned aquatic lands within the Cherry Point Aquatic Reserve are not held in trust for beneficiaries but are held in public trust for the people of the state and managed in accordance with statutory directive.

4.7.2 Major Recreation Activities and Level of Use

The primary recreation activities in the Project area include fishing and shellfishing; boating; shoreline camping, beach walking, and picnicking; scuba diving; and wildlife viewing. To the extent available, use data are provided for each recreational activity discussed below.

4.7.2.1 Fishing and Shellfishing

The variety and abundance of saltwater fish and shellfish provide excellent recreational harvesting opportunities throughout northern Puget Sound. Recreational fishing species include numerous salmon species (Chinook, coho, chum, pink, and sockeye), halibut, other species of bottomfish (rockfish, lingcod, cabezon, and perch), steelhead trout, and small fish species typically caught for recreational bait (herring, smelt, anchovies, sardines, and sand lance).

The study area nearshore environment also provides habitat to numerous species of shellfish that are gathered recreationally for consumption. The primary recreational shellfish resources in Puget Sound are crabs (Dungeness and red rock crabs), oysters (introduced Pacific oysters and native Olympia oysters), and clams (littleneck, butter, horse, and introduced Manila and softshell clams) (Dethier 2006). Shrimp are also a popular recreational shellfish species. Data from the WDFW indicate that recreational shellfish harvesters annually collect approximately 334,000 pounds of clams and oysters in the study area (see Table 4.7-1).

Table 4.7-1 Recreational Harvest per Year by Area and Fish Annual Average (1998–2001)

Washington Department of Fish and Wildlife Catch Area	Weight (lbs)			
	Clams	Oysters	Marine Fish	Salmon
United States				
Deception Pass, Hope	127,992	12,333	4,461	5,851
Eastern Strait of Juan de Fuca	21,756	27,972	3,418	6,645
San Juan Islands	91,203	52,899	6,397	9,003
Neah Bay, Seiku, and Pillar Point	--	--	47,295	53,729
Canada				
West Vancouver Island	--	--	51,315	95,542
Juan de Fuca Strait (Canada)	--	--	49,221	18,909
Total	**240,951**	**93,204**	**162,107**	**189,679**

Notes:

lbs = pounds

Data on shellfish harvest in Canadian areas were not available.

Sources: WDFW (1998–2001); Fisheries and Oceans Canada (2008).

Table 4.7-2 presents data on fishing licenses purchased in the counties bordering northern Puget Sound. The values in Table 4.7-2 represent the average annual number of saltwater and marine licenses purchased in each county for the period from 2003 to 2006. Because the data represent where licenses are sold (and not necessarily where fishing occurs) and one individual can purchase multiple licenses, it is most useful as an indicator of the number of marine fishing recreationists living in the north Puget Sound region.

As indicated in Table 4.7-2, fishing and shellfishing are popular recreational activities in all counties bordering the Project area. Licenses sold in the Project area number over 100,000, which represents almost one-quarter (23 percent) of the total saltwater and marine fishing and seafood-gathering licenses sold in the state. The affected region accounts for 18 percent or more of the state-issued licenses for four of the five types of licenses sold. These figures likely underestimate the number of recreationists in the Project area, as they do not include individuals who live in the populous counties south of the study area (e.g., King, Kitsap, and Snohomish Counties) who may purchase a license in their home county and then travel to recreate in northern Puget Sound.

Table 4.7-2 Fishing Licenses per Year by County

County	1–5 Day Temporary Combination	Razor Clam	Combination	Saltwater Fishing	Shellfish/ Seaweed	Total
Clallam	10,851	184	5,219	3,083	3,789	23,126
Island	5,287	18	5,055	3,503	5,731	19,594
Jefferson	2,445	11	1,736	1,090	3,347	8,629
San Juan	3,589	3	1,069	1,465	2,238	8,363
Skagit	6,489	27	6,415	2,535	6,260	21,726
Whatcom	5,724	30	5,168	2,275	7,075	20,272
Region total	**34,385**	**273**	**24,662**	**13,951**	**28,441**	**101,711**
Percent of state total	25	2	18	28	29	23

Note: All license cancellations and duplications were excluded.

Source: WDFW 2008.

Fish harvest data collected by WDFW (for the regions covering the United States) and Fisheries and Oceans Canada (for Canadian regions, including Vancouver Island and the Canadian area of the Strait of Juan de Fuca) are presented in Table 4.7-1. These agencies maintain harvest records by requiring recreational fishermen to complete catch cards. Data for Canadian areas do not include shellfish. Harvest levels reported in Table 4.7-1 are the average yearly reported catch from 1998 to 2001.

As indicated in Table 4.7-1, the Project area is a popular recreational fishing area in Washington and British Columbia. As a proportion of the total annual Washington State fish catch from 1998 to 2001, the harvest in the affected area represents 42 percent of clams, 35 percent of marine fish, 13 percent of oysters, and 17 percent of salmon.

4.7.2.2 Boating

Boating is a major recreational activity in northern Puget Sound and encompasses a wide variety of activities. As evident by the large number of marinas located throughout the study area, sail boating and motor boating are popular activities. The study area also provides recreational opportunities for smaller paddlecraft, such as kayaks and canoes. According to a 2007 Washington boating survey, 35 percent of boaters in the state boated in Puget Sound and 8 percent boated in the Strait of Juan de Fuca (Duda et al. 2007). This includes all types of motorboats, personal watercraft, sailboats, and canoes/kayaks.

Table 4.7-3 presents the number of motorized boating licenses issued in each of the counties with shorelines in the Project area. Use data for non-motorized forms of boating, such as kayaking, are not included in these data because they do not require a license. Data indicate that approximately 35,000 recreationists engage in motorized boating in northern Puget Sound. Further, in neighboring counties to the south, approximately 100,000 additional motorized boat recreationists may boat in northern Puget Sound waters.

4.7.2.3 Camping, Beachwalking, and Picnicking

In Washington State, shorelines may be privately owned, and public recreation on beaches may occur only on beaches owned or managed by a public agency. Shoreline public recreation areas are managed by the Parks Commission and the WSDNR. While the Parks Commission manages the inland area along with the shorelines, the Aquatic Resources Division of the WSDNR manages the state-owned aquatic lands that are available for public use and access. In addition, locally and federally managed shoreline lands are available for public use.

Table 4.7-3 Number of Boating Licenses by Affected U.S. County and Year

County	2004	2005	2006	2007	2008
Counties in the Project Area					
Clallam	4,841	4,781	4,828	4,645	4,603
Island	5,732	5,780	5,952	5,934	5,986
Jefferson	2,960	3,006	3,087	3,042	3,052
San Juan	3,170	3,140	3,229	3,247	3,278
Skagit	9,455	9,322	9,431	9,261	9,375
Whatcom	9,109	9,175	9,536	9,559	9,517
Subtotal	**35,267**	**35,204**	**36,063**	**3,5688**	**35,811**
Nearby Counties					
King	59,306	58,544	57,650	58,108	57,413
Snohomish	28,115	27,527	27,827	28,051	28,429
Kitsap	12,890	12,980	13,308	13,337	13,288
Subtotal	**100,311**	**99,051**	**98,785**	**99,496**	**99,130**
Total Puget Sound Counties	**135,578**	**134,255**	**134,848**	**135,184**	**134,941**

Source: Washington State Department of Licensing 2008.

Use data along public shorelines are not collected by the WSDNR, but the Parks Commission does estimate use at state parks. Table 4.7-4 presents the Parks Commission's estimate of total visits to state parks in the Project area counties that border the affected marine shoreline. Several state parks along the Project area shoreline are not included in the Parks Commission use estimates. These are Upright Channel, Lime Kiln Point, and Griffin Bay State Parks in San Juan County and the three Marine State Parks on Burrows Island, Saddlebag Island, and Huckleberry Island in Skagit County.

Table 4.7-4 Shoreline State Park Use by County and Activity (2007)

County	Occupied Overnight Shore Sites	Occupied Overnight Moorage Sites	Day Use[a]
Clallam	19,709	424	242,205
Island	145,055	4,656	3,049,863
San Juan	21,191	25,763	176,847
Skagit	46,577	-	709,802
Whatcom	38,512	-	733,365
Jefferson	114,058	330	1,142,695
Total	**385,102**	**31,173**	**6,054,777**

[a] Number of visitors.

Source: Parks Commission 2008.

State parks with saltwater shorelines in the Project area are an important recreation resource. In 2007, approximately 385,000 overnight campers and approximately 6 million day users visited state parks.

Deception Pass State Park in Island County and Fort Worden State Park in Jefferson County are the most visited parks in the area. In 2007, over 110,000 overnight campers and more than 2 million day visitors visited the Deception Pass State Park, and nearly 115,000 overnight campers and approximately 1.1 million day users visited Fort Worden State Park. Most of these parks include areas for boat launches, which are not included in these data.

4.7.2.4 Scuba Diving

The nutrient-rich waters of Puget Sound result in a rich array of marine mammals, fish, and invertebrate life. The diversity of underwater life in Puget Sound creates a world-class scuba diving resource. Despite the cold waters, the area attracts many scuba divers annually. Particularly popular scuba diving locations in the Project area include the San Juan Islands, the kelp forests along the Olympic Peninsula coast in the Strait of Juan de Fuca, and the bays of the mainland such as Padilla or Samish Bays.

4.7.2.5 Wildlife Viewing

The marine waters and shoreline of the study area provide habitat for a wide array of wildlife species attractive to wildlife viewing recreationists. Harbor seals, river otters, sea lions, whales, eagles, and hawks are among the species that can be viewed throughout the study area. The San Juan Islands are a particularly popular wildlife viewing area. It is estimated that whale watching-related tourism in the San Juan Islands alone is a $10 million industry (Kriete 2007).

4.7.3 Major Recreation Resources by Shoreline Area

This section provides an overview of the recreational resources by geographic area. Five geographic subareas within the Project area have been defined: San Juan Islands, Olympic Coast, Birth Point to Anacortes, Anacortes to Admiralty Inlet, and Canadian waters. The primary shoreline facilities, such as state parks and marinas, and the primary water-based activities off of each section of coast are described. Table 4.7-5 summarizes the recreational resources by geographic area as detailed in the NOAA database for Puget Sound and the Strait of Juan de Fuca developed in 2006 by the NOAA Office of Response and Restoration, Hazardous Materials Response Division. It should be noted that the NOAA database does not comprehensively include all recreation resources. For example, it includes the most prominent scuba diving sites but does not include all popular diving locations. Also, some local parks appear to not be included in the data. Therefore, the number of recreation facilities and geographic extent of resources in the Project area presented in Table 4.7-5 is likely a conservative estimate.

4.7.3.1 The San Juan Islands

Location and Access

Located west of Anacortes and southwest from Bellingham in northern Puget Sound, the San Juan Islands form Haro Strait to the west and Rosario Strait to the east. The islands collectively provide Puget Sound residents and other visitors a wide range of high-quality marine recreation opportunities. Access to the islands is provided by ferry service from Anacortes, Washington and Sidney, British Columbia, which delivers thousands of tourists (and their cars and bicycles) annually to the region’s four main islands: Lopez, Shaw, San Juan, and Orcas. Many visitors also access the islands independently by boat, as many of the 200 islands and 400 miles of shoreline are uninhabited.

Table 4.7-5 Summary of U.S. Recreational Resources by Geographic Area

Recreation Resources	Birch Point to Samish Island	Olympic Peninsula	San Juan Islands	Padilla Bay to Keystone Harbor	Total
Number of Locations					
Beach access (from land)	8	5	11	8	32
Beach	17	25	91	23	156
Boat ramp	7	28	17	20	72
Diving site	0	4	4	3	11
Ferry terminal	0	0	0	2	2
Marina	5	9	21	10	45
Number of Acres					
National park	0	0	1,733	6,229	7,962
Local park	0	17	469	503	989
Recreational fishing	167,370	252,684	90,011	44,920	554,985
Regional or state park	3,000	3,529	7,109	4,090	17,727

Source: NOAA 2006.

Overview of Resources and Types of Use

The unique combination of accessibility and remoteness of the islands, with numerous coves and inlets to explore, creates a marine recreational playground for many user groups. The San Juan Islands are located closely together, creating protection from the open sea that is ideal for paddlers, sailors, and divers. In addition, the San Juan Islands NWR, which consists of 83 rocks, reefs, and almost 450 acres of grassy and forested islands, helps maintain pristine habitat for aquatic life, seabirds, and marine mammals. Although only two of the islands in the region are accessible to the public, the scenic landscape throughout the San Juan Islands provides recreationists with world-class conditions for bird watching, wildlife viewing, and scuba diving. Public beach access and shoreline trails dotted throughout the four main islands provide beach walking and hiking opportunities, as well as opportunities for shellfish digging and shoreline fishing. Recreation resources in the San Juan Islands are displayed in Figure 4.7-1.

Shoreline Recreation Resources

Highly visited waterfront areas on the San Juan Islands include the region’s four ferry stops, which consist of small waterside towns providing recreational services for boaters and other visitors. The ferry docks are located at Friday Harbor on San Juan Island, Orcas Landing on Orcas Island, Shaw Landing on Shaw Island, and near Lopez Village on Lopez Island. In addition to these ferry stops, boaters and other land-based recreationists often visit Roche Harbor on San Juan Island and Deer Harbor on Orcas Island. These areas attract visitors seeking to purchase supplies, moor their boats, refuel, and arrange guided trips. Limited guest mooring is available in the island’s marinas, including Friday Harbor, which hosts more than 12,000 overnight visitor boats in June, July, and August (Mueller and Mueller 2003). Other marinas on the islands are located at Roche Harbor (San Juan), Fisherman Bay (Lopez), Peavine Pass (Blakely), and Deer Harbor (Orcas).

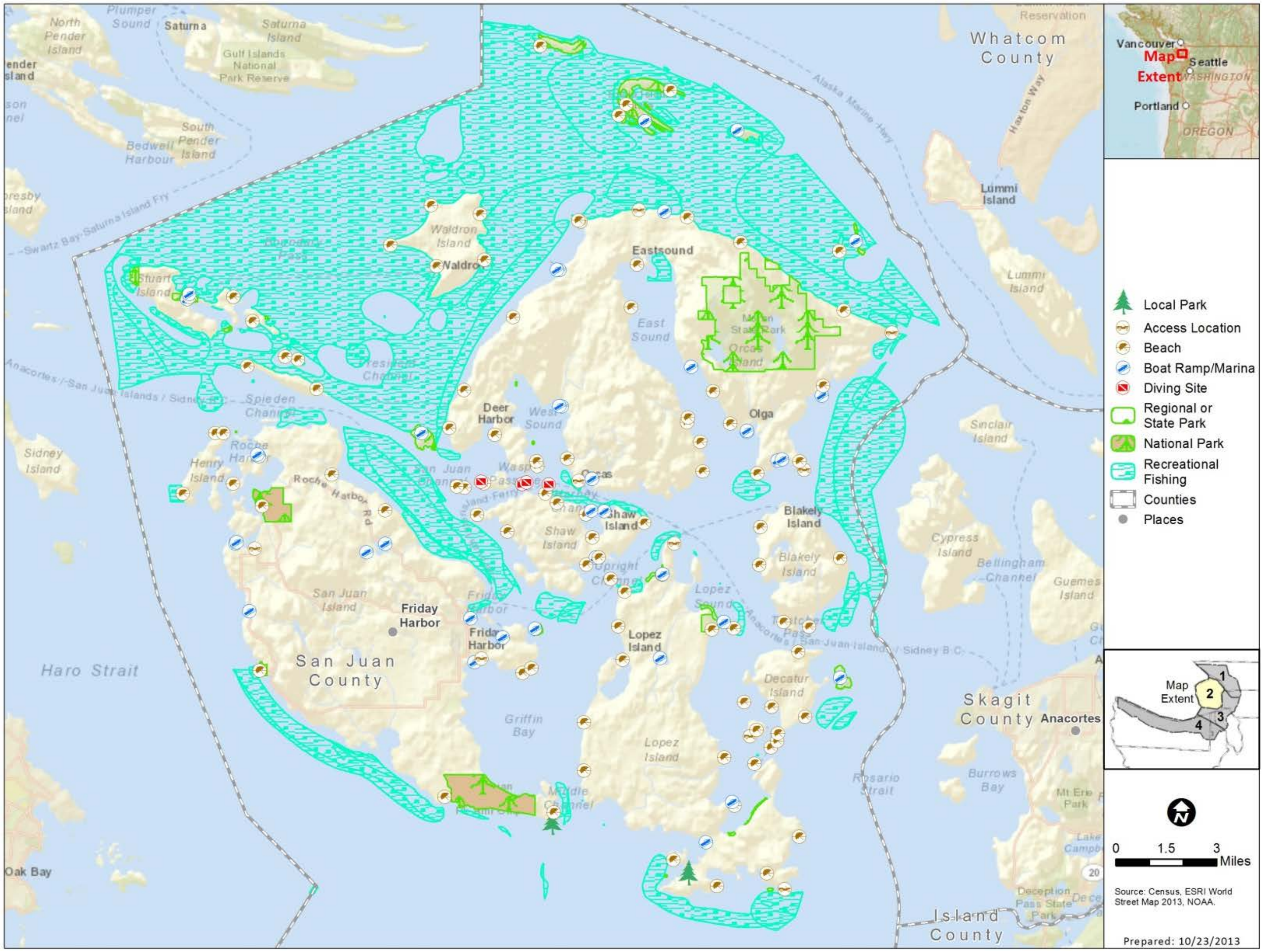

Figure 4.7-1 Recreation Resources in the San Juan Islands

The 16 state parks and numerous public beaches on the islands are popular recreational sites for camping, picnicking, beachwalking, wildlife viewing, and shellfishing. On the islands, there are over 3,500 acres of parks with shoreline access. Five state parks (Moran, Obstruction Pass, Lime Kiln, Upright Channel, and Spencer Spit) are located on the ferry-accessible islands, and four of these are located on the shore. In addition to state parks, 17 parks on the four ferry-accessible islands are maintained by the San Juan County Park Board (San Juan County 2013). Of these, three provide overnight camping facilities. In addition, a national park (San Juan Island National Historical Park) on the San Juan Island coast provides views of the water and 6 miles of shoreline while showcasing the region's history in the Pig War, a territorial dispute between the Americans and British in the mid-1800s.

The largest state park in the islands is Moran State Park, located inland on Orcas Island. The park encompasses Mt. Constitution (the highest point on the islands), where visitors can enjoy views of the surrounding water and islands. Also on Orcas Island, Obstruction Pass State Park offers limited camping and picnicking facilities at the end of a short hike to the shore. Spencer Spit State Park on Lopez Island offers camping and picnicking facilities, as well as snorkeling, swimming, crabbing, and other marine recreation. Upright Channel, also on Lopez Island, is a 20-acre day use park that provides picnic and hiking facilities, as well as easy access to tidelands excellent for clamming.

Several shoreline recreation locations are dedicated primarily to wildlife viewing. The Shark Reef Wildlife Sanctuary on the southern shore of Lopez Island offers wildlife viewing in a pristine marine environment. From San Juan County Park, which overlooks Haro Strait from San Juan Island, orca whales often can be seen offshore during summer. The snorkeling and tide pooling resources at this county park also provide opportunities for viewing wildlife. South of San Juan County Park on the west side of San Juan Island, the 36-acre Lime Kiln State Park is considered one of the best shoreline locations in the world to view whales (Parks Commission 2008).

Other public shoreline recreation locations, including most of the San Juan Islands Marine Parks, are on islands not serviced by the ferry system and are accessible only by boats. Cruisers, sailors, and paddlers enjoy the camping, picnicking, diving, angling, and wildlife viewing activities at these parks. One of the largest of the Marine Parks is Jones Island State Park, with 25,500 feet of shoreline and 21 campsites for up to 65 people. Other similar parks include James Island State Park, Sucia Island State Park, Clark Island State Park, Turn Island State Park, and Stuart Island State Park. There are also abundant overnight options for boaters who can camp on the shore or moor onto one of the area's numerous buoys.

Several of these state parks accessible only by boat are among the 12 shoreline camping locations in the San Juan Islands that form part of the Cascadia Marine Trail. This marine trail, one of only 16 National Millennium Trails designated by the White House, connects 55 shoreline campsites for people paddling the Puget Sound in human or wind-powered, beachable watercraft (most often sea kayaks). Of the 12 San Juan Island campsites on the Cascadia Marine Trail, eight are state parks, three are county parks, and one is a WSDNR recreation site.

Offshore Recreation Resources

The areas surrounding the San Juan Islands are extremely popular with sail boaters, who enjoy the flat waters and gusty winds of the sheltered islands. The most renowned sailing locations in the area are found in the two large sounds (East Sound and West Sound) of Orcas Island. Cruising in motor boats and yachts is another popular way to explore the islands. The fishery resources in the San Juan Islands provide many boaters with quality recreational angling opportunities for lingcod, salmon, and halibut. As indicated in Table 4.7-5, over 140 square miles of water in the San Juan Islands are classified as recreational fishing areas (NOAA 2006).

In addition to motorized boating, the protected waters of the San Juan Islands create one of the best places in Puget Sound for paddling. Kayaks and canoes, which can be brought by ferry or rented upon arrival, are a popular way to experience the islands' marine attractions by boat. The abundant marine life off of the islands' rocky shores is also a valuable scuba diving resource. The tidal conditions, water temperature, and protected waterways make the San Juan Islands one of the premier scuba diving destinations in Washington (Pacific Northwest Marine Activities 2008). There are dozens of prime diving areas in the islands, including several locations in the waters between Shaw Island and Orcas Island. Certified divers who lack equipment or transport can arrange chartered scuba trips in Friday Harbor.

The waters between the mainland ferry and boat terminals and the docks in the islands are also a valuable recreation resource, as traveling to and from the San Juan Islands is a recreational activity in itself for many visitors. Ferries departing from Anacortes enter the islands through Thatcher Pass, between Blakey and Decatur Islands. This narrow waterway provides ferry passengers views of several small islands inhabited only by colonies of seabirds and other marine wildlife. Visitors also have a chance of spotting one of the approximately 90 pairs of bald eagles nesting on the islands, the highest concentration of this species in the lower 48 states (San Juan Islands Chamber of Commerce 2008). Other wildlife viewable by visitors includes river otters and California sea lions, and whales and dolphins in the wider ocean channels.

4.7.3.2 The Olympic Peninsula North Coast

Location and Access

This section describes the recreation resources on the north coast of Washington's Olympic Peninsula and offshore in the Strait of Juan de Fuca. Specifically, this section provides an overview of recreation from Port Townsend west to the town of Neah Bay.

Overview of Resources and Types of Use

The northern Olympic Peninsula coastline along the Strait of Juan de Fuca provides quality recreation resources for a number of user groups. Salmon angling in the strait and at river mouths is a valuable recreation resource for residents and visitors alike. The coastline also contains numerous protected bays and coves that provide shelter for boaters, divers, and paddlers. Public parks, moorages, and beaches along the coast accommodate boating and shoreline recreation. Also, nearby Olympic National Park draws thousands of visitors to the area who often use the north coast recreation resources as well. Recreation resources on the north coast of the Olympic Peninsula are shown in Figure 4.7-2.

Shoreline Recreation Resources

The northern Olympic Peninsula has 5 public shoreline access points, 25 public beaches, 28 boat ramps, and 9 marinas along the coast (see Table 4.7-5). Popular activities in the parks include fishing, picnicking, beach combing, hiking, and shellfish collecting. This section describes the shoreline resources along the Strait of Juan de Fuca, moving from east to west.

Just north of Port Townsend is the area's largest public park, Fort Worden State Park and Conference Center. Once a military fort, the park now hosts campers and day users in addition to conferences and camps. Attractions in Fort Worden include the preserved military installations, the Coast Artillery Museum, Marine Science Center, picnic shelters, bike trails, tennis courts, beaches, and more. In all, Fort Worden contains approximately 2 miles of shoreline with numerous beaches. There are also dorms, 80 RV sites, and 5 campsites to accommodate overnight users.

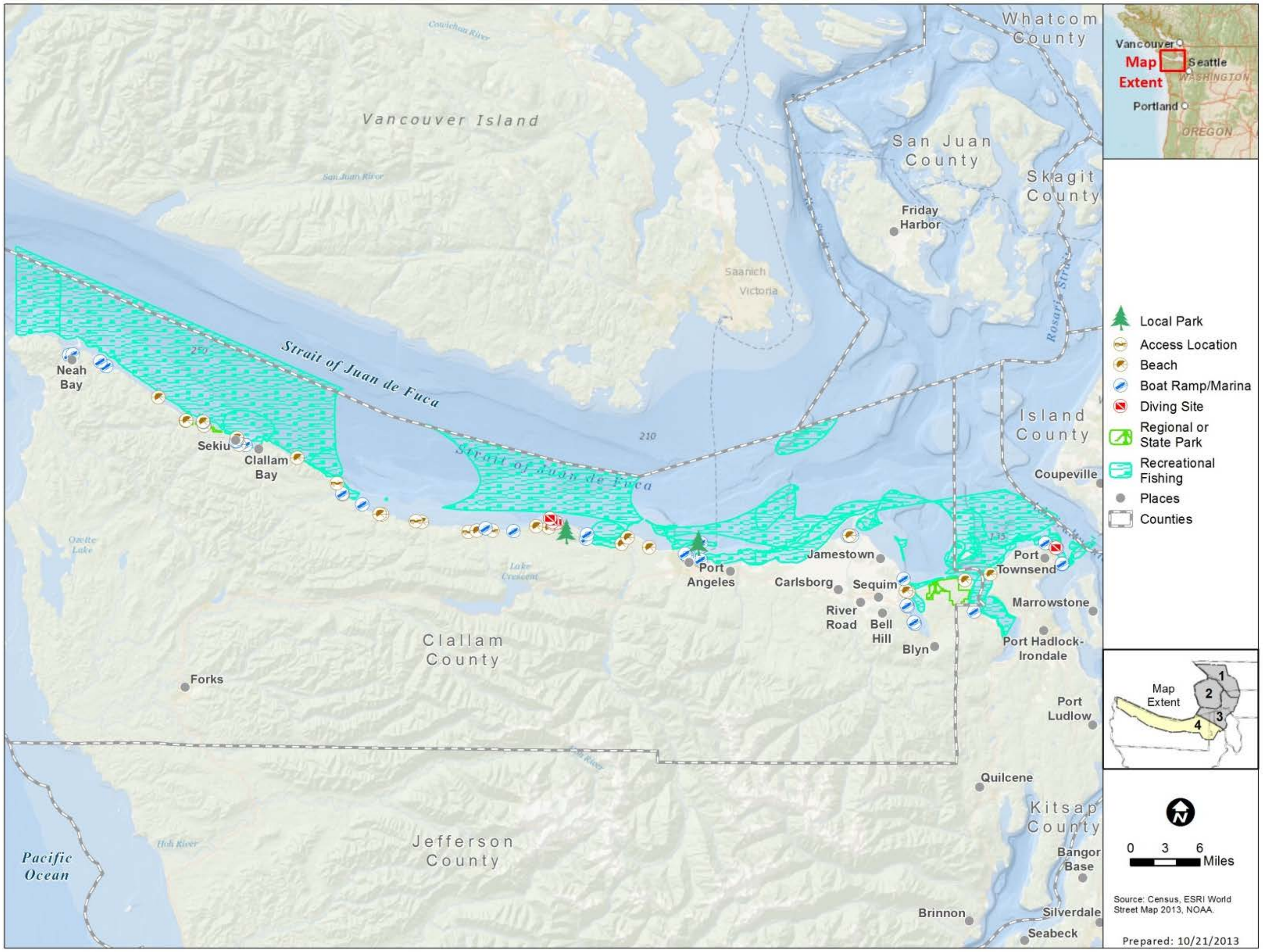

Figure 4.7-2 Recreation Resources on the North Coast of the Olympic Peninsula

West of Fort Warden, Discovery and Sequim Bays shelter shorelines from the Strait of Juan de Fuca. Although public access is limited in Discovery Bay, Millar Peninsula (which separates the two bays) contains a number of public recreation resources. Diamond Point and two WSDNR beaches provide access to over 5 miles of tidelands on Millar Peninsula for walking and birdwatching. Sequim Bay State Park has 60 campsites, 16 RV hookups, and nearly 1 mile of shoreline on Sequim Bay. Park visitors participate in fishing, shellfishing, crabbing, birdwatching, and hiking. Public moorages are available offshore from the park and also at the nearby John Wayne Marina.

North of the town of Sequim, the Dungeness National Wildlife Refuge has numerous recreation resources. Created by the delta of the Dungeness River, Dungeness Spit reaches 5 miles into the Strait of Juan de Fuca, creating Dungeness Harbor as well as excellent habitat for local wildlife. The Dungeness Recreation Area provides 67 campsites, picnic facilities, and trails for users. The Dungeness Recreation Area and Wildlife Refuge combined encompass approximately 9 miles of shoreline around Dungeness Spit. The most popular activities in this area are bird watching, beach walking, and hiking to viewpoints.

Port Angeles is the largest city on the Olympic Peninsula, offering visitors tours, dining, viewpoints, and accommodation on the shores of Port Angeles Harbor. The city is generally considered the gateway to Olympic National Park and to Victoria, Canada. West of Port Angeles off Highway 112, Freshwater Bay County Park’s 1,450 feet of shoreline is used as a launch point by fisherman, paddlers, and scuba divers. Nearby, the Striped Peak Scenic Area and the Salt Creek County Park offer additional access to the Striped Peak area. Salt Creek County Park provides 90 campsites and nearly 1 mile of shoreline, in addition to scenic hiking trails. The adjacent Tongue Point Marine Life Sanctuary has quality shoreline habitat and is a popular destination for tidepoolers and naturalists.

West from Salt Creek, most of the public access shoreline areas are undeveloped WSDNR beaches. The most notable public facilities between Striped Peak and Neah Bay are Pillar Point and Clallum Bay County Parks. Pillar Point, with picnic shelters and a boat launch, is known as a salmon fishing hotspot and is a popular access point for boat anglers. Clallum Bay County Park, near the town of Clallum, was damaged by a storm in 2003 and now contains only restrooms and picnic facilities. Although public shoreline access between Port Angeles and Neah Bay is limited, the scenic highway connecting the towns provides many shoreline views for visitors. In addition, a number of tourist fishing lodges are located along this stretch of coast.

Offshore Recreation Resources

The waters offshore of the northern Olympic Peninsula are a valuable recreational resource. In particular, the salmon resources in the Strait of Juan de Fuca provide excellent angling opportunities, as evident by the numerous fishing resorts in the area. Although there are many fishing grounds offshore, some popular spots include just offshore from Pillar Point and around Seal and Sail Rocks. As indicated in Table 4.7-5, over 395 square miles of water off the north coast of the Olympic Peninsula are classified as recreational fishing areas (NOAA 2006).

Scuba diving is also popular in the study area due to the abundant marine life in the Strait of Juan de Fuca. Offshore from Fort Worden Park and Tongue Point, the Salt Creek County Park kelp forest is a popular destination for divers. Finally, although not as sheltered as other areas, the numerous moorages, marinas, and sheltered bays draw boaters and paddlers to the north Olympic Peninsula—especially to the bays and sheltered coves.

4.7.3.3 Birch Point South to Samish Island

Location and Access

Just south of the U.S./Canada border, Birch Point protrudes into the Strait of Georgia, creating Birch Bay. This section summarizes the recreation resources along the coast from Birch Point south to Samish Island. The study area covers Birch, Bellingham, and Samish Bays as well as Lummi Island, Clark Island, and Samish Island. Most of this area can be accessed from the Washington State highway system, although a short ferry ride is necessary to access Lummi Island by car.

Overview of Resources and Types of Use

The shore of Washington's northern coast has a wide variety of recreation resources. Although not as highly renowned as some other areas, the northern coast is very accessible to users and still offers scenic recreation areas. Numerous marinas and moorages serve as a launching and receiving point for boaters traveling to and from the San Juan or Gulf Islands. Along the coast, fishing, shellfish collecting, boating, sailing, kayaking, and diving are all popular pursuits. The numerous bays along this section of coast are ideal for shellfishing, and also provide calmer, more sheltered waters. Recreation resources from Birch Point to Samish Island are shown in Figure 4.7-2.

Shoreline Recreation Resources

Shoreline recreational resources from Birch Point to Samish Island include 17 public beaches and two state parks. There are five marinas and seven boat ramps in the area (see Table 4.7-5 and Figure 4.7-3). Popular activities in the parks include picnicking, beach combing, hiking, fishing, and shellfish collecting.

The Cherry Point Aquatic Reserve located on the western shores of Whatcom County encompasses 296 acres in the Strait of Georgia. The reserve surrounds the BP Cherry Point dock (Figure 4.7-4). Public recreational activities such as boating, fishing, shellfish harvesting, swimming, and beach walking are popular there.

Just south of birch point, over 1.5 miles of shoreline and nearly 150 campsites are present in Birth Bay State Park. Accessible from Fisherman's Cove in the Lummi Indian reservation, Lummi Island has numerous WSDNR beaches. The Lummi Island Recreation Site also offers picnicking, camping, and moorages accessible only by boat.

South of the Lummi reservation, a number of recreational resources in Bellingham Bay are close to the city. There is public access to the coast at Squalicum Beach (3,160 feet of tidelands), Boulevard Park (4000 feet of shoreline), and Marine Park (730 feet of shoreline and 2,650 feet of adjoining tidelands). Marine Park and Squalicum Beach are used primarily for picnicking and beach walking, while the larger Boulevard Park also accommodates swimming, fishing, and crabbing. Just south of Bellingham, the Chuckanut Bay Marsh and Tidelands is an undeveloped city park offering beach-walking and birdwatching on 1,550 feet of shoreline and 1,800 feet of tidelands. Also on Chuckanut Bay, Teddy Bear Cove Park contains a mile-long trail leading to 1,400 feet of beachfront used primarily by picnickers and beachcombers. In addition to parks, Bellingham has a number of marinas for boaters and a large cruise terminal from which ferries bound for Alaska arrive and depart every Friday. Ferries bound for Victoria and the San Juan Islands also depart from the Bellingham terminal.

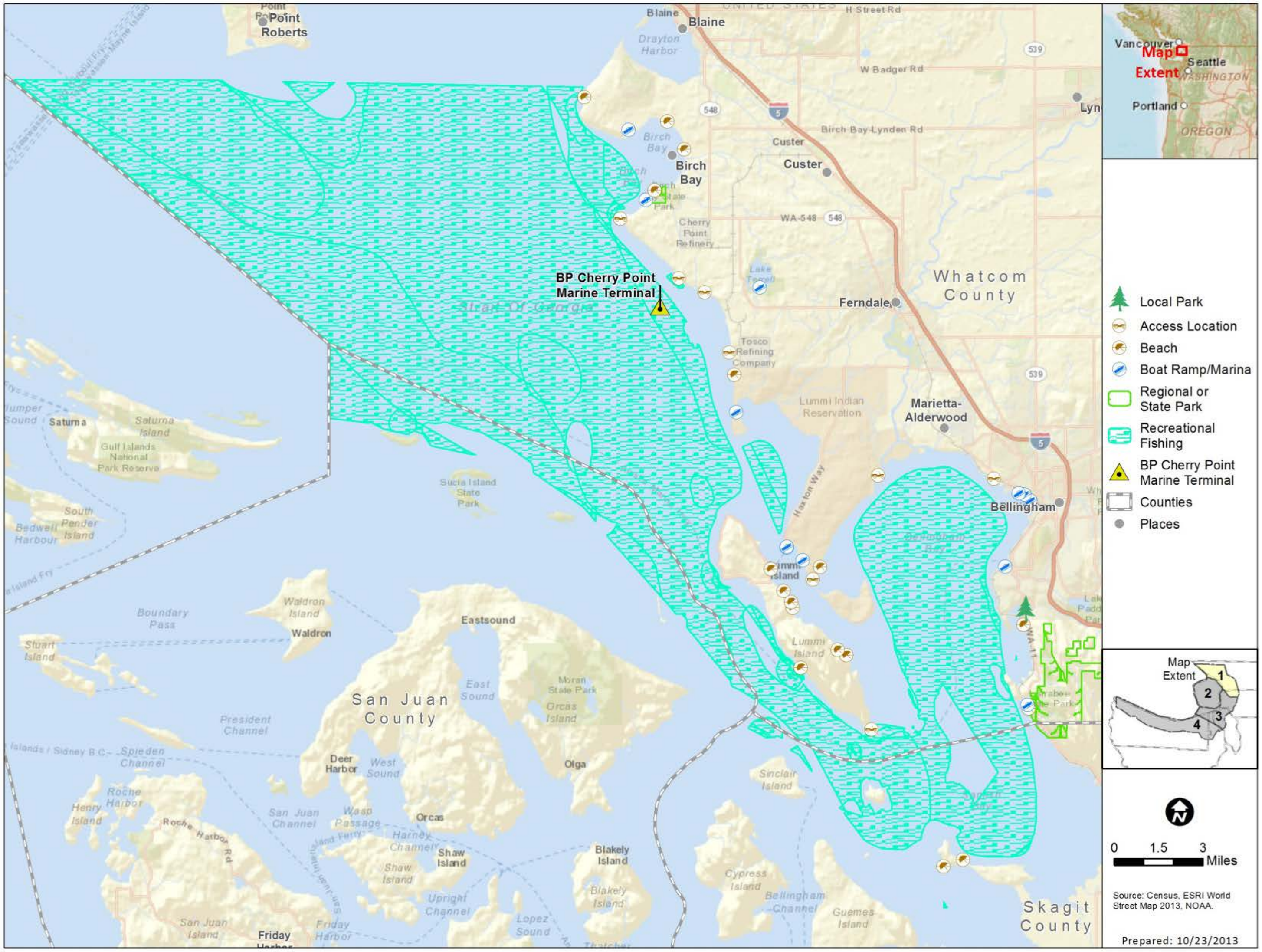

Figure 4.7-3 Recreation Resources from Birch Point to Samish Island

Figure 4.7-4 Cherry Point Aquatic Reserve

Source: WSDNR 2010.

Samish Bay is formed by Governor's Point to the north and Samish Island to the south. In the northern bay, Larabee State Park has over 50 campsites, RV camping, and more than 1.5 miles of shoreline. Popular activities in the park include boating, swimming, crabbing, tidepooling, and diving. A hiking trail in the park climbs 1,500 feet to views of Samish Bay.

Offshore Recreation Resources

Boating is the primary recreational activity in this area. Sailing is popular in the Strait of Georgia and off the coast of Lummi Island. Paddling and windsurfing are popular in Birch, Bellingham, and Samish Bays, and around the offshore islands. The numerous marinas in the area make this area a waypoint for motor boats cruising Puget Sound and the San Juan Islands. Dive spots in the area include offshore from Larabee State Park, Samish Island Picnic Site, and offshore from the numerous islands in the area. Passengers on the ferries traveling to and from Bellingham sightsee and view wildlife.

4.7.3.4 Padilla Bay to Keystone Harbor

Location and Access

This section covers the shoreline and waters spanning from Samish Island south to Goat Island in Skagit Bay, including Fidalgo Island, Cypress Island, and the west coast of Whidbey Island south to Keystone Harbor. Padilla Bay is formed by Samish Island to the north and Fidalgo Island to the south. The narrow Swinomish Channel, separating Fidalgo Island and the mainland, flows between Padilla Bay and Skagit Bay. Deception Pass is another narrow waterway that separates Fidalgo and Whidbey Islands. Except for Cypress Island, all of the shoreline resources in this area are accessible by car from the mainland.

Overview of Resources and Types of Use

The area's diverse landscape contains a variety of easily accessed recreational resources. Public facilities on Padilla Bay and Skagit Bay provide access to sheltered waters excellent for crabbing, diving, paddling, and shellfishing. The rugged west coasts of Fidalgo and Whidbey Islands also provide recreation resources for users seeking deeper, less sheltered waters. Swinomish Channel, Deception Pass, and the narrow passages surrounding Fidalgo Island are the chief passageways for boaters in the area traveling to recreation resources in the San Juan Islands and elsewhere. Recreation resources from Padilla Bay to Keystone Harbor are shown in Figure 4.7-5.

Shoreline Recreation Resources

This area has 23 public beaches and 9 state parks along the coast and outlying islands, in addition to 10 marinas and 20 boat ramps in the area (see Table 4.7-5 and Figure 4.7-5). Beach visitors picnic, beachcomb, hike, fish, collect shellfish, and tidepool. South of Samish Island, Padilla Bay is protected as a National Estuarine Sanctuary due to its excellent wildlife habitat. Shoreline recreation resources on Padilla Bay attract beach visitors. Bay View State Park in central Padilla Bay offers 46 campsites, 30 RV sites, picnic shelters, and 1,320 feet of shoreline used by swimmers, walkers, and fishermen. A nature trail that runs along the protected bay provides wildlife viewing and educational displays. Offshore, Saddlebag Island Marine State Park has five campsites and 1.25 miles of protected shoreline. The island is used by crabbers, fishermen, and boaters departing from Anacortes to other marine attractions. Just west of Saddlebag Island, the small and undeveloped Huckleberry Island Marine State Park is used primarily by kayakers and scuba divers.

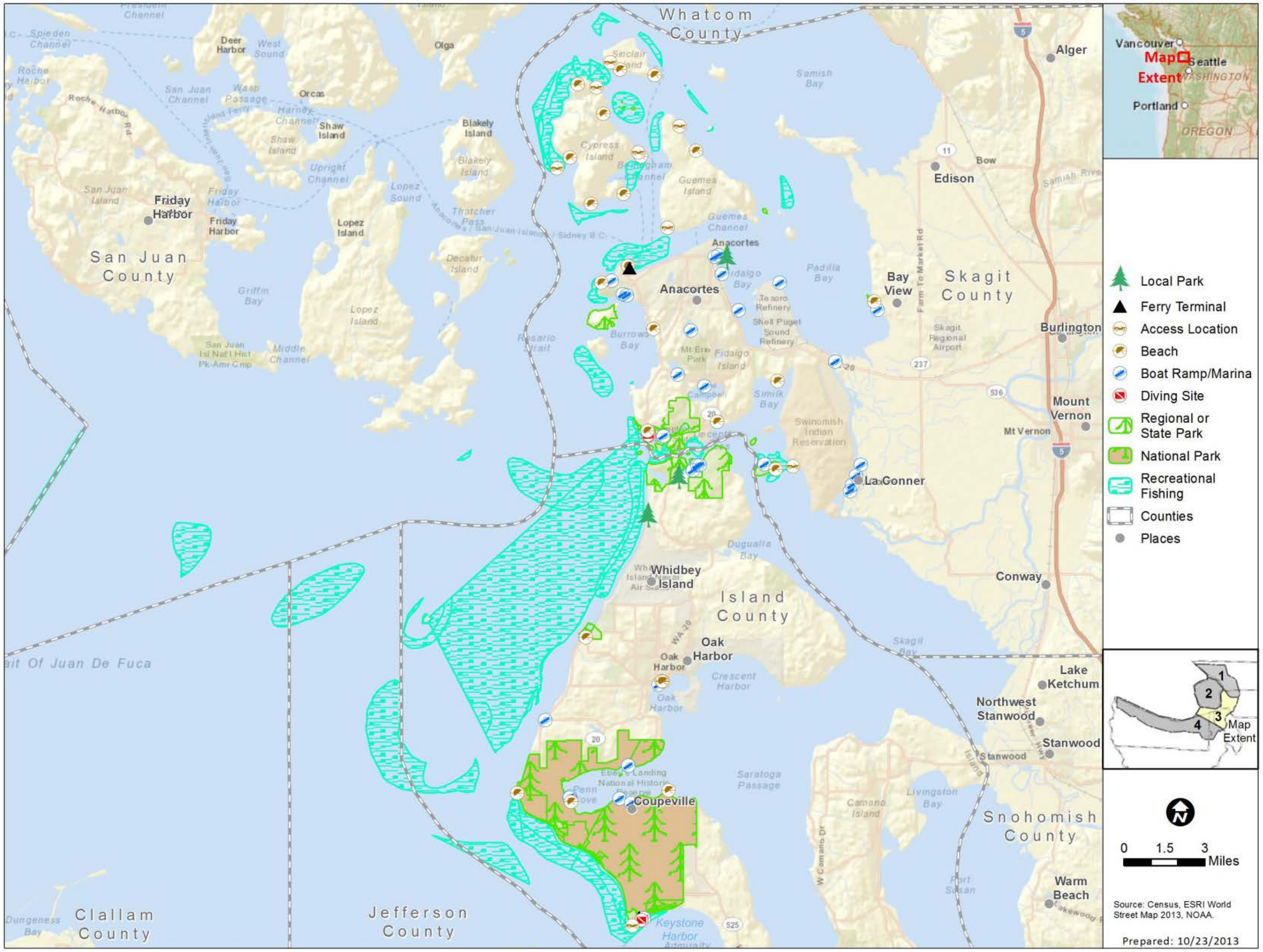

Figure 4.7-5 Recreation Resources from Padilla Bay to Keystone Harbor

The largest town in the area is Anacortes, from which over 1.5 million visitors per year travel on the ferry to the San Juan Islands (Mueller and Mueller 2006). Besides the ferry, Anacortes offers moorage, fuel, and supplies for traveling boaters. Anacortes is more than a launching point, however, as easily accessed recreational resources surround the small town. Cap Sante Park is a 37-acre city park that provides users views, moorages, and picnicking facilities. Just west of Anacortes, Washington Park is a popular and well equipped city park. Resources include 46 RV sites, 22 campsites, boat launch, picnic shelters, showers, hiking trails, and over 7.5 miles of shoreline. Much of the shoreline is below large bluffs, creating dramatic views. Offshore from the west coast of Fidalgo Island, Burrows Island State Park is primarily used by kayakers and boaters as a short stopover point. Goat Island, which is south of Fidalgo Island near where the Swinomish Channel meets Skagit Bay, also serves as a short stopover point for paddlers. Burrows Island allows primitive camping, and Goat Island contains a World War I fort that is a primary attraction.

The narrow waterway separating Fidalgo and Whidbey Islands is the site of the area's most heavily used park. Deception Pass State Park spans both islands and is connected by the Deception Pass Bridge. The park provides 167 campsites, hiking trails, picnic shelters, showers, and kitchens to accommodate the estimated 2.2 million annual visitors (Parks Commission 2007). The nearly 15 miles of shoreline, numerous beaches, protected bays, and dramatic landscape allow users to enjoy the area's natural beauty without requiring a boat. However, the numerous moorages and sheltered coves also make Deception Pass attractive to boaters and kayakers. In addition to the mainland park, Deception Park encompasses Ben Ure and Strawberry Islands in Deception Pass and Deception Island in Rosario Strait. Further south in Skagit Bay, Hope Island and Skagit Island offer camping, hiking, and moorage facilities.

There are three main shoreline parks between Deception Pass and Keystone Harbor on the west coast of Whidbey Island. Joseph Whidbey State Park west of Oak Harbor contains picnic facilities and beach access along 3,100 feet of shoreline. Further south, the adjacent Libbey Beach Tidelands, Fort Ebey State Park, and Ebey's Landing National Historic Reserve attract numerous recreation resource user groups. Most of the shoreline in this area is along high bluffs, which provide views across Admiralty Inlet. Fort Ebey State Park offers 46 campsites and 4 RV hookups, in addition to numerous hiking and biking trails. Ebey's Landing National Historic Reserve has a scenic trail along the shoreline and good opportunities for surf fishing and birdwatching. Just north of Keystone Harbor, Fort Casey State Park attracts many visitors with 35 campsites, hiking, over 1.5 miles of shoreline, and rich history. Fort Casey was built as a military defense during World War I and still retains a number of the batteries and weaponry from that era. As visitors enjoy ocean views, historical markers inform them of the fort's history.

Offshore Recreation Resources

Many recreation resources are found off the coast of the Fidalgo and Whidbey Islands area. Fishing is popular offshore in Deception Pass. Diving is a common pursuit in many areas, including offshore from Deception Pass, Saddle Island, and Washington Park. Sailing is prevalent in Rosario Strait and in Skagit and Padilla Bays. Paddling is a common pursuit in the calm sheltered waters around Padilla Bay, in Deception Pass, and in Skagit Bay. The numerous marinas in the area make north Fidalgo and Whidbey Islands a common waypoint for boats cruising Puget Sound and the San Juan Islands. Crabbing, fishing, and swimming are common activities in the area. Passengers on the ferries departing from Anacortes and Keystone Harbor sightsee and view wildlife in the waters along the ferry routes.

4.7.3.5 Southern Vancouver Island and the Gulf Islands

Location and Access

Vancouver Island forms the northern border of the Strait of Juan de Fuca; the Gulf Islands are located off the east shore of Vancouver Island, where they border the Georgia Strait. This section provides an overview of the offshore recreation resources around the Gulf Islands south of Galiano Island and the recreation resources surrounding Vancouver Island from Crofton to Point Renfrew at the mouth of the Strait of Juan de Fuca. The Gulf Islands in the study area include Galiano Island, Mayne Island, Satuna Island, Pender Island, and Saltspring Island. British Columbia's extensive ferry system is the major means of transportation to travel into the area and between islands. Ferry service to Vancouver Island is available from mainland British Columbia and from such U.S. cities as Port Angeles, Bellingham, Anacortes, Seattle, and Anacortes via the San Juan Islands.

Overview of Resources and Types of Use

The Gulf Islands and southern Vancouver Island provide many recreation opportunities. Because they are protected from storms from the Pacific Ocean, the climate in eastern Vancouver Island and the Gulf Islands is warmer and drier than in surrounding areas. The Gulf Islands are located close together, creating calmer waters and miles of shoreline ideal for boating and paddling. Abundant marine life in the area also provides quality opportunities for shellfish collecting, fishing, diving, wildlife viewing, and windsurfing.

Offshore Recreation Resources

The closely located islands and the protected coasts and inlets provide excellent boating opportunities for sailors, cruisers, and kayakers. The waters surrounding the Gulf Islands and southeastern Vancouver Island are preferred by sailors for their combination of gusty winds and calmer waters compared to unprotected shores. Cruising is another popular way to explore the region's rugged scenery. The numerous mooring sites, marinas, and sheltered coves in the area create good cruising conditions. The Gulf Islands are British Columbia's most frequented kayaking destination, with hundreds of miles of coastline to explore (Kimantas 2007). Kayakers value the Gulf Island's maze of sheltered waterways, dramatic landscape, and plentiful camping facilities. In addition, the publicity associated with the designation of 16 islands in the Gulf Island National Preserve may increase the resource use and recreation value of this area.

The marine resources in the Gulf Islands and south Vancouver Island also draw scuba divers. Just off the shore of Victoria, the Strait of Juan de Fuca and the Georgia Strait converge, creating an abundance of marine life. Ten Mile Point and Ogden Point are popular dive spots near Victoria. A number of popular dive sites are located near Sidney, British Columbia, where marine life is attracted by the artificial reefs created from numerous shipwrecks in the area.

The whale population also creates opportunities for wildlife viewing. Whale watching charters leave daily from Victoria and Sidney to search for orcas, grey whales, humpback whales, and other marine life. Fishery resources, including salmon, halibut, and other game fish, in the Straits of Georgia and Juan de Fuca attract offshore anglers to numerous fishing spots. Active Pass between Mayne and Galiano Islands is one popular place to fish salmon in calm waters as they feed on smaller fish. Chartered fishing boats can be arranged from Port Renfrew, Skoke, Victoria, and Sidney.

Windsurfing is an increasingly popular activity in the area. Just off the coast of Victoria is one of the most popular places for windsurfing, although the activity is common in a number of closer offshore areas.

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4.8 AIR QUALITY AND CLIMATE CHANGE

4.8.1 Air Quality

Washington State and federal law define criteria emissions to include the following: reactive or volatile organic compounds (ROCs or VOCs), nitrogen oxides (NO_X as NO and NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), respirable particulate matter (PM_{10}), and fine particulate matter ($PM_{2.5}$). Elimination of tetraethyl lead in motor gasoline has eliminated emissions of lead (Pb) from vehicles and portable equipment, although tetraethyl lead is still used in some types of aviation gasoline. Principal greenhouse gases (GHGs) include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and other fluorinated gases including nitrogen trifluoride and hydrofluorinated ethers.

The air quality study area encompasses five Washington counties: Whatcom, San Juan, Skagit, Snohomish, Island, Clallam, and Jefferson, as shown in Figure 4.8-1. Operation of marine vessels powered by diesel internal combustion engines emits criteria and toxic air pollutants in exhaust that can affect regional air quality. These emissions can cause deterioration of ambient air quality and can expose sensitive populations[26] to increased health risks, including cancer and respiratory diseases. GHG emissions can contribute to climate change. This section discusses the regulatory setting and existing conditions related to air quality and climate change in the study area. Section 6.8 addresses potential impacts on air quality and climate change associated with the Project.

4.8.2 Regulatory Setting

This section describes the regulatory framework for the study area and the standards that are used to determine whether implementation of the Project would result in adverse effects on air quality or climate.

4.8.2.1 Federal Regulations

The Clean Air Act (CAA), enacted in 1970 and amended several times thereafter (including the 1977 and 1990 Clean Air Act Amendments), establishes the framework for modern air pollution control. The CAA directs the EPA to establish national ambient air quality standards (NAAQS) for the six criteria pollutants listed in Table 4.8-1.

Regional attainment with the NAAQS is based on local ambient air monitoring data collected by the State and local air monitoring stations (SLAMS) network and reported to the EPA. If monitored pollutant concentrations meet federal standards over a designated period (3 years in most cases), the area is classified as being in attainment for that pollutant. If monitored pollutant concentrations violate the standards, the area is considered a nonattainment area for that pollutant. Regions previously designated as nonattainment areas that have since achieved attainment are designated as maintenance areas. For ozone standards, nonattainment and maintenance areas are further categorized into groups according to the increasing severity of the exceedance: marginal, moderate, serious, severe, and extreme. Likewise, for the CO standard, areas are grouped into moderate or serious nonattainment or maintenance areas,

[26] Certain population groups are considered more sensitive to air pollution and odors than others—in particular, children, the elderly, and acutely ill and chronically ill persons, and especially those with cardio respiratory diseases such as asthma and bronchitis. Sensitive receptors (land uses) include locations where such individuals are typically found, namely schools, daycare centers, hospitals, convalescent homes, residences of sensitive persons, and parks with active recreational uses such as youth sports. The EPA and several state- and county-level public health agencies provide guidance and definitions for sensitive receptors.

depending on the severity of the exceedance. If data are insufficient or inadequate to determine whether a pollutant is violating the standard, the area is designated as unclassified. The study area does not contain any nonattainment or maintenance areas (EPA 2013b).

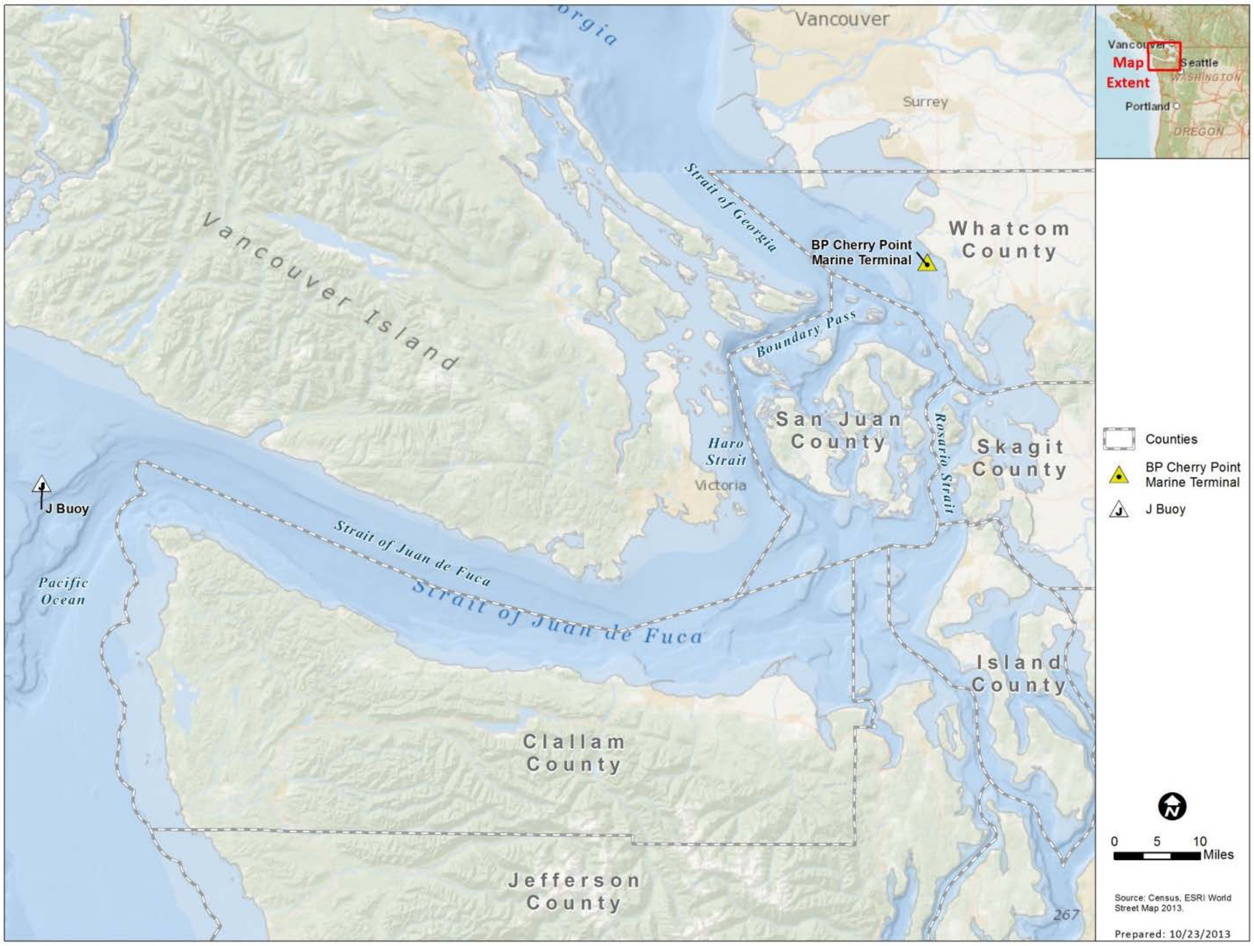

Figure 4.8-1 Map of Counties in the Study Area

Federal Conformity Requirements

Section 176[c] of the CAA stipulates that the federal government not engage, support, or provide financial assistance for licensing or permitting, or approve licenses or permits, for any activity not conforming to the appropriate State Implementation Plan (SIP). The General Conformity rule applies to federal actions in areas designated as nonattainment for one or more criteria pollutant, as applicable. It also ensures that federal actions will not interfere with strategies implemented to attain or maintain the NAAQS for any of the six criteria pollutants. Project-level conformance with the SIP is demonstrated through a General Conformity determination.

General Conformity does not apply to the Project because no county in the study area is designated as nonattainment or maintenance (EPA 2013b).

Table 4.8-1 National Ambient Air Quality Standards

Pollutant	Type[a]	Average Time	Concentration			Statistical Form
			ppmv	ppbv	µg/m³	
Ozone (O_3)	Primary and secondary	8-hour	0.075	75	147	Annual 4th-highest daily maximum 8-hour concentration averaged over 3 years
Nitrogen dioxide (NO_2)	Primary	1-hour	0.100	100	188	98th percentile averaged over 3 years
	Primary and secondary	Annual	0.053	53	100	Annual mean
Sulfur dioxide (SO_2)	Primary	1-hour	0.075	75	196	99th percentile of 1-hour daily maximum concentrations averaged over 3 years
	Secondary	3-hour	0.5	500	1,309	Not to be exceeded more than once per year
Carbon monoxide (CO)	Primary	1-hour	35	35,000	40,072	Not to be exceeded more than once per year
		8-hour	9	9,000	10,304	
Particulate matter (PM_{10})	Primary and secondary	24-hour	--	--	150	Not to be exceeded more than once per year on average over 3 years
Particulate matter ($PM_{2.5}$)	Primary and secondary	24-hour	--	--	35	98th percentile averaged over 3 years
	Primary	Annual	--	--	12	Annual mean averaged over 3 years
	Secondary	Annual	--	--	15	Annual mean averaged over 3 years
Lead	Primary and secondary	3-month rolling	--	--	0.15	Not to be exceeded at any time

Notes:

-- = no standard

ppmv = parts per million by volume (cc/m^3)

ppbv = parts per billion by volume ($cc/10^3\ m^3$)

µg/m³ = micrograms per cubic meter ($10^{-6}\ g/m^3$)

All national ambient air quality standards generally correspond to an Air Quality Index (AQI) of 100.

For gases, equivalent µg/m³ calculated from ppmv based on molecular weight and standard conditions:

- Standard ambient temperature: 25 °C
- Standard barometric pressure: 760 mm Hg
- Standard molar volume: 24.465 liters/g-mole

[a] *Primary standards* refer to limits set to protect public health, including the health of sensitive populations, such as asthmatics, children, and the elderly. *Secondary standards* refer to limits to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

Source: EPA 2012a.

Emission Standards for New Marine Category 3 Diesel Engines

On April 30, 2010, EPA published a final rule in the Federal Register (75 CFR 22896) that established emission standards for new marine diesel engines with per-cylinder displacement at or above 30 liters (known as *Category 3 marine diesel engines*) installed on large ocean-going U.S. vessels, such as tankers and barges. The final rule requires reductions in NO_X emissions and adopts standards for emissions of hydrocarbons and CO from new Category 3 marine diesel engines. In addition, it restricts the production and sale of marine diesel fuel oil above 1,000 parts per million (ppm) sulfur for use in most U.S. waters (EPA 2009), in order to limit emissions of SO_2 upwind of affected airsheds. The vessels calling at the BP Cherry Point dock use Category 3 marine diesel engines.

4.8.2.2 State Regulations

Under the CAA, states can adopt ambient air quality standards that are as stringent as or more stringent than the NAAQS. In Washington State, Ecology has adopted additional, more restrictive criteria based on the EPA requirements as set forth in the Washington Ambient Air Quality Standards (WAAQS). The counties of Whatcom, Skagit, and Island that also are regulated by the Northwest Clean Air Agency have additional local restrictions (Ecology 2011b; Northwest Clean Air Agency 2011). The additional or different standards relate to the level of ozone, PM_{10}, NO_2, SO_2, and total suspended particulate matter (TSP) emissions. These standards are shown in Table 4.8-2. No counties in the study area are designated as nonattainment for the WAAQS (Ecology 2011b).

4.8.2.3 Regulations for Greenhouse Gas Emissions

Neither the federal government nor Washington State has established quantitative thresholds for assessing the relative contribution of GHG emissions to climate change. However, the EPA has issued a Final Mandatory Reporting of Greenhouse Gases Rule that requires reporting of GHG emissions from large stationary sources. Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHGs are required to submit annual reports to the EPA—although no other action is required (40 CFR Parts 86, 87, 89 et al. Final Rule October 30, 2009). In addition, Ecology has developed a regulation aimed at reducing statewide GHG emissions to 1990 levels by 2020 (Ecology 2013e; RCW 70.235.020). To achieve this goal, facilities that produce over 10,000 metric tons of GHGs annually and suppliers of liquid motor fuel must report their emissions (RCW 70.94.151). *GHGs* as defined by RCW 70.235.010 include CO, NH_4, N_2O, HFCs, PFCs, SF_6, and any other gas or gases designated by the department by rule.

The BP Cherry Point Refinery is subject to both of these regulations. However, the GHG emissions associated with the Project would be generated by mobile sources (see Section 6.8), which are exempt from these reporting requirements.

Table 4.8-2 Ambient Air Quality Standards in Washington State

Pollutant	Averaging Period	National Standards		Washington State Standards	Details
		Primary	Secondary		
Ozone	8-hour	0.075 ppm	0.075 ppm	--	The 3-year average of the annual 4th highest daily 8-hour maximum is not to be above this level
	1-hour (daily maximum)	--	--	0.12 ppm (235 mg/m^3)	Not to be above this level on more than 1 day in a calendar year
Particulate matter (as $pm_{2.5}$)	Annual (arithmetic mean)	12.0 µg/m^3	15.0 µg/m^3	--	The 3-year average from a community-oriented monitor is not to be above this level
	24-hour	35 µg/m^3	35 µg/m^3	--	The 3-year average of the annual 98th percentile for each population-oriented monitor within an area is not to be above this level
Particulate matter (as pm_{10})	Annual (arithmetic mean)	--	--	50 µg/m^3	The 3-year average of annual arithmetic mean concentrations at each monitor within an area is not to be above this level
	24-hour	150 µg/m^3	150 µg/m^3	150 µg/m^3	Not to be above this level on more than three days over 3 years with daily sampling
Carbon monoxide	8-hour	9 ppm (10 mg/m^3)	--	9 ppm (10 mg/m^3)	Not to be above this level more than once in a calendar year
	1-hour	35 ppm (40 mg/m^3)	--	35 ppm (40 mg/m^3)	Not to be above this level more than once in a calendar year
Nitrogen dioxide	Annual (arithmetic mean)	0.053 ppm (100 µg/m^3)	0.053 ppm (100 µg/m^3)	0.05 ppm (100 µg/m^3)	Not to be above this level in a calendar year
	1-hour	0.100 ppm	--	--	The 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor is not to be above this level
Sulfur dioxide	Annual (arithmetic mean)	--	--	0.02 ppm	Not to be above this level in a calendar year
	24-hour	--	--	0.10 ppm	Not to be above this level more than once in a calendar year
	3-hour	--	0.5 ppm (1300 µg/m^3)	--	Not to be above this level more than once in a calendar year
	1-hour	--	--	0.40 ppm	Not to be above this level more than once in a calendar year
	1-hour	--	--	0.25 ppm	Not to be above this level more than twice in a consecutive 7-day period
	1-hour	75 ppb	--	--	The 3-year average of the annual 99th percentile of daily maximum 1-hour averages is not to be above this level
	5-minute	--	--	0.80 ppm	This is the Northwest Clean Air Agency's standard, which applies in Island, Skagit, and Whatcom Counties.

Table 4.8-2 Ambient Air Quality Standards in Washington State (Continued)

Pollutant	Averaging Period	National Standards		Washington State Standards	Details
		Primary	Secondary		
Lead	Rolling 3-month average	0.15 µg/m^3	0.15 µg/m^3	--	Not to be above this level
Total suspended particulate emissions	Annual (geometric mean)	--	--	60 µg/m^3	Not to be above this level
	24-hour	--	--	150 µg/m^3	Not to be above this level more than once in a calendar year

Notes:

-- = no standard

mg/m^3 = milligrams per cubic meter

µg/m^3 = micrograms per cubic meter

ppm = parts per million

Modifications to the national ambient air quality standards (NAAQS) have occurred since the Washington Department of Ecology (2011b) developed the table comparing the NAAQS and the Washington ambient air quality standards. The current NAAQS have been incorporated into Tables 4.8-1 and 4.8-2 of this environmental impact statement.

Sources: Ecology 2011c; EPA 2012a.

4.8.3 Climate

The Project area has a maritime climate, with average air temperatures in January ranging from 39 to 43 °F (4 to 6 °C), and average temperatures in July ranging from 54 to 64 °F (12 to 18 °C). Precipitation levels vary across the Straits of Georgia and Juan de Fuca. The southern portion of the Strait of Georgia receives approximately 24 inches (61 centimeters) of precipitation per year, and higher amounts of precipitation occur in Juan de Fuca to the north. The Project area is generally not subject to sea ice and maintains a fairly constant water temperature. The wind predominantly flows from the southeast in winter and the northwest in summer (Davenne and Masson 2001).

4.8.4 Sources of Air Pollutants in the Study Area

4.8.4.1 Vessel Traffic in the Project Area

Vessel traffic occurs within the Strait of Juan de Fuca and the San Juan Archipelago. The types of vessels travelling in the Project area and their associated emissions are described below.

An average-sized crude oil vessel that can carry approximately 500,000 barrels would have a capacity of 60,000–80,000 dwt. The average sized ocean-going, double-hulled, liquid bulk vessel falls into the "Panamax" size class. These ships would be able to handle both crude oil and refined petroleum products based on their dead weight tonnage and maneuverability. The "Handysize" class of tankers is somewhat smaller than the Panamax, with a dead weight tonnage of 10,000–30,000 dwt. Handysize tankers can carry a maximum load of approximately 195,000 barrels. (Maritime Connecter 2013). The largest tankers likely to traverse the study area are "Aframax" tankers, with the capacity to carry up to 879,600 barrels of crude oil (Georgia Strait Alliance n.d.).

Ocean-going vessels have two types of engines: main engines and auxiliary engines. The main engine is a very large diesel engine used to propel the vessel at sea. It is engaged during transit and maneuvering. Auxiliary engines provide power for uses other than propulsion. Typical ocean-going vessels have a single, large, main engine and several smaller auxiliary engines that drive electric generators. The California Environmental Protection Agency Air Resources Board (ARB 2008) developed an estimate for emissions of various types of ocean-going vessels frequenting California ports. Characteristics of the "average tanker" are described in Table 4.8-3.

Table 4.8-3 Average Tanker Engine Output Characteristics

Vessel Type	Speed (knots)	Main Power (kW)	Auxiliary Power (kW)	Boiler Power (kW)
Tanker	15	13,030	2,340	1,590

Note: To convert power from kilowatts (kW) to brake horsepower (BHP), multiply kW by 1.341.

Source: ARB 2008 (Appendix D. Table II-4).

Each engine contributes a different portion of energy during different activities. At cruise speed, the main engine load is typically around 80 percent. Because fuel consumption and engine maintenance costs go up dramatically at higher engine loads, vessel operators tend to operate at this level (ARB 2008). The auxiliary engine load accounts for the remaining 20 percent during transit. The load percentages shift during maneuvering; with an approximate main engine load of 67 percent and auxiliary engine load of 33 percent (ARB 2008).

A Vessel Emissions Calculator was developed by Marine Environmental Associates (2013). Emission factors for ocean-going vessels vary by operating mode (transit, maneuvering, or hotelling[27]), engine type (main engine/slow speed, main engine/medium speed, or auxiliary/medium speed), and fuel type (heavy fuel oil [HFO] or marine distillate [properties similar to diesel #2]). The average tanker engine characteristics and the percent load during transit were used to calculate the total emissions per vessel during a single, one-way trip within the Project area to the BP Cherry Point dock. There are 112 nmi between BP Cherry Point (Blaine, Washington) and the westernmost entrance to the Strait of Juan de Fuca at Cape Flattery (USDC et al. 2012). A medium-speed diesel (HFO) main engine and a slow-speed diesel (HFO) auxiliary engine were assumed when calculating emissions. Outputs (tons per year) were calculated for CO_2, CO, NOx, SOx, PM, and hydrocarbons **(**HC) (Table 4.8-4). A single model was used to estimate emissions from either a crude oil tanker or a refined petroleum product tanker due to the similar size of these vessels. It should be noted that these are general estimates; actual emission rates would depend on a wide array of factors, including cargo weight, travel speed, and sea and weather conditions.

4.8.4.2 Other Sources of Air Pollutants in the Project Area

Other sources of air emissions in the study area include mainly marine diesel engines used in the following types of vessels: crude oil tankers, refined petroleum product tankers and barges, bulk carriers, chemical carriers, container vessels, vehicle carriers, military vessels, ferries, fishing vessels, yacht regattas, whale watching vessels, and small recreational vessels. Large ships, such as tankers and many of the other types of vessels listed above, use Category 3 marine diesel engines. Category 3 engines burn marine diesel fuel with relatively high sulfur content compared to highway diesel. These engines are therefore large mobile sources of air pollution that generate a substantial amount of NO_X, SO_2, and $PM_{2.5}$, in addition to other types of air pollutants (EPA 2010). EPA's emission standards for Category 3 marine diesel engines (75 CFR 22896) are expected to gradually reduce NO_X, CO, and HC emissions from large

27 *Hotelling* refers to when a ship is securely moored or anchored in a port and is not loading or unloading cargo.

ocean-going vessels traveling within the Project area while restrictions on fuel sulfur content will reduce SO_2 emissions (thereby effectively reducing $PM_{2.5}$ as well).

As shown in Table 4.8-4, per the 2005 statewide criteria emissions inventory and 1990-2010 statewide GHG emissions inventory developed by Ecology (2008, 2013a), ocean-going ships account for about 3,637,590 tons of CO_2 emissions (as GHG), 2,633 tons of CO emissions, 29,142 tons of NO_X emissions, 15,774 tons of SOX emissions, 1,682 tons of PM emissions, and 833 tons of hydrocarbon (as VOC) emissions annually off the coast of Washington, much of it within the Strait of Juan de Fuca and the San Juan Archipelago. For the maximum future total of 420 vessel calls per year, the estimated contribution of emissions for the marine vessel (ships) category would be about 0.7 percent for CO_2, 1.6 percent for CO, 1.8 percent for NO_X , 2.6 percent for SO_X, 3.4 percent for PM, and 2.4 percent for hydrocarbons. According to EPA (2013b), these fractions are within the range of uncertainty for fossil fuel combustion, which is about 6 percent.

Table 4.8-4 Estimated Emissions from Vessels in the Study Area

Transit Event	CO_2 tons/yr	CO tons/yr	NO_x tons/yr	SO_x tons/yr	PM tons/yr	HC tons/yr
Emissions per vessel one-way trip, (7.46 hr)[a]	61	0.10	1.26	0.99	0.13	0.05
Minimum South Wing (149 vessels)	9,040	14.7	187	148	20.0	7.1
Minimum North Wing (138 vessels)	8,370	13.6	173	137	18.5	6.6
Minimum total (287 vessels)	17,410	28.3	361	285	38.5	13.7
Maximum South Wing (210 vessels)	12,740	20.7	264	209	28.2	10.0
Maximum North Wing (206)	12,500	20.3	259	205	27.7	9.8
Maximum total (416 vessels)	25,240	41.0	523	414	55.9	19.8
Maximum future total (420 vessels)	25,480	41.4	528	418	56.4	20.0
2005 state emissions inventory, ships[b]	3,637,590	2,633	29,142	15,774	1,682	833
Maximum future percent of inventory, ships	0.7%	1.6%	1.8%	2.6%	3.4%	2.4%

Notes:

CO = carbon monoxide
CO_2 = carbon dioxide
HC = hydrocarbons
NO_x = oxides of nitrogen
PM = particulate matter
SO_x = oxides of sulfur

The model estimates emissions from a single transit by a typical vessel traveling 112 nautical miles; yearly emissions are based on the number of vessels calling at the South Wing, the North Wing, and the combined totals for both wings. A single model was used to estimate emissions from either a crude oil tanker or a refined petroleum product tanker due to the similar size of these vessels.

[a] These are general estimates. Actual emissions are affected by a wide array of factors, including sea and weather conditions, speed, and cargo weight.

[b] Source: Ecology 2008, 2013a.

Source: Marine Environmental Associates 2013.

Tanker ships in berth use their engines to provide electric power for the crude oil pumps and other requirements while the ship is securely moored—known as its *hotelling* load. Because the fuels burned in ship engines contain a high sulfur content, tankers contribute substantial SO_2 emissions to the overall refinery emissions profile. The BP Cherry Point Refinery is engaged with other Northwest stakeholders in establishing effective strategies to reduce marine ship emissions, such as providing shore power during berthing (BP 2011).

Within the study area for air quality, the BP Cherry Point Refinery releases the criteria pollutants SO_2, CO, $PM_{2.5}$ and PM_{10}, in addition to CO_2 and the precursors to ozone (NO_X and VOC). At the BP Cherry Point Refinery, SO_2 results mainly from combustion of fuels that contain sulfur; NO_X emissions are generated from boilers and heaters, calciners, crude tankers, and flares (BP 2011). VOC comes from storage tanks, process equipment, pumps, compressors, and piping components, including valves and flanges, process wastewater transportation and treatment systems (BP 2011). A number of improvements have recently occurred at the BP Cherry Point Refinery to reduce SO_2 and NO_X emissions, such as installation of high-performance, low-NO_x burners and rerouting sulfur-containing gases to a SO_2 scrubber system.

4.8.4.3 Other Sources of Air Pollutants in the Study Area

Other sources of air pollutant emissions exist outside of the Project area but within the study area for air quality. The main sources of air pollution in the State of Washington are motor vehicles, wood smoke, and outdoor burning (Ecology 2013c). Emissions from motor vehicles contribute to ground level ozone (photochemical smog), especially on hot summer days. Woodstoves and fireplaces are a source of wintertime smoke (PM_{10} and $PM_{2.5}$) levels. Outdoor burning is illegal within any Urban Growth Area (UGA) designated under Washington's Growth Management Act.[28] A number of UGAs are designated within the study area, such as Bellingham, Cherry Point, Lopez, Burlington, Port Townsend, Port Angeles, and Sequim (Ecology 2012c).

Other major sources of air pollution are associated with domestic activities such as gas-powered lawn mowers, paints, solvents, aerosol products like hairspray and air fresheners, and charcoal barbeques. Forest fires also contribute smoke in the State of Washington. Air-based mobile sources include aircraft departing from and arriving at Bellingham International Airport and numerous regional, municipal, field, and seaplane base airports in the study area. Air emissions from turbine aircraft engines are primarily CO_2 and water, with a small percentage of emissions comprised of PM, VOCs, SO_2, CO, NO_X, and hazardous (toxic) air pollutants (Federal Aviation Administration 2005).

4.8.5 Greenhouse Gas Emissions

The American Meteorological Society (2012) refers to *climate change* as any systematic change in the long-term statistics of climate elements (such as temperature, pressure, or winds) sustained over several decades or longer. The Society also indicates that climate change may be due to natural external forcings, such as changes in solar emissions or slow changes in the Earth's orbital elements; natural internal processes of the climate system; or anthropogenic forcing. The climate system can be influenced by changes in the concentration of various GHGs in the atmosphere that affect the Earth's absorption of radiation (EPA 2013c).

The principal GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), and water vapor. Also included are man-made fluorinated gases—hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Because CO_2 is the reference gas for climate change, measures of non-CO_2 GHGs are converted into CO_2-equivalent (CO_2-e) values based on their potential to absorb and trap heat in the atmosphere, referred to as their *global warming potential* (EPA 2012). GHGs occur naturally because of volcanoes, forest fires, and biological processes such as enteric

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[28] The Washington Growth Management Act (RCW 36.70A) was adopted in 1990 to prevent threats to the environment, economic development, and the quality of life from uncoordinated and unplanned growth.

fermentation (the digestive process for carbohydrates) and aerobic decomposition (decomposition of organic material with oxygen). They are also produced by burning fossil fuels in power plants and automobiles and from industrial processes, agricultural operations, waste management, and land use changes such as loss of farmland to urbanization.

Nationally, fossil fuel combustion contributed the largest source of both CO_2 and overall GHG emissions in 2011 (EPA 2013c). By sector, the largest contributor to GHG emissions on a national scale is the electric power sector, while the transportation sector is the most significant contributor to GHG emissions within the State of Washington (Ecology 2013d). Table 4.8-5 shows aggregated gross U.S. and State of Washington CO_2-e emissions for all sources. As indicated, the State of Washington accounted for approximately 1.4 percent of CO_2-e emissions in the United States in 2010. In 2011, the BP Cherry Point Refinery emitted 2.43 million metric tons of CO_2e in 2011 (EPA 2013c), or approximately 2.5 percent of the state total.

Table 4.8-5 Total Estimated State and National Gross Greenhouse Gas Emissions

Summary Year	State of Washington (million metric tonnes of CO_2-e)	United States (million metric tonnes of CO_2-e)
1990	88	6,183
2005	95	7,195
2010	96	6,810

Notes:

1 metric tonne = 1,000 kilograms or 2,204.6 pounds (1.1023 short tons)

Values are rounded to the nearest whole number (integer).

Sources: EPA 2013b; Ecology 2013d.

4.9 TRIBAL/SUBSISTENCE FISHING

Tribal/subsistence fishing refers to fishing, other than sport fishing, that is carried out for commercial economic purposes, family subsistence, and traditional/ceremonial purposes. In addition to commercial fishing techniques, traditional fishing techniques often are used, such as rod and tackle, arrows and harpoons, throw nets and drag nets, and traditional fishing boats. In Washington State, subsistence fishing is carried out by Indian tribes; shellfish, fish, and crabs are important to the livelihood and culture of Native Americans living on the Olympic Peninsula of Washington (ORHAB Partnership 2011).

The study area for the tribal/subsistence fishing analysis is the same as the Project area, as shown in Figure 4.9-1. Figure 4.9-1 also shows the tribal lands of member tribes of the Northwest Indians Fisheries Commission and those tribes with traditional fishing areas that could be affected by the Project.

4.9.1 Regulatory Context

Federal and state laws regulate subsistence fishing in Washington State, including the Stevens-Palmer Treaties. The U.S. government recognizes 25 Indian tribes as parties to the Stevens-Palmer Treaties, and 24 tribes have usual and accustomed fishing places within the boundaries of the present-day state of Washington (Woods 2005).

Indian tribes in Washington State who signed treaties with the United States in the mid-1850s retained the right to “fish” at all “usual and accustomed grounds and stations” (U&As). These areas were traditionally harvested before the treaty. The U&As refer to fishing activities and are not applicable to hunting and gathering activities on terrestrial areas, which are governed by other portions of the treaty. The U&As include the shoreline areas involved in the fishing activities, as well as access to the water across uplands. Tribal members are allowed to exercise their treaty-protected harvest rights only within their tribe’s U&A and only with permission of their tribe. (Lummi Nation 2012).

Indian tribes work with other fisheries management organizations to ensure the continued harvest of some species. The Northwest Indians Fisheries Commission (NWIFC) is an organization that represents the treaty tribes of northwest Washington with regard to aboriginal subsistence and commercial fishing. The NWIFC works alongside sovereign tribal governments, under the guidelines put forth by the WDFW, to help ensure that proper rules and regulations are enacted to promote sustainable fishing (NWIFC 2011a). Figure 4.9-1 shows the location of member tribes in the NWIFC.

The Fishery Management and Planning Division of the NWIFC provides technical assistance and coordination to tribes in development and implementation of annual and long-range fishery plans (NWIFC 2011a). Tribes work with the PFMC (which regulates fishing of ground fish such as black cod and tuna off the coasts of California, Oregon, and Washington) and with the International Pacific Halibut Commission (which regulates harvest amounts for halibut). For salmon, tribes must adhere to the U.S./Canada Pacific Salmon Treaty (which regulates fisheries on salmon stocks shared by the two countries). For crab, a state and tribal management process is handled annually by agreement. Shellfish often are found in the U&As, such as along the coastline of Olympic National Park. Northwest Indian tribes who signed treaties with the U.S. government reserve the right to continue fishing at all U&As (Sepez-Aradanas 2002).

Figure 4.9-1 Member Tribes of the Northwest Indians Fisheries Commission

Source: NWIFC 2011a.

4.9.2 Tribal/Subsistence Fishing Activities

The variety and abundance of saltwater fish and shellfish provide excellent harvesting opportunities throughout northern Puget Sound. Subsistence fishing species include numerous salmon species (Chinook, coho, chum, pink, and sockeye), halibut, other species of bottomfish (rockfish, lingcod, cabezon, and perch), steelhead trout, crabs, oysters, clams, and small fish species typically caught for bait (herring, smelt, anchovies, sardines, and sand lance) (NWIFC 2013; Dither 2006). The study area nearshore environment also provides habitat to numerous species of shellfish that are gathered for consumption.

The Cherry Point Aquatic Reserve located on the western shores of Whatcom County supports a high diversity of fish and wildlife, including Cherry Point herring and other forage fish, marine and shore birds, and migratory waterfowl; ESA-listed salmon; Dungeness crab; groundfish; and bivalves and marine invertebrates. The marine waters and aquatic lands of the Cherry Point Aquatic Reserve are a portion of treaty-protected U&As of local Native American Indians and are used by the Indians for commercial, ceremonial, and subsistence purposes. The Cherry Point Aquatic Reserve supports a large tribal ceremonial and subsistence Dungeness crab fishery (WSDNR 2010).

4.9.3 Indian Tribe Fishing Activities

Each tribe in the Project area manages their own fisheries for salmon, other fin-fish, and shellfish within guidelines developed jointly with the WDFW. Each tribe fishes only in those marine and freshwater areas that have been legally defined by the court as their U&A (NWIFC 2013).

4.9.3.1 Salmon

Salmon is an important resource to many tribes in the Northwest—primarily Chinook, coho, chum, pink, sockeye, and steelhead salmon. The tribes use troll, gillnet, and seine gear to catch salmon, as described below (NWIFC 2013).

- Troll vessels operate in marine areas and drag baited hooks or lures at the depth of the target species.
- Drift gillnets[29] up to several hundred feet long are fished in open marine waters and at the mouths of large rivers, using a hydraulic drum aboard a 25- to 350-foot vessel.
- Shorter set gillnets are fished along the shore or in rivers from a small skiff. Purse seines[30] are fished in marine areas and require a larger vessel and usually a power skiff to deploy and retrieve.
- Beach seines, usually from 150 to 300 feet long, are deployed from shore and retrieved by hand.
- Tribal fishers also use hook and line and dipnets to harvest fish for subsistence and ceremonial purposes.

Table 4.9-1 provides information on salmon harvest in the area.

4.9.3.2 Shellfish

Shellfish have been a mainstay of northwestern Washington Indian tribes for thousands of years and remain important today for economic, subsistence, and ceremonial purposes (NWIFC 2011b). The primary shellfish resources in Puget Sound are crabs (Dungeness and red rock crabs), oysters (introduced Pacific oysters and native Olympia oysters), and clams (littleneck, butter, horse, and introduced Manila and soft-shell clams) (Dither 2006).

The tribes have two distinct types of shellfish harvests—commercial and ceremonial/subsistence. Shellfish harvested during a commercial fishery are sold to licensed shellfish buyers, who sell shellfish directly to the public or to other commercial entities. Tribes collect taxes from tribal members who sell shellfish. Those taxes are used to help pay for tribal natural resource programs. Ceremonial and subsistence harvests of shellfish, which have a central role in tribal gatherings and daily nutrition, are intended for tribal use only (NWIFC 2013). Degraded water quality and increased harvest pressure have substantially reduced shellfish resources available to Pacific Northwest tribes, which has led to creation of aquaculture facilities to farm shellfish on some tribal lands (NWIFC 2011b). In addition to these facilities, some tribes place floating bivalve pens to rear shellfish in the natural marine environment.

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29 *Gill nets* are vertical panels of netting usually set in a straight line. Targetted fish species are entangled in the net. Salmon fisheries in particular use gill netting because of their low incidence of catching non-target species.

30 A *seine* is a fishing net that hangs vertically in the water, with floats at the top and weights at the bottom. A *purse seine* is so called because the seine is drawn into the shape of a bag to enclose the catch; this type of fishing is done from a boat. A *beach seine* is fastened to the shore at one end, circled about a school of fish, and then drawn ashore.

Table 4.9-1 Salmon Harvest in Northwest Waters

Salmon Species	Fishing Method		
	Troll Vessels	**Gillnets**	**Seines**
Chinook	Coastal ocean waters and in the Strait of Juan de Fuca, primarily May through September; on a smaller scale, during winter months in the Strait.	Occurs in the vicinity of the Cherry Point and freshwater areas, targeting hatchery returns to Bellingham Bay, Tulalip Bay, and to the Green, Puyallup, Nisqually, and Skokomish Rivers.	None recorded
Coho	During summer in coastal ocean areas and the Strait of Juan de Fuca.	Occurs throughout Puget Sound, primarily in September and October; targeting returns to regions of origin: Nooksack, Samish, Skagit, Stillaguamish, Snohomish, South Sound, Hood Canal, and the Strait of Juan de Fuca.	None recorded
Chum	None recorded	Occurs in October and November throughout Puget Sound, targeting healthy wild stocks in some areas and hatchery returns in others.	None recorded
Pink	None recorded	Net fisheries are recently limited to healthy stocks in the Skagit and Snohomish Rivers.	Directed at pink salmon returning in odd years to the Fraser River.
Sockeye	None recorded	Targets Fraser River sockeye in July and August in the Strait of Juan de Fuca and Rosario/Georgia Straits.	Targets Fraser River sockeye in July and August in the Strait of Juan de Fuca and Rosario/Georgia Straits.
Steelhead	None recorded	None recorded	Tribal harvest in Puget Sound is limited to nominal subsistence and ceremonial harvest.

Source: NWIFC 2013.

4.9.4 Indian Tribes in the Project Area

Indian tribes with coastal U&A in the study area include the Makah Nation, the Lower Elwha Klallam Tribe, the Lummi Nation, and the Nooksack Indian Tribe (Figure 4.9-1).

4.9.4.1 Makah Nation

The Makah Nation has approximately 2,356 enrolled members, with approximately 1,752 living on or near the Makah Reservation; the reservation consists of approximately 31,355 acres of land (Northwest Portland Area Indian Health Board 2013) in and around the town of Neah Bay on the most northwestern tip of the continental United States (Figure 4.9-1). The Makah Nation U&A comprises an additional 300,000 acres, extending east to the Hoko River and south to South Creek, at the south end of Lake Ozette. A large harbor is protected by a breakwater at Neah Bay on the Strait of Juan de Fuca. Makah tribal members derive most of their income from fishing salmon, halibut, Pacific whiting, and other marine fish. Fishing has always been an important part of the livelihood of the Makah people, but by the late 1960s, salmon and steelhead had almost disappeared from tribal lands (USFWS 2013). In the early 1970s, representatives of the Makah Nation asked the U.S. Congress for help in replenishing the diminished salmon runs. Consequently, Congress authorized construction of the Makah National Fish Hatchery, located 1 mile inland from the Pacific Coast. The USFWS works in conjunction with state and tribal fisheries biologists at the Makah National Fish Hatchery to rebuild salmon and steelhead runs along the north Washington coast.

4.9.4.2 Lower Elwha Klallam Tribe

The Lower Elwha Klallam Tribe resides in a small area in the Lower Elwha River Valley and adjacent bluffs, on the north coast of the Olympic Peninsula just west of Port Angeles, Washington (Figure 4.9-1). There are approximately 638 enrolled members, with 1,149 Native Americans living on or near the reservation (Northwest Portland Area Indian Health Board 2013). Principal industries for the Lower Elwha Klallam Tribe are wood products, agriculture, and tourism. Fishing has always been a major source of food for the tribe and includes salmon, steelhead, halibut, ling cod, flounder, herring, smelts, candlefish, and horse clams (Lower Elwha Klallam Tribe 2013). While some fish are caught in marine waters, much of the Lower Elwha Klallam Tribe fishing has occurred on the lower reaches of the Elwha River. To help supplement the fish in the few miles of river below the Elwha Dam, the tribe built the Elwha Fish Hatchery in 1975. In May 2011, this was replaced by the Lower Elwha Klallam Tribe Fish Hatchery (NPS 2013), which is located approximately 1 mile inland from the Pacific Coast. The facility produces chum, coho, and pink salmon and steelhead. Dams on the Elwha River are currently being removed with the objective of restoring native salmon runs to the full reach of this river.

4.9.4.3 Lummi Nation

The Lummi Nation is the largest fishing tribe in Puget Sound. Of the more than 5,000 enrolled tribal members (Lummi Nation 2012a), nearly 2,650 members live on the reservation. The marine portion of the Lummi Nation Reservation encompasses approximately 13,000 acres of tidelands (Lummi Nation 2012a). Figure 4.9-1 shows the location of the Lummi Nation Reservation.

During the 1980s, approximately 30 percent of the tribal work force relied on fishing for their sole source of income. Since 1993, reductions in salmon stocks have resulted in closure of some fisheries and a further reduction in tribal fishery incomes (Lummi Nation 2012b). A salmon fish hatchery and shellfish hatchery are in Lummi Bay, and a fish hatchery is located at Sandy Point on the Strait of Georgia. The Lummi Nation participates in river restoration activities in the Nooksack River (Lummi Nation 2012a).

Eelgrass beds occur along many of the marine shorelines of the Lummi Nation Reservation. These are an important migratory corridor for juvenile salmon originating in the Nooksack watershed and support the Dungeness crab fisheries in nearby water. Suitable substrate for surf smelt and sand lance spawning has been documented along several of the reservation shorelines, including along Bellingham Bay, Hale Passage, and Georgia Strait.

Lummi tribal members harvest Manila clams for ceremonial, subsistence, and commercial purposes. Manila clams are an important economic resource to many tribal members, particularly for members who do not own or have access to a boat. Significant quantities of Manila clams are harvested from intertidal reservation beaches and from a Seapond Aquaculture Facility in Lummi Bay. Various portions of the reservation tidelands contain harvestable volumes of Pacific oysters, purple varnish clams, horse clams, butter clams, native littleneck clams, and cockles. Shellfish harvest is concentrated in Birch, Portage, and Lummi Bays (Lummi Nation 2012a).

4.9.4.4 Nooksack Indian Tribe

The Nooksack Indian Tribe reservation is located approximately 17 miles east of Bellingham, centered at the small town of Deming that is outside of the study area (Figure 4.9-1). The tribe is composed of approximately 2,000 members, on a 2,500-acre reservation that includes 65 acres of trust land (Nooksack Indian Tribe 2013). Their fishing grounds extended from the present Bellingham Bay to British Columbia. Historically, the Nooksack people relied on fishing, hunting, clam digging, root gathering, and trading with neighboring villages (Northwest Portland Area Indian Health Board 2013). Salmon are an important resource to the Nooksack Tribe, who are actively engaged in preservation and restoration of salmon habitat in the south fork of the Nooksack River.

4.10 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

The study area for socioeconomics and environmental justice is the six counties bordering the shorelines of the Project area: Clallam, Island, Jefferson, San Juan, Skagit, and Whatcom Counties (Figure 4.10-1). This section discusses population, housing, employment, income, taxes, the marine and shoreline economy, and minority and low-income populations.

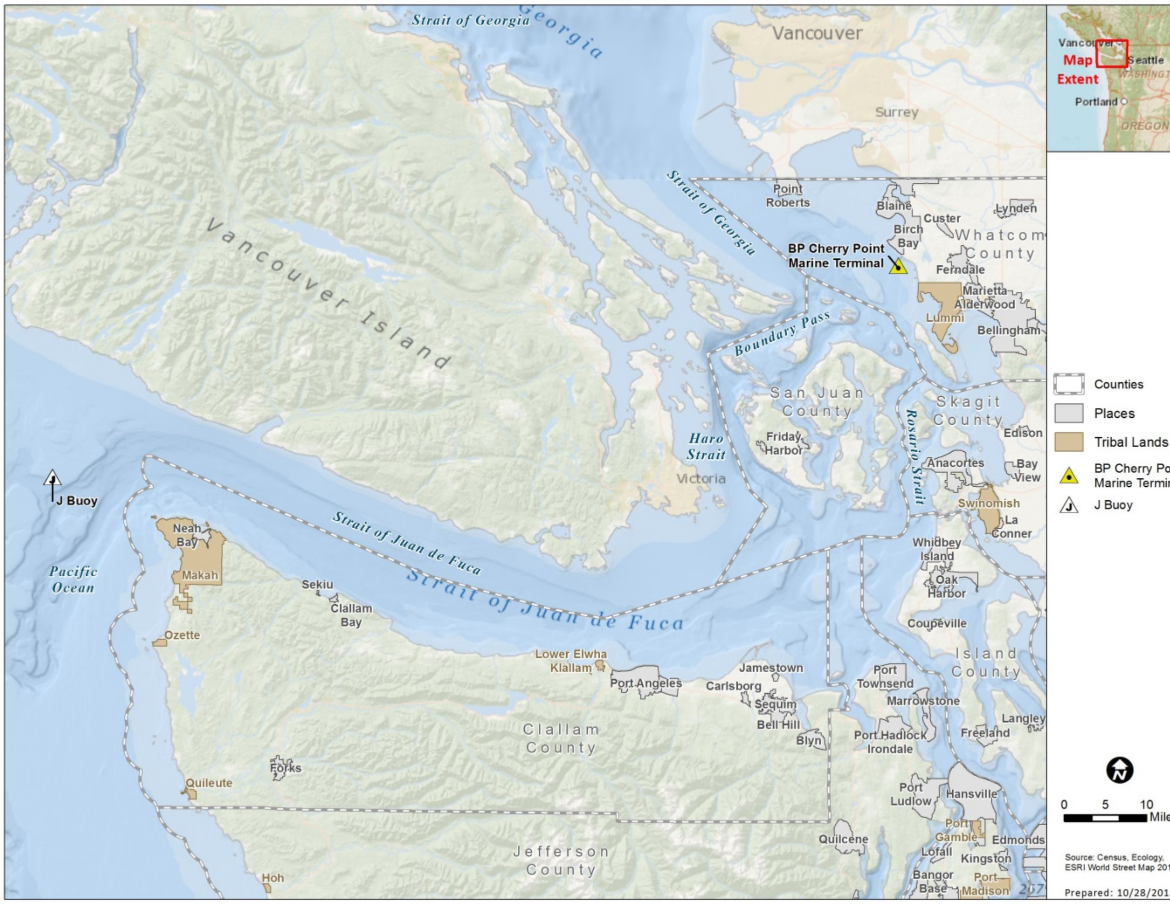

Figure 4.10-1 Study Area for Socioeconomics and Environmental Justice

4.10.1 Population

Population characteristics for each county in the study area, the study area as a whole, and the State of Washington are presented in Table 4.10-1. With an average of 67 people per square mile, the study area has a lower population density than the state average of 101 people per square mile. Island County, which is only 208 square miles and includes the towns of Oak Harbor and Coupeville, is the only county in the study area with a population density (377 people per square mile) that exceeds the state average (WOFM 2013; U.S. Census Bureau 2013a).

The 2010 total population in the study area was 513,592, or 7.6 percent of the 2010 Washington State population. The estimated 2010 population of the primary shoreline communities (those that are incorporated as cities or towns) in the study area is approximately 157,500, or approximately 30 percent of the study area population. The 2010 county populations ranged from 15,769 in San Juan County to 201,140 in Whatcom County. Between 2000 and 2010, the study area population grew at a slightly higher rate (15.2 percent) than the total state population (14.1 percent). Whatcom County had the highest rate of population growth from 2000 to 2010, with an increase of 20.6 percent. Island County had the lowest rate of population growth during this period, with an increase of 9.7 percent.

The fastest-growing shoreline incorporated community in the study area was Sequim in Clallam County, with a growth rate of over 52 percent.

Table 4.10-1 Population Characteristics in the Study Area and State (2000 and 2010)

Area	Year 2000 Population (number of people)	Year 2010 Population (number of people)	Percent Change from Years 2000 to 2010	Year 2010 Population per Square Mile (number of people)
Clallam County	64,525	71,404	10.7	41
Port Angeles	18,397	19,038	3.5	1,780
Sequim	4,334	6,606	52.4	1,046
Island County	71,558	78,506	9.7	377
Coupeville	1,723	1,831	6.3	1,489
Oak Harbor	19,795	22,075	11.5	2,343
Jefferson County	25,953	29,872	15.1	17
Port Townsend	8,334	9,113	9.4	1,306
San Juan County	14,077	15,769	12.0	91
Friday Harbor	1,989	2,162	8.7	1,033
Skagit County	102,979	116,901	13.5	68
Anacortes	14,557	15,778	8.4	1,343
Whatcom County	166,814	201,140	20.6	95
Bellingham	67,171	80,885	20.4	2,987
Study area counties	**445,906**	**513,592**	**15.2**	**67**
Large shoreline communities	136,300	157,488	15.1	-
State of Washington	5,894,121	6,724,540	14.1	101

Sources: WOFM 2013; U.S. Census Bureau 2013a.

The following federally recognized tribes are in the socioeconomics and environmental justice study area, with their 2010 populations shown in parentheses: the Jamestown S'Klallam (11), Lower Elwha Klallam (566), Quileute (460), and Makah (2,031) in Clallam County; the Hoh (116) in Jefferson County; the Samish (36,727), Sauk-Suiattle, Swinomish (806), and Upper Skagit (220) in Skagit County; and the Lummi (3,363) and Nooksack (884) in Whatcom County (GOIA 2012; U.S. Census Bureau 2013a). Non-federally recognized tribes in the study area include the Marietta Band of Nooksack in Whatcom County and the Snoqualmoo in Island County. All of these tribes are located along the shoreline except for the Sauk-Suiattle, Nooksack, and Upper Skagit.

4.10.2 Housing

The existing stock of housing units for each county in the study area, the study area as a whole, and the state is shown in Table 4.10-2. Total housing stock in the study area was estimated at 249,034 units in 2010. Of this total, more than 217,580 units were occupied, and approximately 72 percent of those units were occupied by the owners. Both the greatest population concentration and the most housing units (90,665) were in Whatcom County (U.S. Census Bureau 2013a).

Table 4.10-2 Housing Characteristics in the Study Area and State (2010)

County/State	Total Housing Units	Vacancy Rate (%)	Occupied Housing Units			Unoccupied Housing Units	
			Total	Owner Occupied	Renter Occupied	Total	Seasonal, Recreation and Temporary Use Units
Clallam	35,582	12.0	31,329	22,420	8,909	4,253	1,824
Island	40,234	18.6	32,746	23,231	9,515	7,488	4,687
Jefferson	17,767	20.9	14,049	10,433	3,616	3,718	2,436
San Juan	13,313	42.8	7,613	5,360	2,253	5,700	4,748
Skagit	51,473	11.5	51,473	45,557	14,601	5,916	2,910
Whatcom	90,665	11.4	80,370	49,905	30,465	10,295	5,690
Study area	**249,034**	**15.0**	**217,580**	**156,906**	**69,359**	**37,370**	**22,295**
State of Washington	2,885,677	9.2	2,620,076	1,673,920	946,156	265,601	89,907

Source: U.S. Census Bureau 2013a.

The 2010 U.S. Census counted a total of 37,370 vacant housing units within the study area, representing a 15.0 percent vacancy rate. By comparison, the vacancy rate in the State of Washington was 9.2 percent. The lowest vacancy rate (11.4 percent) and the greatest number of unoccupied units (10,295) were in Whatcom County. Of the total unoccupied units, 22,295 were seasonal, recreational, and occasional use units (U.S. Census Bureau 2013a). For a given level of housing availability, the vacancy rate varies with economic and population growth.

4.10.3 Area Economy

The economy within the study area is characterized below, including data on employment by industry, unemployment rates, income characteristics, and the marine and shoreline economy.

4.10.3.1 Employment

Industry-specific employment information provides insight into the size and structure of a regional economy. Table 4.10-3 presents employment by industry, in terms of number of jobs and percent of total employment, for each county in the study area, the study area as a whole, and the state. Total employment in all sectors in the study area was estimated at 227,146 jobs in 2011.

The primary industrial sectors employing the most people in the study area were educational services, health care, and social assistance, with 21.3 percent of the workforce; retail trade with 12.8 percent of the workforce; and arts, entertainment, and recreation, and accommodation and food services with 10.1 percent of the workforce. Compared to the State of Washington, the study area economy has a higher concentration of employment in each of these three sectors, as well as in the natural resource sector (agriculture, forestry, fishing and hunting, and mining), construction, other services, and public administration. The higher concentration of employment in the arts, entertainment, recreation, accommodation, and food services sector indicates that tourism plays a relatively important role in the study area economy. Also, the higher concentration of employment in the natural resources sector reflects the higher levels of forestry, fishing, and agricultural activity in the study area. For example, according to the Census of Agriculture, in 2007, the study area agricultural product market value totaled almost $620 million, approximately 9.1 percent of the $6.8 billion agricultural value produced in all of Washington State.

Table 4.10-3 Employment by Industry and Unemployment Rates in the Study Area and State (2011)

Employment Sectors	Clallam County	Island County	Jefferson County	San Juan County	Skagit County	Whatcom County	Study Area	State of Washington
Agriculture, forestry, fishing and hunting, and mining	1,258 (4.6%)	352 (1.1%)	461 (3.9%)	151 (1.9%)	2,252 (4.4%)	3,242 (3.3%)	7,716 (3.4%)	79,925 (2.5%)
Construction	2,286 (8.3%)	2,708 (8.5%)	1,162 (9.8%)	1,294 (16.6%)	4,177 (8.2%)	6,404 (6.6%)	18,031 (7.9%)	220,452 (7.0%)
Manufacturing	1,718 (6.2%)	3,229 (10.2%)	799 (6.7%)	263 (3.4%)	5,955 (11.6%)	10,403 (10.7%)	22,367 (9.8%)	330,083 (10.5%)
Wholesale trade	536 (1.9%)	503 (1.6%)	107 (0.9%)	134 (1.7%)	1,455 (2.8%)	2,807 (2.9%)	5,542 (2.4%)	97,669 (3.1%)
Retail trade	3,357 (12.2%)	4,070 (12.8%)	1,564 (13.2%)	757 (9.7%)	6,573 (12.8%)	12,842 (13.2%)	29,163 (12.8%)	363,620 (11.6%)
Transportation and ware-housing, and utilities	1,463 (5.3%)	1,394 (4.4%)	430 (3.6%)	429 (5.5%)	2,397 (4.7%)	4,155 (4.3%)	10,268 (4.5%)	160,705 (5.1%)
Information	648 (2.3%)	592 (1.9%)	565 (4.8%)	180 (2.3%)	789 (1.5%)	1,684 (1.7%)	4,458 (2.0%)	77,945 (2.5%)
Finance and insurance, and real estate and rental and leasing	1,222 (4.4%)	1,862 (5.9%)	649 (5.5%)	623 (8.0%)	2,857 (5.6%)	5,732 (5.9%)	12,945 (5.7%)	188,886 (6.0%)
Professional, scientific, and management, and adminis-trative and waste management services	2,087 (7.6%)	2,911 (9.2%)	1,239 (10.5%)	1,124 (14.4%)	3,969 (7.8%)	8,903 (9.2%)	20,233 (8.9%)	369,301 (11.8%)
Educational services, and health care and social assistance	5,962 (21.6%)	6,512 (20.5%)	2,460 (20.8%)	1,186 (15.2%)	10,782 (21.1%)	21,507 (22.2%)	48,409 (21.3%)	659,183 (21.0%)
Arts, entertain-ment, and recreation, and accommodation and food services	2,728 (9.9%)	2,626 (8.3%)	1,044 (8.8%)	1,092 (14.0%)	4,845 (9.5%)	10,515 (10.8%)	22,850 (10.1%)	275,131 (8.8%)

Table 4.10-3 Employment by Industry and Unemployment Rates in the Study Area and State (2011) (Continued)

Employment Sectors	Clallam County	Island County	Jefferson County	San Juan County	Skagit County	Whatcom County	Study Area	State of Washington
Other services, except public administration	1,843 (6.7%)	1,937 (6.1%)	573 (4.8%)	343 (4.4%)	2,355 (4.6%)	4,417 (4.6%)	11,468 (5.0%)	145,205 (4.6%)
Public administration	2,472 (9.0%)	3,051 (9.6%)	802 (6.8%)	235 (3.0%)	2,779 (5.4%)	4,357 (4.5%)	13,696 (6.0%)	167,857 (5.4%)
Total employed, all sectors	**27,580**	**31,747**	**11,855**	**7,811**	**51,185**	**96,968**	**227,146**	**3,135,962**
Unemployment (%)	**9.0**	**8.0**	**8.7**	**4.9**	**8.4**	**7.3**	**7.9**	**6.8**

Sources: U.S. Census Bureau 2013b; Washington Employment Security Department 2013.

Unemployment in the study area as a whole (as of July 2013) was estimated at 7.9 percent, over 1 percent higher than the state average unemployment level of 6.8 percent. Only San Juan County, at 4.9 percent, had a lower unemployment rate in July 2013 than the state average (Washington Employment Security Department 2013).

4.10.3.2 Income

The 2011 median household and per capita income levels for the study area and the state are provided in Table 4.10-4. For both levels, residents in nearly all counties in the study area have lower median income than the rest of the State. The exception is Island County, for which median household income was slightly higher than the state (although the per capita income was lower than the state). Median household income in 2011 ranged from $46,212 in Clallam County to $59,328 in Island County, while per capita income ranged from $25,672 in Clallam County to $36,453 in San Juan County (U.S. Census Bureau 2013b).

Table 4.10-4 Income Characteristics in the Study Area and State (2011)

County/State	Median Household Income	Per Capita Income
Clallam	$46,212	$25,672
Island	$59,328	$30,352
Jefferson	$46,887	$29,333
San Juan	$51,395	$36,453
Skagit	$55,555	$27,447
Whatcom	$51,389	$26,273
State of Washington	$58,890	$30,481

Source: U.S. Census Bureau 2013.

4.10.3.3 Taxes

The state sales and use tax in Washington is 6.5 percent. The unincorporated counties sales and use tax in the study area ranges from 1.3 to 2.5 percent (Washington Department of Revenue 2013).

Other taxes potentially pertinent to the Project include those related to marine vessels and the refining industry. A use tax for vessel purchases from a private party is levied when the vessel title is transferred, and the tax is assessed at the appropriate county rate. Annual excise taxes for vessels 16 feet or longer are calculated as .05 percent of the fair market value of the vessel purchase price (Washington State Department of Licensing 2013).

In addition to the taxes paid by all industries in Washington, oil refineries pay two additional types of taxes: hazardous substance taxes and oil spill taxes. The oil spill tax is imposed on the BP Cherry Point Dock based on the number of barrels received of crude oil or refined petroleum products from vessels; the hazardous substance tax is .007 percent of their wholesale value. In 2011, the Washington State refining industry paid $261.5 million in state and local taxes. This included retail sales and use taxes, business and occupation taxes, property taxes, unemployment compensation taxes, hazardous substance taxes, oil spill taxes, motor vehicle fuel taxes, and other taxes (Washington Research Council 2012).

4.10.3.4 Marine and Shoreline Economy

Marine and shoreline economic activities within the study area include oil refining, commercial fishing, aquaculture, marine transportation, tourism/recreation, and ship building/repair.

Oil Refining

Oil refining, an activity encompassed within the manufacturing sector, is located along the shoreline to facilitate marine transport of both crude oil and refined petroleum product to and from the refineries. Major petroleum refineries in Washington State include BP Cherry Point and Phillips 66 in Whatcom County near Ferndale, Shell Oil in Skagit County near Anacortes, Tesoro in Skagit County on March Point, and U.S. Oil outside of the study area in Pierce County at Tacoma. The combined capacity of the four major refineries in the study area was 612,500 bbl per day in 2011, of which 234,000 bbl per day of the capacity (38 percent) was at BP Cherry Point. The major refinery in Pierce County, outside of the study area, had the lowest capacity at 42,000 bbl per day, which represented only 7 percent of the total major refinery capacity. The state's five major refineries provided 3.5 percent of the U.S. refining capacity in 2011. The largest finished products from major refineries were gasoline (43 percent), diesel oil (23 percent), and jet fuel (14 percent). In 2011, Washington's five major petroleum refineries directly provided 1,986 full-time jobs paying an annual average wage of $120,276. Refineries also employed 2,919 contract employees on an average day performing maintenance and capital repair (Washington Research Council 2012).

Commercial Fishing

According to the Pacific Fisheries Information Network (PacFIN) and as shown in Table 4.10-5, approximately 2,746 registered commercial fishing vessels in the study area in 2011 landed nearly 31 million pounds of fish, with gross ex-vessel value of almost $79 million. Of this value, approximately 34 percent was landed in Whatcom County and 24 percent was landed in both Jefferson and Clallam Counties. In addition to their participation in subsistence fisheries (see Section 4.9), Native Americans are active in the commercial fishing industry.

In 2011, personal income from fishing, hunting, and trapping (of which fishing constitutes the primary component) accounted for 1.1 percent of total wages and salaries earned in Clallam, Jefferson, Skagit, and Whatcom Counties (data are unavailable for Island and San Juan Counties) (Bureau of Economic Analysis 2013. In addition to income and employment in the fishing sector, commercial fishing activity supports processing activity, both on-vessel and on-shore.

Table 4.10-5 Total Catch and Revenue in the Study Area and State (2011)

Item	Clallam	Island	Jefferson	San Juan	Skagit	Whatcom	Total Study Area	Total State of Washington
Number of vessel identifiers	648	6	374	53	512	1,153	2,746	5,945
Number of processors	56	6	35	15	48	62	222	522
Landed weight in pounds (1,000s)	7,111	1,169	5,814	160	4,410	12,205	30,869	228,947
Revenue ($1,000s)	$17,869	$1,750	$18,874	$908	$13,041	$26,526	$78, 968	$264,436

Source: PacFIN 2012.

Aquaculture

Aquaculture refers to the farming of fish, shellfish, or other aquatic plants and animals; aquaculture is conducted mainly along the coastal shoreline but also in inland state waters. Aquaculture occurs in all study area counties. Some examples include commercial marine finfish net pens; commercial oyster, clam, and geoduck[31] operations; recreational shellfish harvesting on state beaches; and rearing of fish, shellfish, and aquatic plants for personal consumption (Ecology 2013f). According to the Census of Agriculture, in 2007 aquaculture sales totaled $18.9 million in the study area and $162.9 million in Washington State. Nearly 90 percent of the aquaculture value in the study area is produced in Skagit and Jefferson Counties.

While jurisdictions generally must allow for aquaculture along shorelines, they can identify specific environmental designations where it is not allowed (Ecology 2012d). Aquaculture also is conducted on leased state-owned aquatic lands. More than 2,100 acres of state-owned aquatic land are under lease for aquaculture—mostly in tidelands, and approximately 80 percent of these are for oyster culture.

Marine Transportation

The Strait of Juan de Fuca is an important shipping corridor that provides access to the two largest ports in Washington State, the Ports of Seattle and Tacoma, in addition to numerous other ports and marine facilities. There were 1,609 entering transit [32]and 690 individual vessels in and out of the Strait of Juan de Fuca in 2010. Approximately one-third (28 percent) of these transits were tank ships. In 2011, there were 2,934 entering transit and 1,352 individual vessels bound for Washington ports. Of these, 516 entering transit were tank ships and 185 individual vessels were tank ships. Within Puget Sound, there were 3,096 barge transits and 109 commercial fishing vessels (Ecology 2011d).

Tourism/Recreation Economy

As noted above, the relatively high concentration of employment in the arts, entertainment, and recreation, and in the accommodation and food services industries indicates that the study area economy is more reliant on tourism than elsewhere in the state. This is also the finding of a 2009 statewide report

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[31] A *geoduck* is a large, edible saltwater clam.

[32] Entering transit accounts for vessels every time they enter Washington State waters while individual vessels are counted only once during a specified time period even if they call into Washington State waters more than once.

on the economic impacts of Washington travel spending on earnings, employment, and tax receipts (summarized by study area county in Table 4.10-6). Visitor spending includes accommodations (e.g., hotel/motel, campgrounds, or vacation home), food and beverage services, ground transportation and motor fuel, recreation, retail sales, and air transportation. The estimated 2009 total visitor spending in the study area was $1.2 billion, with approximately 36 percent of the spending in Whatcom County and approximately 20 percent in Skagit County. This supported (including indirect and induced effects) study area earnings estimated at $341 million and employment estimated at 17,866 in 2009, with approximately a third of each accruing in Whatcom County. Using the 2011 total employment in the study area estimate of 227,146 and the 2009 tourism employment estimate of 17,866, tourism directly and indirectly supports approximately 7.8 percent of total study area employment.

Table 4.10-6 Travel Impacts in the Study Area Counties and State (2009)

Item	Clallam	Island	Jefferson	San Juan	Skagit	Whatcom	Total Study Area
Visitor spending ($million)	$179.4	$134.0	$103.3	$116.5	$234.8	$435.5	$1,204
Earnings ($million)	$53.4	$44.9	$30.0	$39.4	$59.2	$114.4	$341
Employment	2,977	2,430	1,627	1,584	2,910	6,338	17,866
State tax receipts	$9,954	$7,249	$5,316	$6,159	$15,000,000	$25,700,000	$40,728,678
Local tax receipts	$3,619	$2,526	$2,156	$2,102	$3,100,000	$7,200,000	$10,310,403

Source: Dean Runyan Associates 2009.

Wildlife-related recreation associated with marine waters contributes to the study area tourism economy, as described in Section 4.7. Wildlife-related recreationists often spend significant amounts of money at their destination. For example, in all of Washington State, residents and nonresidents spent $1.2 billion on trip-related expenditures in 2011 (USFWS 2011). Daily, per person average expenditures in 2011 varied from $40 to $64, depending on the activity.

Ship Building/Repair

Another shoreline economic activity in the study area is ship building and repair. Ship building and repair in ship yards include construction of ships; repair, conversion, and alteration of ships; and production of prefabricated ship and barge sections and other specialized services. Ship building and repair services are concentrated in marine areas, including study area communities such as Anacortes and Bellingham. In 2011, total ship building and repair employment in Washington State was 3,520, or 0.3 percent of the total state employment. Although industry data specific to the study area are not readily available, ship building and repair likely accounts for a similarly low percentage of total employment in the study area.

4.10.4 Environmental Justice Populations

As noted, the study area for environmental justice is the six counties bordering the shorelines of the Project area, with particular focus on the census block groups adjacent to the shoreline. An evaluation of environmental justice impacts is mandated by Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (February 11, 1994). Environmental justice addresses the fair treatment of people of all races and incomes with respect to federal actions that affect the environment. Fair treatment implies that no group of people should bear a disproportionate share of negative impacts from an action.

EO 128998 requires that

> *Each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.*

There are two key considerations when assessing environmental justice impacts: whether environmental and human health impacts are disproportionately borne by minority or low-income populations, and whether such impacts are high and adverse.

To identify the potential for disproportionate impacts, this section characterizes the distribution of low-income and minority populations in the study area according to two population percentage criteria.

4.10.4.1 Population Percentage Criteria

To assess potential environmental justice concerns related to the Project in accordance with CEQ guidance, the following two separate analyses were performed within the study area:

- A *50 percent criterion* population analysis was conducted to identify those counties within the affected environment in which minority or low-income individuals equal or exceed 50 percent of the population.

- A *meaningfully greater criterion* population analysis was conducted to compare minority or low-income population percentages within counties to statewide reference populations. A meaningfully greater population is defined as a minority or low-income population within an area that is equal to or greater than 120 percent (1.2 times) of the statewide reference population. This criterion level was selected because it is commonly used for NEPA compliance by federal agencies.

If an overall county or shoreline census block group meets either criterion, the potential exists for environmental justice populations to experience disproportionate effects. As discussed in the environmental consequences section, impacts also may be felt if a minority or low-income population disproportionately engages in an activity that would be adversely affected (such as Native Americans' participation in subsistence fishing).

4.10.4.2 Study Area Counties

Minority populations are members of one of the following racial groups: African Americans, American Indians or Alaskan Natives, Asians, Native Hawaiians or other Pacific Islanders, “Other” races, multiracial, or Hispanic or Latino (CEQ 1997). Low-income populations are defined as those individuals living below the poverty line.

According to the 2010 Census, no minority or low-income population in 2010 exceeded 50 percent of the total county population in any county. However, minority or low-income populations in Clallam, Jefferson, Skagit, and Whatcom Counties were meaningfully greater (more than 1.2 times greater) than the corresponding minority population at the state level (as identified with an asterisk [*] in the relevant racial/ethnic category columns in Table 4.10-7).

Table 4.10-7 Minority and Low-Income Populations in the Study Area Counties and State (2010, 2011)

County	Total Population	African American	Native American or Alaskan Native	Asian or Pacific Islander	"Other"	Two or More Races	Hispanic or Latino Ethnicity	2011 Low-Income Populations
Clallam	71,404	0.8	5.1*	1.5	1.8	3.8	5.1	13.6
Island	78,506	2.2	0.8	4.9	1.5	4.5	5.5	8.3
Jefferson	29,872	0.8	2.3*	1.8	0.7	3.4	2.8	13.2
San Juan	15,769	0.3	0.7	1.2	2.6	2.5	5.4	11.1
Skagit	116,901	0.7	2.2*	2.0	8.7*	3.2	16.9*	12.0
Whatcom	201,140	1.0	2.8*	3.8	3.3	3.8	7.8	15.2*
Washington exceedance criteria [a]	-	4.3	1.8	9.4	6.2	5.6	13.4	15.0
State of Washington	6,724,540	3.6	1.5	7.8	5.2	4.7	11.2	12.5

[a] As described above, a "meaningfully greater" criterion population analysis compares minority and low-income population percentages within counties to statewide reference populations. The meaningfully greater is defined as 20 percent greater levels (i.e., a multiplier of 1.2) of minority or low-income populations than exist for the state. Statewide exceedance criteria percentages are 1.2 times the actual Environmental Justice group population percentages for the State of Washington.

* Denotes minority populations and low-income individuals that were meaningfully greater than the corresponding minority population or low-income individual at the state level in the relevant racial/ethnic or low-income category columns.

Sources: U.S. Census Bureau 2013a, 2013b.

Meaningfully greater Native American or Alaskan Native populations were present in Clallam, Jefferson, Skagit, and Whatcom Counties, which contain the Indian reservations shown in Figure 4.10-2. In Skagit County, there were meaningfully greater populations of Hispanic or Latino and "Other" ethnicities; and in Whatcom County, there was a meaningfully greater low-income population.

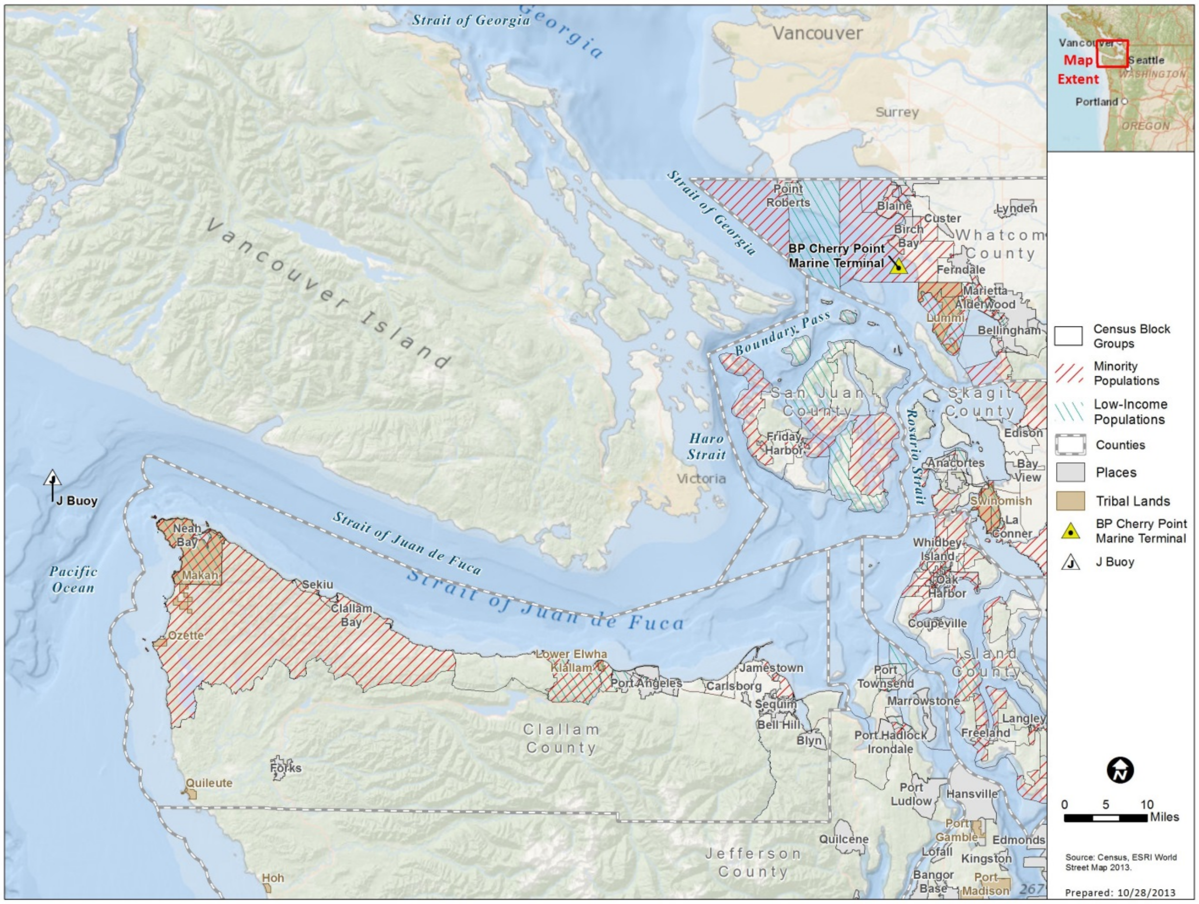

Figure 4.10-2 Minority and Low-Income Populations in the Environmental Justice Study Area

4.10.4.3 Shoreline Census Block Groups

A census block group (CBG) is the smallest geographic area for which the U.S. Census Bureau provides consistent sample data, and generally contains a population of 600 to 3,000 individuals. There are 352 CBGs in the study area, of which 170 are shoreline CBGs analyzed in this section.

According to the 2007–2011 5-year Census, Native American or Alaskan Native populations exceeded 50 percent of the total population in three shoreline CBGs in the study area. Two of the CBGs were located in Clallam County, and one was located in Whatcom County. A total of 130 minority populations in 87 unique CBGs were meaningfully greater than the corresponding minority population at the state level, as shown in Table 4.10-8 and Figure 4.10-2. The greatest number of minority populations were Native American or Alaskan Native (67 percent), multiracial (28 percent), and Asian or Pacific Islander and Hispanic or Latino (13 percent). Island County had the most minority populations identified along the shoreline (47 percent), and Whatcom County had the second largest number of minority populations identified along the shoreline (19 percent).

The 2007–2011 5-year American Community Survey Census estimates showed that the low-income population in one shoreline CGB in Whatcom County exceeded 50 percent of the total CBG population. As shown in Table 4.10-8, a total of 45 low-income populations were identified within 170 CBGs along the shoreline in the study area. The most minority populations were identified along the shoreline in Whatcom County (29 percent) and the second largest minority population was located in Clallam County (20 percent).

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5 RISK ANALYSIS MODELING AND RESULTS

5.1 INTRODUCTION

The focus of the analysis in the EIS is the potential incremental environmental risk from operation of two wings (two berths) at the BP Cherry Point dock compared to operation of a single wing (single berth). The potential change in risk is associated with a change in the frequency of vessel-related accidents by tankers and barges transiting to and from the dock, and the associated risk of a spill (outflow) of crude oil or refined petroleum product. The risk can further be related to spills at the dock from crude oil or refined petroleum product transfer operations and maintenance of the dock. This risk is evaluated separately because it results from different operational mechanisms than vessel-related risk.

Computer-based vessel traffic analysis models were used to analyze the movement of vessels calling at the BP Cherry Point dock and interacting with marine traffic in the Puget Sound region in order to determine the risk of accidents and potential for oil outflow with environmental consequences. Two separate vessel traffic models were used to assess the risk of accident and oil outflow from vessel operations: a simulation model and a statistical model. A separate statistical model was used to assess the risk of accident and oil outflow for dock operations. It should be noted that the TGA VTA statistical model incorporates a number of assumptions and simplifications to accommodate gaps in data or the absence of historical incidents in some categories. The results of the vessel traffic analysis models should not be viewed as accurate forecasts of spill events. What can usefully be obtained from the model results is the direction and relative magnitude of changes in specific risk statistics when comparing different case scenarios.

This section includes a description of each of these models and the results of the model analyses, as follows:

- **George Washington University Vessel Traffic Risk Analysis (GWU VTRA).** A team led by GWU conducted this model analysis. The VTRA Team used a computer-based simulation of traffic movement to identify potential interactions between vessels calling at the BP Cherry Point dock and other vessels transiting the Strait of Juan de Fuca, Admiralty Inlet, and the southern portion of the Strait of Georgia.[1] Interactions between vessels and potential accidents were simulated, and the oil outflow from potential accidents was assessed.
- **The Glosten Associates Vessel Traffic Analysis (TGA VTA).** A second vessel traffic analysis was performed by The Glosten Associates (TGA), a marine sciences and engineering company. The TGA VTA used a statistical model to analyze incremental potential accident and oil outflow at the maximum projected vessel calling volume at the BP Cherry Point dock.
- **Analysis of Operational Spillage at BP Cherry Point Marine Terminal.** A separate analysis of operational spills during dock transfer and maintenance operations was performed by Environmental Research Consulting (ERC).

[1] For purposes other than the analysis required to support this EIS, the GWU VTRA included Puget Sound waters south of Admiralty Inlet. However, this analysis was not within the scope of the EIS and was reported separately by GWU.

5.2 VESSEL TRAFFIC ANALYSIS STUDY AREA, VESSEL TRAFFIC CONSIDERED, AND TIME FRAME ANALYZED IN VESSEL TRAFFIC STUDIES

The two vessel traffic studies considered the same study area and similar vessel traffic types.

- **Study Area Analyzed.** Both studies considered the movement of vessels—particularly large, deep draft vessels and barges—throughout the Strait of Juan de Fuca, Admiralty Inlet, and the southern portion of the Strait of Georgia. The study area was defined as the marine waters beginning 8 miles west of J Buoy (48^0 29.23' N, 124^0 43.66' W), which is located at the west entrance to the Strait of Juan de Fuca. It included all of the Strait of Juan de Fuca and Admiralty Inlet to a line between Pt. Wilson near Port Townsend and Admiralty Head on Whidbey Island. The study area further included the waters of Haro Strait and Boundary Pass, delimited on the west by Vancouver Island and on the north by the U.S./Canada border in the southern portion of the Strait of Georgia. It also included the waters of Rosario Strait, Guemes Channel to Padilla Bay, and the Southern Strait of Georgia south of Point Whitehorn in the vicinity of Cherry Point (Figure 5-1).
- **Vessel Traffic Analyzed.** Both studies analyzed the potential risk of accidents, spills and associated oil outflow involving tank vessels and petroleum-carrying barges that call at the BP Cherry Point dock while transiting in the study area—primarily within the controlled vessel traffic separation lanes for commercial deep draft traffic (Figure 5-2). Only incidents involving vessels transiting to or from the BP Cherry Point dock were considered in the studies. The specific traffic types included in each analysis are described in more detail in subsequent sections of this chapter.
- **Time Frame Analyzed.** Both studies analyzed incremental environmental risk under 'current' and 'future' conditions. For the GWU VTRA vessel traffic simulation, the current condition was 2005, based on available data at the time the study was conducted; and the future condition was projected vessel traffic in 2025, giving a 20-year time horizon. For the TGA VTA statistical vessel traffic study, the current condition was 2010, based on data available at the time the second study was undertaken; and the future condition was projected vessel traffic in 2030, for a 20-year future time frame.

5.3 VESSEL TRAFFIC RISK ANALYSIS SIMULATION MODEL (GWU VTRA)

The vessel traffic simulation model was prepared by the GWU VTRA Team that was composed of faculty members of GWU in Washington D.C., Virginia Commonwealth University in Virginia, and Rensselaer Polytechnic Institute, in New York. The team was led by John R. Harrald and included Johan Rene van Dorp, Jason R.W. Merrick, and Martha Grabowski.

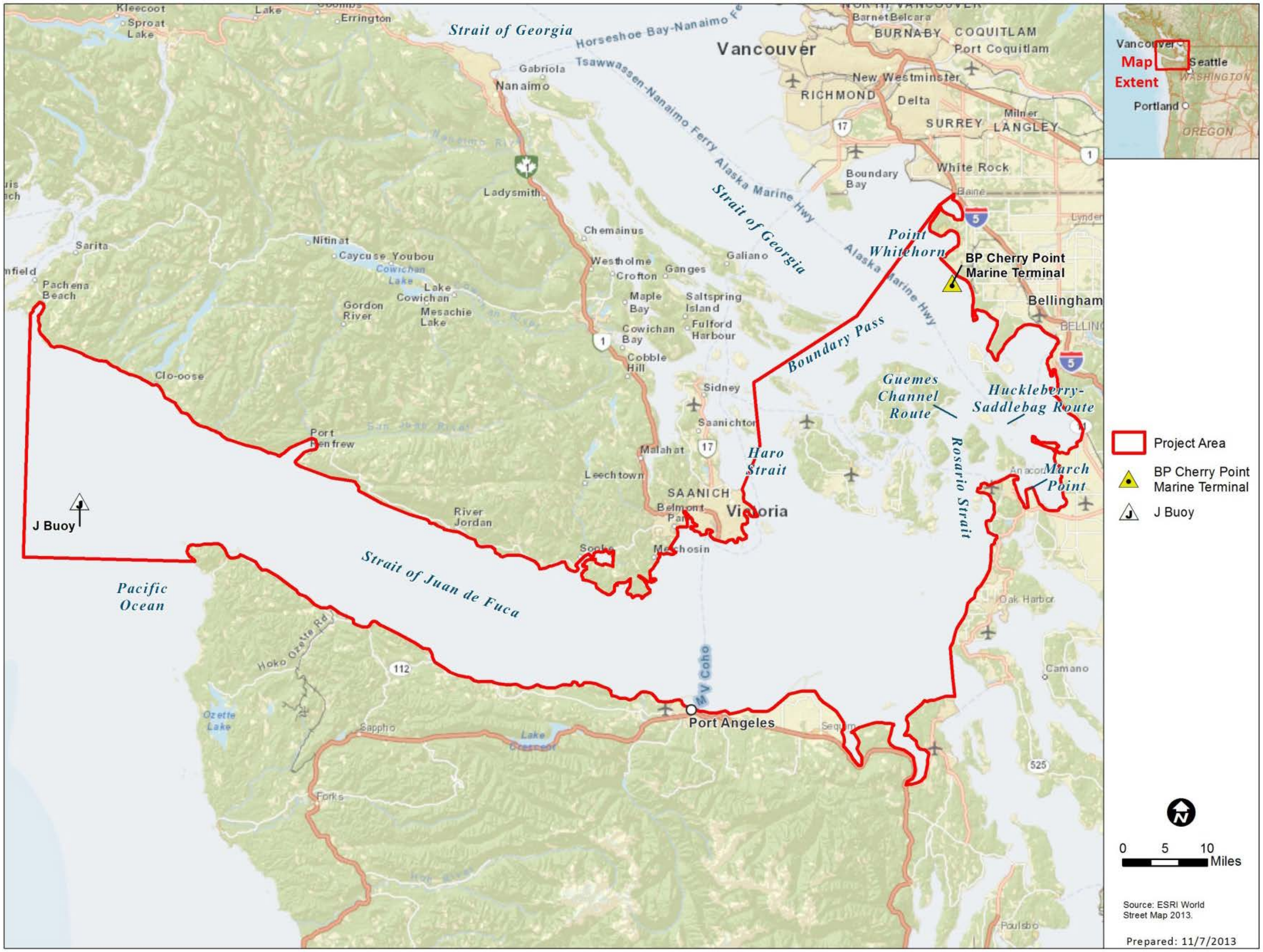

Figure 5-1 Study Area Analyzed for Both Vessel Traffic Studies

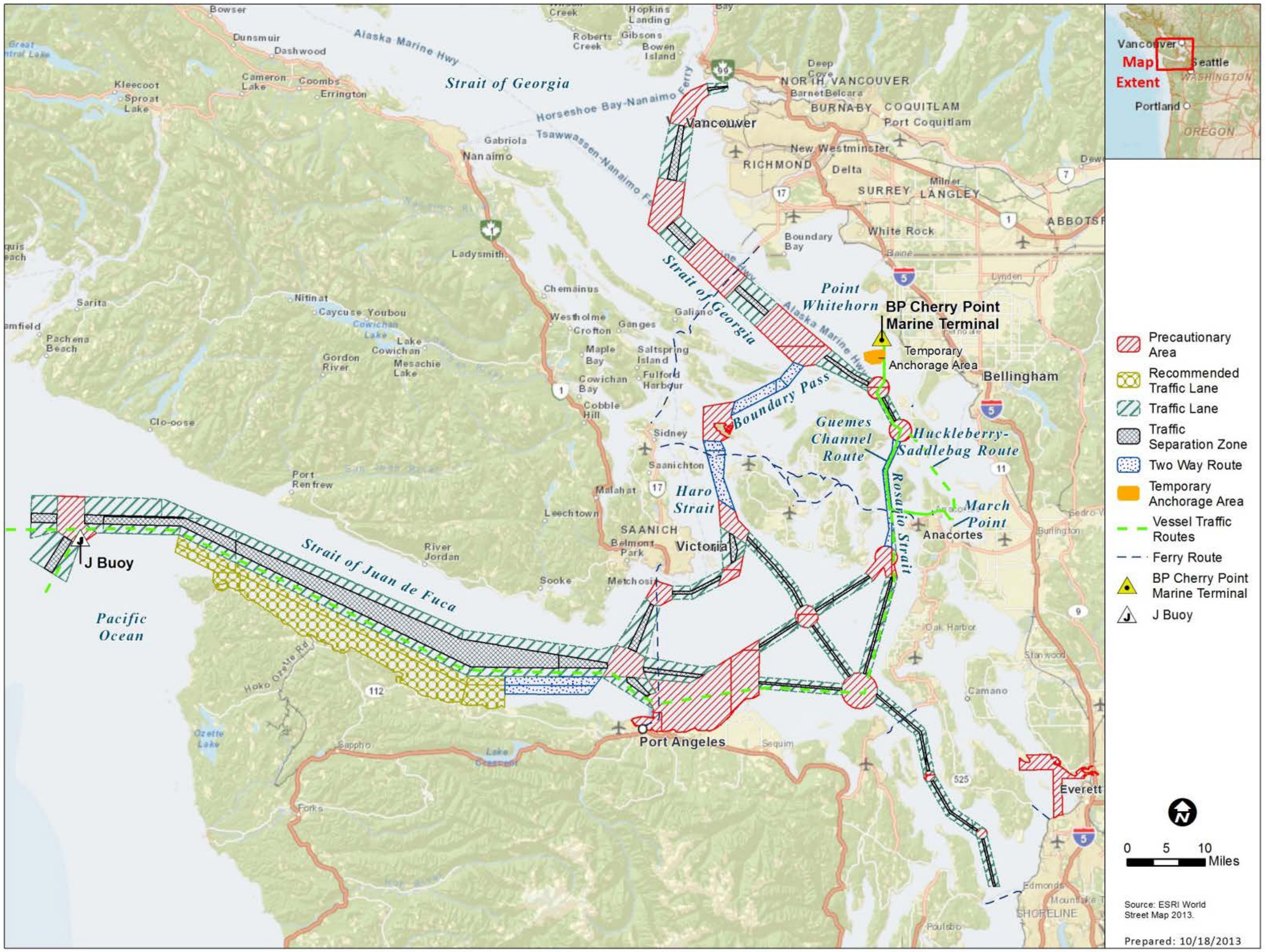

Figure 5-2 Vessel Traffic Separation Lanes

The objectives of the vessel traffic simulation model were to:

- Determine the potential for collisions between vessels carrying crude oil and refined petroleum product calling at the BP Cherry Point dock and other vessels transiting the same routes; for drift and power groundings by vessels calling at the BP Cherry Point dock; and for allisions[2] between vessels calling at the BP Cherry Point dock and fixed objects (such as piers and navigation aids).
- Predict the potential loss of crude oil, refined petroleum product, or vessel fuels when a vessel calling at the BP Cherry Point dock is involved in any one of the four types of accidents (i.e., collisions, allisions, power groundings, and drift groundings [see Section 5.3.1]). In the case of collisions, the simulation model also considered loss from the second vessel involved in the incident.
- Determine the potential for incidents/accidents[3] and oil outflow under vessel traffic conditions (1) prior to construction and operation of the North Wing; (2) after the North Wing was constructed and began operation; and (3) under vessel traffic conditions predicted to occur in 2025.

Development and operation of the vessel traffic simulation and the simulation results are described in the VTRA Team's report, *Assessment of Oil Spill Risk due to Potential Increased Vessel Traffic at Cherry Point, Washington* (herein referred to as the *VTRA Report* and attached as Appendix C to this EIS). A general description of the GWU VTRA model is provided in the following sections.

5.3.1 General Simulation Approach in the GWU VTRA Model

The GWU VTRA simulation model is a real-time simulation of vessel movements in the Strait of Juan de Fuca and Rosario Strait, and the marine approaches to Cherry Point in the southern Strait of Georgia. It operates by simulating the movement of vessels of various types over known vessel traffic routes and recording those potential incidents where vessels approach one another within distances where accidents could occur. Other factors considered included wind, wave, current, and visibility conditions at the location and time of a potential incident. Typical navigation and ship command rules for avoidance of collisions and allisions were applied, as were human factor responses to the situation, resulting in an assessment of the probability that an actual accident would occur. The recorded individual probabilities that an accident would occur at any time within the simulation area were summed over a 1-year period, yielding the annual probability that an accident would occur within the study area. This method was used to estimate the annual probability of collisions between vessels or allisions between a vessel and a fixed object.

Power groundings and drift groundings were also evaluated. Power groundings occur when a vessel underway goes aground primarily due to a failure of the vessel's steering capability or the vessel's command structure. Drift groundings occur when a vessel loses propulsion, or propulsion and steering capability, and goes aground while adrift. Both types of groundings were simulated by randomly selecting a vessel for loss of steering or propulsion and allowing wind and currents to influence the vessel's course for a period of time. The period adrift depends on the availability and time for deployment of assist vessels, based on the location of the vessel in jeopardy during loss of steering or drift.

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[2] The term *collision* refers to one ship striking another ship, while the term *allision* refers to a ship striking a fixed object, such as a pier or navigation aid.

[3] The two vessel traffic studies treated incidents and accidents differently – please see discussion in Appendices C and D.

The probability of all four types of potential accidents (i.e., collisions, allisions, power groundings, and drift groundings), were summed to determine the overall probability of accidents over the simulation period. This probability was portrayed in a geographic display that depicts the probability of accidents in different portions of the study area. Because the subject of the simulation was risk associated with vessels calling at the BP Cherry Point dock, the only incidents/accidents recorded were those involving a tank ship or barge calling at BP. The potential for accidents did not consider vessels carrying crude oil or refined petroleum product calling at other ports, unless those vessels had previously called at the BP Cherry Point dock or were involved in an incident/accident with a vessel calling at the BP Cherry Point dock.

Potential accidents recorded during the simulation were further evaluated to determine the likelihood and potential size of a release of hydrocarbons (crude oil or refined petroleum product as cargo and bunker or diesel as vessel fuel) to the environment. The simulation record of an incident resulting in an accident included the types of vessels involved and the speed and relative bearing of the vessels to each other in the case of collisions, and the speed and course of a vessel involved in an allision or grounding. Using a generalized vessel structural model, the potential for breaching and release of hydrocarbons from cargo and fuel tanks was assessed, and a potential hydrocarbon outflow (oil outflow) in cubic meters was estimated. The potential releases from all accidents recorded during a simulation were summed to assess the total potential oil outflow to the environment.

5.3.2 Vessel Traffic Included in the GWU VTRA Simulations

The data used to drive the simulation included vessel tracks (or routes) for the following types of vessels:

- Crude oil tankers
- Refined petroleum product tankers
- Refined petroleum product barges
- Bulk carriers
- Chemical carriers
- Container vessels
- Vehicle carriers
- Military vessels
- Ferries

All commercial vessels, powered vessels greater than 40 meters (approximately 131 feet) in length, towing vessels greater than 8 meters (approximately 26 feet) in length, and vessels carrying more than 50 passengers must report into the CVTS while underway in the greater Puget Sound region. The movements of these vessels are monitored by radar and recorded in the USCG Vessel Traffic Operation Support System (VTOSS) data base. These records were used to provide the routing or track information for the types of vessels listed above.

Information to predict the movements of fishing vessels, yacht regattas, and whale watching vessels was obtained from other sources. Representative routes for fishing vessels were identified by linking known fishing areas and the historical intensity of use with the home ports of the fishing fleet. USCG records of registered yacht regattas were used to identify routes used for these events. Sound Watch, a conservancy organization that monitors whale watch activity, provided records of whale watching vessel movements that were used to develop tracks for these vessels. Small recreational vessels, whose routes are not constrained to specific routes or cannot be predicted in any meaningful way, were not included in the data base.

Using these data sources, the GWU VTRA Team developed a database of vessel tracks that included all vessel movements that could reasonably be identified for the base year, 2005.

5.3.3 GWU VTRA Simulation Study Area Subareas

The GWU VTRA simulation study area is shown in Figure 5-3. The study area was subdivided into seven subareas. Results were reported for the entire study area and for each of the subareas.

Following completion of the EIS scoping process, two changes were made to the GWU VTRA study area that initially had been defined:

- The western boundary of the study area was extended to a point approximately 8 miles west of "J" Buoy to more completely incorporate vessel traffic routes entering the Puget Sound region.
- At the request of the USCG, the study area was extended to include Puget Sound (waters south of Admiralty Inlet) to aid in the USCG's assessment of traffic in the lower portions of Puget Sound. Because the subject of the EIS is traffic to Cherry Point, risk assessment results for lower Puget Sound are not reported in the EIS.

Within the study area, commercial vessel traffic must operate with the CVTS, which contains a number of vessel separation lanes (see Figure 5-2). While vessel traffic operating throughout the study area was included in the simulation, of principal interest were those vessels carrying crude oil and refined petroleum product and operating in the lanes through the Strait of Juan de Fuca, Admiralty Inlet, and Rosario Strait to the BP Cherry Point dock. These vessels also operated in the vessel traffic lanes along routes to the March Point refineries located in Padilla Bay.

5.3.4 GWU VTRA Simulation Cases

A total of 15 simulation cases (Table 5-1) were run to assess the incremental environmental risk of oil spill from (1) operation of the BP Cherry Point North Wing; (2) implementation of three selected traffic management protocols; and (3) future development of the Gateway Pacific Terminal (GPT), a bulk terminal proposed at a nearby location at Cherry Point. The latter was included to evaluate the cumulative effects of a proposed future vessel-generating project in the vicinity of the BP Cherry Point dock.

The alternative traffic management protocols and the cumulative project included:

- **Saddlebag Route –** Prohibiting use of the Saddlebag Route for transit of vessels southeast from the BP Cherry Point dock to refineries at March Point adjacent to Anacortes in Padilla Bay.
- **Extended Tug Escort –** Extending the requirement that petroleum-laden vessels (crude oil or refined petroleum product) have a tug in escort to include the transit from Neah Bay to Port Angeles (the current requirement for an escort tug begins at Port Angeles).
- **Neah Bay Tug –** Extending to year-round duty the tug stationed at Neah Bay to assist vessels in distress during their approach and entry into the Strait of Juan de Fuca.
- **Gateway Pacific Terminal –** Including the vessel traffic that would be generated by the GPT, an intermodal bulk terminal proposed at a site adjacent to the BP Cherry Point Refinery.

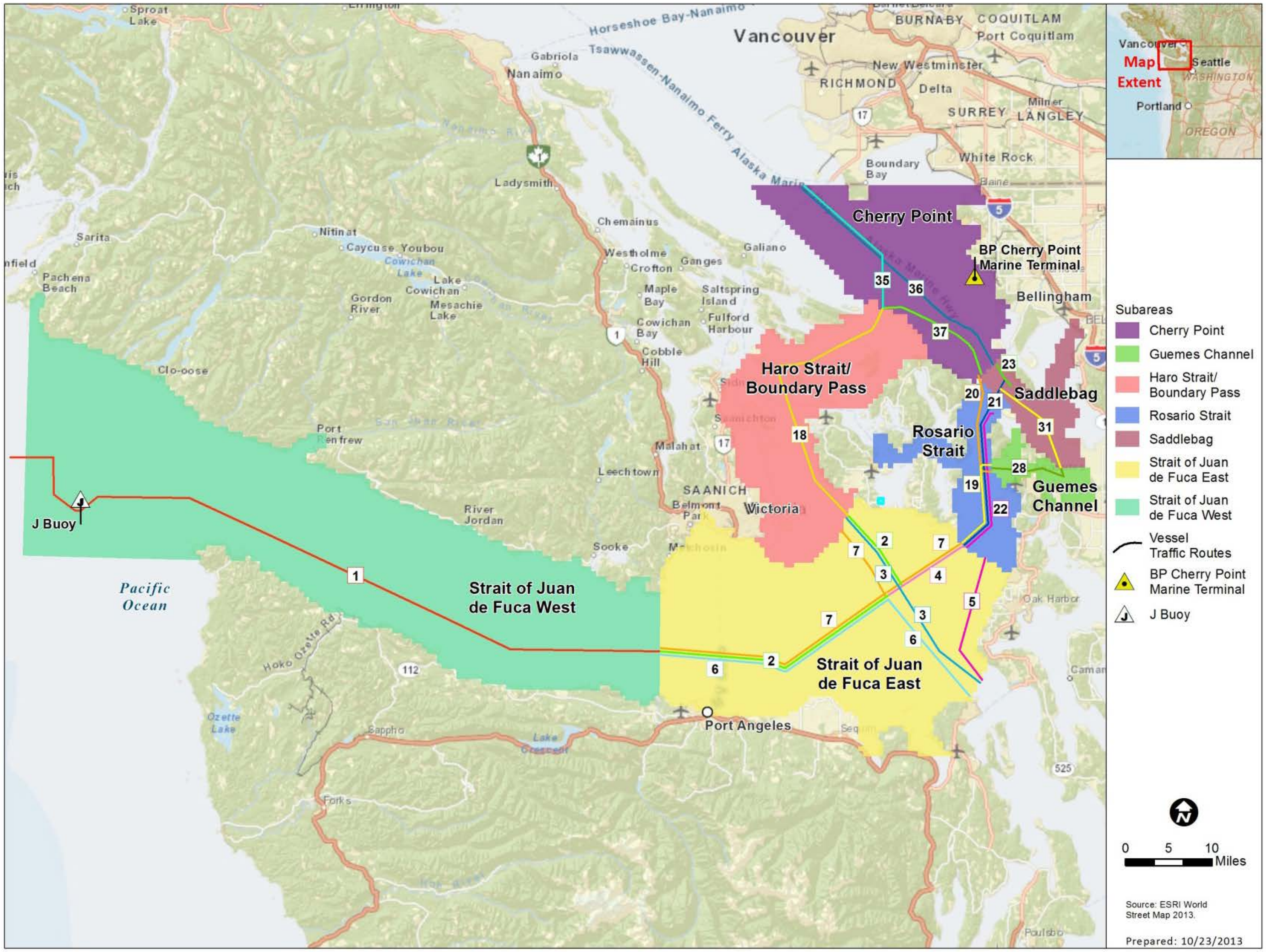

Figure 5-3 GWU VTRA Study Area Showing Subareas

Table 5-1 GWU VTRA Simulation Cases

Case	Year/Traffic	North Wing Operational?	Traffic Management Protocols			Gateway Pacific Terminal Project?
			Use of Saddlebag Route?	Extended Escort Required?	Year-Round Tug at Neah Bay?	
A	2000	No	Yes	No	Yes	No
B	2005	Yes	Yes	No	Yes	No
C	2005	No	Yes	No	Yes	No
D	2025 low	Yes	Yes	No	Yes	Yes
E	2025 low	No	Yes	No	Yes	Yes
F	2025 medium	Yes	Yes	No	Yes	Yes
G	2025 medium	No	Yes	No	Yes	Yes
H	2025 high	Yes	Yes	No	Yes	Yes
I	2025 high	No	Yes	No	Yes	Yes
J	2005	Yes	No	No	Yes	No
K	2025 high	Yes	No	No	Yes	Yes
L	2005	Yes	Yes	Yes	Yes	No
M	2025 high	Yes	Yes	Yes	Yes	Yes
N	2005	Yes	Yes	No	No	No
O	2025 high	Yes	Yes	No	No	Yes

Low = low-range traffic forecast; medium = medium-range traffic forecast; high = high-range traffic forecast

These traffic management protocols and the proposed GPT project were examined in the GWU VTRA study. However, they involved routing and management of vessels while en route to and from the BP Cherry Point dock, and not interaction with the North Wing dock itself. The jurisdiction of the USACE under Section 10 of the Rivers and Harbors Act involves approval of the configuration, construction methods, and ongoing operation and maintenance of facilities—not the routing and management of vessels calling at the facility. Vessel routing, escort requirements, temporary anchoring, and movement of vessels to and from the dock are the purview of the USCG through operation of the CVTS and implementation of the International Regulations for Preventing Collisions at Sea (COLREGS). Consideration of alternative traffic management protocols as EIS alternatives or permit conditions may require rulemaking by agencies other than the USACE.

The alternative traffic management protocols and cumulative impacts are discussed in more detail below.

5.3.4.1 Saddlebag Route

The Saddlebag Route begins at the BP Cherry Point dock and transits south into the upper portion of the Rosario Strait vessel traffic control transit lanes (Figure 5-2). Vessels then depart from the CVTS lanes in the vicinity of Lummi Island and travel southeast between Sinclair Island and Vendovi Island toward Guemes Island. Vessels then pass between Saddlebag/Huckleberry Islands at the southeast point of Guemes Island to enter Padilla Bay. Depending on the availability of marine terminal space at the March Point refineries, vessels may take temporary anchorage off Vendovi Island.

The longer route to Padilla Bay after departing from the BP Cherry Point dock is to transit south through Rosario Strait to its junction with Guemes Channel, then travel east through Guemes Channel to Padilla Bay. The route avoids the Saddlebag Route. BP does not have control over routing of vessels other than its own and does not have authority for routing of shipping in coastal waters; therefore, implementation of a permit condition limiting routing of vessels through the Saddlebag Route is a condition that is only within the purview of the USCG.

5.3.4.2 Extended Tug Escorts

Presently, vessels greater than 40,000 dwt carrying crude oil or refined petroleum products arriving at the Strait of Juan de Fuca (to make their way to Cherry Point via Rosario Strait) must acquire an escort tug as they pass approximately 123 degrees 10 minutes West when inbound. A tug escort is then required while the vessel is underway and east of this line as it transits through Rosario Strait to the Cherry Point area. Analysis of this traffic management protocol examined the potential change in incremental environmental risk/benefit from requiring an escort tug for inbound traffic beginning at “J” Buoy and extending through the entire voyage to the BP Cherry Point dock. Currently, tug escort requirements begin at Port Angeles for inbound shipping. Similar to the Saddlebag Route protocol, the USACE does not have jurisdiction over vessel movement management, including extending requirements for tug escorts.

5.3.4.3 Neah Bay Tug

Beginning in 1999, a prevention and response tug (emergency response towing vessel or ocean-going tug) has been stationed at Neah Bay to assist vessels in distress during winter months. As a third traffic management protocol, the GWU VTRA study analyzed extension of the tug to year-round duty at Neah Bay. Beginning in July 2008, the State of Washington began funding the year-round deployment of a prevention and response escort tug at Neah Bay. Therefore, this traffic management protocol already has been implemented.

5.3.4.4 Gateway Pacific Terminal

The GPT project is proposed to be developed during the time frame studied in the GWU VTRA. At this terminal, various bulk commodities would be delivered by rail, unloaded, temporarily stored, and then loaded into bulk cargo carriers for shipment. Permitting of the GPT was initiated in the mid-1990s and included federal, state, and local permits. At that time, county and state permitting of the project’s marine terminal was completed, but permits for the upland facilities and federal permits were not complete. Permitting activity on the GPT project recently has been re-initiated based on a revised project plan. Completion of the bulk terminal would increase cargo vessel traffic to the Cherry Point area above present and projected future levels. Traffic levels forecasted for the GPT in the 1996 permitting process were incorporated into the vessel traffic simulation in the GWU VTRA.

The VTRA Team defined the 15 simulation cases to allow for the following evaluations:

- **Case A.** This case represents pre-North Wing conditions (year 2000) and allowed for comparison of BP Cherry Point dock operations before and after operation of the North Wing.
- **Cases B and C.** These cases provided a comparison of dock operations with and without North Wing operations under current traffic conditions (year 2005).
- **Cases D, E, F, G, H, and I.** These cases allowed for comparison of dock operations with and without the North Wing for three different future traffic projections (low-, medium-, and high-ranges in year 2025) for vessels calling at the BP Cherry Point dock. They also allowed for comparison of future operations with and without the North Wing to current operations with and without the North Wing.

- **Cases B, J, H, and K.** Comparing Cases J, H, and K to Case B allowed for evaluating restrictions in the use of the Saddlebag Route.
- **Cases B, L, H, and M.** Comparing Cases L, H, and M to Case B examined the effect of extending tug escorting of vessels carrying crude oil and refined petroleum product.
- **Cases B, N, H, and O.** Comparing Cases N, H, and O examined the effects of permanently stationing a rescue tug at Neah Bay.

5.3.5 GWU VTRA Simulation Calibration for Accidents and Oil Outflow

The GWU VTRA simulation was calibrated to a known annual accident statistic for a base year (2005). To determine the calibration value for accidents, marine incident/accident records for Puget Sound from multiple sources for an 11-year period (1995–2005) were collected, reviewed, interpreted, and integrated into a single database for collisions, allisions, and power and drift groundings. From this database, incidents and accidents involving tankers and tug/barges calling at the BP Cherry Point dock during their operation in the greater Puget Sound were identified.

From 1995 to 2005, the database showed that four accidents had occurred: one collision involving a tanker and its tug escort, two allisions while leaving a dock, and one barge grounding as the result of a dragging anchor in heavy winds. None of these four accidents resulted in any reported oil outflow (see Appendix A of the VTRA Report, page A-58). The statistic of four accidents in 11 years (4/11 = 0.3636) was used as the annual accident potential for the base case (Case B – 2005 with North Wing in operation). The value 0.3636 was apportioned among the four accident types based on broader accident statistics, as shown in Table 5-2 (see Appendix A of the VTRA Report).

Table 5-2 GWU VTRA Simulation Accident and Oil Outflow Calibration – Base Case (Case B)

Accident Type	Annual Accident Potential	Annual Oil Outflow Potential (gallons)
Collision	0.0909	12,427
Allision	0.1818	322
Power grounding	0.0792	23,043
Drift grounding	0.0117	1,460
Total	**0.3636**	**37,249**

Source: van Dorp et al. 2008.

Because no reported oil outflow had occurred in the four accidents, a theoretical method was used to calculate the expected oil outflow based on the circumstances of likely accident types and the vessel cargo tank configuration of the vessels likely to be involved. The total expected oil outflow for the base year was determined to be 37,249 gallons (see Appendix E of the VTRA Report).

5.3.6 Modification of 2005 Vessel Traffic Data Base for 2000 and 2025 GWU VTRA Simulations

As part of the GWU VTRA simulation development, vessel traffic forecasts were incorporated into several of the simulation cases. They included a traffic scenario for the year 2000 to simulate operations prior to operation of the North Wing and a future scenario (2025) to reflect potential changes in vessel traffic. The 2000 and 2025 vessel traffic scenarios were constructed by modifying the 2005 base case and adding changes to vessel traffic calling at the BP Cherry Point dock forecasted by BP.

5.3.6.1 BP Cherry Point Dock Forecast Traffic in the GWU VTRA Simulation: Years 2000 and 2025

Due to the uncertainty of future market conditions (year 2025), BP provided three different traffic forecast scenarios to capture potential changes in annual vessel calls at the BP Cherry Point dock resulting from differing future scenarios regarding crude oil supply sources and transportation methods.

The three BP traffic forecast scenarios are provided in Section 2.3:

- Increased pipeline deliveries (low-range traffic forecast)
- Current conditions forecast (medium-range traffic forecast)
- Potential future growth (high-range traffic forecast)

Each of the scenarios provided by BP could occur as a result of market forces and increased or decreased use of transportation systems already in place. The 2025 low-, medium-, and high-range traffic forecast scenarios were used to prepare simulation cases D through I, K, M, and O. None of the scenarios assumed any change in refinery throughput capacity, which is nominally 250,000 bbl/day (10,500,000 gallons/day) (VTRA Report, page F-7). The BP Cherry Point Refinery has no plans to expand refinery capacity beyond its current annualized crude unit charge rate of 234,000 barrels per day between now and year 2025 (BP 2011).

As shown in Table 5-3, BP provided a range of total vessel calls for each scenario. These were divided into crude oil and refined petroleum product vessels and a range for the mix of crude oil and refined petroleum product vessels was also forecasted for each scenario. Since the simulation required a specific number of vessel calls at the dock of each vessel type as an input for the 2000 and 2025 cases, the GWU VTRA Team converted the number of vessels calling at the BP Cherry Point dock in 2005 with a percentage increase or decrease as reflected in BP's forecasts (Table 5-4).

Table 5-3 BP Forecast of Future Vessel Calls by Future Scenario

Forecast Scenario	Range of Total Vessel Calls	Crude Oil Vessels	Refined Petroleum Product Vessels
Increased pipeline deliveries (low-range traffic forecast)	170 – 220	5–10%	90–95%
Current conditions forecast (medium-range traffic forecast)	320 – 400	40–50%	50–60%
Potential future growth (high-range traffic forecast)	350 – 420	30–40%	60–70%

Table 5-4 Annual Vessel Calls at BP Cherry Point Dock by Case

Simulation Case	Year/ Forecast	Crude Oil Vessel Calls	Refined Petroleum Product Vessel Calls	Total Calls
A	2000	115	97	212
B	2005	143	125	268
C	2005	136	108	244
D	2025 low	8	98	106
E	2025 low	9	92	101
F	2025 medium	155	128	283
G	2025 medium	148	102	250
H	2025 high	147	185	332
I	2025 high	121	143	264
J	2005	143	125	268
K	2025 high	141	188	329
L	2005	143	125	268
M	2025 high	147	185	332
N	2005	143	125	268
O	2025 high	147	185	332

Notes:

Low = low-range traffic forecast; medium = medium-range traffic forecast; high = high-range traffic forecast

A *call* was defined as the completion of a vessel's transit to the BP Cherry Point dock, a loading or unloading operation, and departure of the vessel for another destination.

Source: VTRA Team Supplemental Information.

Table 5-4 shows the number of calls for both types of vessels for Cases A through O that resulted from the simulation. A *call* was defined as the completion of a vessel's transit to the BP Cherry Point dock, a loading or unloading operation, and departure of the vessel for another destination. The total number of resulting vessel calls is not constant for the simulation cases for a given year. This is because the simulation reports calls for each case as an output.

5.3.6.2 Adjustments to 2005 Vessel Traffic for 2000 and 2025 in the GWU VTRA Simulation

To adjust the 2005 traffic counts for non-BP calling vessels using the study area to future traffic levels (2025 cases), the VTRA Team evaluated historical data of visits to Puget Sound or transits within Puget Sound. Each type of vessel listed in Section 5.3.2, except for fishing vessels, yachting regattas, and whale watching vessels, was analyzed to forecast changes in general vessel traffic in the study area. The latter three types of vessels were not recorded in the VTOSS or Marine Exchange data bases and therefore could not be analyzed.

Traffic levels for the year 2000 were taken from historical data. The future traffic trends calculated for each vessel type found that significant changes in vessel traffic by the year 2025 were likely to occur in only three vessel types: tank ships (non-BP), bulk carriers, and container vessels. Low-, medium-, and high-range traffic forecast scenarios were calculated for the vessel types shown in Table 5-5.

Table 5-5 Percentage Change for 2000 and 2025 Vessel Traffic in GWU VTRA Simulation

	Year			
		2025		
Vessel Type	2000	Low	Medium	High
Crude oil tankers calling at the BP Cherry Point dock	-20%	-90%	+13%	+17%
Refined petroleum product vessels calling at the BP Cherry Point dock	No change	-2%	+13%	+90%
Other tank vessels	+23%	-54%	+55%	+162%
Bulk carriers	+30%	No change	No change	No change
Container vessels	No change	-54%	+20%	+93%

Low = low-range traffic forecast; Medium = medium-range traffic forecast; High = high-range traffic forecast

Source: van Dorp et al. 2008 (see Appendix F of the VTRA Report, Table F-5).

The change from 2005 traffic levels for 2000 and 2025 was calculated by applying percentages to the 2005 traffic levels in each category shown in Table 5-5. For vessels forecasted to call at the BP Cherry Point dock in 2025, crude oil tankers were expected to range from 90 percent lower to 17 percent higher than in 2005, depending on the scenario—low, medium, or high. At the same time, refined petroleum product vessels calling at the marine terminal were expected to be approximately the same (-2 percent) to 90 percent higher, depending on the scenario. Other tank vessels, bulk carriers, and container vessel traffic were expected to range from a decrease in as much as 54 percent from 2000 to 2025 under BP's low-range traffic forecast scenario to an increase in 2025 of as much as 162 percent under BP's high-range traffic forecast scenario.

5.3.7 Display of GWU VTRA Simulation Output

Results of the simulation were provided by the GWU VTRA Team using a standardized display format called a *geographic profile*. The display format allowed for direct visual comparison of alternative cases to one another and included summary statistical results. An example is shown in Figure 5-4.

These displays include three key elements: a color scale, map, and graph. The results in the map portion of a geographic profile are colored coded in reference to a standardized color scale shown on the left of the geographic profile. The colors vary according to a factor greater or less than the average value for the statistical parameter displayed. For example, the sample display shown in Figure 5-4 shows the number of accidents per year of tankers and tugs docking at the BP Cherry Point dock for Case B – year 2005 with the North Wing in operation. The color corresponding to the average value of accidents is light green, where the factor value is 1 on the color scale. Locations that are red on the map are up to 10 times higher (factor value 10) than the average, and locations that are blue/green are on the order of one-tenth (factor value 0.09) of the average value of number of accidents per year. Viewing this geographic profile example indicates that the higher number of potential accidents is likely to occur in the Rosario Strait portion of the study area because the incidence of orange- and red-colored cells (2.5 to 10 times the average) is higher in this area.

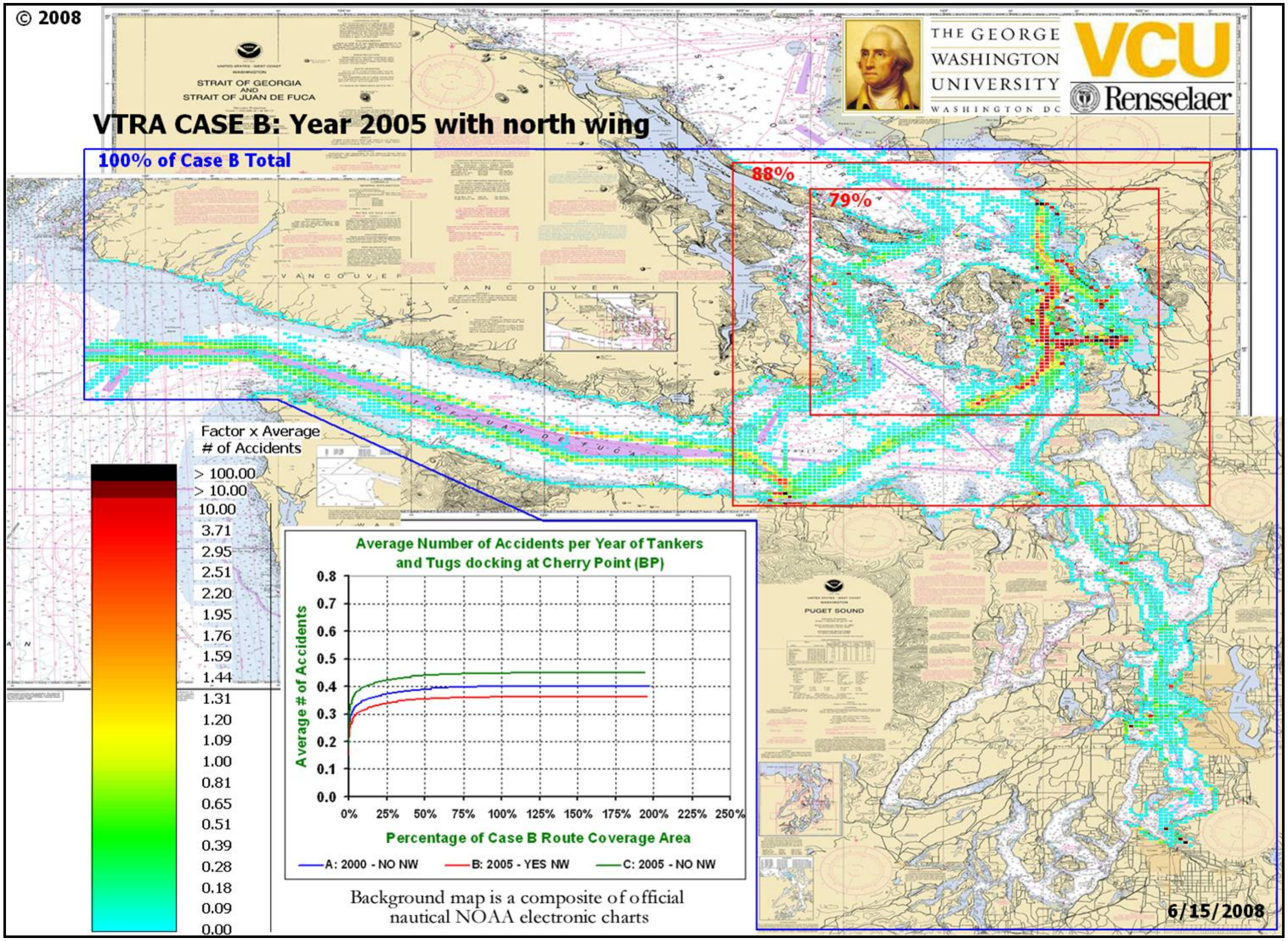

Figure 5-4 GWU VTRA Geographic Profile – Sample Simulation Results

Source: van Dorp et al. 2008.

The map portion of the display also includes two red boxes. The larger box is labeled "88%," meaning that 88 percent of the total annual accident potential occurs within the box and the remaining 12 percent occurs outside of it. Similarly, the smaller box labeled "79%" defines that portion of the simulation study area containing 79 percent of the total accident potential. Comparing these boxes (and the percent value they contain) between different cases gives some geographic context to the comparative results.

The graph portion of the geographic profile displays the grid cell data for the subject of an individual geographic profile. Figure 5-4 compares the results of Case B to Cases A and C.

5.3.8 GWU VTRA Simulation Results

For each vessel traffic simulation case, annual accident potential and expected oil outflow volumes were reported by the simulation model for the routes within the study area traveled by vessels calling at the BP Cherry Point dock. Table 5-6 summarizes the overall simulation results for each of the fifteen cases. It shows that, except for Cases D and E, an allision is the most likely incident that would occur and that the largest oil outflows predicted to occur would result from power groundings.

5.4 GWU VTRA ASSESSMENT OF INCREMENTAL ENVIRONMENTAL RISK

Operation of the marine transportation system and the BP Cherry Point dock includes design features and operating protocols to prevent the release of crude oil or refined petroleum product to the environment. However, the possibility of an accidental release of crude oil or refined petroleum product does exist, with potential negative environmental consequences. Such consequences are the result of two sequential probabilistic events: (1) an accident occurring; and (2) when an accident occurs, the release (spill) of crude oil or refined petroleum product to the environment. Once a release occurs, emergency response measures would be implemented to contain and remove the released material from the environment. Such measures have varying degrees of effectiveness due to environmental conditions (e.g., weather conditions, wave action, and ocean currents) and some impacts on environmental resources are expected to occur in the event of a release. Potential impacts on environmental resources from spills of crude oil or refined petroleum product are discussed in Chapter 6.

5.4.1 Modes of Oil Spill and Environmental Risk in the GWU VTRA Model

Spills of crude oil and refined petroleum product have the potential to occur during: (1) marine transportation to and from the BP Cherry Point dock; (2) loading and unloading at the BP Cherry Point dock; and (3) routine maintenance of the dock and its cargo transfer facilities. The incremental environmental risks associated with each of these modes are discussed and analyzed separately in the following sections.

As noted, the GWU VTRA vessel traffic simulations assessed four types of accidents: collisions, allisions, power groundings, and drift groundings. The different accident types are expected to occur in different circumstances and would generate differing oil outflows. For example, a collision may result in oil outflow from both the vessel calling at the BP Cherry Point dock and the second vessel involved in the collision. In comparison, allisions are expected to result in an oil outflow from a single vessel.

Table 5-6 GWU VTRA Simulation Results

Simulation Case	Annual Accident Potential	Most Likely Accident	Annual Oil Outflow Potential (M^3/bbl/gallons)	Source of Largest Oil Outflow
A – 2000 without North Wing, without GPT	0.4016	Allision	177.58/1,117/ 46,913	Power grounding
B – 2005 with North Wing, without GPT	0.3636	Allision	141.04/887/ 37,253	Power grounding
C – 2005 without North Wing, without GPT	0.4496	Allision	209.29/1,316/ 55,271	Power grounding
D – 2025 low-range traffic forecast with North Wing,	0.1469	Collision	27.25/171/ 7,181	Power grounding
E – 2025 low-range traffic forecast without North Wing	0.1377	Collision	30.64/193/ 8,105	Power grounding
F – 2025 medium-range traffic forecast with North Wing	0.474	Allision	174.4/1,097/ 46,073	Power grounding
G – 2025 medium-range traffic forecast without North Wing	0.5247	Allision	262.98/1,654/ 69,467	Power grounding
H – 2025 high-range traffic forecast with North Wing	0.6819	Allision	229.85/1,446/ 60,731	Power grounding
I – 2025 high-range traffic forecast without North Wing	0.7482	Allision	278.54/1,752 73,583	Power grounding
J – 2005 with North Wing, without Saddlebag Route, without GPT	0.3638	Allision	140.71/885/ 37,169	Power grounding
K – 2025 high-range traffic forecast with North Wing, without Saddlebag Route	0.6973	Allision	230.21/1,448/ 60,815	Power grounding
L – 2005 with North Wing, with extended tug escort, without GPT	0.3583	Allision	136.93/861/ 36,161	Power grounding
M – 2025 high-range traffic forecast with North Wing, with extended tug escort	0.6753	Allision	226.12/1,422/ 59,723	Power grounding
N – 2005 with North Wing, without Neah Bay tug, without GPT	0.3636	Allision	141.16/888/ 37,295	Power grounding
O – 2025 high-range traffic forecast with North Wing, without Neah Bay tug	0.6819	Allision	230.0/1,447/ 60,773	Power grounding

Notes:

bbl = barrels; GPT = Gateway Pacific Terminal

While the values reported for accident potential and oil outflow appear to have great precision, they are forecasts and not actual measured values. The values presented should be considered comparatively and not based on their absolute value. Further comparison of results for individual grid cells, or aggregations of grid cells for small areas, also should be viewed comparatively as the simulation results are not designed to produce high geographic resolution.

Source: van Dorp et al. 2008 (see Appendix G of the VTRA Report).

5.4.2 Marine Transportation Incremental Risk in the GWU VTRA Model

Marine transportation risk in the study area occurs over transportation routes from the entrance of the Strait of Juan de Fuca to the BP Cherry Point dock (Figure 5-2). The GWU VTRA vessel traffic simulation was developed to assess the potential risk of an accident where oil outflow (crude oil or refined petroleum product spills) could occur and the amount of outflow likely to occur under varying accident situations.

As described in Section 5.2.5, the GWU VTRA vessel simulation included 15 separate simulation cases. For each case, output statistics were produced summarizing the average accident potential for each accident type, the total or cumulative accident potential, and the oil outflow or losses associated with each type of accident. These statistics describe the annual accident and oil outflow potential over the entire study area, giving a regional measure of risk.

The GWU VTRA vessel traffic simulation provided the basis for assessment of risk (both the potential for accidents and the likely outflow) from three different perspectives:

1. **Current and Future Regional Incremental Risk.** NEPA requires evaluation of potential environmental impacts under the range of operating conditions the project is expected to encounter. For the BP Cherry Point dock, this includes current conditions (i.e., the time period when the North Wing began operations) and future conditions (i.e., consideration of future changes in use of the marine terminal and associated changes in marine traffic in the greater Puget Sound).

2. **Current and Future Regional Incremental Risk by Accident Type/Spill Volume.** The GWU VTRA vessel traffic simulation results included evaluation of the types of accidents that may occur (collisions, allisions, power groundings, and drift groundings) and the amount of oil outflow associated with each accident type. Because all accidents except collisions are likely to happen close to shore, they may cause more immediate effects on intertidal and nearshore resources and on human uses.

3. **Geographical Incremental Risk.** Different environmental resources may be exposed to different levels of risk, depending on their location. Vessel traffic simulation results (annual accident and oil outflow potential) were examined by identified subareas of the study region to determine whether operation of the North Wing caused an increase or decrease in risk in different areas.

5.4.3 Current and Future Regional Incremental Environmental Risk in the GWU VTRA Model

The GWU VTRA vessel traffic simulation results include statistics describing the annual risk of accident and potential total oil outflow over the entire route taken by vessels transiting to and departing from the BP Cherry Point dock. Comparing these statistics under current and future conditions shows the incremental change, and the associated impact of operating the North Wing, in the potential risk of accidents and oil outflow over the entire study area.

To assess incremental environmental risk under current conditions, vessel traffic simulation Case C (year 2005 without the North Wing) and Case B (year 2005 with the North Wing) were compared (Table 5-7). This comparison shows that, although approximately 10 percent more vessel calls occurred with the North Wing in operation, the potential risk of all accidents combined fell by 19 percent, and the total potential oil outflow fell by approximately 33 percent. These results are shown in Figures 5-5 and 5-6.

In both Cases B and C, the most likely type of accident to occur was an allusion; however, the potential for allisions fell by 14 percent with the North Wing in operation. Similarly, the largest potential source of oil outflow was from a power grounding, but the total potential spill volume from power groundings was reduced by 30 percent with the North Wing in operation. These results are shown in Figures 5-5 and 5-6.

Table 5-7 Current (2005) and Future (2025) Regional Incremental Environmental Risk with and without the North Wing

Simulation Case	Total Cherry Point Calls	Percent Change in Calls	Annual Accident Potential	Percent Change in Accident Potential	Most Likely Accident Event			Annual Oil Outflow Potential		Largest Outflow Source		
					Type	Frequency	%	Gallons	%	Type	Gallons	%
Current (2005) Incremental Regional Risk with and without the North Wing												
C – 2005 without North Wing	244	-	0.4496	-	Allision	0.2106	-	55,272	-	Power grounding	33,021	-
B – 2005 with North Wing	268	10	0.3636	-19	Allision	0.1818	-14	37,254	-33	Power grounding	22,983	-30
Future (2025) Incremental Regional Environmental Risk with and without the North Wing												
I – 2025 high-range traffic forecast without North Wing	264	-	0.7482	-	Allision	0.2787	-	73,584	-	Power grounding	46,758	-
H – 2025 high-range traffic forecast with North Wing	332	26	0.6819	-9	Allision	0.3065	10	60,732	-17	Power grounding	39,361	-16
G – 2025 medium-range traffic forecast without North Wing	250	-	0.5247	-	Allision	0.25	-	69,468	-	Power grounding	39,097	-
F – 2025 medium-range traffic forecast with North Wing	283	13	0.474	-10	Allision	0.2239	-10	46,074	-37	Power grounding	28,795	-38
E – 2025 low traffic forecast without North Wing	101	-	0.1377	-	Collision	0.0518	-	8,106	-	Power grounding	4,491	-
D – 2025 low-range traffic forecast with North Wing	106	5	0.1469	7	Collision	0.061	18	7,182	-11	Power grounding	4,491	0
Current (2005) to Future (2025) Incremental Risk from Change in Traffic (with North Wing)												
B – 2005 with North Wing	268	-	0.3636	-	Allision	0.1818	-	37,254	-	Power grounding	22,983	-
H – 2025 high-range traffic forecast with North Wing	332	24	0.6819	88	Allision	0.3065	69	60,732	63	Power grounding	39,361	70
F – 2025 medium-range traffic forecast with North Wing	283	6	0.474	30	Allision	0.2239	23	46,074	24	Power grounding	28,795	25
D – 2025 low-range traffic forecast with North Wing	106	-60	0.1469	-60	Collision	0.061	-66	7,182	-81	Power grounding	4,491	-81

Table 5-7 Current (2005) and Future (2025) Regional Incremental Environmental Risk (Continued)

Simulation Case	Total Cherry Point Calls	Percent Change in Calls	Annual Accident Potential	Percent Change in Accident Potential	Most Likely Accident Event			Annual Oil Outflow Potential		Largest Outflow Source		
					Type	Frequency	%	Gallons	%	Type	Gallons	%
Change in Incremental Risk from Current (2005) without North Wing to Future (2025) with North Wing												
C – 2005 without North Wing	244	--	0.4496	--	Allision	0.2106	-	55,272	-	Power grounding	33,021	-
H – 2025 high-range traffic forecast with North Wing	332	36	0.6819	52	Allision	0.3065	46	60,732	10	Power grounding	39,361	19
F – 2025 medium-range traffic forecast with North Wing	283	16	0.474	5	Allision	0.2239	6	46,074	-17	Power grounding	28,795	-13
D – 2025 low-range traffic forecast with North Wing	106	-57	0.1469	-67	Collision	0.061	-71	7,182	-87	Power grounding	4,491	-87
Current (2005) to Future (2025) Incremental Risk from Change in Traffic without North Wing												
C – 2005 without North Wing	244	-	0.4496	-	Allision	0.2106	-	55,272	-	Power grounding	33,021	-
I – 2025 high-range traffic forecast without North Wing	264	8	0.7482	66	Allision	0.2787	32	73,584	33	Power grounding	46,758	41
G – 2025 medium-range traffic forecast without North Wing	250	2	0.5247	17	Allision	0.25	19	69,468	26	Power grounding	39,097	18
E – 2025 low-range traffic forecast without North Wing	101	-59	0.1377	-69	Collision	0.0518	-75	8,106	-85	Power grounding	4,491	-87

Source: van Dorp et al. 2008.

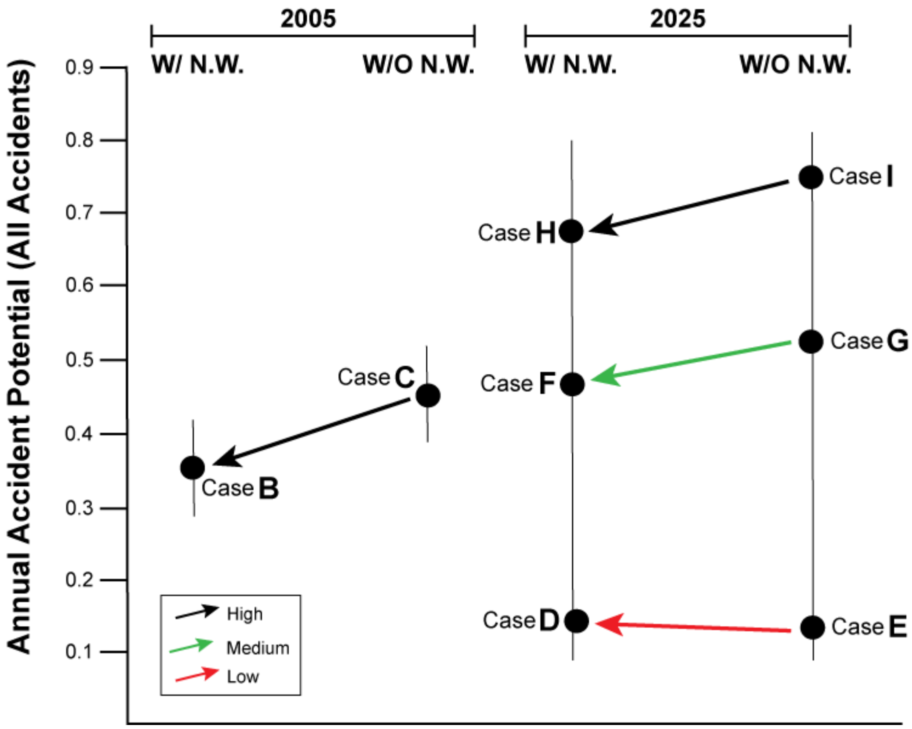

Figure 5-5 Comparison of Current (2005) and Future (2025) Annual Accident Potential

Source: van Dorp et al. 2008.

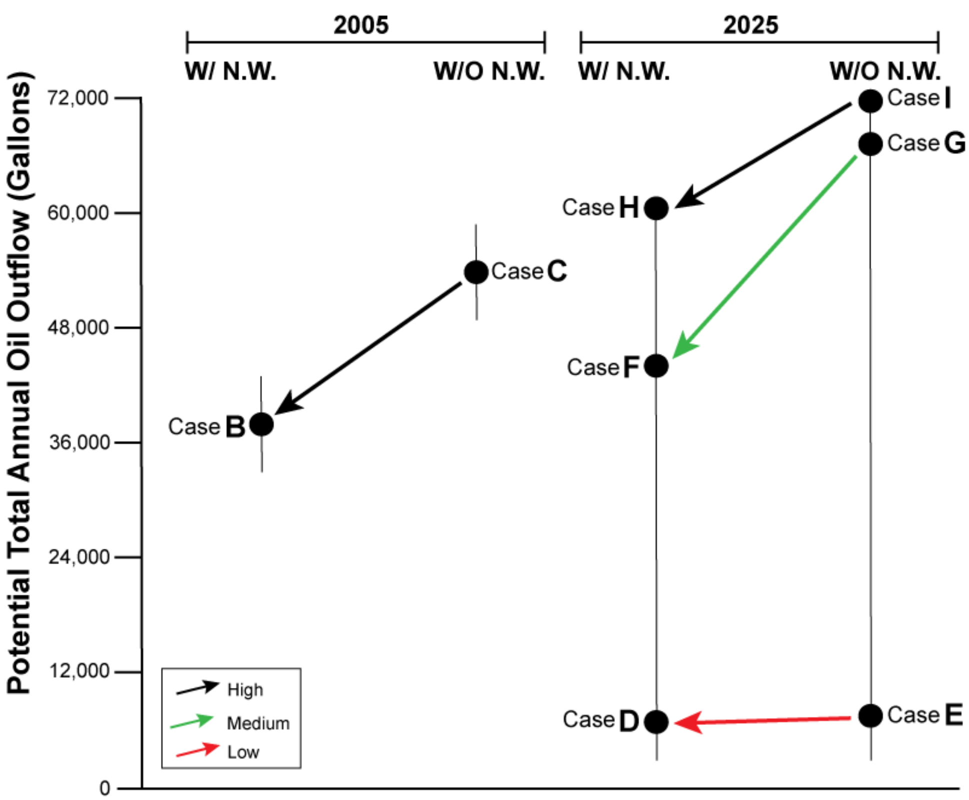

Figure 5-6 Comparison of Current (2005) and Future (2025) Annual Oil Outflow Potential

Source: van Dorp et al. 2008.

To assess incremental environmental risk under future conditions, vessel traffic simulation Cases I and H (2025 high-range traffic forecast), Cases G and F (2025 medium-range traffic forecast), and Cases E and D (2025 low-range traffic forecast) were compared to each other (see Table 5-1 for case descriptions). These cases also include projected traffic generated by the proposed GPT to be located in the vicinity of the BP Cherry Point dock site. These results are shown in Figures 5-5 and 5-6.

These comparisons showed that, although the number of calls at the BP Cherry Point dock increased in the future over a range of 5 to 26 percent, annual accident potential dropped by approximately 10 percent—except in the low-range traffic forecast case, which showed a slight increase. It should be noted that the slight increase in the low-range traffic forecast case was associated with an annual accident potential that is significantly less than the accident potential in the medium- and high-range traffic forecast cases. In all cases, total potential oil outflow and the associated direct impact on the environment was reduced over a range of 11 to 37 percent with operation of the North Wing.

In the medium- and high-range traffic forecast cases, allisions were the most likely type of accident to occur. Although overall accident potential fell in the high-range traffic case, allisions increased by 10 percent. In the low-range traffic case, collisions were the single most likely type of accident to occur, increasing by approximately 20 percent. For all cases, the greatest potential for oil outflow resulted from power groundings, but the simulation showed that the change in potential oil outflow with the North Wing in operation would result in no increase in the low-range traffic forecast case to as much as a 38-percent decrease in the medium-range traffic forecast case.

Conclusions of Current and Future Incremental Environmental Risk in the GWU VTRA Model

The GWU VTRA traffic simulation study found that:

- Under current operations, the potential for accident and the total potential oil outflow were reduced with use of the North Wing.
- In the future (2025), the annual accident potential and the total potential for oil outflow also are expected to be reduced with operation of the North Wing. In the low-range future traffic forecast, the results show a slight increase in accident potential may occur, but this increase is in contrast to an expected reduction in oil outflow in the medium- and high-range traffic forecast cases.

5.4.4 Regional Incremental Risk by Accident Type and Oil Outflow Volume

Following the evaluation of overall incremental environmental risk for the study area, the incremental risk by each accident type was evaluated. Using the same cases (Cases B and C for current conditions and Cases I to H, G to F, and E to D for high-, medium- and low-range traffic forecast scenarios, respectively), the incremental change in potential accident frequency and oil outflow was evaluated separately for collisions, allisions, drift groundings, and power groundings. These results are shown in Table 5-8 and in Figure 5-7. For review purposes, the potential accident frequency and related oil outflow are listed in descending order in Table 5-8. When reviewing the simulation results, it is important to compare both the percent change between cases for an accident type and the relative contribution of an accident type to the total. This is most clearly seen in Figure 5-7.

Table 5-8 Current (2005) and Future (2025) Regional Accident Potential and Oil Outflow by Accident Type

Simulation Case	Accident Type	Annual Accident or Oil Outflow Potential	Percent of Total	Percent Change	Accident Type	Annual Accident or Oil Outflow Potential	Percent of Total	Percent Change	Accident Type	Annual Accident or Oil Outflow Potential	Percent of Total	Percent Change	Accident Type	Annual Accident or Oil Outflow Potential	Percent of Total	Percent Change	Total
Current (2005) Incremental Regional Risk with and without North Wing																	
Accident Potential in Order of Likelihood																	
C – 2005 without North Wing	Allision	0.2106	47		Collision	0.1317	29		Power grounding	0.094	21		Drift grounding	0.014	3		0.45
B – 2005 with North Wing	Allision	0.1818	50	C-B -16	Collision	0.0909	25	C-B -45	Power grounding	0.079	22	C-B -18	Drift grounding	0.012	3	C-B -17	0.364
Oil Outflow in Order of Released Volume (gallons)																	
C – 2005 without North Wing	Power grounding	33,012	60		Collision	20,748	38		Drift grounding	1,470	3		Allision	336	1		209.3
B – 2005 with North Wing	Power grounding	23,058	62	C-B -43	Collision	12,435	33	C-B -67	Drift grounding	1,344	4	C-B -8	Allision	168	0	C-B -103	141
Future (2025) Incremental Regional Risk with and without North Wing																	
Accident Potential in Order of Likelihood																	
I – 2025 without North Wing	Allision	0.2787	37		Collision	0.258	34		Power grounding	0.186	25		Drift grounding	0.025	3		0.748
H – 2025 with North Wing	Allision	0.3065	45	I-H 9	Collision	0.1981	29	I-H -30	Power grounding	0.156	23	I-H -20	Drift grounding	0.022	3	I-H -15	0.682
G – 2025 with-out North Wing	Allision	0.25	48		Collision	0.1418	27		Power grounding	0.116	22		Drift grounding	0.017	3		0.525
F – 2025 with North Wing	Allision	0.2239	47	G-F -12	Collision	0.1308	28	G-F -8	Power grounding	0.104	22	G-F -11	Drift grounding	0.015	3	G-F -13	0.474
E – 2025 with-out North Wing	Collision	0.0518	38		Allision	0.0448	33		Power grounding	0.036	26		Drift grounding	0.005	4		0.138
D – 2025 with North Wing	Collision	0.061	42	E-D 15	Allision	0.0437	30	E-D -3	Power grounding	0.038	26	E-D 4	Drift grounding	0.005	3	E-D -6%	0.147

Table 5-8 Current (2005) and Future (2025) Regional Accident Potential and Oil Outflow by Accident Type (Continued)

Simulation Case	Accident Type	Annual Accident or Oil Outflow Potential	Percent of Total	Percent Change	Accident Type	Annual Accident or Oil Outflow Potential	Percent of Total	Percent Change	Accident Type	Annual Accident or Oil Outflow Potential	Percent of Total	Percent Change	Accident Type	Annual Accident or Oil Outflow Potential	Percent of Total	Percent Change	Total
Future (2025) Incremental Regional Risk with and without North Wing (Continued)																	
Oil Outflow in Order of Released Volume (gallons)																	
I – 2025 without North Wing	Power grounding	46,746	63		Collision	25,074	34		Drift grounding	38	2		Allision	8,820	0		278.5
H – 2025 with North Wing	Power grounding	39,270	65	I-H -19	Collision	19,992	33	I-H -26	Drift grounding	31	2	Ii-H -23	Allision	7,056	0	I-H -9	229.9
G – 2025 with-out North Wing	Power grounding	39,018	56		Collision	28,854	42		Drift grounding	33	2		Allision	8,820	0		263
F – 2025 with North Wing	Power grounding	28,812	62	F-G -36	Collision	15,876	34	F-G -82	Drift grounding	26	2	F-G -26	Allision	12,348	1	F-G 37	174.4
E – 2025 with-out North Wing	Power grounding	4,452	55		Collision	3,402	42		Drift grounding	4	2		Allision	1,764	1		30.64
D – 2025 with North Wing	Power grounding	4,452	62	D-E 0	Collision	2.520	35	D-E -36	Drift grounding	4	2	D-E -11	Allision	1,764	1	D-E 24	27.25

Source: van Dorp et al. 2008.

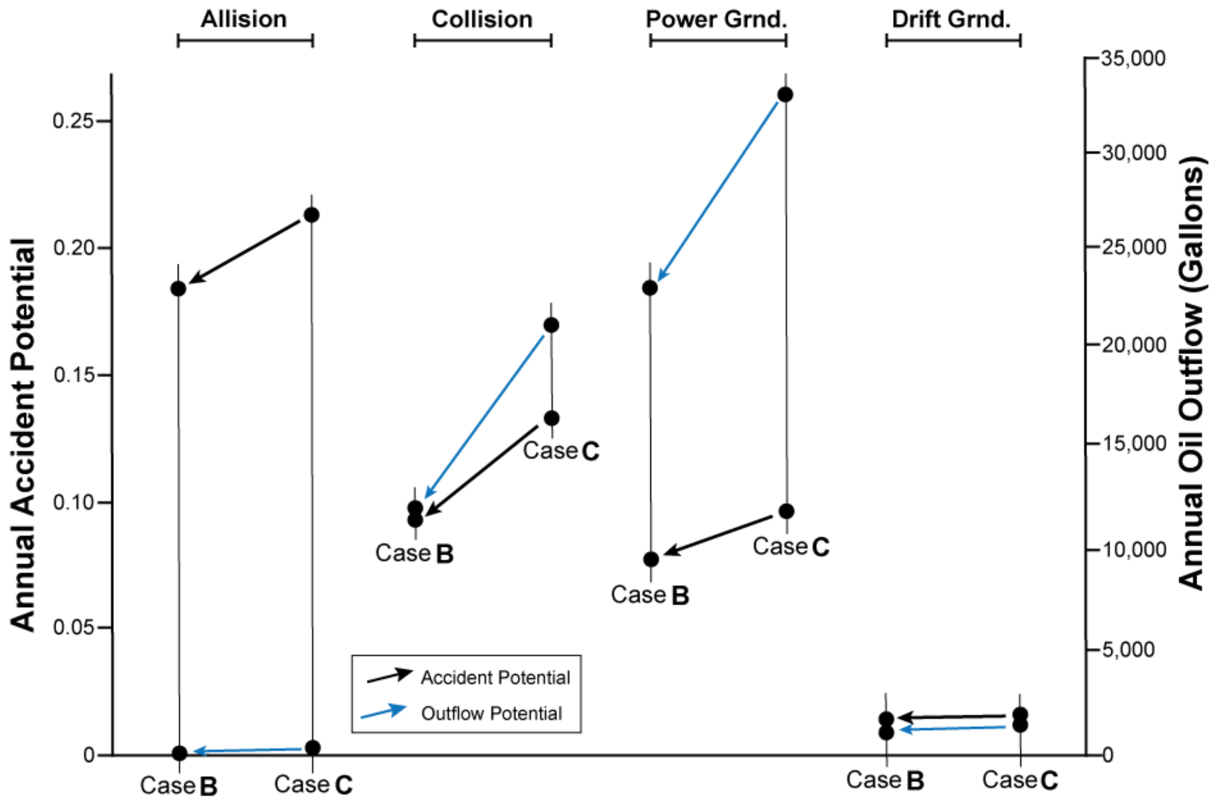

Figure 5-7 Comparison of Current (2005) and Future (2025) Annual Accident Potential and Oil Outflow Potential by Accident Type

Source: van Dorp et al. 2008.

Under current conditions, the most likely type of accident to occur is allision (an arriving or departing tanker or barge striking a fixed object). The second most likely accidents are collisions, followed by power groundings, and then drift groundings. Allisions account for approximately one-half of the total accident potential; when combined, allisions and collisions account for approximately 76 percent of the total accident potential in Cases B and C. Operation of the North Wing is expected to reduce allisions by approximately 16 percent and collisions by approximately 45 percent.

Power groundings are expected to produce the largest oil outflow under current conditions (approximately 60 percent), followed by collisions (33–38 percent). Allisions, the most likely type of accident to occur, contribute only 1 percent to the total annual expected oil outflow. Operation of the North Wing was found to reduce oil outflow from power groundings by 43 percent and from collisions by 67 percent. The relative magnitude of reductions can clearly be seen in Figure 5-7.

The GWU VTRA simulation results show that both current annual accident potential and expected oil outflow are reduced for each type of accident with operation of the North Wing. The simulation results also show that, although allisions have the greatest annual accident potential, the expected oil outflow from this type of accident is small (Figure 5-7)—in the range of approximately 158 to 322 gallons. The results also show that collisions and power groundings, and their associated oil outflow, contribute significantly to accident potential and oil outflow, but are reduced with operation of the North Wing. Relative to the other accident types, drift groundings contribute only minimally to environmental risk under current conditions.

Results for the future traffic cases also are shown in Table 5-8 and in Figures 5-8 (accident potential) and 5-9 (oil outflow). Both annual accident potential and expected oil outflow are reduced in the future for most types of accidents with operation of the North Wing.

Exceptions to the general reduction in accident potential include an approximately 9-percent increase in predicted allisions under the high-range traffic forecast scenario, and a 15-percent increase in collisions under the low-range traffic forecast scenario. However, as shown in Figure 5-9, allisions contribute very little to oil outflow and would be reduced in the high-range traffic forecast. Similarly, while collisions increase in the low-range traffic forecast, oil outflow decreases in the low-range traffic forecast with operation of the North Wing.

In 2025 with the North Wing in operation, oil outflows are predicted to be reduced in all cases except for allisions, where they statistically are shown to increase under the medium- and low-range traffic forecasts. However, the outflows for allisions are on the order of approximately 252 gallons, a small amount compared to all other accident types. As shown in Figure 5-9, significant reductions in oil outflows occur for collisions and power groundings, the two primary sources of oil outflows in the future traffic cases.

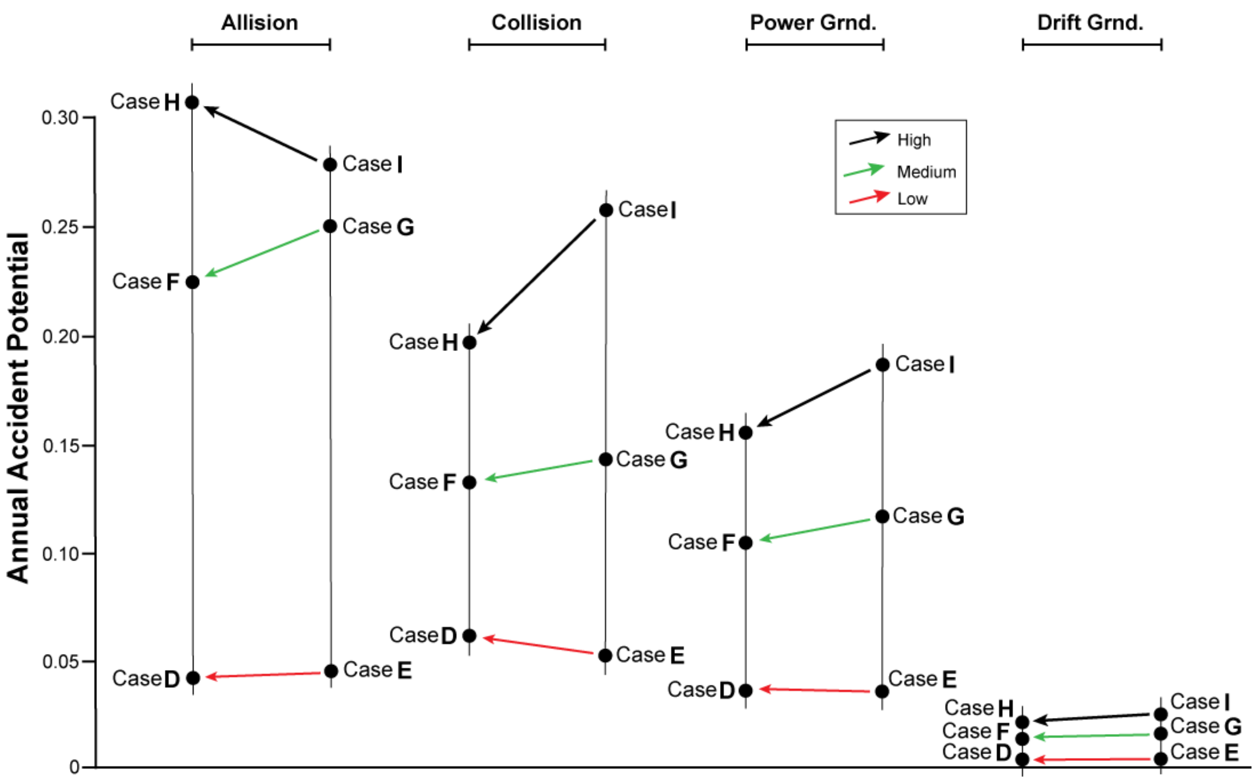

Figure 5-8 Comparison of Current (2005) and Future (2025) Annual Accident Potential by Accident Type

Source: van Dorp et al. 2008.

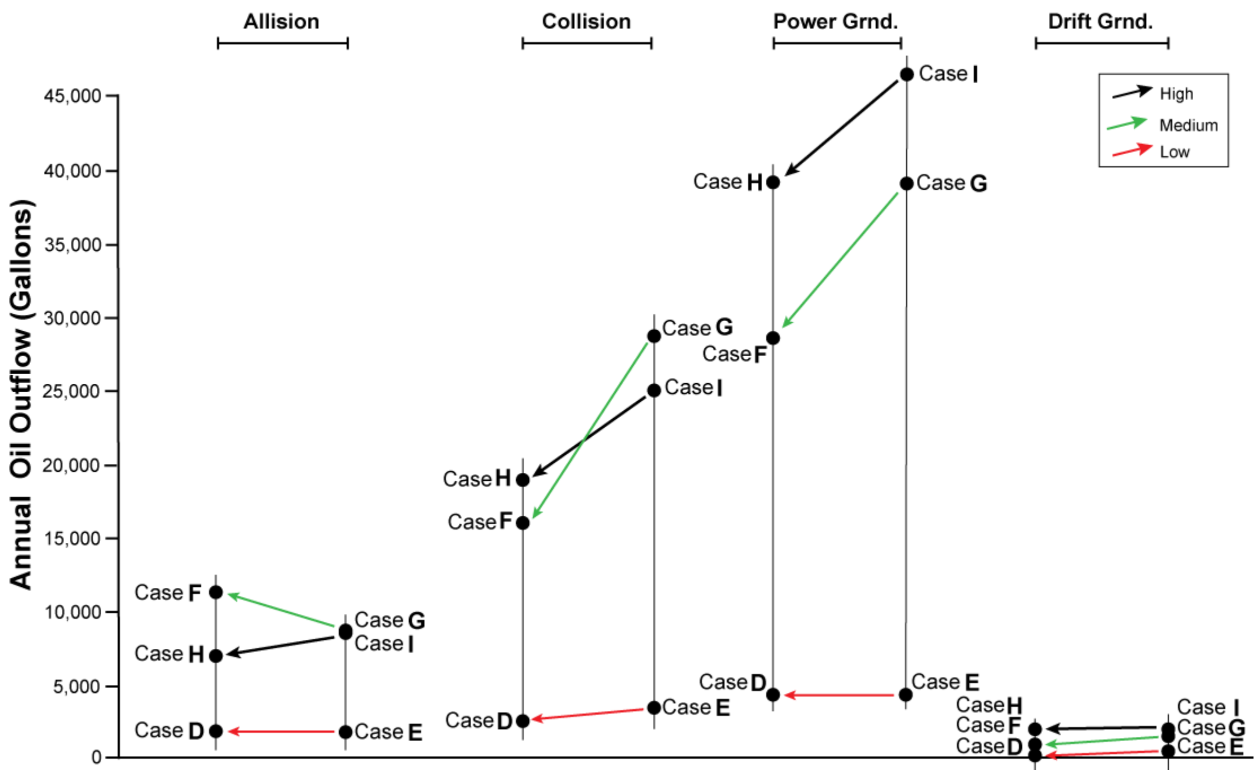

Figure 5-9 Comparison of Current (2005) and Future (2025) Annual Oil Outflow Potential by Accident Type

Source: van Dorp et al. 2008.

Conclusions of Current and Future Regional Incremental Environmental Risk by Accident Type and Oil Outflow Volume

The GWU VTRA traffic simulation study found that:

- Under current conditions, total annual accident potential and associated oil outflow volumes are reduced for all accident types with operation of the North Wing.
- Under future conditions, total annual accident potential and associated oil outflow is reduced for accident types that contribute most significantly to environmental risk with operation of the North Wing. In those cases/accident types where the future annual accident potential is expected to increase with operation of the North Wing, potential oil outflows are lower, thus reducing overall environmental risk.

5.4.5 Incremental Environmental Risk by Subarea in the GWU VTRA Model

In Sections 5.4.3 and 5.4.4, incremental environmental risk was considered across the entire transit routes used by vessels in the study area. Over this area, both navigation conditions and environmental resources that may be affected vary. When constructing the simulation, the VTRA Team subdivided the GWU VTRA simulation study area into the following seven subareas (see Figure 5-3):

- **Strait of Juan de Fuca West.** This subarea starts approximately 8 miles west of the entrance buoy (J Buoy) to the Strait of Juan de Fuca to approximately a line between Port Angeles and Victoria, British Columbia. This subarea encompasses both U.S. and Canadian waters, and includes major inbound and outbound vessel traffic lanes. It is a wide waterway with few obstructions that is open to the Pacific Ocean at the entrance.

- **Strait of Juan de Fuca East.** This subarea includes the basin bounded on the north by the San Juan Islands, on the east by Whidbey Island, on the south by the Olympic Peninsula, and on the west by the western portion of the Strait of Juan de Fuca. Admiralty Inlet and the entrance to the lower reaches of Puget Sound are located at the southeast corner of this basin. This subarea includes a number of designated vessel traffic lanes and several cautionary areas where vessel traffic crossings can occur. While inland from the Pacific Ocean, it is still influenced by wind and wave conditions generated in the ocean. It is an open basin with some submerged and partially submerged shoals and islands. Vessel traffic passing through this subarea includes traffic to Seattle area ports.
- **Haro Strait – Boundary Pass.** This subarea connects the Strait of Juan de Fuca and the southern reaches of the Strait of Georgia. It is bounded by the San Juan Islands on the east and Vancouver Island on the west. It is a somewhat narrow passage and includes a restricted channel called Turn Point at the transition from Haro Strait to Boundary Pass. Adjacent to the designated vessel traffic lanes are areas of shallows and numerous islands. This is the primary passage for commercial traffic between the Pacific Ocean and ports in the Vancouver, British Columbia area.
- **Rosario Strait (San Juan Islands).** This subarea connects the subareas of the Strait of Juan de Fuca East and Cherry Point through a narrow waterway between the San Juan Islands on the west and Whidbey Island and numerous other islands on the east. The most constrained of all the waterways, Rosario Strait is restricted to passage in only one direction when crude oil and refined petroleum product vessels are present. This passage, with numerous islands and some shoals, is the primary route for traffic to Cherry Point and for fishing vessels in transit from Seattle area ports to northern fishing grounds. This subarea also includes Thatcher Pass, Upright Channel, and portions of San Juan Channel in the interior of the San Juan Islands. These waterways constitute the route of the Washington State Ferry between Anacortes and the San Juan Islands and Sydney, British Columbia. This busy ferry route crosses the Rosario Strait vessel traffic lane.
- **Cherry Point.** This subarea, which includes the BP Cherry Point dock and several other port facilities, is at the north end of Rosario Strait in the southern portion of the Strait of Georgia. It is bounded on the southwest by the San Juan Islands and on the east by the headlands of Whatcom County. To the northwest are the open reaches of the Strait of Georgia. Vessel traffic passing through this subarea rejoins the vessel traffic lanes toward ports in the Vancouver, British Columbia area.
- **Saddlebag.** The Saddlebag subarea includes the Saddlebag Route—one of two transit routes between the BP Cherry Point dock and the March Point refineries in Padilla Bay. The Saddlebag subarea includes this transit route and the northern portion of Padilla Bay. It also includes the route from the Saddlebag transit to the Port of Bellingham in Bellingham Bay. The waters in this subarea are generally wide, navigable channels. However, lesser islands and shoal waters are present, as is a narrow restriction at the southern end of Guemes Island. This subarea also includes the Vendovi anchorage.
- **Guemes Channel.** Guemes Channel is a second route from the area of the BP Cherry Point dock to the refineries at March Point. This subarea includes the waters between Guemes Island and Fidalgo Island and the waters of Padilla Bay. This subarea includes some areas of shallow water, but the shipping lanes are generally free of shoals and lesser islands.

For each subarea, annual accident potential and expected oil outflow results were generated by the GWU VTRA simulation for each simulation case. Comparisons among simulation cases were made by subareas to determine whether there were changes in the locations of areas of higher accident potential and potential oil outflows with and without operation of the North Wing.

Changes in current environmental risk by subarea were determined by comparing Case B (2005 with the North Wing) to Case C (2005 without the North Wing). The results of this comparison are shown in Table 5-9 and displayed in Figure 5-10. The simulation demonstrated that operation of the North Wing reduced the current annual accident potential and expected oil outflow in all but one of the subareas (Haro Strait-Boundary Pass subarea). The Cherry Point subarea had the highest accident potential without operation of the North Wing but showed clear reductions in both accident potential and potential oil outflow with operation of the North Wing (see Figure 5-10). Guemes Channel and Rosario Strait had the highest potential oil outflows without operation of the North Wing and showed reductions in potential oil outflows with operation of the North Wing. In addition, Guemes Channel showed a reduction in accident potential, and Rosario Strait showed a small reduction in accident potential, with operation of the North Wing. The Haro Strait-Boundary Pass subarea showed an increase in both accident potential and oil outflow, but the actual values for this subarea were comparatively the smallest of all subareas.

Changes in future incremental environmental risk by subarea were determined by comparing the following simulation cases:

- Cases H and I – 2025 high-range traffic forecast scenario
- Cases F and G – 2025 medium-range traffic forecast scenario
- Cases D and E – 2025 low-range traffic forecast scenario

These comparisons produced a range of changes in environmental risk. The results of these comparisons are shown in Tables 5-10, 5-11, and 5-12, and in Figures 5-11 and 5-12.

Annual accident potential would remain the same or would be reduced in most subareas for the high, medium, and low future (2025) traffic forecasts, with several exceptions. A small increase in accident potential occurred in the Cherry Point subarea under the high-range future traffic forecast. Risk of accidents in the Cherry Point subarea remained unchanged for the low-range future traffic forecast case and fell 13 percent under the medium-range future traffic forecast. Accident potential showed a 6-percent increase in the Strait of Juan de Fuca East subarea, but the actual accident potential was among the smallest actual accident potential rates. Under the low-range future traffic forecast, increases were shown for several subareas, including Guemes Channel, Haro Strait – Boundary Pass, Saddlebag, and the Strait of Juan de Fuca West (Tables 5-9, 5-10, and 5-11). However, actual accident potential rates in these subareas were also among the lowest of all rates. In the future 2025 scenario, operation of the North Wing resulted in a large reduction in expected oil outflow in the Guemes Channel subarea, the location of the comparatively highest oil outflows in the high- and medium-range future traffic forecast cases. Oil outflow was relatively unchanged in the Guemes Channel under the low-range traffic forecast. In all other subareas, potential oil outflow was comparatively low without operation of the North Wing and remained low with operation of the North Wing, except in the Rosario Strait subarea. In the Rosario Strait subarea, oil outflow was reduced under the medium-range traffic forecast but increased under the high-range traffic forecast.

Table 5-9 Current (2005) Regional Incremental Environmental Risk by Subarea with and without the North Wing

Simulation Case	Subarea	Annual Accident Potential	Percent Change	Most Likely Accident Event			Annual Oil Outflow Potential		Largest Outflow Source		
				Type	Frequency	Percent Change	Gallons	Percent Change	Type	Gallons	Percent Change
C – 2005 without North Wing	Cherry Point	0.2012	-15	Allision	0.1866	-15	5,922	-18	Power grounding	4,662	-19
B – 2005 with North Wing		0.1701		Allision	0.1577		4,830		Power grounding	3,822	
C – 2005 without North Wing	Guemes Channel	0.1066	-46	Collision	0.0473	-43	16,632	-83	Power grounding	13,146	-81
B – 2005 with North Wing		0.0573		Power grounding	0.0270		2,814		Power grounding	2,478	
C – 2005 without North Wing	Haro Strait – Boundary Pass	0.0046	153	Collision	0.0029	-36	1,134	97	Power grounding	966	100
B – 2005 with North Wing		0.0116		Collision	0.0019		2,268		Power grounding	1,974	
C – 2005 without North Wing	Rosario Strait	0.0427	-7	Collision	0.0323	-12	17,682	-27	Collision	10,752	-38
B – 2005 with North Wing		0.0395		Collision	0.0285		12,894		Power grounding	6,720	
C – 2005 without North Wing	Saddlebag	0.0130	-72	Power grounding	0.0070	-2	4,872	13	Power grounding	4,074	5
B – 2005 with North Wing		0.0036		Power grounding	0.0069		5,502		Power grounding	4,284	
C – 2005 without North Wing	Strait of Juan de Fuca East	0.0397	-92	Power grounding	0.0202	2	6,594	-5	Collision	3,360	0
B – 2005 with North Wing		0.0033		Power grounding	0.0206		6,258		Power grounding	3,318	
C – 2005 without North Wing	Strait of Juan de Fuca West	0.0215	-18	Collision	0.0211	2	2,184	13	Collision	1,260	8
B – 2005 with North Wing		0.0177		Collision	0.0216		2,478		Collision	1,302	

Source: van Dorp et al. 2008.

Table 5-10 Future (2025) Regional Incremental Environmental Risk by Subarea with and without the North Wing – High-Range Traffic Scenario

Simulation Case	Subarea	Total Cherry Point Calls	Percent Change in Calls	Annual Accident Potential	Percent Change in Accident Potential	Most Likely Accident Event			Annual Oil Outflow Potential		Largest Outflow Source		
						Type	Freq.	%	Gallons	%	Type	Gallons	%
I – 2025 high-range traffic forecast without North Wing	Cherry Point	264	26	0.2424	7	Allision	0.2173	9	546	8	Power grounding	4,242	19
H – 2025 high-range traffic forecast with North Wing		332		0.2601		Allision	0.2363		6,342		Power grounding	5,040	
I – 2025 high-range traffic forecast without North Wing	Guemes Channel	264	26	0.2507	-33	Collision	0.1079	-38	13,188	-50	Power grounding	30,114	-42
H – 2025 high-range traffic forecast with North Wing		332		0.1690		Power grounding	0.0664		19,824		Power grounding	17,430	
I – 2025 high-range traffic forecast without North Wing	Haro Strait – Boundary Pass	264	26	0.0148	-15	Collision	0.0105	-20	546	7	Collision	252	10
H – 2025 high-range traffic forecast with North Wing		332		0.0125		Collision	0.0084		546		Power grounding	252	
I – 2025 high-range traffic forecast without North Wing	Rosario Strait	264	26	0.0659	-14	Collision	0.0519	-18	13,482	27	Collision	8,442	6
H – 2025 high-range traffic forecast with North Wing		332		0.0565		Collision	0.0423		16,926		Collision	8,988	
I – 2025 high-range traffic forecast without North Wing	Saddlebag	264	26	0.0244	-23	Power grounding	0.0114	1	3,948	19	Power grounding	3,444	20
H – 2025 high-range traffic forecast with North Wing		332		0.0189		Power grounding	0.0115		4,746		Power grounding	4,242	
I – 2025 high-range traffic forecast without North Wing	Strait of Juan de Fuca East	264	26	0.0659	6	Power grounding	0.0293	3	6,342	16	Power grounding	2,898	19
H – 2025 high-range traffic forecast with North Wing		332		0.0695		Power grounding	0.0301		7,392		Collision	3,444	
I – 2025 high-range traffic forecast without North Wing	Strait of Juan de Fuca West	264	26	0.0314	-3	Collision	0.0308	-3	2,646	3	Collision	1,302	22
H – 2025 high-range traffic forecast with North Wing		332		0.0303		Collision	0.0297		2,646		Collision	1,848	

Source: van Dorp et al. 2008.

Table 5-11 Future (2025) Regional Incremental Environmental Risk by Subarea with and without the North Wing – Medium-Range Traffic Scenario

Simulation Case	Subarea	Total Cherry Point Calls	Percent Change in Calls	Annual Accident Potential	Percent Change in Accident Potential	Most Likely Accident Event			Annual Oil Outflow Potential		Largest Outflow Source		
						Type	Freq.	%	Gallons	%	Type	Gallons	%
G – 2025 medium-range traffic forecast without North Wing	Cherry Point	250	13	0.2253	-15	Allision	0.2052	-14	5,544	5	Power grounding	4,746	10
F – 2025 medium-range traffic forecast with North Wing		283		0.1924		Allision	0.1761		6,090		Power grounding	5,040	
G – 2025 medium-range traffic forecast without North Wing	Guemes Channel	250	13	0.1208	-13	Power grounding	0.0526	-25	28,014	-58	Power grounding	20,328	-58
F – 2025 medium-range traffic forecast with North Wing		283		0.1054		Collision	0.0394		11,886		Power grounding	8,442	
G – 2025 medium-range traffic forecast without North Wing	Haro Strait – Boundary Pass	250	13	0.0080	-20	Collision	0.0053	-26	546	-23	Collision	252	9
F – 2025 medium-range traffic forecast with North Wing		283		0.0064		Collision	0.0039		252		Power grounding	252	
G – 2025 medium-range traffic forecast without North Wing	Rosario Strait	250	13	0.0547	-17	Collision	0.0442	-20	22,470	-36	Collision	16,128	-55
F – 2025 medium-range traffic forecast with North Wing		283		0.0455		Collision	0.0355		14,532		Collision	7,392	
G – 2025 medium-range traffic forecast without North Wing	Saddlebag	250	13	0.0142	-7	Power grounding	0.0084	7	3,696	13	Power grounding	3,444	3
F – 2025 medium-range traffic forecast with North Wing		283		0.0133		Power grounding	0.0090		4,242		Power grounding	3,444	
G – 2025 medium-range traffic forecast without North Wing	Strait of Juan de Fuca East	250	13	0.0489	10	Power grounding	0.0219	15	6,342	-2	Power grounding	3,696	1
F – 2025 medium-range traffic forecast with North Wing		283		0.0539		Power grounding	0.0251		6,342		Power grounding	3,696	
G – 2025 medium-range traffic forecast without North Wing	Strait of Juan de Fuca West	250	13	0.0163	31	Collision	0.0159	32	1,596	10	Collision	546	17
F – 2025 medium-range traffic forecast with North Wing		283		0.0214		Collision	0.0209		1,596		Collision	798	

Source: van Dorp et al. 2008.

Table 5-12 Future (2025) Regional Incremental Environmental Risk by Subarea with and without the North Wing – Low-Range Traffic Scenario

Simulation Case	Subarea	Total Cherry Point Calls	Percent Change in Calls	Annual Accident Potential	Percent Change in Accident Potential	Most Likely Accident Event			Annual Oil Outflow Potential		Largest Outflow Source		
						Type	Freq.	%	Gallons	%	Type	Gallons	%
E – 2025 low-range traffic forecast without North Wing	Cherry Point	101	5	0.0395	-5	Allision	0.0325	-1	546	19	Power grounding	294	34
D – 2025 low-range traffic forecast with North Wing		106		0.0374		Allision	0.0320		630		Power grounding	378	
E – 2025 low-range traffic forecast without North Wing	Guemes Channel	101	5	0.0413	14	Power grounding	0.0173	28	1,512	-34	Power grounding	840	-9
D – 2025 low-range traffic forecast with North Wing		106		0.0471		Collision	0.0221		966		Power grounding	756	
E – 2025 low-range traffic forecast without North Wing	Haro Strait - Boundary Pass	101	5	0.0041	41	Collision	0.0027	51	294	171	Power grounding	168	155
D – 2025 low-range traffic forecast with North Wing		106		0.0057		Collision	0.0041		756		Power grounding	462	
E – 2025 low-range traffic forecast without North Wing	Rosario Strait	101	5	0.0169	-10	Collision	0.0133	-15	2,520	-31	Collision	1,344	-28
D – 2025 low-range traffic forecast with North Wing		106		0.0151		Collision	0.0113		1,764		Power grounding	966	
E – 2025 low-range traffic forecast without North Wing	Saddleba g	101	5	0.0050	20	Power grounding	0.0031	-9	1,260	-10	Power grounding	1,050	-4
D – 2025 low-range traffic forecast with North Wing		106		0.0060		Collision	0.0029		1,092		Power Ground.	1,050	
E – 2025 low-range traffic forecast without North Wing	Strait of Juan de Fuca East	101	5	0.0141	7	Collision	0.0075	2	1,554	-12	Power grounding	840	-9
D – 2025 low-range traffic forecast with North Wing		106		0.0151		Collision	0.0076		1,386		Power grounding	756	
E – 2025 low-range traffic forecast without North Wing	Strait of Juan de Fuca West	101	5	0.0046	81	Collision	0.0045	84	252	56	Collision	168	57
D – 2025 low-range traffic forecast with North Wing		106		0.0084		Collision	0.0083		336		Collision	294	

Source: van Dorp et al. 2008.

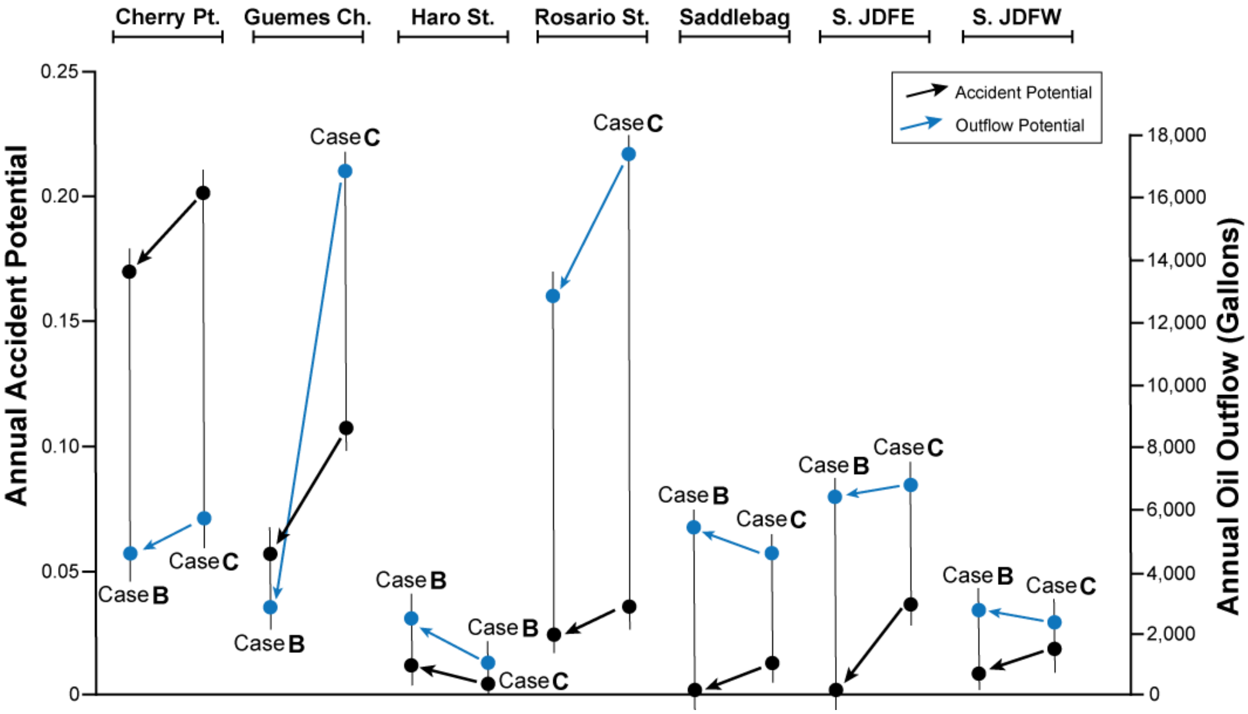

Figure 5-10 Comparison of Current (2005) and Future (2025) Annual Accident Potential and Oil Outflow Potential by Subarea (Case B – Case C)

Source: van Dorp et al. 2008.

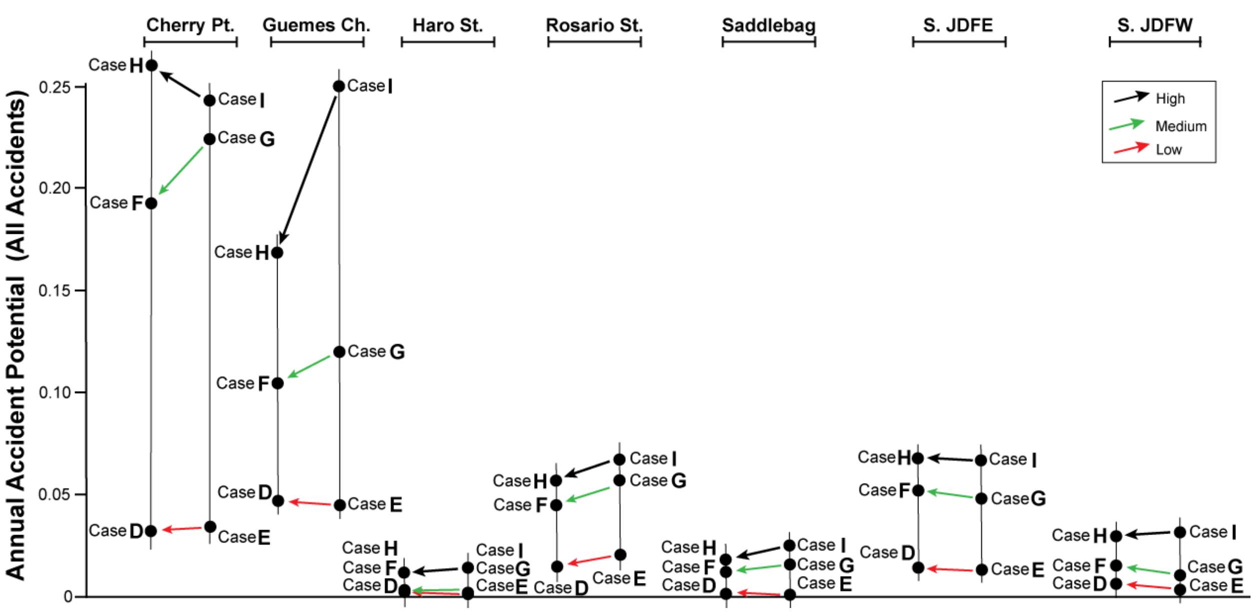

Figure 5-11 Comparison of Current (2005) and Future (2025) Annual Accident Potential by Subarea

Source: van Dorp et al. 2008.

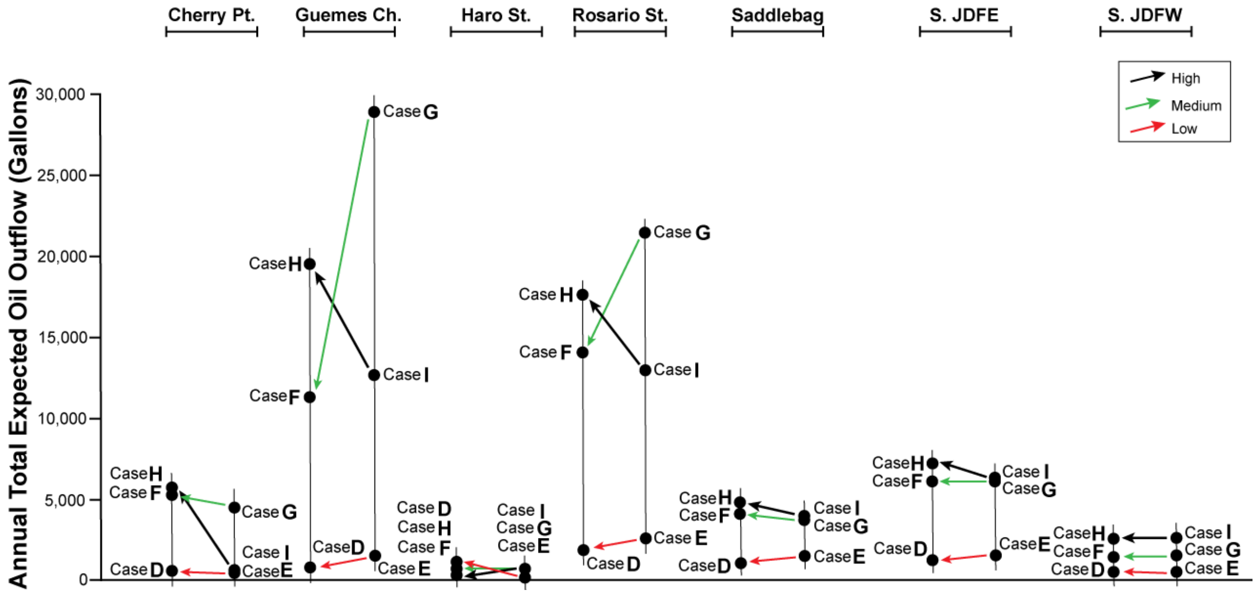

Figure 5-12 Comparison of Current (2005) and Future (2025) Annual Oil Outflow Potential by Subarea

Source: van Dorp et al. 2008.

Review of the geographic profiles for each accident type (see Appendix G-4 of the VTRA Report) shows that the most likely locations of accidents involving vessels calling at the BP Cherry Point dock vary with accident type. Review of Case B geographic profiles show the following:

- **Allisions.** The simulation results indicate that 88 percent of all allisions are expected to occur in the vicinity of the BP Cherry Point dock. Allisions also are expected to occur near refinery facilities at Anacortes and at Port Angeles. The vessel traffic simulation reports that 99.8 percent of all oil outflow related to allisions would occur in the vicinity of the BP Cherry Point dock.
- **Collisions.** The majority of collisions are expected to occur in open water, primarily along the transit routes in the approaches to Rosario Strait, in Rosario Strait itself, and at the approach to Port Angeles. Other areas that would experience a higher potential for collisions include Guemes Channel and the entrance to Padilla Bay.
- **Power Groundings.** The majority of power groundings are expected to occur along the shoreline of Rosario Strait and Guemes Channel (including the entrance to Padilla Bay) and at Port Angeles.
- **Drift Groundings.** Approximately 92 percent of drift groundings, the least likely accident type to occur, are expected on the shoreline of Rosario Strait and the Guemes Channel, or at Port Angeles. Drift groundings also may occur along the southern shoreline of the Strait of Juan de Fuca from Cape Flattery to approximately Pillar Point, but are much less likely there.

Conclusions of Subarea Incremental Environmental Risk

The GWU VTRA traffic simulation study found that:

- Current (2005) annual accident potential and expected oil outflow was reduced or changed very little in all but one of the subareas with operation of the North Wing. The Haro Strait – Boundary Pass subarea showed an increase in both annual accident potential and oil outflow, but the actual values for this subarea were comparatively the smallest of all subareas.
- Future (2025) annual accident potential was highest in the Cherry Point and Guemes Channel subareas, but potential oil outflow was significantly reduced (Guemes Channel) or remained essentially the same (Cherry Point) with operation of the North Wing. Annual oil outflow was predicted to be relatively high in Rosario Strait and to increase in the high-range vessel traffic forecast case, but the potential for accidents in Rosario Strait was relatively low and fell with operation of the North Wing.

5.4.6 Incremental Environmental Risk of Alternative Traffic Management Protocols

Three alternative traffic management protocols that involved changes to vessel operations were identified during scoping for the GWU VTRA study and for the EIS. These alternative protocols are defined in Section 5.3.4 and included:

- Prohibiting use of the Saddlebag Route between Cherry Point and Padilla Bay;
- Extending the use of escort tugs west from Port Angeles to Neah Bay; and
- Positioning a permanent assist tug at Neah Bay.

These alternative traffic management protocols were analyzed thorough GWU VTRA vessel traffic simulation Cases B, J, H, and K for the Saddlebag Route; Cases B, L, H, and M for the extended tug escort protocol; and Cases B, N, H, and O for the Neah Bay tug. The results of these comparisons shown in Table 5-13 indicate that no appreciable difference likely would have occurred in 2005 or would occur in the future (2025) from implementation of these alternatives.

In the case of the Neah Bay tug, the authors of the GWU VTRA study noted that vessels calling at the BP Cherry Point dock are a very small portion of overall vessel traffic entering the Strait of Juan de Fuca and that a tug positioned at Neah Bay would serve all vessel traffic, not only vessels carrying crude oil and refined petroleum product. They note that the conclusion regarding the effectiveness of the Neah Bay tug in reducing annual accident and oil outflow potential for vessels carrying crude oil and refined petroleum product may not necessarily apply to all vessel traffic entering the Strait of Juan de Fuca.

Conclusions Related to Alternative Traffic Management Protocols

The GWU VTRA traffic simulation study found that:

- Prohibiting use of the Saddlebag Route, extension of the tug escorts from Port Angeles to Neah Bay, and permanent stationing of a tug at Neah Bay are unlikely to change the degree of environmental risk associated with vessel traffic calling at the BP Cherry Point dock.

Table 5-13 Current and Future Incremental Environmental Risk – Alternative Operating Protocols

Case	Operating Protocol	Total Oil Outflow		Most Likely Accident Event			Total Oil Outflow		Highest Oil Outflow Potential		
		Total Annual Accident Potential	Percent Change in Accident Potential	Type	Freq.	Percent	Gallons	Percent	Type	Gallons	Percent
Use of Saddlebag Route											
B – 2005 with North Wing	Saddlebag – Yes	0.3636		Allision	0.1818		37,254		Power grounding	22,974	
J – 2005 with North Wing	Saddlebag – No	0.3638	0.00	Allision	0.1827	0.00%	37,170	0.00%	Power grounding	23,184	0.01%
H – 2025 high-range traffic forecast with North Wing	Saddlebag – Yes	0.6819		Allision	0.3065		60,774		Power grounding	39,354	
K – 2025 high-range traffic forecast with North Wing	Saddlebag – No	0.6973	0.02%	Allision	0.3125	0.02%	60,774	0.00%	Power grounding	38,304	-0.03%
Use of Extended Escort Tugs											
B – 2005 with North Wing	Escort tug – No	0.3636		Allision	0.1818		37,254		Power grounding	22,974	
L – 2005 with North Wing	Escort tug – Yes	0.3583	-0.01%	Allision	0.1818	0.00 %	36,204	-0.03%	Power grounding	22,680	-0.01%
H – 2025 high-range traffic forecast with North Wing	Escort tug – No	0.6819		Allision	0.3065		60,522		Power grounding	39,354	
M – 2025 high-range traffic forecast with North Wing	Escort tug – Yes	0.6753	-0.01%	Allision	0.3064	0.00%	59,682	-0.02%	Power grounding	39,102	-0.01%
Use of Year-Round Tug at Neah Bay											
B – 2005 with North Wing	Neah Bay tug – No	0.3636		Allision	0.1818		37,254		Power grounding	22,974	
N – 2005 with North Wing	Neah Bay tug – Yes	0.3636	0.00%	Allision	0.1818	0.00%	37,254	0.00%	Power grounding	22,974	0.00%
H – 2025 high-range traffic forecast with North Wing	Neah Bay tug – No	0.6819		Allision	0.3065		60,522		Power grounding	39,354	
O – 2025 high-range traffic forecast with North Wing	Neah Bay tug – Yes	0.6819	0.00%	Allision	0.3065	0.00%	60,522	0.00%	Power grounding	39,354	0.00%

Source: van Dorp et al. 2008.

5.5 STATISTICAL VESSEL TRAFFIC ANALYSIS

A separate vessel traffic study was developed by The Glosten Associates (2013). The *BP Cherry Point Vessel Traffic Analysis* (TGA VTA) assessed the incremental environmental risk of the upper limit of the BP forecast for future vessel traffic to the BP Cherry Point dock (420 vessel calls). To perform a comprehensive impact analysis under NEPA, the maximum projected future traffic case (the maximum number of calls) needed to be analyzed. Since the GWU VTRA simulation results only accounted for a maximum of only 323 calls at the BP Cherry Point dock, a second vessel traffic study was performed. This study was based on 2010 transit data and used a statistical method to analyze the potential risk of accidents and oil outflows for 420 calls in the year 2030.

5.5.1 TGA VTA Analysis Approach

The study area was divided into a series of subareas (see Figure 5-13). The geographic subareas for the TGA VTA are the Western Strait of Juan de Fuca, Eastern Strait of Juan de Fuca, Haro Strait/Boundary Pass, Rosario Strait, Saddlebag, Guemes Channel/Fidalgo Bay, and Cherry Point. These subareas are similar to the subareas used in the GWU VTRA.

Potential for accident statistics were developed for six types of incidents: collisions, allisions, groundings, transfer errors, bunker errors, and other non-impact errors.[4] "Other" non-impact errors include equipment failures, fires, explosions, operator errors, and structural failures.

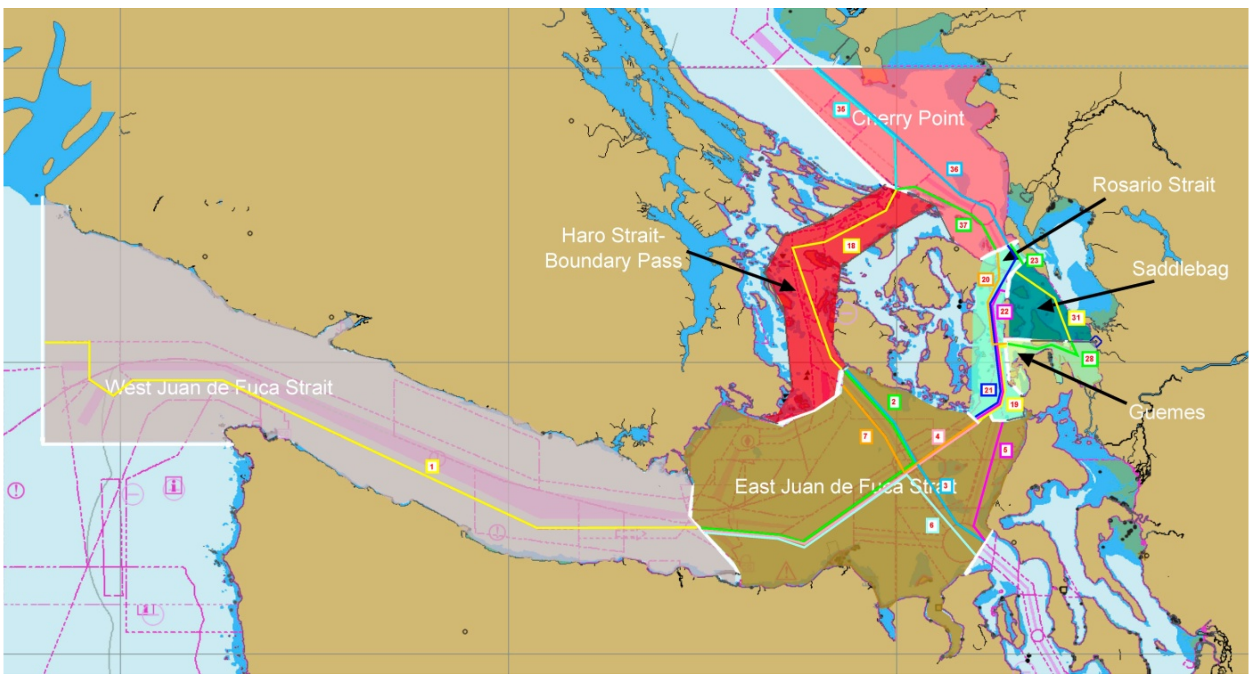

Figure 5-13 TGA VTA Study Area Showing Subareas

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4 The GWU VTRA did not explicitly include transfer errors, bunkering errors, or other non-impact errors. In the subsequent TGA VTA, these accident types were added to further understand the effect of accident type on incremental environmental risk.

The analysis considered the total time each vessel operated in the study area (as vessel traffic days), including the time underway in transit, maneuvering, at anchor, and moored at a dock. The TGA VTA included the following components in its analysis:

- **Vessel type –** Tanker, tank barge, bulk carrier, cargo, tug, and passenger and fishing vessels (six vessel types);
- **Vessel activity –** Underway, maneuvering (operating in proximity to a dock or anchorage), at anchor, or at dock (four vessel activities);
- **Incident type –** Collision, allision, grounding, bunker transfer error, cargo transfer error, and other non-impact error (six incident types); and
- **Location –** Geographic subregions within the study area (seven subareas).

Combining these components yields 1,008 possible scenarios (6x4x6x7). For each scenario, the number of potential annual incidents was estimated. For each of these incidents, the probability that a spill would occur was estimated. For incidents where a spill occurs, the spill volume was estimated. This analysis created a cumulative probability distribution for annual potential incidents, annual potential spills, and annual potential oil outflow.

It should be noted that BP's recent announcement (see discussion in Section 2.4.6) that it would offer low-sulfur refined product as a fuel for loading directly to vessels calling at the BP Cherry Point dock or via a fueling barge was not considered independently in the analysis because it did not introduce a new source of risk. Transfer spill statistics already include loading of refined product via more than one loading arm. The number of fueling operations expected to occur is small.

5.5.1.1 Vessel Traffic Included in the TGA VTA Analysis

Vessel traffic in the TGA VTA analysis included the following traffic groups:

- **BP Traffic.** Current and future tank vessels and tugs/barges calling at the BP Cherry Point dock and tugs assisting in maneuvering vessels to the dock.
- **General Traffic.** Current and future non-BP traffic, including tankers, tank barges, bulk carriers, general cargo carriers, tugboats, and passenger/fishing vessels generated by existing major port facilities (other than the BP Cherry Point dock). General traffic includes projected increases or decreases in tanker, bulk carrier, container, and other traffic calling at existing ports and other marine facilities.
- **Cumulative Traffic.** Future non-BP traffic, including tankers, tank barges, bulk carriers, general cargo carriers, tugboats, and passenger/fishing vessels, that is likely to be generated by terminal or other facilities *that do not yet exist*. This includes future oil production from the Alaska Outer Continental Shelf, expansion of the Kinder Morgan pipeline transporting crude oil from the tar sands region in Canada, and the proposed GPT at Cherry Point, Washington.

Vessel traffic data for the TGA VTA analysis were derived from several principal data sources, including:

- **Marine Exchange of Puget Sound (MX) –** Tracks vessel movements in United States waters within Puget Sound.
- **Canadian Coast Guard's Victoria Marine Communications and Traffic Service (MCTS) –** Forecasts traffic to and from ports in the Vancouver metropolitan area and vessel movements through the Canadian waters of Haro Strait and the Strait of Juan de Fuca.

- **Washington State Department of Ecology, Vessel Entries and Transits (VEAT) Annual Report –** Data from 1995 to 2010 were used to further validate vessel calls to ports in the State of Washington.

Vessel data were expressed in "vessel traffic days" within specific geographic subareas. The total time for each vessel in the system was divided into the number of hours spent in one of four activities: (1) underway; (2) at anchor, (3) at dock; or (4) maneuvering. Vessel traffic days for each vessel type under each activity were summed for each traffic group (BP traffic, general traffic, and cumulative traffic) in each of the seven geographic subareas, as shown in Figure 5-13.

Vessel traffic forecasts were prepared for two time periods: 2010 to represent current conditions, and 2030 to represent future conditions. The 2010 time period was established to take advantage of the most current year in which data from all three sources were available. The forecast for 2030 was prepared to provide a 20-year future time period for analysis, which is consistent with the length of the future forecast time period used in the GWU VTRA. Vessel traffic forecasts were prepared for general traffic for years 2010 and 2030 and for cumulative traffic for the year 2030.

To calculate incident rates by vessel type and activity, data for average annual vessel traffic for the period 1995–2010 were used. Table 5-14 and Figure 5-14 show the average annual traffic days by vessel type for each geographic subarea for the period 1995–2010. Both Table 5-14 and Figure 5-14 demonstrate that the vessel type with the greatest presence in the study area is the "other" category (tugs, fishing vessels > 60 feet, and passenger vessels).[5] Figure 5-14 also shows that these vessels primarily operate in the Strait of Juan de Fuca, Guemes Channel/Fidalgo Bay, and Saddlebag subareas, and for a large portion of the time they are at dock. Among deep draft vessels, bulk carriers and tugs account for approximately 51 percent of the total underway time in the study area. When considering the activities of greatest exposure (i.e., underway and anchoring), tankers accounted for approximately 8 percent and tank barges for approximately 9 percent of underway time; tankers accounted for approximately 23 percent and tank barges for approximately 23 percent of anchoring time.

The estimate of calls to the BP Cherry Point dock for 2010 was derived from the 2010 MX database and compared to data supplied by BP. There were 329 calls in 2010. All calls to the BP dock were modeled as tankers and not tank barges. The BP data on future vessel calls in 2030 were based on internal business forecasts prepared by the company. In BPs forecasts of possible future traffic scenarios for vessels calling at the BP Cherry Point dock, the highest forecast given was a maximum of 420 calls per year and would have both wings of the dock in operation. The forecast used in the TGA VTA also incorporated the following assumptions:

- No deliveries to the refinery of U.S. Midwest source crude oil by rail;
- A decline in Alaskan oil production leading to broader sourcing of crude oil stocks to support the current level of refinery operations; and
- No planned increase in refinery production and no increase in the requirement for crude oil stocks.

[5] Small fishing, charter, and recreational watercraft were not included in the statistical analysis because their movements and behavior could not be accurately tracked with the data sources available, and they are assumed to represent insignificant quantities of oil outflow. Military vessels are active in the study area, but data regarding their movements are not available.

Table 5-14 Average Annual Vessel Days by Subarea, Vessel Type, and Activity Type (1995–2010)

Vessel Type	Juan de Fuca West	Juan de Fuca East	Haro Strait Boundary Pass	Guemes Channel	Saddlebag	Rosario Strait	Cherry Point	Activity Type total	Activity Type (%)
Average Vessel Days Underway									
Tanker	277.4	152.1	20	24.7	6.2	69.9	66.1	616.33	8%
Tank barge	173.8	210.1	16.6	22.9	3.4	124.4	178.7	729.99	9%
Bulker	760	372.3	210.7	1.4	0.2	2.9	161.5	1,508.92	19%
Cargo	641.5	347.4	125.6	0.5	0	3.4	106.8	1,225.32	15%
Tug	431.7	720.4	111.1	64.5	51.7	461.5	728.4	2,569.39	32%
Passenger and fishing	427.5	408.6	82.3	124.3	104.4	36.3	142.8	1,326.16	17%
Underway total	2,711.9	2,210.9	566.3	238.3	165.9	698.4	1,384.3	7,976.11	-
Underway	34%	28%	7%	3%	2%	9%	17%	32%	-
Average Vessel Days Maneuvering									
Tanker	0	26.6	0	42.7	6.6	0	42.3	118.22	16%
Tank barge	0.2	27.8	0.3	47.3	9.9	0	52.3	137.81	18%
Bulker	0	4.8	0	1	0.3	0	1.4	7.44	1%
Cargo	0	2.2	0	0.4	0.1	0	0	2.75	0%
Tug	1.1	97.9	3.7	164.5	62	5.4	151.8	486.56	64%
Passenger and fishing	0	0.3	0	0.7	2.1	0	0	3.13	0%
Maneuvering total	1.3	159.6	4	256.6	81	5.4	247.8	755.91	-
Maneuvering	0%	21%	1%	34%	11%	1%	33%	3%	-
Average Vessel Days Anchored									
Tanker	0	437.5	0	315.9	247.5	0	12.7	1,013.64	23%
Tank barge	0	602.3	0	292.2	110.7	0	0	1,005.15	23%
Bulker	0	32.5	0	4.2	0.6	0	1.4	38.63	1%
Cargo	0	22	0	2.6	0.1	0	0	24.7	1%
Tug	0	1,382.1	0	675.8	235.3	0	0	2,293.27	52%
Passenger and fishing	0	0	0	0	0	0	0	0	0%
Anchored total	0	2,476.4	0	1,290.7	594.2	0	14.1	4,375.39	-
Anchored	0%	57%	0%	29%	14%	0%	0%	18%	-
Average Vessel Days Docked									
Tanker	0	147.4	0	250.2	0	0	337.3	734.91	6%
Tank barge	2	14.8	3.6	403.8	73.5	0	558.1	1,055.79	9%
Bulker	0	6.9	0	51.8	21.2	0	39.8	119.67	1%
Cargo	0	13.1	0	13.2	160	0	0	186.23	2%
Tug	7.3	87.4	24.6	787.3	348.9	37.2	901.1	2,193.86	19%
Passenger and fishing	0	749.7	220.5	2,833.9	3,189.1	0	179	7,172.16	63%
Docked total	9.3	1,019.3	248.7	4,340.2	3,792.7	37.2	2,015.3	11,462.62	-
Docked	0%	9%	2%	38%	33%	0%	18%	47%	-

Table 5-14 Average Annual Vessel Days by Subarea, Vessel Type, and Activity Type (1995–2010) (Continued)

Vessel Type	Juan de Fuca West	Juan de Fuca East	Haro Strait/ Boundary Pass	Guemes Channel	Saddlebag	Rosario Strait	Cherry Point	Activity Type Total	Activity Type (%)
Average Vessel Days for All Vessel Types and Activities									
Total Days	2,722.5	5,866.2	819	6,125.8	4,633.8	741	3,661.5	24,570.03	-
Total Percent	11%	24%	3%	25%	19%	3%	15%	-	-

Source: TGA 2013 (see Table 7a in Appendix VTA).

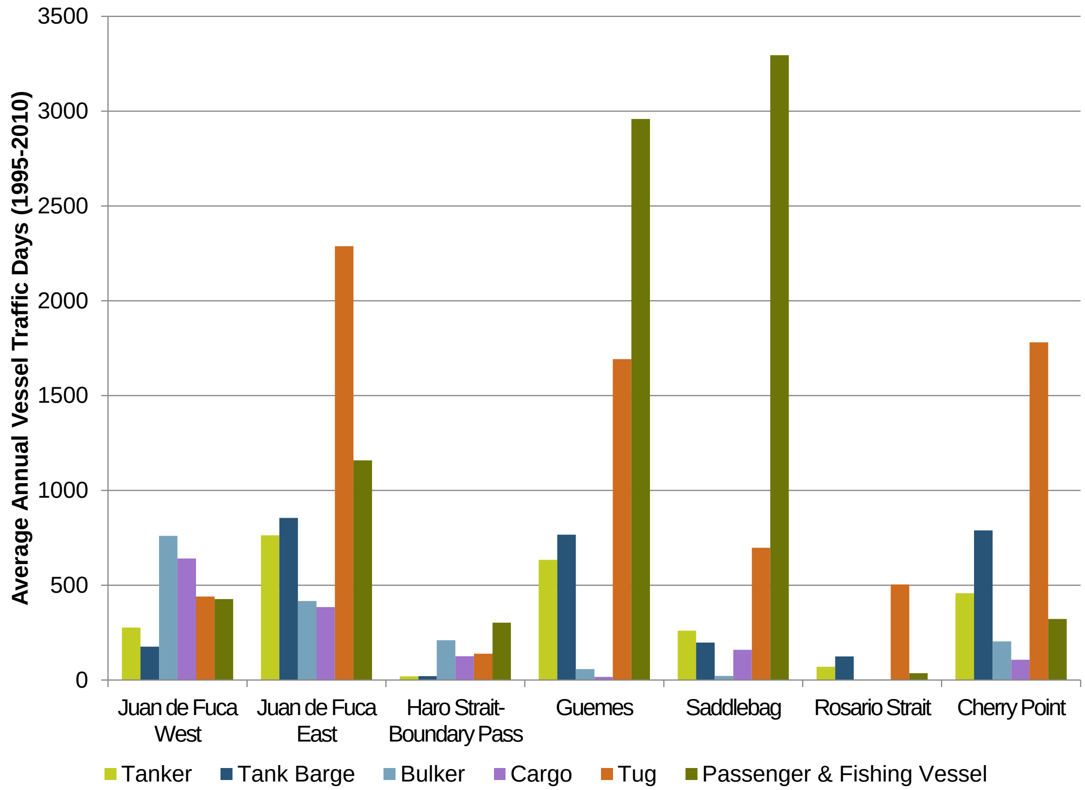

Figure 5-14 Average Annual Vessel Days by Subarea and Vessel Type (1995–2010)

Source: NEI 2013.

- The forecast of 420 calls per year in 2030 is divided into (1) tankers delivering crude oil and partially refined petroleum product; and (2) tankers exporting refined petroleum product. The distribution between crude oil and refined petroleum product tankers is shown in Table 5-15. For 2010, actual total calls were distributed among crude oil and refined petroleum product based on the MX data. The same proportional distribution between crude oil and refined petroleum product that occurred in 2010 was used for the TGA VTA.

Table 5-15 Actual and Forecasted Number of Vessel Calls at the BP Cherry Point Dock

BP Traffic Levels	Number of Vessel Calls		
	Crude Oil	Refined Petroleum Product	Total
BP 2010 actual: one wing	228	101	329
BP 2010 actual: two wings	228	101	329
BP single-wing maximum: one wing – 2010	232	103	335
BP single-wing maximum: one wing – 2030	219	116	335
BP forecast upper limit: two wings – 2030	274	146	420

The forecast for vessel calls at BP is conditioned by the number of dock wings in operation. As previously noted, the maximum number of calls operating at the South Wing by itself would be 335 vessel calls. Any forecast above 335 calls requires that a second wing be in operation. The data also show that operation of a second wing reduces tanker wait time for an available berth. Two years of data from before and after the North Wing began operation showed average wait times of 1.49 days per call and 0.78 day per call, respectively. The addition of the second wing reduced wait time by 48 percent per call.

Six calls were added to the 2010 actual calls (329) to model the “single-wing maximum” (335 vessel calls). Eighty–five calls were added to the 2010 actual calls to model the BP 2030 forecast (upper limit) with two wings (420 vessel calls).

Traffic patterns for additional calls were all modeled following the transit, docking, and anchoring patterns of past vessels, as determined from MX data. The typical BP tanker: (1) transits through the following subareas: Strait of Juan de Fuca West, Strait of Juan de Fuca East, Rosario Strait, and Cherry Point; (2) docks in Cherry Point; and (3) anchors at historically active anchorages in the following subareas: Strait of Juan de Fuca East, Guemes Channel, Saddlebag, or Cherry Point. The additional tanker wait time was distributed to these subareas when accounting for a single-wing dock.

5.5.1.2 TGA VTA Analysis Cases

A set of seven separate cases was developed in the statistical analysis to assess the potential incremental risk of the maximum forecasted number of calls at the BP Cherry Point dock. The set of cases also allows for analysis of the effects of BP traffic independent of cumulative traffic from projects that have been announced but are not yet in operation. The set of cases and the principal components of each case are given in Table 5-16.

Table 5-16 TGA VTA Analysis Cases

Case	Year	South Wing?	North Wing?	Total BP Traffic (number of vessel calls)	Non-BP Traffic
1	2010	Yes	No	Single-wing maximum (335)	2010 existing
2	2010	Yes	No	2010 actual calls (329)	
3	2010	Yes	Yes	2010 actual calls (329)	
4	2030	Yes	No	Single-wing maximum (335)	General traffic in 2030
5	2030	Yes	Yes	BP upper limit forecast (420)	
6	2030	Yes	No	Single-wing maximum (335)	General traffic plus cumulative traffic in 2030
7	2030	Yes	Yes	BP upper limit forecast (420)	

5.5.1.3 TGA VTA Analysis Approach

Forecasting vessel traffic 20 years into the future is limited by the compatibility and scarcity of historical input data and significant annual variations in the data that are available. It is difficult to accurately and precisely predict the actual number of incidents, spills, and volume of oil spilled in 2030 with and without the North Wing at the BP Cherry Point dock. The most meaningful analysis is to compare common statistical measures between cases. The approach chosen in this comparative risk assessment was to use Monte Carlo simulation to predict a range of spill volume outcomes.

The Monte Carlo simulation is an industry standard technique for combining probability distributions of the underlying parameters. It is implemented by choosing thousands of random numbers from the probability distributions of the underlying parameters and multiplying them together to get thousands of different outcomes. For this project, 10,000 random selections were chosen from the underlying probability distributions to produce 10,000 predictions of risk for each of the seven analysis cases. Thus, instead of predicting singular incident,[6] spill, and outflow values for the required comparisons, a probability distribution was calculated for each value. Further discussion of the statistical analyses used in the TGA VTA is found in the *BP Cherry Point Vessel Traffic Analysis* (TGA 2013), included as Appendix D to this EIS.

5.5.1.4 Incident Rate/Oil Spill Outflow Approach in the TGA VTA

Calculation of potential annual incidents relied on incident rates by vessel type, activity type, incident type, and geographic location derived from the historical record of incidents in Puget Sound. A total of 1,116 recordable vessel incidents occurred in the study area during the 16-year period from 1995 to 2010. Of these incidents, 62 percent involved vessels not included in the study (such as pleasure craft, smaller fishing vessels, and workboats). The remaining 429 vessel incidents were classified by vessel type, activity type, incident type, and location.

Incident rates were calculated by dividing the number of incidents by the number of vessel traffic days. Distinct incident rates were calculated for each combination of time period, vessel type, activity, and subarea. In some cases, incident rates were combined and adjusted because so few or no incidents had occurred during the 16-year time period. The general adjustment approach was to assume that one incident occurred in 17 years. The incident rate adjustment added the equivalent of 18.3 incidents

[6] Use of the term *incident* in the TGA VTA is different from use of the term in the GWU VTRA. In the TGA VTA, an incident is one of six event types: collision, allision, grounding, transfer error, bunker error, or other non-impact error. The GWU VTRA includes only four incident types: collisions, allisions, power groundings, and drift groundings.

(4.3 percent) to the dataset of 429 incidents. They contributed uniformly to all analysis cases. Adjusted incident rates do not affect the incremental difference between cases.

Given an incident, there is a probability that a spill could occur. Given a spill, an estimate of oil volume outflow was calculated. This estimate included consideration of vessel type, whether the vessel was single- or double-hulled, incident type, cargo (crude oil or refined petroleum product) capacity, fuel (bunkers) capacity, and the percentage of the total capacity that was lost. Using discrete historical Puget Sound data, cumulative distribution functions were prepared and then sampled 10,000 times to produce predictions of spill volume for each scenario (a combination of vessel type, activity type, incident type, and location).

5.5.1.5 Risk Statistics in the TGA VTA Analysis

The predictions of spill incidents were plotted as cumulative probability distributions, and statistics of the distributions were tabulated for the annual number of potential incidents, the annual number of potential spills, and the annual potential oil outflow. The average number of potential incidents and spills also were reported. The results are summarized in Table 5-17. The following four statistics are shown in the table:

- **Average Annual Potential Incidents.** The average of 10,000 predictions of the number of incidents in a year, including collisions, allisions, and groundings—together considered “impact” incidents—and transfer errors, bunkering errors, and other “non-impact” incidents.
- **Average Annual Potential Spills.** The average of 10,000 predictions of annual number of incidents that result in an oil spill (i.e., not all incidents will result in a spill).
- **50th-Percentile Potential Spill Volume.** The median of 10,000 predictions of the total annual spill volume. Half of the predicted spill volumes were equal to or larger than this volume. If half or more of the 10,000 predictions are no amount spilled, the median spill volume would be zero.
- **95th-Percentile Potential Spill Volume.** The 95th percentile is the 500th largest of the 10,000 predictions of the total spill volume. Likewise 9,500 of the 10,000 predictions of spill volume were smaller.

It is appropriate to compare the average prediction for the number of incidents and for the number of spills but not the other two risk statistics. The methodology for sampling oil outflows includes several binary processes. For example, in the Monte Carlo simulations, the question is asked “If a collision occurs, was there a spill?” The answer is binary, either “yes” (one) or “no” (zero). There are no fractions of an incident or spill. The number of incidents and the number of spills are integer values for all 10,000 predictions. The median will be an integer. For example, the median from 10,000 predictions for the annual potential number of collisions is zero. Because the median value in all seven cases is zero, the difference between cases is zero. However, the average of 10,000 integers may not be an integer. Differences are captured in the incremental risk analysis by reporting the average for the annual number of potential incidents and spills.

The appropriate measure to compare oil outflow is not the average of the 10,000 predictions, but rather the median (50th-percentile) and 95th-percentile. The reason is that oil spill volume predictions have low possibilities of very large values. Predictions with very large outflow volumes significantly affect the average. Consequently, comparisons between the averages of two sets of 10,000 predictions, one of which might contain a very large oil outflow and the other of which might not (purely because of the random sampling of very rare events) are not meaningful. In place of the average, the median is reported. The median is not distorted by rare, large volume predictions. These rare, large-volume predictions influence the 95th-percentile results. When looking at the 95th-percentile results for a very rare incident type (such as collisions), conclusions should be made from differences in order of magnitude rather than percent differences. To emphasize this appropriate interpretation of results, spill volume outflow results are plotted on a logarithmic scale. This presentation style makes it easy to compare differences in orders of magnitude.

Table 5-17 Summary of Incremental Risk Analysis Results in the TGA VTA

Case	1	2	3	4	5	6	7
Year	2010	2010	2010	2030	2030	2030	2030
North Wing?	No	No	Yes	No	Yes	No	Yes
South Wing?	Maximum capacity	Actual calls	Actual calls	Maximum capacity	N+S = 420 calls	Maximum capacity	N+S = 420 calls
Traffic group	2010	2010	2010	2030 general	2030 general	General + cumulative	General + cumulative
Average annual potential incidents	27.78	27.62	27.62	34.35	34.85	46.14	46.66
Average annual potential spills	9.99	9.89	9.88	12.39	12.68	16.58	16.97
50th-percentile spill volume (gallons)	985	975	961	1,109	1,193	2,141	2,396
95th-percentile spill volume (gallons)	90,900	86,172	81,620	62,644	69,617	95,490	114,977

N + S = North and South Wings

Source: TGA VTA 2013.

The median and 95th-percentile model results should be properly understood in order to glean meaningful information from the results. The rarer an incident type, the less often it is sampled by the model and the greater the uncertainty in the model results. Therefore, the results for the very rare incident types (collisions, allisions, and groundings) have substantially greater uncertainty than those for the less rare incident types (transfer errors, bunker errors, and other non-impact errors). This is especially true for the 95th-percentile results, which inherently convey information about an even smaller subset of model results. This does not mean that the results are invalid. Rather, it means that when looking at the 95th-percentile results for a very rare incident type (such as collisions), conclusions should be made from differences in order of magnitude rather than differences in percent. To emphasize this appropriate interpretation of results, spill volume outflow results are plotted on a logarithmic scale. This presentation style makes it easy to compare order of magnitude differences.

5.5.1.6 Predicted Potential Incidents, Spills, and Oil Outflow in the TGA VTA

It should be noted that the TGA VTA statistical model incorporates a number of assumptions and simplifications to accommodate gaps in data or the absence of historical incidents in some categories. The results of the TGA VTA should not be viewed as accurate forecasts of spill events. What can usefully be obtained from the model results is the direction and relative magnitude of changes in specific risk statistics when comparing different cases. For example, the results show that, when comparing Case 2 (year 2010 without the North Wing) to Case 3 (year 2010 with the North Wing), all statistics decrease slightly with operation of the North Wing. This indicates that implementation of the North Wing reduces incremental risk in 2010. However, the increment is very small and may be within the random variability of the model. Table 5-17 reports the risk statistics for each case.

For example, in 2010 with both wings in operation (Case 3), 50 percent of the predictions of cumulative oil outflow over a year were 961 gallons or less. Similarly, 95 percent of the predictions of the cumulative oil outflow over a year were approximately 81,620 gallons or less. When comparing Case 3 to Case 5, the 50^{th}-percentile spill volume increases but the 95^{th}-percentile spill volume decreases significantly. This result is largely attributable to completion in the shift of the petroleum barge fleet to a double-hull configuration (see Section 5.8 for further discussion on double-hull regulations). Double hulls do not affect bunker error or transfer error spills, which are more common but smaller, and thus dominate the 50^{th}-percentile spill volumes. However, the larger, rarer spill volumes from impact incidents are reduced significantly by double hulls. Consequently, both an increase in the 50^{th}-percentile spill volume and a decrease in the 95^{th}-percentile spill volume are observed. Inferences regarding incremental environmental risk were made by comparing selected cases, as summarized in Table 5-17.

5.5.2 Maximum Case Incremental Environment Risk in the TGA VTA Analysis

In the summary of the GWU VTRA results, the incremental environmental risk associated with potential oil outflow was analyzed both geographically (at the regional and subarea levels) and by accident type (collision, allision, power grounding, and drift grounding). A similar summary was developed for the TGA VTA results to evaluate the incremental environmental risk. The TGA VTA analyzed the incremental environmental risk associated with the maximum number of forecasted calls at the BP Cherry Point dock as follows:

- **Regional risk –** Change in risk throughout the overall study area
- **Subarea risk –** Change in risk by subarea
- **Risk by incident type –** Change in risk for each type of incident

The results of these analyses are presented in the following subsections.

The term *environmental risk* denotes the probability of an incident and—for incidents where an oil outflow occurs—the combined volume of crude oil, refined petroleum product, or bunker oil potentially released. The consequences of an oil outflow in terms of environmental damage are qualitatively discussed in Chapter 6 of this EIS.

5.5.2.1 Regional Risk in the TGA VTA Analysis

The results of the statistical model analysis for the entire study area are shown in Tables 5-17, 5-18, and 5-19. This analysis includes vessels calling at the BP Cherry Point dock and all other types of vessel traffic studied (general traffic) for all vessel activities (underway, maneuvering, anchored, and docked) and all incident types (collision, allision, grounding, bunker error, cargo transfer error, and other non-impact error). Tables 5-18 and 5-19 show the results for 2010 and 2030 with and without the North Wing in operation. Table 5-20 shows the additional potential incremental risk that may arise from other projects in the area that are proposed but have not yet been constructed and that would generate vessel traffic in the study area (cumulative traffic).

Evaluation of the regional effect of operating a second wing of the BP Cherry Point dock at the maximum number of calls forecasted was performed by using the aggregate results of selected cases. From a regional incremental risk perspective, 420 calls at the BP Cherry Point dock may result in a marginal increase in the number of incidents and spill volume compared to 335 or 329 calls at the BP Cherry Point dock. While all incident types exhibit an increase, transfer errors and other non-impact errors were predicted to increase to a greater degree than the other incident types from Case 4 to Case 5 and from Case 5 to Case 7.

Table 5-18 TGA VTA Case 2 vs. Case 3 – 2010 Current Conditions

Risk Statistic	Case 2 South Wing	Case 3 North and South Wings	Change (%)
Average annual potential incidents	27.62	27.62	0 (0%)
Average annual potential spills	9.89	9.88	-0.01 (0%)
50th-percentile potential spill volume (gallons)	975	961	-14 (-1%)
95th-percentile potential spill volume (gallons)	86,172	81,620	-4,552 (-5%)

Note: Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

Table 5-19 TGA VTA Case 4 vs. Case 5 – 2030 Future Conditions

Risk Statistic	Case 4 South Wing	Case 5 North and South Wings	Change (%)
Average annual potential incidents	34.35	34.85	0.50 (1%)
Average annual potential spills	12.39	12.68	0.29 (2%)
50th-percentile potential spill volume (gallons)	1,109	1,193	84 (8%)
95th-percentile potential spill volume (gallons)	62,644	69,617	6,973 (11%)

Note: Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

2010 Existing Conditions – One Wing vs. Two Wings

Under current conditions (2010), the change in environmental risk with operation of two wings versus one is determined by comparing the results of Case 2 (2010 with a single wing) to Case 3 (2010 with both wings), as shown in Table 5-18. Case 2 rather than Case 1 (which analyzed maximum calls at the South Wing) was used because both Case 2 and Case 3 had actual calls and therefore offered a comparison based on changing one variable, the addition of the second wing.

Using the actual traffic levels during 2010, these results show that operation of both wings produced no change in the number of potential incidents and spills across the study area. Between Cases 2 and 3, there was a small reduction in the 50th- and 95th-percentile spill size. These results are similar to the results of the GWU VTRA.

Table 5-20 Current (2010) and Future (2030) Incremental Environmental Risk in the Western Strait of Juan de Fuca with and without the North Wing

Risk Statistic	Case 2	Case 3	Case 2 vs. 3	Case 4	Case 5	Case 4 vs. 5	Case 7	Case 5 vs. 7
	S	N + S		S	N + S		N + S	
Average annual potential incidents	3.47	3.48	NC	4.09	4.18	2%	4.79	12%
Average annual potential spills	0.87	0.84	-3%	0.94	0.98	4%	1.24	21%
50th-percentile potential spill volume (gallons)	0	0	NC	0	0	NC	2	92%
95th-percentile potential spill volume (gallons)	5,609	4,269	-23%	2,669	3,372	26%	7,002	52%

Notes:

NC = No change; S = South Wing; N+S = North and South Wings

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading.

Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

2030 Future Conditions – One Wing vs. Two Wings

The change in future environmental risk when considering only changes in vessel traffic calling at the BP Cherry Point dock (without including cumulative traffic) can be studied by comparing the results of Case 4 (2030 with a single wing) to Case 5 (2030 with both wings), as shown in Table 5-19. There is no change in general traffic between the two cases. In Case 4, there are 335 calls with one wing operating; in Case 5, there are 420 calls with two wings operating.

These results show that operation of both dock wings may result in a very small increase in risk across the study area in 2030. This occurs primarily because forecasted traffic with both wings in operation is 420 calls per year while single-wing operation traffic would be limited to approximately 335 calls per year. The 50^{th}- and 95^{th}-percentile potential spill volumes also increase in 2030 with both wings in operation. As with potential incidents and accidents, this increase is related to the additional 85 vessels calling per year when two wings are in operation. When evaluating accident types, however, the increase is primarily in non-impact incidents that include bunkering, transfers, and other non-impact incidents rather than impact accidents (collisions, allisions, and groundings) (Appendix D).

5.5.2.2 Subarea Risk in the TGA VTA Analysis

The incremental environmental risk in each subarea of operating both wings at the upper limit of projected calls at the BP Cherry Point dock was evaluated by comparing the annual potential incidents, potential spills, and potential spill volumes (Tables 5-20 through 5-26). The same comparisons; Case 2 versus Case 3 (2010 one wing versus two wings) and Case 4 versus Case 5 (2030 one wing versus two wings), were made and the results were summarized. General traffic levels were held constant between Cases 2 and 3 and Cases 4 and 5. The geographic location and extent of each subarea are shown in Figure 5-13.

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading. When the value between cases changed less than 5 percent, especially when the change in value was an order of magnitude lower than other similar values, changes are not considered meaningful. For example, the change in average annual spill potential in the Western Strait of Juan de Fuca subarea between Case 2 and Case 3 is 3 percent, but this is a change in one one-hundredth of a potential spill per year when other subareas have values ranging above 2.

Review of Tables 5-20 through 5-26 led to the following overall conclusions regarding incremental risk in subareas. Keeping general traffic the same, the resulting predicted change in the subareas with BP traffic can primarily be attributed to the additional vessel calls. However, while keeping all traffic the same, there will still be variation in the model predictions between runs, because of the random (Monte Carlo) sampling of inputs to the model. Changes in subareas not typically visited by additional BP calls, such as Haro Strait and Boundary Pass, are attributed to this random sampling variation.

2010 Existing Conditions – One Wing vs. Two Wings (Case 2 vs. 3)

In all subareas, the average number of annual potential incidents and potential spills was unaffected by operation of the North Wing. From Case 2 to Case 3, there was a projected potential increase in Rosario Strait and in Haro Strait/Boundary Pass of 0.01 spill per year. However, the projected potential increase was on a base of 0.11 spill and 0.15 spill per year by subarea, respectively. The average number of spills per year in these two subareas was an order of magnitude smaller than in other subareas. An increase also was shown for the Guemes Channel but at the relatively low level of 2 percent.

In all subareas, except the Guemes Channel and Cherry Point, the 50th-percentile spill volume was unchanged or declined. In both of these locations, the 50th-percentile spill sized increased but on an extremely small spill volume. The 95th-percentile spill volume decreased in some subareas and increased in others. The greatest reduction at the 95th-percentile spill volume was in both subareas for the Strait of Juan de Fuca. The greatest increase at the 95th-percentile spill volume was in Rosario Strait. However, the increase of 34 percent was on a very low spill volume. In all other subareas, there was minimal change at the 95th-percentile spill volume.

2030 Future Conditions – One Wing vs. Two Wings (Case 4 vs. 5)

The comparison of Case 4 to Case 5 in 2030 includes both the operation of an additional wing and additional calls at the BP Cherry Point dock. Operation of only the South Wing to import crude oil and export refined petroleum product would be limited to approximately 335 calls, which is 85 calls lower than the maximum forecast with both wings in operation. The maximum forecast can only be accommodated with both wings in operation.

In 2030, the Western and Eastern Strait of Juan de Fuca, Guemes Channel/Fidalgo Bay, Haro Strait/Boundary Pass and Saddlebag subareas showed no meaningful change in the number of average annual potential incidents or the number of spills. Rosario Strait exhibited an increase in potential spills but not incidents. However, the increase in spill is based on an extremely small spill rate. The Cherry Point subarea showed an increase in both potential incidents and spills. This increase is primarily due to the increase in vessel traffic days in this subarea in Case 5.

Table 5-21 Current (2010) and Future (2030) Incremental Environmental Risk in the Eastern Strait of Juan de Fuca with and without the North Wing

Risk Statistic	Case 2	Case 3	Case 2 vs. 3	Case 4	Case 5	Case 4 vs. 5	Case 7	Case 5 vs. 7
	S	N+S		S	N+S		N+S	
Average annual potential incidents	6.41	6.41	NC	7.32	7.36	1%	10.18	27%
Average annual potential spills	2.22	2.20	-3%	2.39	2.38	->1%	3.55	33%
50th-percentile potential spill volume (gallons)	18	16	->1%	18	19	3%	73	74%
95th-percentile potential spill volume (gallons)	11,316	8,164	-28%	6,926	8,109	17%	16,170	50%

Notes:

NC = No change; S = South Wing; N+S = North and South Wings

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading.

Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

Table 5-22 Current (2010) and Future (2030) Incremental Environmental Risk in Haro Strait/ Boundary Pass with and without the North Wing

Risk Statistic	Case 2	Case 3	Case 2 vs. 3	Case 4	Case 5	Case 4 vs. 5	Case 7	Case 5 vs. 7
	S	N+S		S	N+S		N+S	
Average annual potential incidents	0.73	0.74	1%	0.92	0.91	-1%	1.87	51%
Average annual potential spills	0.15	0.16	6%	0.19	0.19	NC	0.36	47%
50th-percentile potential spill volume (gallons)	0	0	NC	0	0	NC	0	NC
95th-percentile potential spill volume (gallons)	5	4	-9%	13	10	-25%	108	973%

Notes:

NC = No change; S = South Wing; N+S = North and South Wings

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading.

Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

Table 5-23 Current (2010) and Future (2030) Incremental Environmental Risk in Guemes Channel/ Fidalgo Bay with and without the North Wing

Risk Statistic	Case 2	Case 3	Case 2 vs. 3	Case 4	Case 5	Case 4 vs. 5	Case 7	Case 5 vs. 7
	S	N+S		S	N+S		N+S	
Average annual potential incidents	5.54	5.51	-1%	6.84	6.82	->1%	8.17	17%
Average annual potential spills	2.32	2.36	2%	2.97	2.95	->1%	3.53	16%
50th-percentile potential spill volume (gallons)	12	13	8%	23	22	-6%	41	47%
95th-percentile potential spill volume (gallons)	2,869	3,259	14%	2,515	2,534	1%	3,305	23%

Notes:

NC = No change; S = South Wing; N+S = North and South Wings

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading.
Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

Table 5-24 Current (2010) and Future (2030) Incremental Environmental Risk in Saddlebag with and without the North Wing

Risk Statistic	Case 2	Case 3	Case 2 vs. 3	Case 4	Case 5	Case 4 vs. 5	Case 7	Case 5 vs. 7
	S	N+S		S	N+S		N+S	
Average annual potential incidents	3.89	3.85	-1%	6.15	6.15	NC	8.21	25%
Average annual potential spills	1.29	1.26	-2%	2.29	2.29	NC	2.93	22%
50th-percentile potential spill volume (gallons)	1	1	NC	13	12	-1%	23	46%
95th-percentile potential spill volume (gallons)	641	669	4%	1,267	1,291	2%	1,948	34%

Notes:

NC = No change; S = South Wing; N+S = North and South Wings

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading.
Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

Table 5-25 Current (2010) and Future (2030) Incremental Environmental Risk in Rosario Strait with and without the North Wing

Risk Statistic	Case 2	Case 3	Case 2 vs. 3	Case 4	Case 5	Case 4 vs. 5	Case 7	Case 5 vs. 7
	S	N+S		S	N+S		N+S	
Average annual potential incidents	0.80	0.84	5%	0.90	0.91	1%	1.25	27%
Average annual potential spills	0.11	0.12	8%	0.12	0.13	8%	0.16	19%
50th-percentile potential spill volume (gallons)	0	0	NC	0	0	NC	0	NC
95th-percentile potential spill volume (gallons)	3	4	34%	3	4	28%	8	47%

Notes:

NC = No change; S = South Wing; N+S = North and South Wings

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading.

Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

Table 5-26 Current (2010) and Future (2030) Incremental Environmental Risk in Cherry Point with and without the North Wing

Risk Statistic	Case 2	Case 3	Case 2 vs. 3	Case 4	Case 5	Case 4 vs. 5	Case 7	Case 5 vs. 7
	S	N+S		S	N+S		N+S	
Average annual potential incidents	6.78	6.79	<1%	8.13	8.51	5%	12.20	30%
Average annual potential spills	2.93	2.93	NC	3.48	3.76	8%	5.19	28%
50th-percentile potential spill volume (gallons)	40	41	3%	57	72	27%	193	63%
95th-percentile potential spill volume (gallons)	10,344	10,427	<1%	8,053	10,475	30%	16,866	34%

Notes:

NC = No change; S = South Wing; N+S = North and South Wings

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading.

Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

For all subareas except Cherry Point, the 50th-percentile spill volume was relatively unchanged between Case 4 and Case 5. The 95th-percentile spill volume was increased in several subareas, including the Western and Eastern Strait of Juan de Fuca, Rosario Strait, and Cherry Point, and was decreased in Haro Strait/Boundary Pass. The decrease in Haro Strait is a very small amount. Increases in the Cherry Point subareas are primarily related to increased traffic calling at the BP Cherry Point dock in Case 5. The increase in Rosario Strait was discounted because it is an extremely small amount.

5.5.2.3 Risk by Incident Type in the TGA VTA Study

The incremental environmental risk of operating two wings with the upper limit of vessel calls at the BP Cherry Point dock (420 vessel calls) was evaluated for each type of incident that could lead to an oil outflow. The same cases were compared to show existing conditions, future conditions, and future cumulative conditions for each incident type separately: Case 2 versus Case 3 (2010 one wing versus two wings), Case 4 versus Case 5 (2030 one wing versus two), and Case 5 (2030 general traffic) versus Case 7 (2030 general traffic and cumulative traffic). Tables 5-27 through 5-32 show the results for each type of accident. The same protocol for identifying measurable changes from case to case that was used in evaluation of subarea results was applied to the review of results by incident type.

Table 5-27 Current (2010) and Future (2030) Incremental Environmental Risk of Collisions with and without the North Wing

Risk Statistic	Case 2	Case 3	Case 2 vs. 3	Case 4	Case 5	Case 4 vs. 5	Case 7	Case 5 vs. 7
	S	N+S		S	N+S		N+S	
Average annual potential incidents	0.73	0.76	4%	0.87	0.88	1%	1.42	38%
Average annual potential spills	0.10	0.11	10%	0.07	0.08	14%	0.10	20%
50th-percentile potential spill volume (gallons)	0	0	NC	0	0	NC	0	NC
95th-percentile potential spill volume (gallons)	673	601	-11%	79	120	50%	477	75%

Notes:

NC = No change; S = South Wing; N+S = North and South Wings

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading.

Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

Table 5-28 Current (2010) and Future (2030) Incremental Environmental Risk of Allisions with and without the North Wing

Risk Statistic	Case 2	Case 3	Case 2 vs. 3	Case 4	Case 5	Case 4 vs. 5	Case 7	Case 5 vs. 7
	S	N+S		S	N+S		N+S	
Average annual potential incidents	1.79	1.80	-1%	1.98	2.00	1%	3.56	43%
Average annual potential spills	0.14	0.15	7%	0.13	0.13	NC	0.22	41%
50th-percentile potential spill volume (gallons)	0	0	NC	0	0	NC	0	NC
95th-percentile potential spill volume (gallons)	2,704	3,142	16%	1,115	1,083	-3%	8,081	87%

Notes:

NC = No change; S = South Wing; N+S = North and South Wings

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading.
Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

Table 5-29 Current (2010) and Future (2030) Incremental Environmental Risk of Groundings with and without the North Wing

Risk Statistic	Case 2	Case 3	Case 2 vs. 3	Case 4	Case 5	Case 4 vs. 5	Case 7	Case 5 vs. 7
	S	N+S		S	N+S		N+S	
Average annual potential incidents	1.35	1.34	-1%	1.41	1.44	2%	2.03	29%
Average annual potential spills	0.14	0.13	-8%	0.11	0.11	NC	0.14	21%
50th-percentile potential spill volume (gallons)	0	0	NC	0	0	NC	0	NC
95th-percentile potential spill volume (gallons)	3,883	2,385	-38%	552	624	13%	4,269	85%

Notes:

NC = No change; S = South Wing; N+S = North and South Wings

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading.
Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

Table 5-30 Current (2010) and Future (2030) Incremental Environmental Risk of Transfer Errors with and without the North Wing

Risk Statistic	Case 2	Case 3	Case 2 vs. 3	Case 4	Case 5	Case 4 vs. 5	Case 7	Case 5 vs. 7
	S	N+S		S	N+S		N+S	
Average annual potential incidents	2.35	2.32	-1%	2.32	2.44	5%	3.13	22%
Average annual potential spills	2.16	2.14	-1%	2.13	2.25	5%	2.89	22%
50th-percentile potential spill volume (gallons)	15	15	NC	13	16	23%	37	56%
95th-percentile potential spill volume (gallons)	2,179	2,166	-<1%	2,171	2,187	<1%	2,269	4%

Notes:

NC = No change; S = South Wing; N+S = North and South Wings

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading.

Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

Table 5-31 Current (2010) and Future (2030) Incremental Environmental Risk of Bunker Errors with and without the North Wing

Risk Statistic	Case 2	Case 3	Case 2 vs. 3	Case 4	Case 5	Case 4 vs. 5	Case 7	Case 5 vs. 7
	S	N+S		S	N+S		N+S	
Average annual potential incidents	2.27	2.27	NC	4.19	4.20	<1%	5.71	26%
Average annual potential spills	2.09	2.09	NC	3.87	3.87	NC	5.25	26%
50th-percentile potential spill volume (gallons)	8	10	16%	53	52	-1%	100	48%
95th-percentile potential spill volume (gallons)	582	597	3%	809	810	<1%	975	17%

Notes: NC = No change; S = South Wing; N+S = North and South Wings

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading.

Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

Table 5-32 Current (2010) and Future (2030) Incremental Environmental Risk of Other Non-Impact Errors with and without the North Wing

Risk Statistic	Case 2	Case 3	Case 2 vs. 3	Case 4	Case 5	Case 4 vs. 5	Case 7	Case 5 vs. 7
	S	N+S		S	N+S		N+S	
Average annual potential incidents	19.12	19.13	<1%	23.57	23.90	1%	30.80	22%
Average annual potential spills	5.25	5.25	NC	6.08	6.25	3%	8.36	25%
50^{th}-percentile potential spill volume (gallons)	146	142	-3%	217	233	7%	498	53%
95^{th}-percentile potential spill volume (gallons)	18,212	17,408	-4%	16,535	17,585	6%	23,752	27%

Notes:

NC = No change; S = South Wing; N+S = North and South Wings

Percentages greater than 5 percent are highlighted in the tables to illustrate larger changes. Increases between cases are indicated with light shading, and decreases are indicated with dark shading.
Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

2010 Existing Conditions – One Wing vs. Two Wings

The results show very little change in the risk statistics between the one wing and two wing cases in 2010. The absolute change in the average annual number of potential incidents and spills was less than 0.05 for all incident types (see Table 5-18). In the incident type categories with the larger initial values (transfer errors, bunker errors) and the largest initial value (other non-impact errors) there was no change between the two cases. Similarly the 50^{th}-percentile potential spill size remained essentially the same for all incident types except bunker errors, where the value increased from 8 to 10 gallons. While the frequency of allisions increased slightly in Case 3, the frequency of groundings decreased by the same amount. The decrease in groundings in Case 3 from Case 2 is comparable to a reduction at the 95^{th}-percentile spill volume of 1,498 gallons.

Comparison of predicted values across incident types indicates that other non-impact errors have the largest potential spill volume at the 95^{th}-percentile spill size. Potential 95^{th}-percentile spill volumes for other non-impact errors could be in the range of 17,000 gallons (Table 5-32). The next highest incident type, allisions, was in the range of approximately 3,000 gallons. In contrast, 95 percent of all spill volumes due to collisions were predicted to be less than 600 gallons.

2030 Future Conditions – One Wing vs. Two Wings

In 2030, with general non-BP traffic, comparing both wings in operation and 420 calls per year to one wing in operation at 335 calls per year shows no meaningful change in any of the statistical measures for allisions, groundings, or bunker errors—except the 95^{th}-percentile spill size for groundings, which increases by 13 percent. The increased percentage in the potential number of spills and the 95^{th}-percentile spill size for collisions were changes from a very small base number, as was the increase in 95^{th}-percentile spill size for groundings. Other non-impact errors show an increase in the 95^{th}-percentile spill size during the same period.

5.6 CONCLUSIONS FROM BOTH STUDIES REGARDING INCREMENTAL CHANGE IN POTENTIAL ACCIDENTS AND OIL SPILLS

Both the GWU VTRA and TGA VTA examined the change in probability of accidents involving tank ships and barges bound for the BP Cherry Point dock under current and future traffic conditions, and under future conditions with other proposed projects assumed to be in operation (cumulative projects).

The general conclusions regarding the incremental increase in potential accidents and oil spills from the GWU VTRA and the VTA are:

- At current and future traffic levels (calls of tank ships and barges) up to the maximum capacity of a single-wing dock (approximately 335 calls per year), operation of a second wing reduces the potential for accident, oil spill, and potential oil spill volume. (GWU VTRA – Section 10.2)
- At future traffic levels (calls of tank ships and barges) at the maximum level projected for operation of the BP Cherry Point dock (420 calls per year), an increase in the potential for accidents and oil spills may occur irrespective of the dock configuration. (TGA VTA – Section 10.2)
- The addition of traffic generated by the other proposed projects (cumulative projects) in the region will likely increase the potential for accidents and oil spills. (TGA VTA – Section 10.2)
- The types of accidents likely to produce the largest cumulative spill volume (at the 95^{th} percentile of all predicted annual outflows) are “other non-impact error” incidents. This includes spills caused by equipment failures, fires, explosions, operator errors, and structural failures. (TGA VTA – Section 10.2)
- The subarea with the greatest potential change in spill size (but not frequency) may be the Cherry Point area at the maximum annual calls on two wings compared to the maximum annual calls on a single wing projected by BP. (TGA VTA – Section 10.2)

As discussed in Section 2.3, BP provided three scenarios regarding future vessel calls as an input to the vessel traffic studies; increased pipeline deliveries (low-range traffic forecast), current conditions forecast (medium-range traffic forecast), and potential future growth (high-range traffic forecast). Actual vessel call volume at the BP Cherry Point dock for delivery of refinery feedstock crude oil and partially refined petroleum product and for export of refined petroleum product varies according to market conditions and the changing source locations for crude oil. While the refinery has operated at a nominal level of 225,000 bbl/day (9,450,000 gallons/day) production, annual vessel calls have averaged 321 calls per year over the period of 1998 to 2010. During this same period, they have ranged from 247 to 416 calls per year.

In addition to the potential change in accident and oil spill potential and potential oil spill volume, consideration must also be given to the variation in the annual number of calls at the BP Cherry Point dock. Based on the emergence of Bakken crude oil delivered by rail, construction of unloading facilities at the refinery by BP, and the market’s desire to deliver crude from Alberta via a pipeline conversion or expansion, the number of future tank ship and barge calls is more likely to continue in the mid-range or possibly low-range traffic projection. Therefore, the upper limit of forecasted calls is unlikely to occur, and thus any potential increase in the number of accidents and oil spills associated with the upper limit of vessel calls, as predicted by the TGA VTA, is also unlikely to occur. The incremental change in environmental risk may be no change or a reduction in risk.

5.7 CUMULATIVE EFFECTS ON INCREMENTAL ENVIRONMENTAL RISK

5.7.1 Future Traffic Forecasts – Cumulative Traffic

In addition to project effects, NEPA requires consideration of the cumulative effects of other reasonably foreseeable future projects, programs, and actions that may occur in the same area as the proposed project. NEPA first requires an analysis of impacts on existing environmental conditions from a proposed project. After these effects have been determined, the cumulative effects of other projects, plans, and programs that are not the responsibility of the proposed project, but nevertheless could occur, are considered to inform decision makers. In this case, the impact analysis considers not only existing conditions but also future conditions (2025/2030).

The cumulative impact analysis for the EIS was a two-step process. Firstly, the effects of cumulative projects on oil spill frequency and volume of oil outflow was calculated. Then the potential impacts of cumulative projects to environmental resources were assessed (see Section 6.15).

Cumulative effects must be considered in a geographic context and over a time frame that includes extended project operations. To identify future projects, programs, and actions the following was considered: (1) changes in present vessel traffic (current time frame – 2005/2010) by vessel traffic type and calling port; and (2) projects under development that would generate new deep draft vessel traffic in the system in the future (2025/2030). Both current (2005/2010) and future (2025/2030) time frames were analyzed in the GWU VTRA and in the TGA VTA. To structure the cumulative effects analysis, changes in vessel traffic were categorized as follows:

- **General Traffic – Current Time Frame in the GWU VTRA (2005) and the TGA VTA (2010).** Current traffic, categorized by type, was based on actual traffic/transit data.
- **General Traffic – Future Time Frame in the GWU VTRA (2025) and the TGA VTA (2030).** To determine future traffic, the current time frame general traffic was increased or decreased based on economic forecasts of marine transport activity (by vessel type) in the study area. Changes were made to the existing traffic volume along each transit route to form the basis for the GWU VTRA and TGA VTA future case analysis.
- **Cumulative Traffic – Future Time Frame in the TGA VTA (2030).** Cumulative traffic includes new vessel traffic to ports not currently operating or to existing ports with expansions planned before 2030.

5.7.2 Foreseeable Future Projects, Plans, and Programs

A review of planned projects or significant changes in economic conditions during the 2005/2010 to 2025/2030 time periods was conducted, and a number of potential projects and port expansions were identified. Each project and condition was evaluated to determine whether it should be considered a change to general traffic or a cumulative project. The identified projects and port expansions are listed in Table 5-33 and the manner by which they were incorporated into the GWU VTRA and TGA VTA studies is described. No other programs or plans were identified that would significantly affect future vessel traffic.

5.7.3 GWU VTRA Future Changes to General Vessel Traffic

For the 2025 simulation cases in the GWU VTRA, changes in vessel traffic were forecast based on trend analysis of historical traffic. As described in Section 5.4, this analysis found that, of all types of vessels included in the simulation, container vessels and tank vessels calling at marine terminals other than the

BP Cherry Point dock were likely to increase for the medium and high future vessel traffic forecasts and were likely to fall for the low traffic forecast. These changes in the types of vessels that were likely to be present in the simulation area were made to vessel traffic counts used for the 2025 simulation cases in the GWU VTRA.

Table 5-33 Economic Trends and Projects Affecting Future Traffic Volumes

Economic Trend/ Future Project	Traffic Effect	GWU VTRA	TGA VTA
Change in North Slope crude oil production	Reduced deliveries of North Slope crude oil to PNW refineries – reduction in tanker calls from Valdez Alaska.	Not included	Included as a change in cumulative traffic – tanker category
Offshore Alaska crude oil production	Offshore production comes on line – increased tanker calls from Alaska to PNW refineries.	Not included	Included as a change in cumulative traffic – tanker category
Expansion of Delta Port (Vancouver), with increased container traffic	Planned increase in container cargo capacity will support an increase in the number of container ship calls.	Included as a change in general traffic – increase in container ship traffic into the region but not associated with a specific project	Included as a change in general traffic – container ship category
Expansion of Delta Port for coal exports	Planned increase in bulk cargo capacity will support an increase in the number of bulk carrier calls.	Not included – project not announced at the time the GWU VTRA was completed	Included as a change in general traffic – bulk carrier category
Expansion of the Kinder Morgan Liquid Bulk Terminal at Vancouver	Will support increased KM pipeline capacity to export crude oil produced in Alberta Tar Sands region – additional 350 annual tanker calls at Vancouver.	Not included –project not announced at the time the GWU VTRA was completed	Included as a change in cumulative traffic – tanker category
Crude oil by rail facilities at BP and other PNW refineries	Installation of rail unit train unloading facilities to allow delivery of Bakken crude oil to PNW refineries. May reduce the number of tanker calls into Puget Sound to supply refinery crude feed stock at current refinery production levels.	Not included –project not announced at the time the GWU VTRA was completed	Not included
Gateway Pacific Terminal	Installation of a dry bulk commodities terminal adjacent to the BP Cherry Point Refinery. Projected to receive up to 487 annual bulk carrier calls.	Included as a change in general traffic, which was increased by 241 annual vessel calls based on the available information at the time the GWU VTRA was completed	Included as a change in cumulative traffic – tanker category

KM = Kinder Morgan; PNW = Pacific Northwest

5.7.4 TGA VTA Future Changes to General Vessel Traffic

For the 2030 cases in the TGA VTA, changes in vessel traffic volume for general traffic were incorporated into the statistical analysis and are reflected in the results for Cases 4 through 7. This allows comparison among these cases to determine the incremental environmental effects of the North Wing in the context of likely future conditions. This analysis has been previously described in Sections 5.5.2.1, 5.5.2.2 and 5.5.2.3 for regional and subarea risk, and risk by incident type under the heading “2030 Future Condition – One Wing vs. Two Wings.”

5.7.5 TGA VTA Cumulative Traffic Effects

The TGA VTA segregated new traffic generated by the cumulative projects from future changes in general traffic to allow for the explicit assessment of incremental environmental risk associated with the cumulative projects. Evaluations were performed for regional and subarea risk and risk by incident type.

5.7.5.1 TGA VTA Regional Risk – Cumulative Traffic Effects

The change in future environmental risk with operation of two wings when considering new traffic generated by future projects can be determined by comparing TGA VTA Case 5 (2030 with both wings general traffic only) to TGA VTA Case 7 (2030 with both wings general traffic plus cumulative traffic), as shown in Table 5-34. The cumulative projects considered included expansion of Kinder Morgan terminal facilities in Vancouver, additional Alaskan tanker traffic port facilities and other facilities in the Vancouver area, and the GPT project at Cherry Point (Table 5-33).

Table 5-34 TGA VTA Case 5 vs. Case 7 – Cumulative Projects

Risk Statistic	Case 5 General Traffic Only	Case 7 General Traffic and Cumulative Traffic	Change (%)
Average annual potential incidents	34.85	46.66	11.81 (34%)
Average annual potential spills	12.68	16.97	4.29 (34%)
50th-percentile potential spill volume (gallons)	1,193	2,396	1,203 (101%)
95th-percentile potential spill volume (gallons)	69,617	114,977	45,359 (65%)

Notes:

N+S = North and South Wings

Refer to Table 5-16 for a description of the analysis cases in the TGA VTA.

Source: TGA 2013.

The results show that the addition of cumulative projects in the region would likely increase the number of incidents and spills and would increase the size of both the 50th- and 95th-percentile spill volumes. These potential increases are due to the increase in the volume of deep draft and tug traffic in the region other than traffic calling at BP. The percent increase in average number of incidents by incident type ranges from 28 percent for transfer errors to 78 percent for allisions.

5.7.5.2 TGA VTA Subarea Risk – Cumulative Traffic Effects

In 2030, with the addition of the cumulative projects (Kinder Morgan terminal expansion, Outer Continental Shelf and Alaskan North Slope production, and the GPT), all key statistics in all subareas increased (Tables 5-20 through 5-26). The increase from less than 1 gallon to 2 gallons in the Western Strait of Juan de Fuca between Cases 5 and 7 can be treated as no change because the amount is very small; however, a large percentage increase at the 95th percentile is predicted. The 95th-percentile prediction of spill volume increases from 3,372 to 7,002 gallons in this subarea. The 95th-percentile prediction of spill volume increases from 8,109 to 16,170 gallons in the Eastern Strait of Juan de Fuca. As in the other case comparisons described above, the 95th-percentile potential spill volume in the Cherry

Point subarea is the largest reported, at approximately 17,000 gallons. The 95^{th}-percentile spill volumes in all other areas are predicted to be significantly smaller.

5.7.5.3 TGA VTA Risk by Incident Type – Cumulative Traffic Effects

In 2030, the number of incidents, number of spills, and spill volumes increased with the addition of the cumulative projects. There are no changes to median outflow volumes due to collisions, allisions, or groundings because these incident types are rare with or without the increase of cumulative traffic. The median outflow volumes from these incident types are negligible. Increases in all incident types are observed at the 95^{th} percentile, as expected.

Other non-impact errors continued to produce the highest values for all key risk statistics when reviewing results by incident type.

5.8 INCREMENTAL ENVIRONMENTAL RISK – DOCK OPERATIONS

Results of the TGA VTA indicate that, among the various types of incidents with the potential to occur, higher incident rates are associated with transfer errors, bunker errors, and other non-impact errors—essentially, incidents that occur while a vessel is not underway. Transfer errors are associated with loading and unloading of refined petroleum product and crude oil at the BP Cherry Point dock, while bunker errors would occur at anchor during a vessel bunkering (fueling) operation. Other non-impact errors include structural failures, equipment failures, fires/explosions, operator errors, and discharges/spills/leaks for unknown reasons and would occur at dock, while underway (in transit), while maneuvering, or while anchored. In addition to ship operations, routine maintenance of the dock and trestle facilities has the potential to cause spills to the marine environment.

The GWU VTRA did not consider transfer errors, bunkering errors or other non-impact errors as part of the simulation analysis. The TGA VTA did evaluate each of these types of incidents, and the results are reported in Section 5.5. The TGA VTA did not include an analysis of maintenance-related spills. A separate analysis of incidents, spills, and spill volumes was performed for the BP Cherry Point Dock by ERC, the results of which are discussed in this section.

5.8.1 BP Cherry Point Dock Spill History

As part of its dock operations, BP maintains records of and reports all spills that occur during vessel transfers and maintenance-related activities. Because bunkering is not currently carried out at the BP Cherry Point dock, no bunkering-related spills have occurred there.

Based on records from BP, Table 5-35 shows the spill history at the BP Cherry Point dock, including incident type and estimated volume of spills. With implementation of the Oil Pollution Act of 1990 (OPA 90) and subsequent federal and state regulations regarding spill reporting and response, a significant reduction in the number, size, and effect of transfer and maintenance spills occurred. Therefore, the BP spill history recorded in Table 5-35 was divided into pre-OPA 90 and post-OPA 90 segments. It also should be noted that the Cherry Point Refinery and associated marine terminal were owned and operated by ARCO Petroleum, Inc. until April 2000. At that time, BP acquired the facility and began its own operation and management of the facility and record keeping.

The spill history for the BP Cherry Point dock for the pre-OPA 90 period shows an annual average of one spill, with an average size of 437 gallons. This period was dominated by a single spill that occurred in 1972, when 21,000 gallons were accidentally released as a result of equipment failure on the tanker

T/V *World Bond* while unloading crude oil. The second largest spill size during this period was in 1981, when 400 gallons of jet fuel were spilled during a loading operation.

Table 5-35 Spill History from BP Cherry Point Dock Operations (1972–2010)

Year	Dock	Vessel	Refined Petroleum Product		Crude Oil		Other		Total	
	No. of Spills	No. of Spills	No. of Spills	Average Spill Size (gallons)	No. of Spills	Average Spill Size (gallons)	No. of Spills	Average Spill Size (gallons)	No. of Spills	Average Spill Size (gallons)
1972		3	2	250	1	21000			3	7,167
1973		1					1	100	1	100
1974										
1975		1			1	200			1	200
1976										
1977										
1978										
1979										
1980										
1981		3	2	284	1	80			3	216
1982										
1983										
1984										
1985	1	3	3	3			1	<1	4	1
1986	1	1					2	84	2	84
1987		3	2	126[a]	1	10			3	87
1988		4	3	4	1	2			4	4
1989		1					1	<1	1	<1
Average Pre-OPA 90	**<1**	**1**	**1**	**37**	**<1**	**1,183**	**<1**	**10**	**1**	**437**
1990		7	3	15	3	0.44	1	<1	7	5
1991		4	3	70			1	42	4	56
1992		3	1	20	1	42	1	<1	3	21
1993		4	3	9	1	<1			4	5
1994		4	4	18					4	18
1995		4	4	13					4	13
1996		3	2	<1			1	<1	3	<1
1997		5	5	20					5	20
1998		2	1	3	1	<1			2	2
1999	1				1	<1			1	<1
2000	1	2	2	18			1	<1	3	9
2001	1	4	2	<1			3	<1	5	<1
2002	1	6	6	<1	1	<1			7	<1
2003	1	5	4	<1	1	5	1	<1	6	2
2004	1	2	1	<1			2	<1	3	<1
2005	1		1	<1					1	<1
2006										
2007	3						3	<1	3	<1
2008	1		1	<1					1	<1
2009										
2010	2	1	1	<1			2	<1	3	<1
Average Post-OPA 90	**1**	**3**	**2**	**9**	**<1**	**2**	**1**	**2**	**3**	**8**

Notes**:**

OPA 90 = Oil Pollution Act of 1990

[a] One reported spill has no estimated volume; the average reflects only the volume of the one spill with a reported volume.

Very small spills with no reported numerical quantities are estimated as 1 cup or 0.06 gallons. Spills reported in drops are rounded to 1 cup or 0.06 gallon. All columns per year with no reported value were assumed to be 0.

Source: BP Cherry Point Refinery 2008.

Following implementation of OPA 90, the spill history shows that the number of spills has increased to three reported spills per year and the average annual spill size has decreased to 7 gallons per spill. The increased number of reported spills is most likely the result of increased reporting requirements, not an actual increase in the number of spills. The increased rate of spill reporting for smaller, previously un-reported and often undetected spills was verified in other U.S. studies, such as those conducted on EPA-regulated facilities and for the United States as a whole (Etkin 2004, 2009). The significant reduction in average spill size most likely is related to increased care in transfer operations and maintenance practices.

5.8.2 Post-OPA 90 Spill Size and Spill Volume from Dock Operations with and without the North Wing

ERC (2011) analyzed the spill history recorded by BP and spill records from Washington Department of Ecology and the USCG; both of these agencies are responsible for maintaining incident and spill records. Agency record keeping includes a protocol for recording and classifying spills that leads to some variances between databases. ERC assembled these data from all three sources, resolved the anomalies between databases, and formed a single database of the spill history in Puget Sound for all refinery dock operations. The average number of post-OPA 90 spill incidents and spill size reported by ERC, with and without the North Wing in operation, are shown in Table 5-36. This table indicates a reduction in the average number of spills per year although the maximum spill in any given year remains the same, at six. The same comparison shows that average spill volume decreased from 295 to 43 gallons.

Table 5-36 Post-OPA 90 Average Annual Spill Incidents and Spills Volumes from Dock Operations at the BP Cherry Point Refinery

	Spills (incidents/year)				Spill Volume (gallons)			
	Pre North Wing (1991–2000)		With North Wing (2001–2010)		Pre North Wing (1991–2000)		With North Wing (2001–2010)	
Refinery	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
BP Cherry Point	2.6	6	2.2	6	295	1,900[a]	43	402

Post-OPA 90 = Post Oil Pollution Prevention Act in 1990.

[a] On December 12, 1997, a release of jet fuel occurred while loading a tank barge. BP reported this spill to Ecology and the USCG as a spill of 100 gallons and a separate spill of 1 gallon. The agency's databases include a single spill of 1,900 gallons, indicating a disparity between the amounts of material spilled and recovered due to containment and recovery efforts, and the amount of material entering the marine environment.

5.8.3 Post-OPA 90 Spill Size and Spill Volume from Dock Operations at Puget Sound Refineries

ERC also reviewed the average number of spill incidents and spill size for other Puget Sound refineries with marine terminals during the same two periods 1991–2000 (pre-North Wing) and 2001–2010 (with North Wing), as shown in Table 5-37.

Both BP and government agency data show that, in the 2001–2010 period, the annual number of spill incidents and the average spill volume declined by approximately 15 percent. Further, average incidents per year fell at all refineries except Tesoro/Anacortes, where it increased. Similarly, average spill size fell at all refineries except Shell/Anacortes, where it increased. While only the BP Refinery implemented a second berth (North Wing) that allowed it to affect changes in dock operations, similar reductions in spill frequency and size occurred at the other refineries—indicating that changes other than the addition of a second berth reduced average spill frequency and size.

Table 5-37 Post-OPA 90 Spills and Spill Volumes from Dock Operations at Puget Sound Refineries

	Spills (incidents/year)				Spill Volume (gallons)			
	Pre-North Wing (1991–2000)		With North Wing (2001–2010)		Pre-North Wing (1991–2000)		With North Wing (2001–2010)	
Refinery	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
BP Cherry Point	2.6	6	2.2	6	295	1,900	43	402
Conoco-Phillips	3.6	5	1.1	4	777	3,639	51	420
Shell Anacortes	5.6	14	1.6	4	496	2,221	1114	1,001
Sound Tacoma	0.4	1	-	-	1	5	-	-
Tesero Anacortes	0.6	2	1.5	6	46	451	11	35
US Oil Tacoma	1.5	3	0.7	2	8,874	79,396	127	200
Total all refineries	14.2	23	7.1	14	10,490	79,418	345	1,640
Average all refineries	2.4	14	1.4	6	1,808	79,396	69	1,001

Post-OPA 90 = Post Oil Pollution Act of 1990

Source: ERC 2011.

Overall, the average number of spills and average spill volume for all refinery docks fell approximately 50 percent and 65 percent, respectively. These data indicate that a reduction in spill frequency and volume at the BP Cherry Point dock was partially affected by changing regulations, such as those related to oil transfer operations (e.g., pre-booming) , protective measures taken by the refineries, and clean-up technology that affected all refinery docks. It also reflects changes in spill reporting requirements related to categorizing spill size.

5.8.4 Dock Spill Frequency and Volume Related to Refinery Throughput

Risk of incident and spill from dock operations also may be related to refinery capacity (daily refinery production) as this incorporates both input of crude oil feedstock and distribution of refined product. Currently, the BP Refinery receives crude oil inputs via its marine terminal and the Puget Sound Pipeline; BP distributes refined petroleum product via a truck loading rack at the refinery, the Olympic Pipeline to Washington and Oregon markets, and through the marine terminal by tanker and barge to Oregon and California markets. With completion of its rail unloading facility, BP will be able to receive crude oil from inland sources by incoming unit train and may distribute refined petroleum product by outgoing unit train. In any given time period, the receipt of crude oil deliveries and distribution of refined petroleum product will be balanced by market conditions and transportation system capacity. Given the complexity of the different transportation systems used to provide crude oil and deliver refined petroleum product, another perspective on dock spill risk is comparing it to overall refinery capacity and the performance of other refineries in Puget Sound.

The average annual spill frequency and spill volume for the BP Cherry Point dock and for all other Puget Sound refineries is shown in Table 5-38. While BP's refinery capacity has increased from approximately 189,000 bbl/day (prior to the North Wing) to 225,000 bbl/day (after the North Wing was in operation), both the incident rate and the average spill volume per barrel of daily refining capacity have declined.

Table 5-38 Refinery Capacity and Average Annual Incidents and Spill Volume from BP Cherry Point Dock Operations

	BP Average Daily Capacity (bbl)	Total Puget Sound Refining Capacity (bbl)	BP Incident Rate[a]	Incident Rate All Refineries[a]	BP Spill Volume Rate[b]	Spill Volume Rate All Refineries[b]
Post-OPA 90 (1991–2010)	208,893	579,003	0.00077	0.00124	0.07416	0.63093
Pre-North Wing (1991–2000)	189,174	536,357	0.00088	0.00174	0.09881	1.22500
With North Wing (2001–2010)	224,772	616,133	0.00065	0.00073	0.04951	0.03685

bbl = barrels

[a] Number of incidents per million gallons total annual refining capacity.

[b] Spill volume per million gallons total annual refining operating capacity.

5.8.5 Dock Spill Frequency and Volume Related to Vessel Calls

ERC analyzed the BP Cherry Point dock spill history. Using the spill history and the records of calls by vessel type for the same years, ERC projected the expected potential spill frequency and volume before and after operation of the North Wing. The analysis provided the expected incident rate (incidents per transfer) and spill volume (gallons per transfer). These calculated values were then used to project the potential annual number of spills and potential spill volume at 420 calls, the highest number of annual calls forecasted by BP (Table 5-39). These calculations assume a single transfer operation per call. Based on the calculated incident and spill rates with the North Wing in operation, the annual incidents are projected to increase from 2 to 2.52 for 420 calls, and the total potential spill volume may increase from 4 to 5 gallons annually.

Table 5-39 BP Cherry Point Dock Spill Frequency and Volume Related to Number of Transfers

	Post-OPA 90/ Pre-North Wing (1991–2000)	Post-OPA 90/ with North Wing (2001–2010)	BP Maximum Forecast
Average annual transfers	278	335[a]	420
Spills / transfer	0.0078[b]	0.006[b]	0.006
Average annual spills	2.17	2.01	2.52
Percent change		-8%	26%
Volume (gallons) / transfer	0.089[b]	0.012[b]	0.012
Annual spill volume (gallons)	24.74	4.02	5.04
Percent change	NA	-84%	25%

Post-OPA 90 = Post Oil Pollution Act of 1990

[a] Maximum number of calls at single-wing operation.

[b] Rate calculated by ERC – Table 5-2, ERC 2011.

5.8.6 Conclusions Regarding Incident Rate and Volume of Dock Spills

The analysis by ERC based on the historical incident and spill volume records indicates that potential dock spills may increase at 420 calls with both wings in operation from a single wing operating at maximum capacity (335 calls/year) by 0.5 spill per year (or one additional spill every other year) and an increase of 1 gallon per year.

Overall conclusions regarding the potential for dock spills at the BP Cherry Point dock are:

- The TGA VTA shows an increase in spill frequency at the upper bound case of 420 although the size of spill is very small.
- The ERC analysis shows a small increase in the average frequency and size of spills at 420 calls although both increases are small—an increase of less than one spill/year and an increase in spillage of approximately 1 gallon per year.
- If the BP Cherry Point dock operates at the current average level of operation with respect to calls per year, no increase in average spill frequency or spill volume is expected for dock operations.

5.9 CONSEQUENCES OF OIL SPILLS AND RESPONSE OPTIONS

In 2005, Ecology initiated a rulemaking proceeding as part of its contingency planning for response to potential oil spills. In support of the rulemaking, an extensive investigation of alternative oil spill response options was evaluated using modeling based on the Spill Impact Model Application Package (SIMAP) model (French-McKay et al. 2005). The purpose of the study was to analyze a number of oil spill scenarios in major shipping lanes in Washington waters and to evaluate the way in which proposed response planning guidelines might provide additional protection to natural and socioeconomic resources. A computer model was used to simulate hypothetical spills and responses to those spills in order to determine oil fates and impacts.

Because the impacts of a spill can vary tremendously depending on the movement of the oil, as influenced by winds, currents, and the exact location of oil release, hundreds of random variations in these factors were incorporated into the modeling to determine the range of impacts that might be expected and to determine the situations in which the worst-case impacts might be realized.

A set of spill scenarios was developed for each of six general areas – Outer Coast (near Cape Flattery), Strait of Juan de Fuca, San Juan Islands, Inner Straits, lower Columbia River, and upper Columbia River.

Three different oil types – Alaska North Slope crude, bunker fuel, and diesel fuel – in different amounts ranging from 25,000 bbl (approximately 1,050,000 gallons) from a hypothetical tank barge up to 250,000 bbl (approximately 10,500,000 gallons/day) (an Exxon *Valdez*-sized spill) from a large tanker were included in the Ecology study (French-McKay et al. 2005).

The characteristics of the SIMAP results relevant to their use in this EIS include the following:

- Model results were based on 100 separate model runs for each scenario that stochastically varied key parameters, including oil spill location, wind, wave, current, and tide conditions.
- Oil release sites were randomly distributed along defined segments of the shipping lane.
- Oil fate and effects (e.g., spreading, weathering, and dilution into the water column) would be mitigated by deployment of oil spill clean-up equipment in accordance with Ecology contingency planning requirements. This would include deployment of booms for containment of surface slicks and protection of critical resources.

- Oil spill events of 25,000 bbl (approximately 1,050,000 gallons) of bunker fuel; 65,000 bbl (approximately 2.7 million gallons) of crude oil, bunker fuel, and diesel; and 25,000 bbl (1,050,000 gallons) of crude oil were simulated.

Of these characteristics, the spill event size was divergent from both the GWU VTRA and TGA VTA results. The largest annual oil outflow predicted by the GWU VTRA results is 1,107 bbl (approximately 46,494 gallons). The largest annual oil outflow predicted by the TGA VTA results is 2,737 bbl (approximately 114,977 gallons). These numbers are far smaller than the events simulated for the Ecology study. As part of the Ecology oil spill contingency planning investigation, a historical analysis of spill size was undertaken (Etkin 2001). This analysis considered actual spill history, historical worst-case discharge, and most probable worst-case discharge. The 1,107-bbl (approximately 46,494 gallons) oil outflow from the results of the GWU VTRA analysis taken as a single event was within the 78th percentile[7] of all actual spills that occurred in U.S. waters from 1985 to 2000, as shown in Figure 5-15 (taken from Etkin 2001), indicating how the GWU VTRA and TGA VTA results relate to actual U.S. spill history.

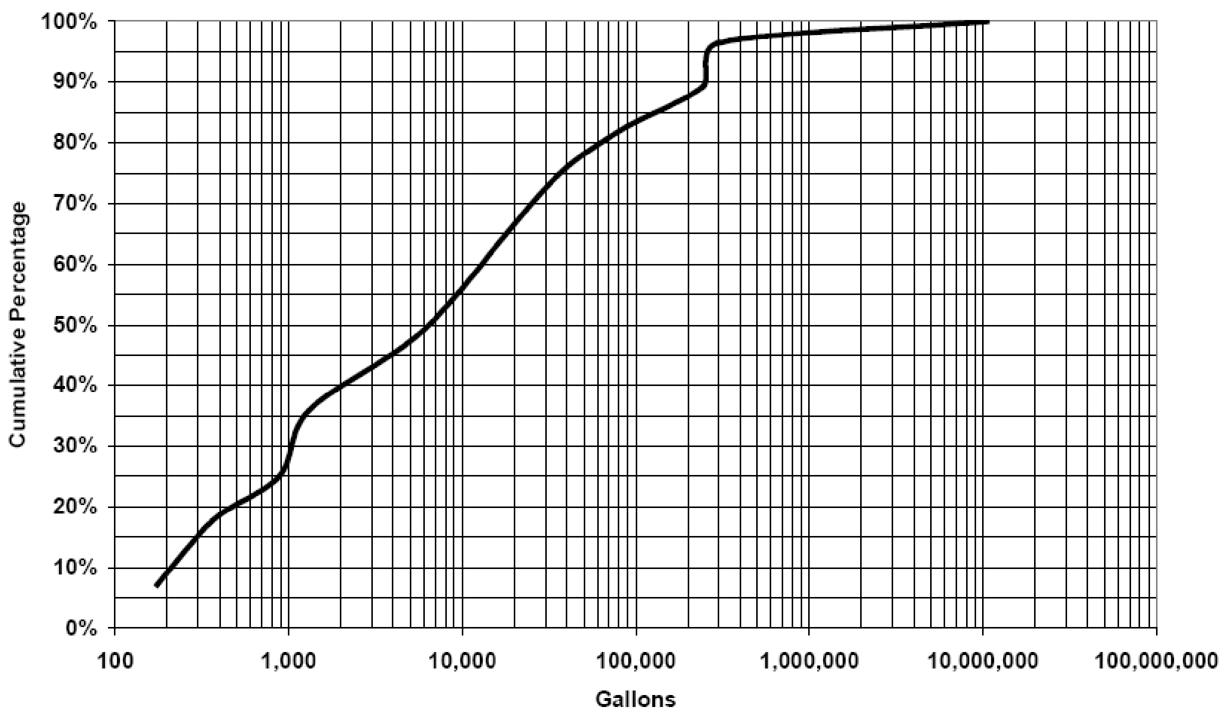

Figure 5-15 Probability Distribution Function of Actual Oil Spill Sizes from Tanker Allisions, Collisions, and Groundings in U.S. Waters from 1985 to 2000

Source: Etkin 2001.

While the statistical history of actual oil spills is a predictor of likely or expected spill size and frequency, oil spills of larger magnitude can and do occur. The Ecology oil spill contingency planning investigation also examined the maximum expected oil spills that could occur based on vessel size, loading, and environmental conditions. The range of maximum spill sizes is shown in Figure 5-16 (taken from Etkin 2001). Oil spill events of 25,000 bbl (approximately 1.5 million gallons), 65,000 bbl (approximately

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7 In other words, 78 percent of all actual spills that occurred in U.S. waters from 1985 to 2000 were at or below 1,107 bbl (46,491 gallons) of oil; 22 percent of spills were larger.

2.7 million gallons), and 250,000 bbl (approximately 10,500,000 gallons) were evaluated using the Ecology SIMAP oil spill model (French-McKay et al. 2005). Only spills of 65,000 bbl (approximately 2.7 million gallons) and 250,000 bbl (approximately 10.5 million gallons) were studied for the San Juan Islands (Rosario Strait).

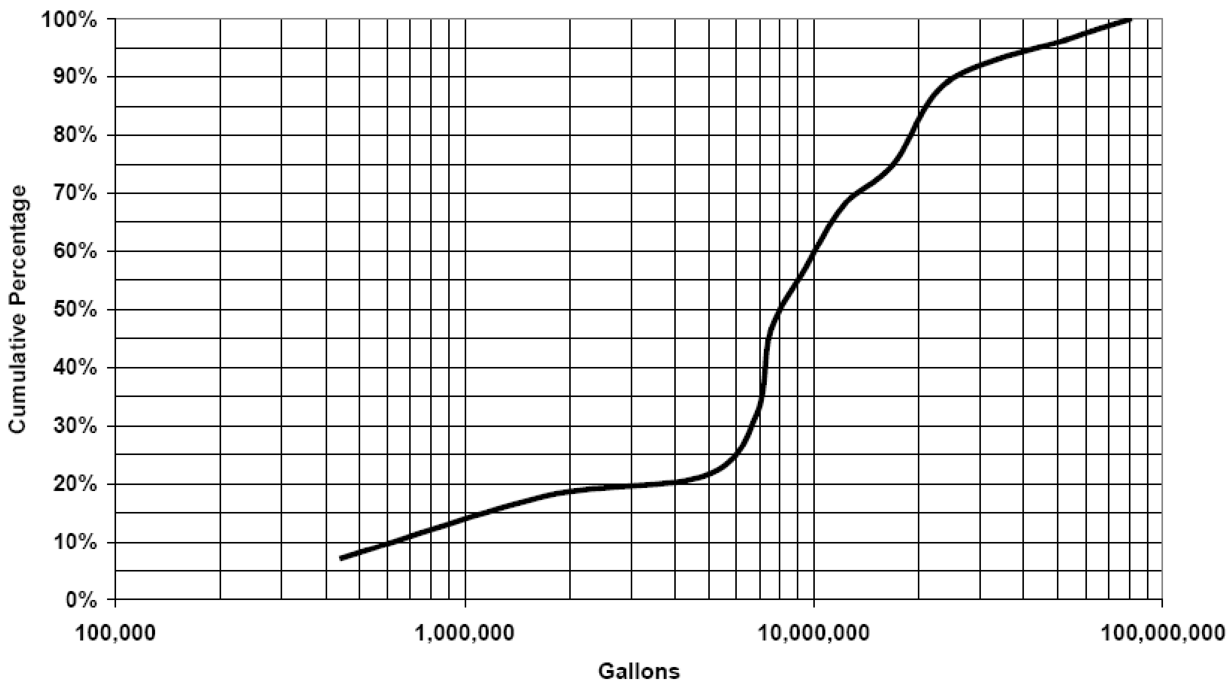

Figure 5-16 Probability Distribution Function of Potential Worst-Case Discharge from Tanker Allisions, Collisions, and Groundings in U.S. Waters from 1985 to 2000

Source: Etkin 2001.

Of the various scenarios modeled in the Ecology (2006) study, two scenarios were selected to illustrate the fate and effects of oil spills in the geographic portion of the GWU VTRA and TGA VTA vessel simulation study area with the higher likelihood for accidents and oil spills and that most closely represent the GWU VTRA and TGA VTA results.

The two scenarios used to illustrate the fate and effects of oil spills are:

- A combined crude oil, bunker fuel, and diesel spill of 65,000 bbl (approximately 2.7 million gallons) in San Juan Islands *without spill response;* and
- A combined crude oil, bunker fuel, and diesel spill of 65,000 bbl (approximately 2.7 million gallons) in San Juan Islands *with spill response*.

Of the six general areas studies by Ecology (2006), the Ecology San Juan Islands study area corresponds to the GWU VTRA subareas with the highest combined risk of all accident types (Cherry Point, Rosario Strait, and Guemes Channel subareas); therefore, results from the San Juan Islands study area were used in the analysis of the fate and effects of oil spills for this EIS.

Of the three different oil types – Alaska North Slope crude oil, bunker fuel, and diesel fuel – the Alaska North Slope crude oil (Alaska Crude) most closely resembles the type of oil that would be transported to the BP Cherry Point dock. For this reason, the results from the Alaska Crude analysis were used in the analysis of the fate and effects of oil spills for this EIS.

Of the different spill sizes, the 65,000-bbl (approximately 2.7-million gallons) spill size was selected to illustrate the consequences of accidents predicted by the vessel traffic studies because it is closer in size to the predicted annual average oil outflow of 1,107 bbl (approximately 46,494 gallons) in the GWU VTRA and 2,737 bbl (approximately 114,977 gallons) in the TGA VTA.

5.9.1 Scenario SI-Crud-N

To characterize the range of potential effects from a 65,000-bbl (approximately 2.7 million gallons) spill in Rosario Strait with no removal[8] (scenario SI-Crud-N), 100 oil spill simulations were run and sorted to identify the 50th-percentile (median) and 95th-percentile (generally worst-case) results.

Figures 5-17 and 5-18 show the expected water surface spread by oil thickness of a hypothetical 65,000-bbl (approximately 2.7 million gallons) oil spill in the transit lanes of Rosario Strait, with no clean-up actions undertaken. In the 50th-percentile scenario (Figure 5-17), surface distribution of oil occurs from north of Point Whitehorn down to the northern reach of Rosario Strait, through the Guemes Channel and into the upper portion of Padilla Bay. In the 95th-percentile (worst-case) scenario (Figure 5-18), the area of surface oiling includes all of Rosario Strait, Guemes Channel, and Padilla Bay. The difference in geographic spread between the 50th- and 95th-percentile runs is related to different wind, wave, and current conditions between the runs.

5.9.2 Scenario SI-Crud-R-ST

To characterize the range of potential effects from a 65,000-bbl (2.7-million gallon) spill in Rosario Strait with the use of mechanical removal based on state standards and protection booming (scenario SI-Crud-R-ST), 100 oil spill simulations were run and sorted to identify the 50th-percentile and 95th-percentile results. The mechanical response capability applied in this modeling study was specified by one of three levels of response capability according to the worst-case discharge of the vessel:

- **Federal –** USCG Vessel and Facility Response Plans for Oil: 2003 Removal Equipment Requirements and Alternative Technology Revisions: Notice of Proposed Rulemaking. Federal Register Vol. 67 (198): pp. 63,331–63,452. October 11, 2002.
- **State (Washington) –** Current state guidance (proposed planning standards in WAC 173-181).
- **Third Alternative –** Hypothetical higher response capability alternative as determined by the Contingency Plan Rule Advisory Committee.

The actual required response capability for each level consists of specifications for amounts of, and timing of arrival for, booming equipment, oil removal equipment (skimmers, vacuum trucks, recovery vessels), and storage equipment—depending on the location and amount of oil spilled (Etkin 2005).

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8 Includes the use of protection booms only.

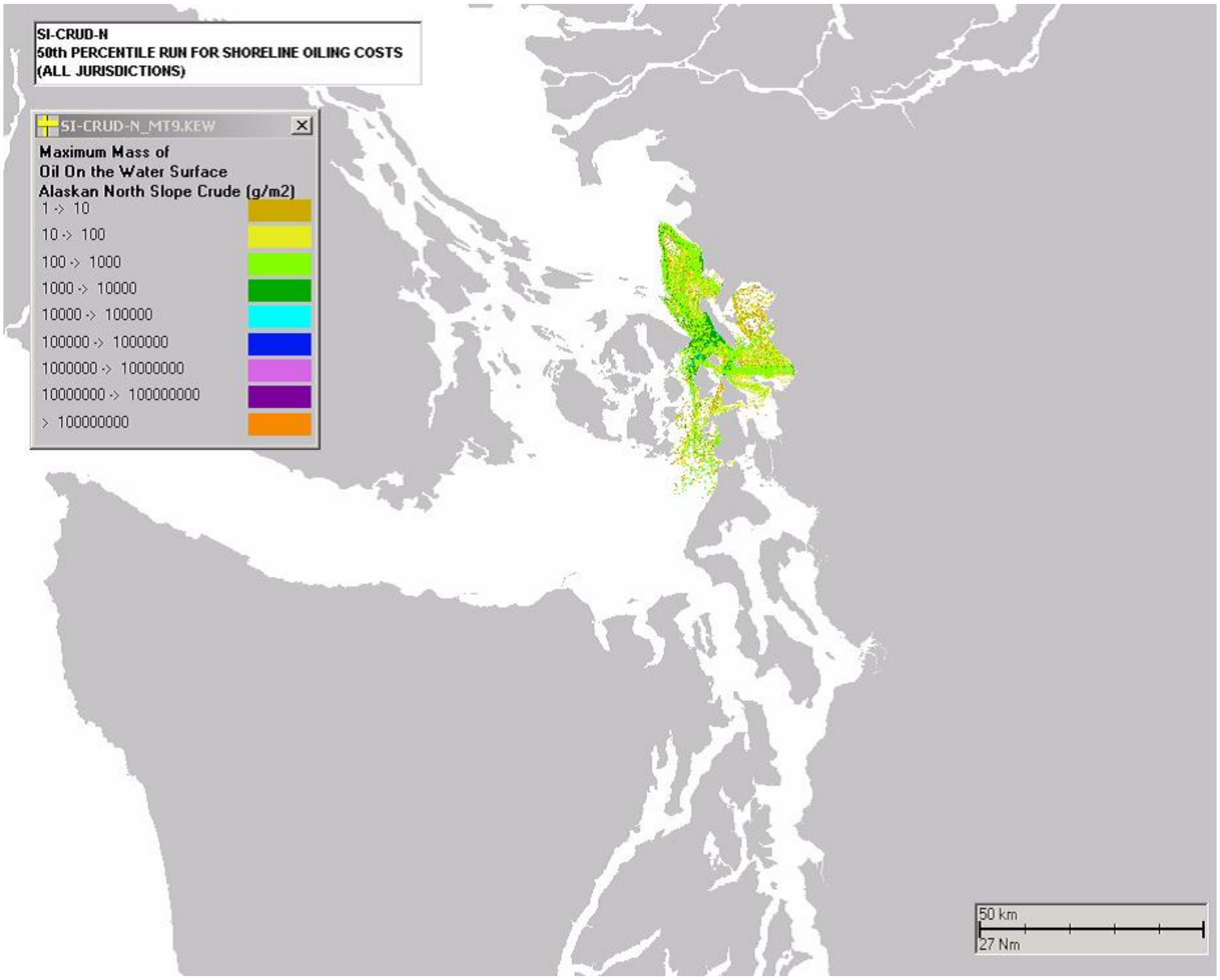

Figure 5-17 San Juan Islands, Crude Oil and No Removal: Water Surface Exposure to Floating Hydrocarbons for the 50th-Percentile Run Based on Shoreline Costs

Source: Etkin 2001.

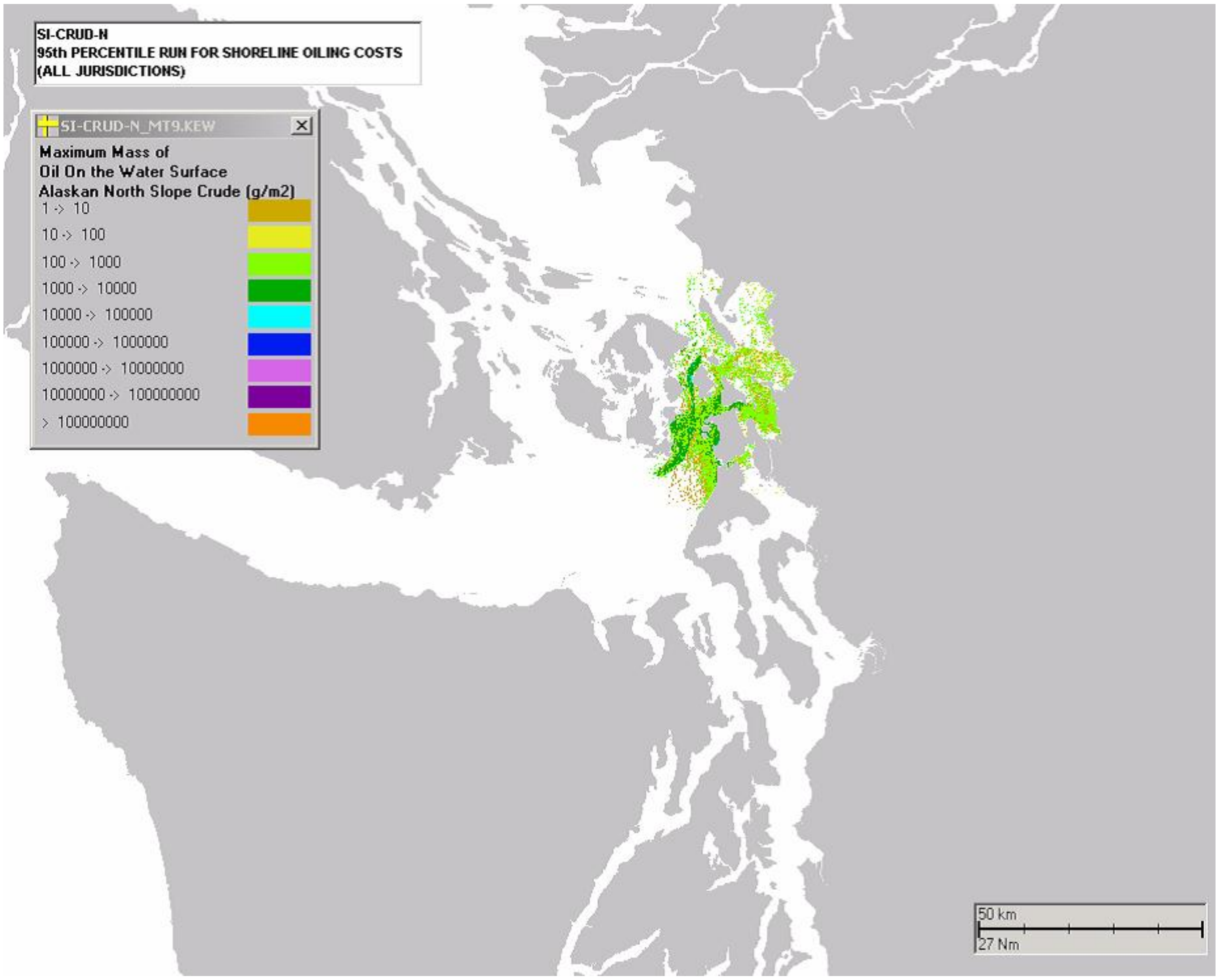

Figure 5-18 San Juan Islands, Crude Oil and No Removal: Water Surface Exposure to Floating Hydrocarbons for the 95th-Percentile Run Based on Shoreline Costs

Source: Etkin 2001.

Figures 5-19 and 5-20 show the expected water surface spread by oil thickness of a hypothetical 65,000-bbl (approximately 2.7-million gallon) oil spill in the transit lanes of Rosario Strait with mechanical removal based on state standards and protection booming actions being undertaken. In the 50th-percentile scenario (Figure 5-19), surface distribution of oil occurs from Cherry Point into the upper reaches of Rosario Strait. In the 95th-percentile scenario (Figure 5-20), the area of surface oiling occurs primarily within Rosario Strait.

It should be noted that, although the results showed recovery rates of as high as 70 percent, this likely overestimated the ability of on-water recovery. However, it may be possible to recover this much oil with effective aerial monitoring and tracking of the location of oil slicks, effective day and night oil recovery methodologies, and intensive training of response crews to foster rapid response and effective recovery operations under the conditions present in the waters of the state (Etkin 2005).

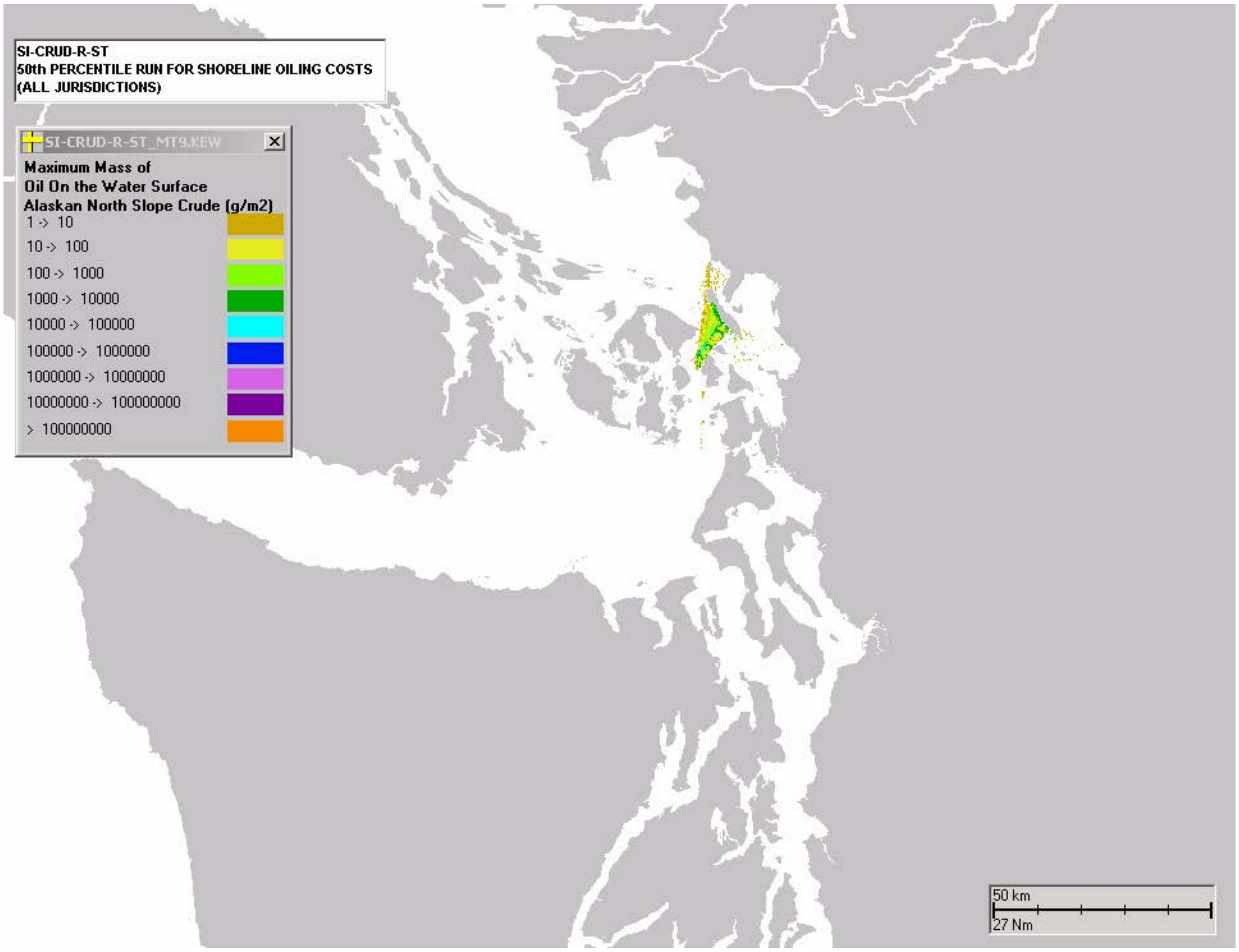

Figure 5-19 San Juan Islands, Crude Oil and State Mechanical Removal: Water Surface Exposure to Floating Hydrocarbons for the 50th-Percentile Run Based on Shoreline Costs

Source: Etkin 2001.

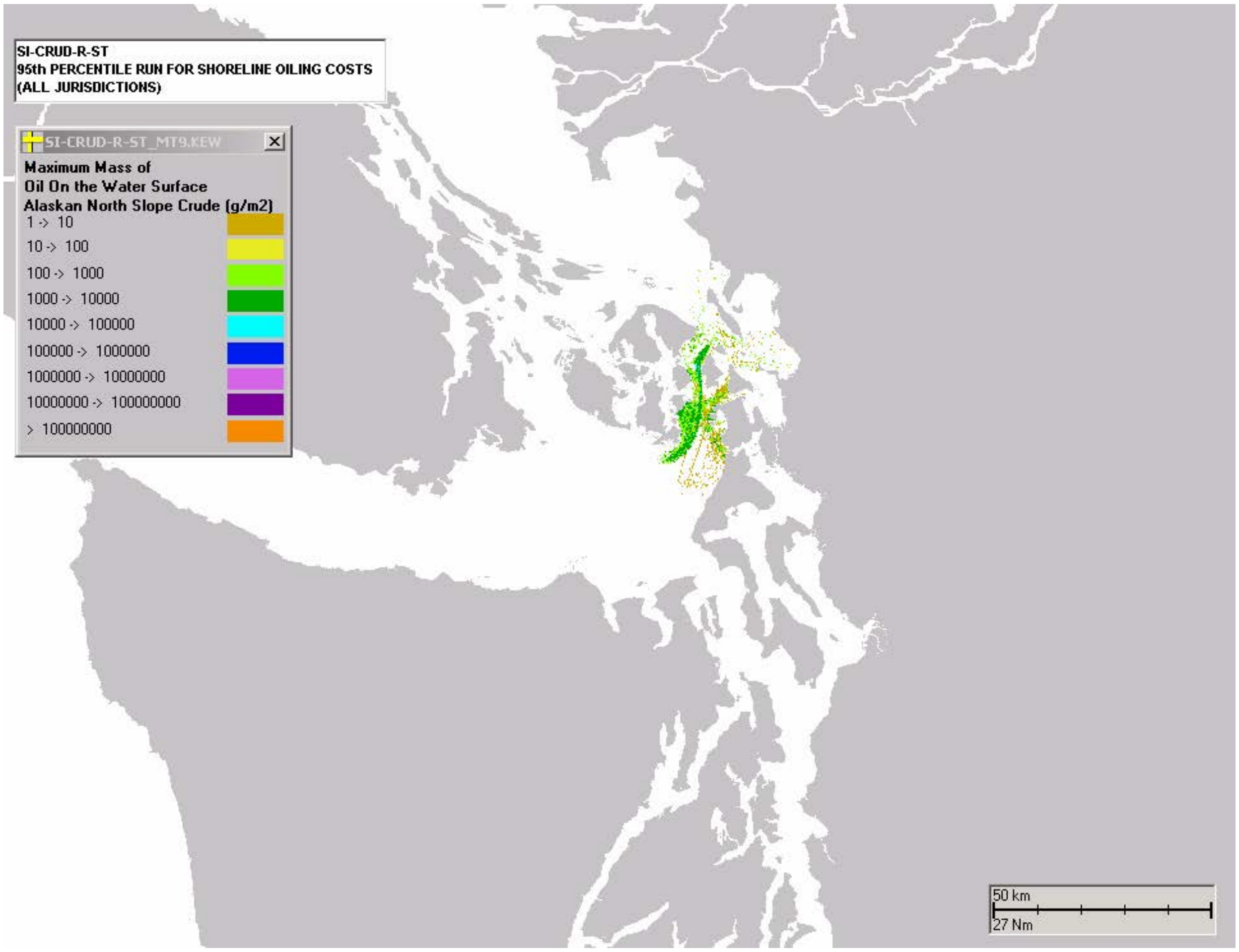

Figure 5-20 San Juan Islands, Crude Oil and State Mechanical Removal: Water Surface Exposure to Floating Hydrocarbons for the 95th-Percentile Run Based on Shoreline Costs

Source: Etkin 2001.

5.10 OIL SPILLS AND RESPONSE ACTIVITIES

This section addresses the potential effects of spilled oil and refined petroleum products (also combined as *oil* in this section), and subsequent response activities on the environment. Response activities include (1) stopping the source of the release of oil; (2) containing the released oil; (3) recovering the contained and stranded oil; and (4) cleaning up the shorelines, structures and other facilities affected by oil. General information on oil spills and response actions is provided, followed by analyses of the effects of oil spills and response actions on each resource addressed in Chapter 4.

The impacts of an oil spill are difficult to predict because each spill is a unique event. The spill itself, the open water environment, and the response efforts all contribute to complex, constantly changing exposure conditions for resources in the offshore and nearshore environments (ASA 2013).

When an oil spill occurs, the resulting environmental impact depends on a number of factors, including the following:

- Characteristics of released materials, which change with time due to weathering and response activities;
- Volume and duration of the release of oil;
- Location and nature of the release;
- Physical oceanographic conditions (e.g., currents, temperature), which vary in space and time;
- Weather at sea during the spill (winds, light exposure, air temperature), affecting the oil's chemistry;
- Presence of environmental resources ;
- Timing of breeding cycles and seasonal migrations of species;
- Location of critical habitats (live bottom, deep water corals, cold seeps; fishing grounds);
- Response effectiveness to stop or slow the release of oil, as well as changes in the location, nature, and volume of the release; and
- Impacts of oil hydrocarbon/dispersant/contaminant mixes over time.

5.10.1 Fate and Behavior of Oil

For this assessment, the spilled oil can be considered in three general classes: crude/bunker oil (*heavy*) range, diesel oil (*middle)* range, and gasoline (*light)* range. For this assessment, bunker fuel is considered a heavy oil that is generally similar to crude oil in behavior and potential impacts.

As a general summary, crude/bunker oils and refined petroleum products are generally lighter (less dense) than seawater, and float on or to the surface unless they are dispersed into the water directly or by external forces, as summarized below. The range of heavy to light petroleum hydrocarbons is composed of chemicals that behave differently when released. Most of the compounds in oil are not soluble in water. However, the low-molecular-weight aromatic compounds such as benzene, toluene, ethylbenzene, and xylenes (known collectively as *BTEX*), and some of the lighter PAHs are volatile (evaporate from the water surface) and soluble in water. In addition, the smaller non-aromatic compounds (such as pentane, hexane, and octane) evaporate rapidly. Over time, oil contains less and less of both volatile and soluble compounds, leaving a residual heavier material that can become sticky and tar-like (ASA 2013). In some cases, the oil (especially heavy bunker fuel oil) is heavier than water when it is spilled or becomes heavier than water after the lighter fractions evaporate, and the residual may sink to the bottom.

Oil weathers and degrades when exposed to air and sunlight. When first released, floating oil tends to form slicks, which thin out over time into sheens. Heavy oils may collect into thick clumps. Some heavy oils form *mousse*, in which water becomes incorporated into the oil, making it thicker and more viscous. Eventually, floating heavy oil breaks up into weathered tar balls, which are transported by currents. If winds are onshore, oil will come ashore and be deposited where it lands (ASA 2013). The middle range oils tend to form slicks but do not form mats or tar balls when they are deposited on the shore. The light range fractions tend to disperse rapidly from the water surface through evaporation and dissolution, and do not generally result in long-term contamination of the shoreline or marine waters.

Oil dispersed in water forms small oil droplets or tar balls. The smaller the particles of oil, the more readily they are dispersed throughout the water column and the more effective the biodegradation process.

Oil may be dispersed from the water surface by natural turbulence from breaking waves, tidal currents, and vessel transit. If dispersants are appropriately applied to oil on the water surface, this process is enhanced. Dispersants are soap-like surfactant mixtures, composed of compounds that coat the oil surface and encourage it to break into smaller particles. Oil dispersion rate is highest in storm conditions and when large amounts of dispersants are applied to the oil. (ASA 2013.)

5.10.2 Oil Spill Response

In addition to the direct effects of oil, response operations may affect natural resources. The Northwest Area Contingency Plan (NWACP 2013) provides a checklist of containment and clean-up options and strategies that may be used in the region. The following list from the NWACP is not in order of importance and may not apply to every situation.

- Natural recovery (which may include setting aside areas for research purposes and countermeasures effectiveness determination);
- Booming and containment – containing the oil with booms made of neoprene or an absorbent material;
- Skimming barriers and berms – containing the oil with barriers, and then skimming/removing the oil from the surface;
- Physical herding;
- Manual oil removal/cleaning;
- Mechanical oil removal;
- Sorbents – inert and insoluble materials that the oil adheres to;
- Vacuuming;
- Debris removal;
- Sediment reworking/tilling;
- Vegetation cutting/removal;
- Flooding/deluge;
- Dispersants – rapidly disperses large amounts of oil from the sea surface into the water column by breaking up the oil to form water-soluble micelles that are rapidly diluted;
- In-situ burning – the controlled burning of oil on water at the spill site; and
- Decanting – separation of water from recovered oil and return of excess water into the response area.

The use of specific response technologies for a specific spill is determined based on the type, location, and severity of the spill. The use of chemical dispersants is currently permitted only on a case-by-case basis in Washington and only offshore (Mearns et al. 2001); therefore, it is unclear whether dispersants would be used in the Project area. In-situ burning would be allowed only when consistent with the NWACP's *In-Situ Burning Policy and Guidelines*. These guidelines state that the Northwest Area Committee allows, and in certain cases encourages, in-situ burning—provided that requirements have been met. The authority to approve a burn rests with the Unified Command, who must determine that an application to burn conforms to the guidelines. The decision to burn or not burn must be made expeditiously. The guidelines define *pre-approval areas* as those areas more than 3 miles from significant population centers. All other areas are considered on a case-by-case basis. A general discussion of potential impacts of response actions is provided in Chapter 6 for each resource.

The USCG, Ecology, and other groups in Washington State have developed oil spill preparedness plans and actions that aim to prevent pollution and prepare rapid, aggressive, and well-coordinated response to oil spill emergencies. Plans relevant to the Project area include the following:

- The Ecology Spills Prevention, Preparedness and Response Program (Program), 2009–2015 Strategic Plan.
- The Ecology/USCG Strategic Work Plan adopted in June 2007.
- The Northwest Area/Region Ten Regional Contingency Plan 2012–2013.
- The Pacific States/British Columbia Oil Spill Task Force 2009–2011 work plan.

In the event that a catastrophic spill occurs in the Project area, the USCG would implement the NWACP to oversee oil spill response and cleanup. Along with other trustee agencies, they would implement the National Resource Damage Assessment process pursuant to the Oil Spill Prevention Act of 1990, as amended. NMFS and the USFWS would likely enter into an emergency consultation with the USCG concerning the effect of the oil spill response.

5.10.2.1 Oil Spill Response in the Project Area

BP performs oil spill response drills on an annual basis to assess refinery and agency response to a simulated spill. All existing operating procedures are reviewed on a quarterly cycle, as well as any changes to operations or new equipment. Other documents that are regularly updated with different ships and operational procedures include the Port Information and Terminal Manual; Individual Load Plan for each ship; and the Oil Handling Facility Manual, which meets requirements of both Ecology and the USCG. A Cargo Safety Advisor is present during all loading and transfer activities on the North Wing, as well as for new ships on the South Wing. This advisor improves ship-to-shore communication and is trained to identify spill and safety hazards. In addition, spill response kits are located throughout the facility to contain and clean up any spills that occur before they can reach water. (BP 2011).

BP's Oil Spill Response Team is responsible for practicing on-water equipment deployment at least twice a year; updating the dock procedures for loading and unloading ships; maintaining the Oil Spill Response Plan; ensuring the integrity of facilities used to transport, load, and unload oil and chemicals; and ensuring the integrity of the infrastructure to deal with spills and their impacts (BP 2008). The Oil Spill Response Team maintains a minimum of 20 HAZWOPER-trained Spill Responders, and an on-site contractor also maintains a minimum of 20 additional contractors for clean-up response (BP 2011).

Vessel and facility response plans require owners and operators to ensure (via contract or other approved means) oil spill mechanical recovery capability in addition to other response planning facets (e.g., salvage and marine firefighting, spill management team, and exercise). On August 31, 2009, the final rule for the *Vessel and Facility Response Plans for Oil: 2003 Removal Equipment Requirements and Alternative Technology Revision* or the "CAPS" rule established minimum equipment capability limits (CAPS) on the amount of resources that vessel and facility plan holders are required to ensure available by contract or other approved means. This rulemaking enhances the existing response requirements for vessels and facilities by requiring advance contracts for dispersants and related delivery equipment and aerial tracking and trained observation personnel (USCG 2012).

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6 ENVIRONMENTAL CONSEQUENCES

6.1 Introduction

This EIS is focused on the incremental change in the potential risk of an accident and oil spill from operation of two wings at the BP Cherry Point dock (the North Wing and South Wing) compared to operation of a single wing (the South Wing). Risk of an oil spill event is related to the level of vessel traffic calling at the dock; therefore, the results of the vessel traffic modeling studies described in Chapter 5 were used to estimate the change in potential risk and the related environmental consequences in the event of an incident.

Impacts from construction of the North Wing of the BP Cherry Point dock were evaluated in an environmental report (ENSR 1992) and subsequent addendum to the environmental report (ENSR 1997). Construction of the North Wing was completed in 2001, and BP does not seek to construct or modify any new facilities under the Proposed Action. Furthermore, the decision of the 9th Circuit Court challenged only the operation of the new platform and not its construction; the decision required an in-depth review by the USACE of the extent to which operation of the second platform would increase vessel traffic. Impacts from construction of the North Wing therefore are not addressed in this EIS.

The environmental resources in the Project area were analyzed to determine the likely environmental consequences of:

- Operations activities at and in the maneuvering area of the North Wing;
- Changes in the number of vessels transiting to the BP Cherry Point dock through the Project area;
- Spill of crude oil, bunker oil, or refined petroleum product in the Project area;
- Clean-up actions in the event of a spill; and
- Removal of the North Wing.

The analysis of change in the potential risk of accidents and oil spills included several different future forecasts of traffic calling at the BP Cherry Point dock (see discussion in Chapter 5).

The maximum forecasted traffic with both wings in operation is 420 calls per year. With a single wing in operation, traffic would be limited to approximately 335 calls per year (see discussion regarding maximum single-wing capacity in Chapter 5). Operation of two wings at the BP Cherry Point dock results in a potential increase of 85 vessels per year above the maximum capacity of vessels calling at a single wing. As discussed in Section 5.5.1, the actual number of vessel calls at the BP Cherry Point dock was 329 for 2010, which is less than the maximum forecast of 420 calls. From 1998 to 2010, annual vessel calls have ranged from 247 to 416 calls, averaging 321 calls per year. The maximum forecast of 420 vessels is four more vessel calls than the highest number of calls in a single year to date. As discussed in Section 5.5.3, the number of future tanker and barge calls is uncertain but more likely to continue in BP's current conditions forecast (mid-range traffic scenario) or the low-range traffic scenario than to increase to 420 calls per year. Thus, 420 calls per year is considered a conservatively high estimate for use in the analysis to assess changes in vessel traffic from the Proposed Action.

Two vessel traffic models were used to analyze the movement of vessels calling at the BP Cherry Point dock and interacting with marine traffic in the Puget Sound region. The general conclusions regarding the incremental increase in potential accidents and oil spills from double-wing operations in the GWU VTRA (van Dorp et al. 2008) and the TGA VTA (TGA 2013) are summarized below:

- At current and future traffic levels (calls of tankers and barges) up to the maximum capacity of a single-wing dock (approximately 335 calls per year), operation of a second wing reduces the potential for accident, oil spill, and potential oil spill volume (GWU VTRA).
- At future traffic levels (calls of tankers and barges) at the maximum level projected for operation of the BP Cherry Point dock (420 calls per year), an increase in the potential for accidents and oil spills may occur irrespective of the dock configuration (TGA VTA).
- The accidents likely to produce the largest cumulative spill volume (at the 95^{th} percentile of all predicted annual outflows) are spills resulting from a non-impact incident type. This includes spills caused by equipment failures, fires, explosions, operator errors, and structural failures (TGA VTA).
- The subarea with the greatest potential change in spill size (but not frequency) may be the Cherry Point area at the maximum annual calls on two wings compared to the maximum annual calls on a single wing projected by BP (TGA VTA).
- The addition of vessel traffic generated by other proposed projects (cumulative projects) in the region likely will increase the potential for accidents and oil spills (TGA VTA).
- No increase in spills related to double-wing dock operations (transfers and maintenance spills) is projected to occur. Spills from transfer operations related to bunkering of vessels calling at the BP Cherry Point dock may increase. Such spills would occur at the bunkering location and not at the BP Cherry Point dock, where bunkering operations are currently prohibited (ERC).

Total loss of oil cargo from a fully loaded large tanker has not occurred to date in U.S. waters, although a few such incidents (involving sinking or groundings of fully loaded tankers) have occurred in foreign waters (Etkin 2001). In theory, such a spill could occur in Washington State, in addition to spills of smaller amounts of oil. For this reason, this chapter broadly discusses the potential impacts from a spill of crude oil or refined petroleum product and the associated clean-up actions. Potential impacts from a spill are discussed broadly for each resource because a spill of any size theoretically could occur anywhere in the Project area.

It is important to note that this analysis does not provide an assessment of the actual risk of an oil spill occurring in the Project area, only an estimate of the potential increase in risk using certain parameters in two model types. Furthermore, it is the change in potential accident frequency and oil spill volume that is used to characterize the incremental risk. As described in Chapter 5, accident frequency values or oil spill volumes are cited only to provide context in terms of the magnitude of these potential events.

The general impacts of the various grades of petroleum considered in this EIS are summarized in Section 5.6. For this assessment, petroleum grades are considered in two classes: 1) crude/bunker (heavy range); and 2) refined petroleum products which include diesel (middle range), jet fuel (middle range), and gasoline (light range). For this assessment, bunker fuel is considered a heavy-grade oil, with potential impacts that are similar to those of crude oil.

Chapter 6 discusses the potential environmental effects on each resource described in Chapter 4, followed by a summary discussion of the relationship between short-term uses and long-term productivity (Section 6.14), irretrievable and irreversible commitments of resources (Section 6.15), and any unavoidable impacts (Section 6.16). The analysis of alternatives (Section 6.11) addresses potential impacts under the No Action Alternative (which involves removal of the existing North Wing of the BP Cherry Point dock) and under Alternative A (the Proposed Action without conditions on operations). Cumulative effects (the impacts from the Proposed Action combined with impacts from reasonably foreseeable projects in the vicinity) are discussed in Section 6.12. Section 6.13 describes proposed mitigation measures that could be implemented to offset identified potential environmental impacts from the Proposed Action.

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6.2 Nearshore and Marine Resources

Impacts on nearshore marine resources would occur only to those species with the potential to occur in the study area. Species presence and timing in the study area are described in Section 4.2. Impacts on species groups and on specific federally and state-listed species are described below.

Potential impacts specific to ESA-listed species expected to occur in the study area are described in the draft Biological Evaluation, prepared pursuant to ESA Section 7(c) (Appendix G). The draft Biological Evaluation also provides a conclusion as to the effects of the Proposed Action on ESA-listed species and their critical habitat (Table 6.2-1). Critical habitat that does not occur in the study area is not discussed further in the EIS. Table 6.2-2 provides a summary of state-listed species that may occur in the study area.

For each species grouping, effects on federally and state-listed species are included in the discussions of more common species, unless otherwise noted. If the Proposed Action would result in effects on federally or state-listed species different from those described for a species grouping, additional effects analyses are provided for those species. Potential impacts on critical habitat also are discussed as appropriate.

6.2.1 Impacts on Nearshore and Marine Resources from Operations at the North Wing

Activities at the North Wing include mooring vessels, loading and unloading refined petroleum products, oily water collection, ballast discharge, and dock maintenance. Potential impacts on marine resources from operations at the North Wing may stem from maintenance activities, air emissions, accidental releases of oil or other hazardous materials (e.g., hydraulic fluid), and improper discharge of ballast water. Annual preventive maintenance activities involving in-water, on-water, and underwater work are conducted under permits issued by the USACE and other appropriate state and federal agencies. Major maintenance activities at the North Wing are conducted periodically and may be permitted separately.

6.2.1.1 Marine Mammals

Ongoing operations and maintenance activities at the BP Cherry Point dock could result in accidental spills of oil or other hazardous materials such as paint, cleaning or hydraulic fluids, and lubricating oil. As described in Section 6.8, instances of spills associated with operation of the BP Cherry Point dock are not routine and are not expected to occur with sufficient frequency or magnitude to adversely affect marine mammals.

It is possible that baleen whale could be present in the vicinity when vessels are arriving or departing from the North Wing. The low likelihood that baleen whales would be present in the study area, combined with the small potential increase in vessel traffic calling at the BP Cherry Point dock, makes a measurable increase in the probability of a vessel strike over baseline conditions unlikely.

Measures to reduce potential effects on whales during maintenance activities include posting observers at the dock during maintenance activities, when required. If a whale is observed near the dock in these circumstances, maintenance activities would be suspended until the whale moves away from the area.

Table 6.2-1 Effects of the Proposed Action on Federally Listed Species That Occur in the Study Area

Species Common Name	Species Scientific Name	Status	Critical Habitat Status	Project Effect
Marine Mammals				
Humpback whale	*Megaptera novaeangliae*	E	None	May affect; not likely to adversely affect
Blue whale	*Balaenoptera musculus*	E	None	May affect; not likely to adversely affect
Fin whale	*Balaenoptera physalus*	E	None	May affect; not likely to adversely affect
Southern resident DPS killer whale	*Orcinus orca*	E	Designated	May affect; not likely to adversely affect
Marine Turtles				
Leatherback turtle	*Dermochelys coriacea*	E	Designated	May affect; not likely to adversely affect
Birds				
Marbled murrelet	*Brachyramphus marmoratus*	T	Designated outside of study area	May affect; not likely to adversely affect
Fish				
Bull trout	*Salvelinus confluentus*	T	Designated	May affect; not likely to adversely affect
Chinook salmon (Puget Sound ESU)	*Oncorhynchus tshawytscha*	T	Designated	May affect; not likely to adversely affect
Chum salmon (Hood Canal summer-run)	*Oncorhynchus keta*	T	Designated	May affect; not likely to adversely affect
Puget Sound steelhead	*Oncorhynchus mykiss*	T	Proposed outside of study area	May affect; not likely to adversely affect
Eulachon (Southern DPS)	*Thaleichthys pacificus*	T	Designated outside of study area	May affect; not likely to adversely affect
Green sturgeon (Southern DPS)	*Acipenser medirostris*	T	Designated	May affect; not likely to adversely affect
DPS Bocaccio	*Sebastes paucispinis*	E	Proposed	May affect; not likely to adversely affect
DPS Canary rockfish	*Sebastes pinniger*	T	Proposed	May affect; not likely to adversely affect
DPS Yelloweye rockfish	*Sebastes ruberrimus*	T	Proposed	May affect; not likely to adversely affect

DPS = distinct population segment
E = endangered
ESU = evolutionary significant unit
T = threatened

Table 6.2-2 State-Listed Species That May Occur in the Study Area

Species Common Name	Species Scientific Name	State Listing Status
Marine Mammals		
Dall's porpoise	*Phocoenoides dalli*	Monitored
Southern resident killer whale	*Orcinus orca*	Endangered
Gray whale	*Eschrichtius robustus*	Sensitive
Humpback whale	*Megaptera novaeangliae*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Blue whale	*Balaenoptera musculus*	Endangered
Harbor seal	*Phoca vitulina*	Monitored
Marine Turtles		
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Birds		
Common loon	*Gavia immer*	Sensitive
Western grebe	*Aechmophorus occidentalis*	Candidate
Brown pelican	*Pelecanus occidentalis*	Endangered
Brandt's cormorant	*Phalacrocorax penicillatus*	Candidate
Common murre	*Uria aalge*	Candidate
Marbled murrelet	*Brachyramphus marmoratus*	Threatened
Cassin's auklet	*Ptychoramphus aleuticus*	Candidate
Tufted puffin	*Fratercula cirrhata*	Candidate
Bald eagle	*Haliaeetus leucocephalus*	Sensitive
Peregrine falcon	*Falco peregrinus*	Sensitive
Streaked horned lark	*Eremophila alpestris strigata*	Endangered
Purple martin	*Progne subis*	Candidate
Fish		
Chinook salmon	*Oncorhynchus tshawytscha*	Candidate
Chum salmon	*Oncorhynchus keta*	Candidate
Bull trout	*Savelinus confluentus*	Candidate
Black rockfish	*Sebastes malanops*	Candidate
Brown rockfish	*Sebastes auriculatus*	Candidate
Bocaccio rockfish	*Sebastes paucispinis*	Candidate
Canary rockfish	*Sebastes pinniger*	Candidate
China rockfish	*Sebastes nebulosus*	Candidate
Copper rockfish	*Sebastes caurinus*	Candidate
Greenstriped rockfish	*Sebastes elongates*	Candidate

Table 6.2-2 State-Listed Species That May Occur in the Study Area (Continued)

Species Common Name	Species Scientific Name	State Listing Status
Fish (Continued)		
Quillback rockfish	*Sebastes maliger*	Candidate
Redstripe rockfish	*Sebastes proriger*	Candidate
Tiger rockfish	*Sebastes nigrocinctus*	Candidate
Widow rockfish	*Sebastes entomelas*	Candidate
Yelloweye rockfish	*Sebastes ruberrimus*	Candidate
Pacific herring	*Clupea pallasi*	Candidate
Eulachon	*Thaleichthys pacificus*	Candidate
Pacific cod	*Gadus macrocephalus*	Candidate
Pacific hake	*Merluccius productus*	Candidate
Walleye pollock	*Theragra chalcogramma*	Candidate
Pacific lamprey	*Entosphenus tridentatus*	Candidate
Mollusks		
Newcomb's littorine snail	*Algamorda subrotundata*	Candidate
Pinto abalone	*Haliotis kamtschatkana*	Candidate

Introduction of aquatic nuisance species (ANS) through ballast discharge could result in alterations to the ecosystem that eliminate native species, which in turn could alter the food web and result in decreased populations of native aquatic species. Marine mammals could be indirectly affected if prey items become more or less abundant due to the presence of ANS. Vessels calling at the BP Cherry Point dock would comply with State of Washington and USCG regulations that require offshore ballast water exchange (see Section 1.4.1). In the rare event that ballast water must be discharged from a cargo tank, the BP Cherry Point dock has reception facilities available for this type of ballast water, preventing it from entering the marine environment.

6.2.1.2 Marine Turtles

Loggerhead, olive ridley, and green sea turtles rarely occur in Puget Sound or near the coast of Washington. The study area is considered beyond the normal range for occurrences of these species and contains unsuitable habitat due to cold water temperatures. Most hard-shell turtles seek optimal seawater temperatures near 18°C (65°F) and are cold-stressed at seawater temperatures below 10°C (50°F) (Mrosovsky 1980; Schwartz 1978). Water temperatures recorded at various locations throughout the study area are under 10°C (50°F) the majority of the year and do not approach 18°C (65°F) (NOAA 2014a). Consequently, loggerhead, olive ridley, and green sea turtles are not expected to occur within the study area and would not be affected by ongoing operation of the BP Cherry Point dock. Although adult leatherbacks turtles could be present in the study area near "J" Buoy, they are unlikely to occur near the BP Cherry Point dock and would not be affected by ongoing operation of the North Wing.

6.2.1.3 Birds

The presence of workers during annual maintenance activities may attract or disturb different species of birds. Some species, such as gulls or corvids, may be attracted to the area if extra food items become available, from lunch waste for example. Maintenance activities would be limited in duration and magnitude, and are not expected to adversely affect birds present in the study area.

Exposure to air emissions and discharges to marine waters from moored vessels (see Section 6.8, “Air Quality and Climate Change” and Section 6.4, “Water Quality,” respectively) could cause mortality or reduction in fitness at very high concentrations. Prey species such as herring and smelt that spawn near the dock also could be affected by an accidental spill of oil or other hazardous material. Instances of spills associated with operation of the BP Cherry Point dock are not part of normal operations and maintenance activities, and are not expected to occur in sufficient magnitude or frequency to adversely affect birds or their prey species.

Birds could be indirectly affected if prey items became more or less abundant as a result of the introduction of ANS caused by an accidental release of ballast water. Historical records of such incidents show that these events are rare and of such a size as to not create an additional risk of invasive species introduction.

Vessels approaching the BP Cherry Point dock would pass through a documented herring pre-spawning holding area located just offshore from the dock (WDFW 2014); this could disrupt feeding opportunities for birds. Vessels approaching the terminal would be travelling slowly, and foraging birds likely would move away. The area of disturbance from approaching vessels is small relative to the available herring habitat, and minimal impact on foraging birds is expected from vessel disturbance near the BP Cherry Point dock.

Impacts on marbled murrelets could include effects on prey species from accidental oil spills near the dock and invasive species transfer from ballast exchange. Accidental spills are not expected to occur in sufficient magnitude or frequency to adversely affect prey for marbled murrelets, and compliance with ballast water exchange regulations would prevent the spread of ANS. Impacts on state-listed bird species would be similar to those described for birds in general.

6.2.1.4 Fish

Ongoing operations and maintenance activities at the BP Cherry Point dock could result in accidental spills of oil or other hazardous materials such as hydraulic fluid. In addition, accidental releases of ballast water and increased lighting could affect fish.

As described in Section 5.8, instances of spills associated with operation of the BP Cherry Point dock are not part of normal operations and maintenance activities, and are not expected to occur in sufficient magnitude or frequency to adversely affect fish.

If ANS were introduced via ballast discharge, native fish may need to compete with the new species for the same natural resources and life requirements such as food, water, and habitat. In extreme circumstances, ANS could out-compete native species, resulting in their extinction. Historical records of such incidents show that these events are rare and of such a size as to not create an additional risk of invasive species introduction. In addition, NMFS has consulted with the USCG on implementation of the ballast water management regulations and has concluded that the low potential for introduction of invasive species is not likely to jeopardize the existence of listed species (NMFS 2012).

Most fish use vision to orient and perform activities such as foraging, breeding, and avoiding predators. Fish behavior can be affected by artificial light stimuli. A common reaction of fish groups in the presence of artificial light is to school and move toward the light source. Levels of aggregation and attraction to light vary by species (Marchesan et al. 2004). Artificial lighting at the dock may facilitate nocturnal predation by visual aquatic predators and piscivorous (fish-eating) birds. Increased lighting at the BP Cherry Point dock would be associated with vessels unloading at night. The effect would be temporary because lights would be on only during unloading.

Critical habitat for bull trout, Chinook salmon, chum salmon, and juvenile canary rockfish occurs within the vicinity of the BP Cherry Point dock and could be affected by ongoing operations and maintenance activities. Increased lighting at the dock associated with vessels unloading at night would not affect nearshore critical habitat because it would be temporary and lights would be on only during unloading. Minor shading of the nearshore habitat in the vicinity of the dock could affect natural aquatic vegetation cover in the area; however, shading would be minimal and is not expected to result in lasting habitat alterations. Ongoing operations and maintenance activities at the BP Cherry Point dock could result in accidental spills of oil or other hazardous materials (e.g., hydraulic fluid or contaminated ballast) that may affect nearshore critical habitat, including its food base. Given the spill history at the BP Cherry Point dock and BP's oil spill avoidance and response measures (see Section 5.8); it is unlikely that operation of the dock would result in long-term impacts on Pacific salmon or bull trout critical habitat. Green sturgeon critical habitat does not occur in the vicinity of the BP Cherry Point dock; therefore, it would not be affected by ongoing operations and maintenance activities at the dock. Impacts on state-listed fish species would be similar to those described for fish in general.

Cherry Point Herring

The Cherry Point herring stock spawns in the subtidal area near the BP Cherry Point dock from mid-March through early June, with peak spawning occurring in mid-May. Effects on Cherry Point herring from operations at the North Wing would be similar to the impacts on fish discussed above. An accidental spill of oil or other hazardous material in proximity to spawning Cherry Point herring could adversely affect individual herring eggs or larvae. As described in Section 5.8, instances of spills associated with operation of the BP Cherry Point dock are not part of the normal operations and maintenance activities, and are not expected to occur in sufficient magnitude or frequency to adversely affect Cherry Point herring.

6.2.1.5 Invertebrates

Effects on invertebrates from proposed operation of the BP Cherry Point dock could include the accidental release of ballast water and minor releases of oil and other contaminants. Potential impacts on invertebrates from a release of ballast water would be similar to those described above for fish. Vessels calling at the BP Cherry Point dock would comply with USCG regulations for ballast exchange and discharge (see Section 1.4.1). Should vessels require discharge of ballast from their cargo tanks, the BP Cherry Point dock has reception facilities available. Potential impacts on invertebrates from a minor release of oil or other contaminants would be similar to impacts from a crude oil spill, which is described in Section 6.2.3.5. As described in Section 5.8, instances of spills associated with operation of the BP Cherry Point dock are not part of the normal operations and maintenance activities, and are not expected to occur in sufficient magnitude or frequency to adversely affect invertebrates. Impacts on state-listed invertebrate species would be similar to those described for invertebrates in general.

6.2.2 Impacts on Nearshore and Marine Resources from Changes in Vessel Traffic

Impacts on nearshore marine resources from changes in vessel traffic in the study area could result from vessel strikes, increased noise, and entrainment of larval fish in vessel water intakes.

6.2.2.1 Marine Mammals

Vessel Strikes

Whales are vulnerable to collisions with all vessel types, sizes, and classes. Most reports of collisions involve large whales; however, collisions with smaller species also occur. Vessel strikes occur when either the whale or the vessel (or both) fail to detect the other in time to take avoidance action. Variables that affect the likelihood of collisions between whales and vessel include vessel speed, type, and size.

The probability that collision of a whale with a vessel would cause a fatal or serious injury increases with speed. Whales struck by vessels traveling at speeds less than 13 knots are more likely to survive than when struck by a vessel traveling at speeds greater than 13 knots (Dolman et al. 2006). Collisions between vessels and whales are associated with a wide variety of vessels (size and class). A review of the NMFS Large Whale Ship Strike database (Jensen and Silber 2004) reported two instances of vessel-struck whales in the study area between 1975 and 2002. In both instances, finback whales were struck. Both strikes resulted in mortality. While vessel strikes have occurred in the study area, vessels and tugboats bound for the BP Cherry Point dock North Wing proceed in a usually predictable straight path at relatively low speeds. Such vessels are likely to be detected and avoided (NMFS 2008).

Between 2002 and 2013, approximately nine fin whales have been stranded ashore in the Puget Sound with a vessel strike indicated as the cause (Cascadia Research 2013). Vessel strikes of humpback, blue, and fin whales also have been recorded (Jensen and Silber 2004). The vessel traffic calling at the BP Cherry Point dock currently represents approximately 1 percent of the commercial vessel traffic in the study area, and the potential increase in vessel traffic from the North Wing is small. The low likelihood that a humpback, blue, or fin whale will be present in the study area, combined with the small potential increase in vessel traffic calling at the BP Cherry Point dock, makes a measurable increase in the probability of a vessel strike over baseline conditions unlikely.

Collisions of killer whales with vessels are rare but remain a potential source of serious injury or mortality. Shipping vessels and tugboats proceed in a usually predictable straight path toward the BP Cherry Point dock at relatively low speeds. Such vessels do not target whales and are likely to be detected and avoided by southern resident killer whales (NMFS 2008). Vessels and barges bound for the BP Cherry Point dock use Rosario Strait almost exclusively. This route has a lower density of killer whales compared to Haro Strait (see Appendix G); therefore, the probability of killer whales encountering vessels in the Rosario Strait route would be lower than in the Haro Strait route. Known collisions of vessels of any type with southern resident killer whales in the lower British Columbia region (near Vancouver Island) was limited to three observations between the 1960s and 2006 (NMFS 2008). These observations indicate that vessel collisions are likely to be similarly infrequent with all vessel traffic in the Cherry Point area and Rosario Strait. Because vessel traffic calling at the BP Cherry Point dock represents only a portion of all shipping traffic (approximately 1 percent), the likelihood of a vessel collision with killer whales attributed to vessel traffic associated with the North Wing is expected to be very low.

While collisions between pinnipeds and large vessels are unlikely, pinnipeds could be disturbed while at haul-out sites. Calkins and Pitcher (1982) found that disturbances from vessel traffic cause extremely variable effects on hauled-out sea lions, ranging from no reaction to complete and immediate departure from the haulout. Increased vessel traffic associated with the BP Cherry Point dock could lead to an increased disturbance of pinnipeds, including state-listed harbor seals and Dall's porpoise, which could result in behavioral effects. It is not likely that the very small proportional change in vessel traffic relative to baseline traffic would result in disruption of normal behavior patterns in a biologically significant manner. Changes in vessel traffic could affect foraging behavior, but little data exist to determine the relevance to pinnipeds. In addition to potential direct effects on foraging behavior, pinnipeds could be indirectly affected if schools of forage fish change their behavior due to changes in vessel traffic. This is unlikely given that the increase in vessels represents a small proportion of total vessel traffic in the study area.

Although sea otter collision with a vessel could occur, this is unlikely because healthy sea otters typically are vigilant and able to avoid collisions.

While whales, pinnipeds, and sea otters are present in the study area, the probability of a vessel strike occurring as a result of the Proposed Action is sufficiently unlikely to be considered discountable. The likelihood of a vessel strike with federally or state-listed species would not be appreciably different from the potential for a strike with other more common mammals—a low probability event.

Noise

Oceanic traffic in Puget Sound generally contributes sound at a level from 10 Hz to beyond 10 kHz, with the majority of sounds occurring at low frequencies (Bassett 2010). Vessel movement to and from the BP Cherry Point dock would occur within existing designated shipping lanes, which are characterized by high levels of use by both commercial and recreational vessels. The incremental increase in vessel traffic from use of the North Wing could expose whales to increased sound levels from a transiting vessel. Basset et al. (2012) estimate the source level for oil/chemical tankers at 181 dB re 1 µPa at 1 m and for tugs, at 173 dB re 1 µPa at 1 m. These levels are representative of the vessels calling at the BP Cherry Point dock, including those vessels contributing to the increase in calls resulting from operation of the North Wing, because no change is expected in the vessel speed, condition of the vessel, vessel load, or onboard activities of the vessels calling at the dock other than a small incremental increase in the frequency of calls. These levels are well below NMFS proposed guidelines (NMFS 2012) for avoidance of potential injury to or harassment of marine mammals.

Baleen whales are sensitive to low-frequency sound occurring in the 0.01 to 1 kHz range (Okeanos 2008). Humpback, blue, and fin whale calls also occur at low frequencies but span a slightly larger range (from 0.03 to 8 kHz); their hearing is presumed good at corresponding frequencies (NMFS 2010c). Noise from increased vessel traffic associated with the Proposed Action has the potential to mask biologically significant sounds these whales use to communicate, avoid predators, and gain awareness of the environment. Although there are many documented, clearly discernable responses of marine mammals to anthropogenic sound, reactions are typically subtle, consisting of shorter surfacing intervals, shorter dives, fewer blows per surfacing, longer intervals between blows, ceasing or increasing vocalizations, shortening or lengthening the duration of vocalizations, and changing the frequency or intensity of vocalizations. While some of these changes may be statistically significant, it is unknown if they affect whales at the individual or population level (NRC 2003). Exposure to anthropogenic sounds may also lengthen migration, increase the duration of foraging bouts, or limit foraging opportunities before long periods of fasting and migration (NRC 2003). Should baleen whales be present in the study area, changes in vessel traffic from the proposed operation of the BP Cherry Point dock would not significantly alter the background noise level (139 to 159 dB re 1µPa) reported by ConocoPhillips (2007) during construction at its terminal. Although an increase in vessel traffic from proposed operation of the BP Cherry Point dock could lead to a slight increase in low-frequency noise, it is unlikely to adversely affect baleen whales because of the transient nature of the vessels, which would not cause long-term alteration of background noise levels.

Most toothed whales hear in a frequency range that extends from 1 kHz to at least 120 kHz, but they are most sensitive to sounds in the range of 18 to 42 kHz (Szymanski et al. 1999). While vessels and tugs associated with the BP Cherry Point dock would generate some broadband noise in the hearing range of toothed whales, the majority of energy would be below their peak hearing sensitivity (18 to 42 kHz), thereby reducing the possibility of affecting these species. If any toothed whales were present in areas that experience elevated noise levels, the duration of their exposure would be limited to the brief period when the vessel is nearby.

Killer whales are classified by NMFS as belonging to the mid-frequency hearing group, with a functional hearing range of 150Hz to 160 KHz. This frequency range overlaps with the frequency range of sound generated by commercial shipping traffic. However, much of the energy contributed by vessels calling at the BP Cherry Point dock falls below 1 kHz, which is a frequency range not particularly important to killer whales. Furthermore, in the case of whale/vessel interactions, whales are likely to begin moving away from the vessel when they hear the vessel (Richardson et al. 1995). This would reduce a whale's exposure to sound both in duration and intensity. The incremental increase in vessel traffic resulting from the Proposed Action is a small incremental increase in an already small component of the vessel traffic that occurs in the vicinity of southern resident killer whales. Therefore, temporary elevated sound levels associated with vessel traffic in the study area is not expected to adversely affect southern resident killer whales.

Pinnipeds have sensitive hearing across fairly wide frequency bands, with a range from approximately 0.05 to 50 kHz and underwater peak sensitivity occurring in the 1 to 25 kHz range (Okeanos 2008; Kastelein et al. 2005). Little information is available on sea otter hearing sensitivity. Limited studies have documented mother and pup calls ranging from 3 to 5 kHz, with the probability that some calls reach higher frequencies (Sandegren et al. 1973). As described above for toothed whales, the majority of sound levels generated by vessels under the Proposed Action would be below the peak hearing sensitivity for pinnipeds and sea otters.

The change in vessel traffic associated with continued operation of the North Wing could lead to a slight increase in low-frequency noise. Bassett et al. (2012) developed a vessel noise budget in which they estimated the relative contribution of each vessel type to the overall sound energy level introduced into Admiralty Inlet by vessel traffic. The total acoustic energy input of vessel traffic equipped with an automatic identification system[1] in the study area over the course of the year was estimated to be 438 megajoules. Of that amount, container ships, vehicle carriers, general cargo, and bulk carriers contributed 79 percent of the energy. Tugs, only a fraction of which are transporting oil, contributed 9 percent, and oil/chemical tankers contributed 2 percent. The remainder was attributed to ferries, cruise ships, fishing vessels, and others. Because vessel traffic calling at the BP Cherry Point dock currently represents approximately 1 percent of the commercial vessel traffic in the study area and the potential increase in vessel traffic with operation of the North Wing is very small, the contribution of noise from these vessels is not expected to adversely affect pinnipeds or sea otters. Noise impacts on state-listed marine mammal species would be similar to those described for marine mammals in general.

[1] The Maritime Transportation Security Act of 2002 §70114 requires that all self-propelled commercial vessels of at least 65 feet overall in length be equipped with and operate an automatic identification system. These systems transmit vessel identification, course, and speed similar to transponders used by the aircraft industry.

6.2.2.2 Marine Turtles

Loggerhead, olive ridley, and green sea turtles rarely occur in Puget Sound or near the coast of Washington. The study area is considered beyond the normal range of occurrence for these species and contains unsuitable habitat due to cold water temperatures. Most hard-shell turtles seek optimal seawater temperatures near 18°C (65°F) and are cold-stressed at seawater temperatures below 10°C (50°F) (Mrosovsky 1980 and Schwartz 1978). Water temperatures recorded at various locations throughout the study area are under 10°C (50°F) the majority of the year and do not approach 18°C (65°F) (NOAA 2014a). Loggerhead, olive ridley, and green sea turtles are not expected to occur in the study area and therefore would not be affected by increased vessel traffic transiting to the BP Cherry Point dock. Leatherback turtles have the potential to occur in the study area; effects on this species from increased vessel traffic are discussed below.

Vessel Strike

Adult leatherbacks turtles could be present in the study area during summer and fall when jellyfish aggregate; however, this species is more common in waters off the coast of Washington, outside the study area. Vessel traffic transiting to and from the BP Cherry Point dock has the potential to strike or disturb leatherback turtles feeding or swimming at or below the surface of the water. Because vessels would be moving at low speeds, leatherback turtles would be able to detect their presence and move away (Hazel et al. 2007). Vessel traffic calling at the BP Cherry Point dock currently represents approximately 1 percent of the commercial traffic in the study area, and the potential increase in vessel traffic with operation of the North Wing is very small. For these reasons, an increase over baseline conditions in the probability of a vessel strike to a leatherback turtle is unlikely.

Noise

Sea turtles respond to low-frequency sounds, but with less sensitivity than mammals (McCauley et al. 2000; URI 2013). It is believed that the range of maximum sensitivity for sea turtles is from 0.20 to 0.80 kHz, with hearing below 0.080 kHz being less sensitive but potentially usable to the animal (Lenhardt 1994; Moein et al. 1994). Vessel sounds attributed to large vessels, tankers, and tugs traveling to the BP Cherry Point dock would generate low-frequency sound in the range of 0.005 to 0.5 kHz (NOAA 2008). The role of underwater hearing in sea turtles is unclear (URI 2013); however, it is possible that noise from increased traffic associated with the Proposed Action could mask biologically significant sounds.

Leatherback auditory sensitivity is not well studied but likely would be similar to that of other sea turtles. Some investigations suggest that leatherback hearing is limited to low-frequency bandwidths (Lenhardt 1994; Moein et al. 1994). The incremental increase in vessel traffic from operation of the North Wing could lead to a temporary, slight increase in low-frequency noise but is unlikely to adversely affect leatherback turtles because of the transient nature of the vessels. The increase in vessel traffic from ongoing operation of the North Wing would not significantly alter the background noise level (139–159 dB [ConocoPhillips 2007]) and is unlikely to adversely affect leatherback turtles.

Critical Habitat

Vessel traffic moving to and from the BP Cherry Point dock would transit through a small portion of leatherback critical habitat in the vicinity of “J” Buoy. This area contains the Juan de Fuca Eddy, which develops offshore of northern Washington and the mouth of the Strait of Juan de Fuca as a result of wind-driven current with the continental slope (NMFS 2009). Leatherbacks could be using this eddy current for migration as well as foraging. As vessels pass through designated critical habitat, turtles could move away from the source of the noise, temporarily displacing them from the area. However, the passage of watercraft in the area is an existing, temporary, and common occurrence. The small incremental increase in traffic transiting to the BP Cherry Point dock is not expected to adversely affect designated critical habitat for the leatherback turtle.

6.2.2.3 Birds

Disturbance by vessels can be a major threat to birds through effects on behavior, reproduction, and fitness of individuals in colonies and effects on foraging or resting habitats (Schwemmer et al. 2011). Increased vessel traffic could result in increased noise and physical disturbance of birds present in the study area.

Birds are very sensitive to sound, but little is known about the effects of underwater noise on diving birds. Some species of birds are more sensitive to noise than others (SAIC 2011). Rapid changes in underwater sound pressure levels can cause a range of effects on birds, including physical injury in the form of sublethal injuries, lethal injuries, and auditory effects, in addition to non-physical behavioral effects (SAIC 2011). There is a wide variability in susceptibility to noise-related injury among bird species. The USFWS considers the cumulative sound exposure level (SEL) of 183 dB re 1µPa2-sec and the single-strike criterion of 206 dB re 1µPa2 (peak) to be the thresholds for inner ear hair cell damage, which is the point at which injury occurs. Large commercial vessels such as crude oil tankers produce relatively loud and predominately low-frequency sound that is unlikely to exceed the injury thresholds for birds. For example, at a distance of 3 km, SELs for bulk carriers traveling at 7.4 ms-1 were 127 dB re 1 µPa2 s (McKenna et al. 2012). An increase in vessel traffic due to operation of the BP Cherry Point dock could lead to a slight temporary increase in low-frequency noise but would not cause long-term alteration of background noise levels.

Increased vessel traffic could result in increased physical disturbance of birds present in the study area. Loons tend to avoid shipping lanes altogether, while some species of sea duck tend to flush as vessels approach (Schwemmer et al. 2011). Flushing (avoidance behavior) is energetically costly to birds; increased vessel traffic could affect resident diving birds such as loons, grebes, and auks. Evidence suggests that some birds, such as marbled murrelets, are capable of habituating to heavy vessel traffic (Ralph et al. 1995; Speckman et al. 2004). Ships would continue to follow established shipping lane pathways, and birds would likely avoid these areas or become habituated, thus reducing potential disturbance effects. In addition, fish (including prey fish for piscivorous birds) are unlikely to be affected by the small increase in vessel traffic. Therefore, the relatively small increase in vessels (<1 per day) at the maximum vessel traffic forecast is not expected to increase disruptions to the behavior of birds, including federally and state-listed species, in a biologically meaningful way.

6.2.2.4 Fish

Noise

Adult fish are able to detect vessel noise over a large range of frequencies, from 10 to several hundred Hz, when the sound level is greater than approximately 30 dB above their hearing threshold (Mitson 1995). Fish within a few hundred meters of passing vessels (e.g., tankers) may exhibit avoidance behaviors (Mitson 1995). A study on the behavior of larval fish in response to exposure to varying levels of sound found no significant effect on behavior or fish tissue (Jorgensen et al. 2005 as cited in Popper and Hastings 2009). An increase in vessel traffic from operation of the BP Cherry Point dock would lead to a small incremental increase in noise, which could directly affect fish species present in the study area by causing them to exhibit avoidance behavior when vessels are present. However, because the overall increase in exposure to noise would be small relative to existing conditions, noise effects on fish present in the study area, including federally and state-listed species, are expected to be minimal and discountable.

Entrainment

Entrainment (the direct uptake of aquatic organisms by the suction field generated by water intakes on vessels) could occur in the study area. Sources of potential entrainment include engine cooling water, ballast water, and terminal utility water intakes. Potential impacts from entrainment could include physical stress due to pressure changes and/or abrasions, or contact with screens and pump impellers and mortality. The change in pressure associated with water intakes can burst the swim bladders of some species. The potential for entrainment primarily would affect fish eggs and larval fish because larger adult fish have been found to escape by avoiding large vessels (Dettmers et al. 1998). Because entrainment is associated with specific life stages, effects would be limited to times when eggs and larval fish are present in the study area. The amount of egg and larval fish entrainment associated with the incremental increase in vessel traffic at the BP Cherry Point dock cannot be meaningfully measured, detected, or evaluated. Because of the small incremental increase in the number of vessels under the maximum vessel traffic forecast, the potential for entrainment to adversely affect the reproduction, population size, or distribution of the fish species in the study area, including federally and state-listed species, is expected to be discountable.

Cherry Point Herring

Effects on Cherry Point herring from increased vessel traffic would be limited to the potential for entrainment of eggs and larvae while vessels are transiting though Rosario Strait and when vessels are at dock. Entrainment impacts on Cherry Point herring during transit and vessel docking are discussed above. As also discussed above, adult fish are able to detect vessel noise over a large range of frequencies. An increase in vessel traffic from operation of the BP Cherry Point dock would lead to a small incremental increase in noise. This increase could directly affect staging and spawning herring present in the study area by causing them to exhibit avoidance behavior when vessels are present. Because the overall increase in exposure to noise would be small relative to existing conditions, effects on herring present in the study area are not expected to be biologically meaningful to the productivity or persistence of the Cherry Point herring stock. Effects therefore are considered discountable.

Critical Habitat

Vessel traffic moving to and from the BP Cherry Point dock would pass through critical habitat for Chinook and chum salmon, green sturgeon, and rockfish. Transiting vessels could cause these fish to temporarily move away from the source of the noise until the vessel has passed through the area; however, vessel traffic would not directly block migration routes for salmon and sturgeon. Critical habitat for adult canary and bocaccio, and adult and juvenile yelloweye rockfish is designated in waters deeper than 30 meters (98 feet) within the study area. The draft of a millennium tanker is approximately17 meters (56 feet), which would not affect deepwater habitat. Increased vessel traffic could increase water turbidity, which could in turn affect nearshore aquatic habitat and macroinvertebrates. Vessels would move at low speeds, which would minimize this temporary and localized effect. Moving vessels also would increase mixing of the surface and subsurface layers of the water column in the area immediately surrounding the vessel path and wake. This mixing of the layers is not expected to affect water quality because the increase in vessel traffic attributable to the Proposed Action would be very small and those vessels would stay within the CVTS, an area that is already disturbed by vessel traffic. Vessel traffic would not transit through bull trout critical habitat.

6.2.2.5 Invertebrates

The study area is home to a diverse and extensive invertebrate population, some of which are important commercial and recreational fisheries species for Washington State. While the adult stage of most invertebrates uses the demersal habitat (ocean floor) and would not be affected by changes in vessel traffic, it is possible that entrainment could occur during their pelagic larval stage. The duration of the pelagic larval stage varies by species and ranges from a few weeks to a few months. During this stage, free-floating larvae would be present in the water column and could become entrained by passing vessels. Because entrainment is associated with a specific life stage, effects would be limited to the time when larvae are present in the study area. The amount of larval entrainment associated with the incremental increase in vessel traffic from proposed operation of the BP Cherry Point dock cannot be meaningfully measured, detected, or evaluated. Because of the small change in the number of vessels under the maximum traffic forecast, the potential for entrainment to adversely affect the reproduction, population size, or distribution of invertebrate species, including state-listed species, in the study area is expected to be minimal and discountable.

6.2.3 Impacts on Nearshore and Marine Resources from a Crude or Bunker Oil Spill

This discussion considers the potential impacts from a crude oil spill of any size, anywhere in the Project area. The probability of accidents and the potential oil spill in each location with and without operation of the North Wing are described in detail in Chapter 5. Results are summarized in Section 6.1.

Extensive research and detailed post-spill studies have shown that many components of the marine environment are highly resilient to short-term adverse changes in the environment in which they live and that, consequently, a major oil spill rarely will cause permanent effects (Dicks 1998). Persistence of oil material in the intertidal zone provides a pathway for long-term impacts on intertidal organisms feeding in the area, such as blue crabs and larval fish (depending on the seasonality of the spill). If oil is buried in sediments, it may persist for a long time, and latent impacts may be variable and subtle. Most oil washed ashore can be removed by natural processes and modern cleaning techniques; but some oily residues, if buried, can persist for a long time, albeit not permanently.

Marine vessel operations in Puget Sound are highly regulated and closely scrutinized. Puget Sound possesses the lowest commercial vessel oil spill rate in the nation. In an effort to avoid catastrophic spills, Washington State maintains a rescue tug at Neah Bay during the winter to aid disabled vessels (NMFS 2008). In addition, all tank vessels greater than 5,000 gross tons will be required to have a double hull by 2015 (46 USC 3703a). The probability of a catastrophic oil spill occurring is minimal (van Dorp et al. 2008). Should a spill occur, the USCG would implement the Northwest Area Contingency Plan to oversee oil spill response and cleanup (described in Section 6.2.5). Along with other trustee agencies, the USCG also would implement the Natural Resource Damage Assessment process pursuant to OPA 1990, as amended.

6.2.3.1 Marine Mammals

Discrete populations of marine mammals could be directly or indirectly affected by an oil spill in the study area. Effects of oil spills on marine mammals include irritation or ulceration of skin, mouth, or nasal cavities through contact with oil. Marine mammals breathe air and must come to the surface frequently to take a breath of air. In a large oil spill, these animals may be exposed to volatile chemicals during inhalation (NMFS 2013). Oil or refined petroleum products may cause damage to the airways and lungs of marine mammals and may cause congestion, pneumonia, emphysema, and even death from breathing in droplets of oil or vapors (AMSA 2011). Oil or products entering the eyes can cause ulcers, conjunctivitis, and blindness, making it difficult to find food, which may lead to starvation. Accidental ingestion of oil may cause kidney damage, altered liver function, and digestive tract irritation. Marine mammals may become secondarily oiled by eating oiled prey items or may accumulate toxins through eating contaminated prey. Damage to and suppression of a marine mammal's immune system may occur, which can cause secondary bacterial or fungal infections. Stress from ingested oil can be additive to ordinary environmental stresses.

Whales have no fur that can be oiled and do not depend on fur for insulation; therefore, they are not susceptible to the insulation effects (hypothermia) that often puts haired marine mammals (such as fur seals or sea otters) at risk (NMFS 2013). However, oil can foul baleen whales filter-feeding mechanisms, thereby decreasing their ability to eat.

Oil can coat the fur of seals, which reduces their insulating capacity, leading to death from hypothermia—particularly in young pups with little blubber (AMSA 2011). Some marine mammals, such as fur seals, may drown or become easy prey if oil sticks to flippers and bodies, preventing full movement and escape from predators. Depending on the time of year in which a spill occurs, young could be poisoned by absorbing oil through the mother's milk (AMSA 2011). Seal pups also may be affected by disguise of the scent that pups and mothers rely on to identify each other, leading to rejection, abandonment, and starvation of seal pups.

Effects on baleen whales from an oil spill could include irritation or ulceration of skin, mouth, or nasal cavities through contact with oil. Oil or refined petroleum products may cause damage to the airways and lungs of baleen whale and may cause congestion, pneumonia, emphysema, and even death by breathing in droplets of oil or vapors (AMSA 2011). Accidental ingestion of oil may cause kidney damage, altered liver function, and digestive tract irritation. Baleen whales also could be affected by contamination of their food sources.

Evidence suggests that killer whales are unlikely to detect and avoid spilled oil (NOAA 2014b). Observations immediately after the Exxon *Valdez* oil spill showed killer whales in direct contact with oil (Matkin et al. 2008). The effects of vapor or oil inhalation on killer whales range from death to sub-lethal damage to mild irritation, depending on the concentration and length of exposure. Consumption of lethargic oiled prey could lead to ingestion of a significant quantity of oil over time (Matkin et al. 2008). Effects of a catastrophic oil spill on killer whale populations would depend on the spill scenario. Studies carried out in Prince William Sound some 25 years after the Exxon *Valdez* oil spill, where 22 orcas were killed, have shown that one pod of killer whales is recovering while one pod will never recover because the group no longer has viable females (Malakoff 2014). The Exxon *Valdez* studies referenced in this document provide information on the effects of oil spilled into the marine environment specific to some nearshore and marine resources. It should be noted that the Exxon *Valdez* was an unaccompanied, single-hull tanker, grounded in a remote location that resulted in an oil spill. Vessels in Puget Sound would have double hulls, be accompanied by tugs, and be restricted to the CVTS, with spill response capabilities nearby; this scenario would result in very different environmental conditions in the event of a spill.

Because killer whales are unlikely to detect and avoid spilled oil, "hazing" methods are sometimes used to deter whales from the area of a spill (NOAA 2014b). Hazing methods may include acoustic deterrent devices, pre-recorded killer whale calls, boat traffic that provides noise and motion, helicopters generating considerable noise and wave movement at close range, and fire hoses that can direct streams of water at whales (NOAA 2014b).

An accidental oil spill could adversely affect killer whale critical habitat occurring in the Strait of Juan de Fuca and the summer and Core Area (Haro Strait and San Juan Islands) by decreasing water quality and prey population, thereby reducing food availability. If a spill were to occur, the federal response agencies would initiate emergency consultation for ESA-listed species with NMFS and the USFWS.

6.2.3.2 Marine Turtles

Loggerhead, olive ridley, and green sea turtles rarely occur in Puget Sound or near the coast of Washington. The study area is considered beyond the normal range for occurrence of these species and contains unsuitable habitat due to cold water temperatures. Most hard-shell turtles seek optimal seawater temperatures near 18°C (65°F) and are cold-stressed at seawater temperatures below 10°C (50°F) (Mrosovsky 1980; Schwartz 1978). Water temperatures recorded at various locations throughout the study area are under 10°C (50°F) the majority of the year and do not approach 18°C (65°F) (NOAA 2014a). Loggerhead, olive ridley, and green sea turtles are not expected to occur in the study area and therefore would not be affected by ongoing operation of the BP Cherry Point dock.

Adult leatherbacks turtles could be present in the study area during summer and fall when jellyfish aggregate; however, this species is more common in waters off the coast of Washington, outside the study area. Leatherback turtles are air breathers, and must come to the surface frequently to take a breath of air. In a large oil spill, these animals may be exposed to volatile chemicals during inhalation (NMFS 2013). Oil may cause damage to the airways and lungs of turtles and may cause congestion, pneumonia, emphysema, and even death from breathing in droplets of oil or vapors. Contact with oil can cause irritation or ulceration of skin, mouth, or nasal cavities. Oil or products entering the eyes can cause ulcers, conjunctivitis, and blindness, making it difficult to find food, which may lead to starvation (AMSA 2011). Little is currently known about the effects of a crude oil spill on the leatherback’s staple subsistence item, jellyfish, which attracts the leatherbacks to the Washington coast. Recent research suggests that some of the most toxic polycyclic aromatic hydrocarbons (PAHs) of crude oil can be bioaccumulated in gelatinous zooplankton and potentially be transferred up the food web and contaminate its predators (Almeda et al. 2013a).

Oil that becomes stranded on beaches can contaminate areas where turtles breed, causing contamination of eggs, adult turtles, or newly hatched turtles. Because no marine turtles breed on beaches in the study area, this effect would not result in the event of a spill in the study area.

Leatherback turtle critical habitat is designated at the western extent of the study area in the vicinity of “J” Buoy. This area contains the Juan de Fuca Eddy, which develops offshore of northern Washington and the mouth of the Strait of Juan de Fuca as a result of wind-driven current with the continental slope (NMFS 2009). Leatherbacks could be using this eddy current for migration and foraging. If an oil spill were to occur, the quality and quantity of leatherback turtle prey (namely jellyfish) could be contaminated or decreased. If a spill were to occur, the federal response agencies would initiate emergency consultation for ESA-listed species with NMFS and the USFWS.

6.2.3.3 Birds

Effects of oil spills on birds include those associated with physical oiling of the individual as well as toxicological effects from contact with oil via inhalation, ingestion, or dermal absorption. When oil penetrates into the feathers, it causes marked loss of insulation, waterproofing, and buoyancy in the plumage (Burger and Fry 1993). These alterations increase the risk of hypothermia and impair flight, making birds susceptible to starvation and predation.

Aside from the physical effects of oiling, toxicity of oil components such as PAHs can adversely affect birds. During preening, birds typically ingest oil on feathers. Ingestion of oil by wild birds has been associated with severe weight loss, hemolytic anemia, kidney damage, liver damage, foot problems, gut damage, and immunosuppression (Troisi et al. 2006). Ingestion of PAHs by seabirds is known to affect eggs, causing teratogeny (embryo deformities) and changes in egg size and shell thickness (Vidal et al. 2011), and can reduce future reproductive success.

Light to moderate exposure to oil could reduce future reproductive success because of pathological effects on liver or endocrine systems that interfere with the reproductive process (Tseng 1999). Stress from ingested oil can be additive to ordinary environmental stresses, such as low temperatures and metabolic costs of migration. Oil also could adversely affect food resources (e.g., insect larvae, mollusks, other invertebrates, or fish), which could decrease survival, future reproduction, and growth of individual bird species.

Even small spills may potentially kill large numbers of birds (Burger and Fry 1993). Due to their life history and habitat use, diving alcids (auks) that forage from the surface are the some of the most vulnerable seabirds to oil pollution (Wiese and Ryan 2003). Several diving auks occur in the study area, including common murre, marbled murrelet, Cassin’s auklet, and tufted puffin.

Studies on the impacts of the Exxon *Valdez* oil spill in 1989 showed that marbled murrelets had the highest rate of mortality of all bird species (Carter and Kuletz 1995). Mortality within a breeding population and lower reproductive success from oil exposure could cause severe localized population impacts because of the species’ naturally low recruitment rate (USFWS 1997, 2009). Oil pollution poses a significant threat to marbled murrelets in Washington State, where a single large spill could extirpate an entire population (Carter and Kuletz 1995). The potential for disruption of breeding activities can depend on the combination of mortality of adults, mortality of mates affecting surviving mates, displacement from foraging areas due to human activity, sub-lethal oil ingestion, and possible impacts on the prey base (Carter and Kuletz 1995). Population-level effects of an oil spill on marbled murrelets would depend on the oil spill scenario.

If a large spill moved onto the shore, several waterfowl species that breed, stage, or stop there during migration also may be at direct risk from oiling of skin or feathers—or indirectly through ingestion of contaminated prey. Raptors, eagles, owls, vultures, and other predatory or scavenging birds that are present in the spill vicinity could experience negative effects of dietary exposure to PAHs. PAHs are known to accumulate in the brain, liver, and muscle tissues of vultures; and chronic exposure can lead to sublethal effects (Dhananjayan and Muralidharan 2013) similar to those experienced by piscivorous birds foraging in an oil spill area.

For large spills that are not immediately or successfully cleaned up, the potential for contamination would persist for a longer time, and the likelihood of birds being exposed to the weathered oil would be greater. Clean-up success could vary, depending on the environment; but over time, any remaining oil would gradually degrade. Although oiling of birds would not likely remain a threat after clean-up efforts, some toxic products could remain in sediments, plant tissues, or prey items for some time. If a spill were to occur, the federal response agencies would initiate emergency consultation for ESA-listed species with NMFS and the USFWS.

6.2.3.4 Fish

While surveying for oil spill exposure and effects on fish is a continuing challenge, the weight of current evidence suggests that sublethal effects are more likely to occur than direct or indirect mortalities, for any of the various species and their life history stages, under most circumstances. The case of extreme quantities of oil spilled relative to water volumes in confined areas would be the exception. Near-surface concentrations observed under oil spill slicks usually have been less than the acute values for fish, macro invertebrates, and plankton; and those concentrations diminish quickly with depth. For example, extensive sampling following the Exxon *Valdez* oil spill (approximately 11,000,000 gallons in size) revealed that hydrocarbon levels were well below those known to be toxic or to cause sublethal effects in fish and plankton (Neff 1991). The low concentration of hydrocarbons in the water column following even a large oil spill may be the primary reason for the lack of lethal effects on fish and plankton.

Heavier oils, such as crude, may not affect fish at all; or, in the case of fish in larval or spawning stages, may be quite detrimental (NOAA 2011) from smothering of eggs and/or larvae. Also, larval/juvenile fish are generally more sensitive to toxicity than adults (Hose et al. 1996). Increased mortality of larval/juvenile fish would be expected because they are often found at the water's surface, where contact with oil is most likely, and because they are relatively immobile, whereas adult fish would be able to swim away from the spill.

Fish that have been exposed to oil may suffer from changes in heart and respiratory rate, enlarged livers, reduced growth, fin erosion, deformities, and a variety of effects at biochemical and cellular levels (USFWS 2010). Oil also may affect the reproductive capacity of fish and may result in deformed fry (UNEP 2011). Resident fish species, eggs, and larvae would be affected by an oil spill more than adult pelagic fish as they do not leave the area. Adult pelagic fish are not tied to a specific habitat and could vacate the area in the event of a spill, thereby reducing potential effects.

Indirect effects on fish from an oil spill include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources; and effects from consumption of contaminated prey (Morrow 1974; Brannon et al. 1986; Purdy 1989). Floating oil can contaminate plankton, which includes algae, fish eggs, and the larvae of various fish and invertebrates. Fish that feed on these organisms can subsequently become contaminated (USFWS 2010).

Effects on critical habitat for bull trout, Chinook and chum salmon, green sturgeon, and rockfish from a crude or bunker oil spill could include a decrease in prey population and water quality, as well as a decrease in the availability of habitats necessary for these species growth, reproduction, and feeding. Primary constituent element habitat types that could be affected by a spill include nearshore and offshore marine and estuarine eelgrass meadows and kelp beds; rocky and sedimentary shores; and benthic habitats deeper than 30 meters (98 feet). The effects of a crude spill on these habitat types are described in Section 6.3.3. If a spill were to occur, the federal response agencies would initiate emergency consultation for ESA-listed species with NMFS and the USFWS.

Cherry Point Herring

The Cherry Point herring stock spawns in the subtidal area near the BP Cherry Point dock from mid-March through early June, with peak spawning occurring in mid-May. Effects on Cherry Point herring from an oil spill would be the same as described above for fish in general. Given their unique life history, if a spill occurred while eggs and larvae were present in the area, the population could experience recruitment class failure. This could cause a precipitous decline in the Cherry Point herring population. However, as part of a metapopulation, such a decline of Cherry Point herring is not expected to threaten the persistence of the South Georgia Strait DPS to which it belongs (Gustafson et al. 2006). Cherry Point herring could be indirectly affected by a loss of eelgrass and kelp beds, which provide important spawning habitat.

6.2.3.5 Invertebrates

Because many invertebrate species are relatively immobile and often are indiscriminate filter-feeders, they may not be able to avoid exposure to oil. In addition, they do not possess the same suite of enzymes to break down contaminants that finfish and other vertebrates have (NOAA 2013a).

Direct exposure to oil may cause mortality to invertebrates residing in the affected area. Floating oil and volatile compounds (which evaporate at the surface or dissolve in the water column) can contaminate plankton, including the larvae of various invertebrates, which take in a large amount of water relative to their body size. Contamination can produce long-term effects on respiration, mobility, digestion, growth, and reproduction (Earth Gauge 2011). Sinking oil can affect invertebrates that live on the ocean bottom. If mobility is reduced, invertebrates can become more vulnerable to predators or transported to new locations to which they are not adapted. Oil that has washed into shallow areas may cause marine invertebrates that live in plant beds to become trapped in oil on plant stems. Marine invertebrates in shallow-water habitats may be narcotized by exposure to dissolved fractions of crude or refined oil if the dose-response exposure is great enough. PAHs can persist in water, wash onto shorelines, and settle in sediment to become chronic pollutants. Many invertebrates cannot metabolize PAHs, which instead accumulate in the tissues and affect the food web (Earth Gauge 2011). Phototoxic PAHs (those that become toxic when exposed to sunlight) are particularly dangerous to transparent zooplankton (tiny animals that float on ocean currents near the surface where they are exposed to sunlight) that act as a main food source for larger organisms, including baleen whales (Earth Gauge 2011). Some stress-tolerant organisms, including polychaete worms, snails, and mussels, have been found to be more abundant at oiled sites—possibly due to the species benefiting from the organic enrichment of the area from the oil or from reduced competition or predation from other, more sensitive species being depleted.

Shellfish may be physically smothered by oil washing ashore, and oil may change the physical environment for plants and animals by forming asphalt-like pavements, sometimes altering the environment so extensively that the organisms can no longer survive in that habitat (NOAA 2011). If the spill reaches shallower water, PAHs may attach to sediments, which would affect bottom-dwelling organisms like shellfish. As these organisms spend time in or near contaminated sediments, PAHs accumulate in their tissues. Intertidal shellfish such as mussels and clams can remain contaminated by oil years later (NOAA 2011).

6.2.4 Impacts on Nearshore and Marine Resources from a Refined Petroleum Product Spill

6.2.4.1 Marine Mammals

Effects on marine mammals from a refined petroleum product spill in the study area would be similar to the effects described above for a spill of crude oil. The main difference is that refined petroleum product is more volatile, so the oil would likely not persist in the environment as long, generally evaporating within 1–2 days (NOAA 2014c). However, while it is present, refined petroleum product would be more toxic to marine mammals and could cause localized, severe impacts on water column and intertidal resources because it has a higher concentration of soluble toxic compounds than heavy oils. For example, gasoline, diesel, and JP5 jet fuel all contain volatile hydrocarbon compounds such as benzene, aromatic hydrocarbons, toluene, and naptha that are acutely toxic at relatively low concentrations. Concentrated exposure to refined petroleum products could result in adverse behavioral changes, loss of energy, neurological damage, inflammation of the mucous membranes, lung congestion, pneumonia, and liver damage (NMFS 2008; Matkin et al. 2008). If a spill were to occur, the federal response agencies would initiate emergency consultation for ESA-listed species with NMFS and the USFWS.

A refined petroleum product spill could threaten killer whale critical habitat in the Strait of Juan de Fuca and the summer and Core Area (Haro Strait and San Juan Islands) by decreasing water quality and prey population, thereby reducing food availability.

6.2.4.2 Marine Turtles

Effects on marine mammals from a refined petroleum product spill in the study area would be similar to the effects described above for a spill of crude oil. The main difference is that refined petroleum product is more volatile; therefore, the oil would not remain in the environment as long. While present, however, refined petroleum product would be more toxic to marine turtles than heavy oils, as described above.

Marine turtles rarely occur in Puget Sound or near the coast of Washington. Because their occurrence is atypical, it is unlikely that a refined petroleum product spill in the study area would affect marine turtles.

Leatherback turtle critical habitat is designated at the western extent of the study area in the vicinity of "J" Buoy. This area contains the Juan de Fuca Eddy, which develops offshore of northern Washington and the mouth of the Strait of Juan de Fuca as a result of wind-driven current with the continental slope (NMFS 2009). Leatherbacks could be using this eddy current for migration and for foraging. If a refined petroleum product spill were to occur, the quality and quantity of leatherback turtle prey (namely jellyfish) could be contaminated and decreased. Given the deepwater habitat found in this area, however, effects of a spill of refined petroleum product are expected to be less than if crude oil were spilled. Compared to a crude oil spill, the toxic event associated with a refined petroleum product spill would generally be over fairly quickly. If a spill were to occur, the federal response agencies would initiate emergency consultation for ESA-listed species with NMFS and the USFWS.

6.2.4.3 Birds

PAHs contribute to the toxicity of refined petroleum products, but the amounts of PAH in petroleum products vary greatly. Short-term hazards to birds and other organisms in the water column from diesel oil include acute toxicity and potential inhalation hazards (Irwin et al. 1997). Chronic effects of some of the constituents in diesel oil (e.g., toluene, xylene, naphthalenes, and alkyl benzenes) include changes in the liver and harmful effects on the kidneys, heart, lungs, and nervous system. Increased rates of cancer and immunological, reproductive, fetotoxic (toxic to fetuses), and genotoxic (damaging to DNA) effects have been associated with chronic exposure to constituents of diesel (Irwin et al. 1997). If diesel oil is applied directly to bird eggs, the eggs fail to hatch (Kopischke 1972).

Small diesel spills (500–5,000 gallons), such as those associated with typical fishing vessels, usually evaporate and disperse naturally within a day or less (NOAA 2013b). Small spills occur frequently and their effects are monitored in Alaskan waters; no significant avian mortality has been associated with the hundreds of small diesel spills that have occurred in Alaska during the past decade of monitoring (NOAA 2013b). McCay et al. (2004) developed a model to determine the potential harm to wildlife caused by diesel spills of up to 1,250,000 gallons in San Francisco Bay and compared the results to those for spills of gasoline, crude oil, and heavy crude oil. Their results indicated that the majority of birds killed under any of these scenarios were waterfowl (diving ducks, geese), seabirds (murres), and shorebirds (sandpipers). Compared to crude or heavy crude oil spills, modeled diesel spills resulted in less than one-half of the number of killed birds (McCay et al. 2004). When diesel reaches the shoreline, it penetrates porous sediments quickly, rather than forming a slick. It is then easily washed away by tidal flushing. Diesel is readily and completely degraded by naturally occurring microbes within 1–2 months (NOAA 2013b). Much larger spills will evaporate more slowly but persist for a much shorter time than spills of crude oil.

Shoreline contamination is usually minimal following aquatic spills of refined petroleum products because of the tendency of these oils to dilute and dissipate quickly before reaching the shore. If these products do reach shorelines, they may result in long-term contamination and chronic exposure for birds.

The bird species affected depends on the location of the oil and the behavior of the birds. Species that would suffer the greatest losses are gregarious, spend most of their time on the water—often near shipping lanes, and dive into the water to find food or to avoid disturbance. Seabirds, such as auks, guillemots, murres, puffins, and sea ducks, are particularly susceptible to contamination from spills (USGS 1999). Because the marbled murrelet, common murre, Cassin's auklet, and tufted puffin are diving auks and puffins, they would be vulnerable to a spill of refined petroleum product during foraging activities. The effects from a refined petroleum product spill described above for birds in general would apply to these species. If a spill were to occur, the federal response agencies would initiate emergency consultation for ESA-listed species with NMFS and the USFWS.

6.2.4.4 Fish

The type of oil and the timing of release influence the severity of effects on fish. Refined petroleum product can cause acute toxicity to fish, but the toxic event typically is over fairly quickly when compared to a spill of crude oil, as described above. However, fish can be substantially affected in some circumstances, especially when oil spills into shallow or confined waters. Fish kills in shallow waters have been caused by spills of light oils and petroleum products (such as diesel fuel, gasoline, and jet fuel). If fish eggs or larvae are present in shallow water where a spill of refined petroleum product occurs, they could experience high rates of both acute mortality and sublethal effects. In addition, fish kills could occur in shallow-water nearshore areas, where spilled oil naturally concentrates (NMFS 2013).

Effects on critical habitat for bull trout, Chinook and chum salmon, green sturgeon, and rockfish from a refined petroleum product spill could include a decrease in prey population and water quality, as well as a decrease in the availability of habitats necessary for these species growth, reproduction, and feeding. Primary constituent element habitat types that could be affected by a spill include nearshore and offshore marine and estuarine eelgrass meadows and kelp beds; rocky and sedimentary shores; and benthic habitats deeper than 30 meters (98 feet). The effects of a refined petroleum product spill on these habitat types are described in Section 6.3.4. If a spill were to occur, the federal response agencies would initiate emergency consultation for ESA-listed species with NMFS and the USFWS.

Cherry Point Herring

Effects on Cherry Point herring from a refined petroleum product spill would be similar to the effects on fish in general described above. Given their unique life history, if a spill occurred while eggs and larvae were present in the area, the population could experience recruitment class failure. This could cause a precipitous decline in the Cherry Point herring population. However, as part of a metapopulation, such a decline of Cherry Point herring would not be expected to threaten the persistence of the South Georgia Strait DPS to which it belongs (Gustafson et al. 2006). The loss of eelgrass and kelp beds, which provide important spawning habitat, also could occur.

6.2.4.5 Invertebrates

Effects on invertebrates from a refined petroleum product spill in the study area would be similar to the effects described for a spill of crude oil. The main difference is that refined petroleum product is more volatile, so the oil would not remain in the environment as long. While present, however, refined petroleum product would be more toxic to invertebrates than heavy oils and could result in mortality of invertebrates present in the spill area.

6.2.5 Impacts on Nearshore and Marine Resources from Oil Spill Cleanup

Marine impacts resulting from the cleanup of spilled oil depend on the clean-up technique used and the environment where it is applied. Potential impacts on marine resources from containment and clean-up options/strategies used in the study area are described below.

NMFS and the USFWS would likely enter into an emergency consultation with the USCG regarding the effect of the oil spill response. Consultation with the USACE also may occur to evaluate the ongoing operation under USACE's Section 10 permit and to determine whether any changes should be made to the terms and conditions of the permit, which would address the circumstances contributing to the oil spill.

6.2.5.1 Marine Mammals

The use of oil dispersants would remove spilled oil from the marine environment and quickly reduce the risk of exposure. After the use of dispersants, remaining oil would be less sticky and therefore less likely to adhere to marine mammals. However, the surfactants in dispersants could remove the natural oils present in haired marine mammals, specifically seals, reducing their insulation properties and causing hypothermia (Battelle 1988; NMFS 2013; Marine Research Specialists 2002). Because cetaceans do not have fur that can be oiled, they would not be susceptible to insulation effects. Cleaning oiled beaches and rocky shores with dispersants could be effective in preventing oiling of pinnipeds that haul out in those areas. Using dispersants increases the exposure of organisms residing in the water column and on the sea floor to the toxic effects of oil. Dispersed oil could accumulate in more stagnant areas or could be consumed by plankton in the water column and enter the food chain (NAS 2010). Marine mammals could be indirectly affected through ingestion of contaminated prey. During spill cleanup, procedures typically are in place for responding to live animals that are exposed to oil spills; and animals brought into rehabilitation facilities are provided veterinary care to remove oil and treat any related health effects (NMFS 2013).

Other methods of cleanup that might affect marine mammals include the use of booms, skimming, manual or mechanical removal, application of sorbents, vacuuming, removal of debris, sediment reworking, cutting or removal of vegetation, flooding, and in-situ burning. Clean-up operations may involve a large number of vessels and aircraft in coastal and pelagic habitats, with the potential to disturb marine mammals and possibly displace them from important feeding or reproductive grounds or other important habitat. The use of booms and skimmers to contain and collect surface oil, and in-situ burning to remove oil, could directly affect marine mammals by displacing them from their habitat; residue from in-situ burning could pose inhalation risks. Marine mammals also could be affected by a reduction or contamination of prey, or shifts in prey distribution.

Activities associated with oil spill cleanup could occur in critical habitat for southern resident killer whales. These activities could displace killer whales from migration, resting, and foraging habitat in the study area. If a spill were to occur, the federal response agencies would initiate emergency consultation for ESA-listed species with NMFS and the USFWS.

The effects of clean-up operations on ESA-listed whales would be similar to those described for marine mammals in general. Whales could be displaced from their habitat and be exposed to inhalation risks during the use of booms and skimmers to contain and collect surface oil, and during in-situ burning to remove oil. These species also could be affected by a reduction, contamination, or shift in distribution of food sources during clean-up activities. Artificial deterrents (hazing) within the affected area are sometimes used during the response process to encourage avoidance because capture and rehabilitation of whales is improbable (NOAA 2014b).

6.2.5.2 Marine Turtles

Clean-up operations involving a large number of vessels and aircraft in coastal and pelagic habitats have the potential to disturb leatherback turtles, possibly displacing them from important feeding or migration grounds, both of which are primary constituent elements of designated critical habitat. During oil spill cleanup, procedures are typically in place for responding to live animals that are exposed to oil spills; and animals brought into rehabilitation facilities are provided veterinary care to remove oil and treat any related health effects (NMFS 2013). In addition, increased vessel traffic associated with response operations could raise the risk of vessel-strike injury or mortality to turtles within the affected area (NMFS 2013). If a spill were to occur, the federal response agencies would initiate emergency consultation for ESA-listed species with NMFS and the USFWS.

6.2.5.3 Birds

The response to an oil spill often involves cleaning of the affected water and shorelines as well as capture and rehabilitation of animals affected by the spill. During the clean-up process, vessel traffic and human beach traffic could increase sufficiently to affect foraging and nesting of birds that are present in these areas at the time. In addition, application of chemical dispersants to oil slicks creates a suite of potential impacts on birds via inhalation, contact, and secondary ingestion through prey species. Further, zooplankton occupying the water column are particularly vulnerable to chemical dispersant exposure (Almeda et al. 2013b); reductions in zooplankton populations would negatively affect the food web and may indirectly reduce foraging opportunities for piscivorous birds

Other methods of cleanup that might affect birds include the use of booms, skimming, manual or mechanical removal, application of sorbents, vacuuming, removal of debris, sediment reworking, cutting or removal of vegetation, flooding, and in-situ burning. Clean-up methods that occur at sea could disturb seabird foraging habitat. Alterations to vegetation also could affect birds by disturbing nesting and loafing areas along the shoreline.

In-situ burning is an efficient means of removing oil from the water surface, but birds could be affected by the particulates entrained in the smoke plume. The smoke plume contains sulfur dioxide (SO_2), nitrogen dioxide (NO_2), PAHs, and carbon monoxide (CO). Based on outcomes of previous oil spills, birds appear to be more capable of handling the risks posed by the fire and temporary smoke plume than they are of handling oil slicks (NOAA n.d. [a]).

The species of bird that is oiled can greatly influence the success or failure of rehabilitation efforts (Tseng 1999). While hardy species such as mallard ducks and Canada geese suffer from very few captivity-related problems, other birds do not recover well after handling. Species such as loons and grebes are considered high stress and must be rehabilitated much more quickly to avoid complications from aspergollosis (a fungal infection in the lungs); pressure sores on the keel, posterior hock joints, and feet; and anemia from malnutrition and chronic disease (Tseng 1999). State-listed species in the study area that are more susceptible to effects from an oil spill, and subsequent cleanup, include the western grebe and common loon.

Studies have shown that marbled murrelet foraging is disturbed by the increased human activity associated with cleanup, staging, and monitoring programs (Carter & Kuletz 1995). In addition, prey species for murrelets, including the Pacific sand lance and juvenile Pacific herring, can be affected by chemical dispersants that can lead to higher mortality in eggs and juveniles. Rehabilitation efforts can be costly and of limited value to affected marbled murrelet populations because this species has a low tolerance for capture and rehabilitation (Carter and Kuletz 1995).

6.2.5.4 Fish

While dispersants (both chemical and natural) reduce the potential impact of an oil spill on surface-dwelling animals, it introduces a large volume of oil into the water column. When chemicals are used for dispersion, the chemical along with dispersed oil can sink to the bottom to come into contact with fish and eggs that are stuck to surfaces or buried in the sediment, resulting in increased toxicity to these organisms. Dispersed oil can kills eggs before they hatch or lead to damage or deformities in juvenile fish. Using dispersants increases the exposure of organisms residing in the water column and on the sea floor to the toxic effects of oil. Dispersed oil could accumulate in more stagnant areas or could be consumed by plankton in the water column and enter the food chain (NAS 2010). Fish could be indirectly affected through ingestion of contaminated prey.

Other methods of cleanup that might affect fish include the use of booms, skimming, manual or mechanical removal, application of sorbents, vacuuming, removal of debris, sediment reworking, cutting or removal of vegetation, flooding, in-situ burning, and pressure washing. Clean-up operations may involve a large number of vessels and aircraft in coastal and pelagic habitats, with the potential to disturb fish and possibly displace them from important feeding or reproductive grounds or other important habitat. In addition, fish could be indirectly affected by a reduction or contamination of prey, or shifts in prey distribution.

Effects on critical habitat for bull trout, Chinook and chum salmon, green sturgeon, and rockfish from a refined product spill could include a decrease in prey population and water quality, as well as a decrease in the availability of habitats necessary for these species growth, reproduction, and feeding. Primary constituent element habitat types that could be affected by a spill include nearshore and offshore marine and estuarine eelgrass meadows and kelp beds; rocky and sedimentary shores; and benthic habitats deeper than 30 meters (98 feet). The effects of a crude spill on these habitat types are described in Section 6.3.5.

Cherry Point Herring

A spill and resulting cleanup in the Cherry Point area could cause detrimental effects on the Cherry Point herring population. Effects from clean-up actions on Cherry Point herring would be the same as described above for fish in general. Cherry Point herring could be indirectly affected by a loss of eelgrass and kelp beds, which provide important spawning habitat.

6.2.5.5 Invertebrates

Invertebrates could be harmed by extensive beach cleaning through chemical cleaning, hot water/high-pressure hoses, and manual and mechanical treatments. If dispersants are used, invertebrates that might normally be unaffected by floating oil could become contaminated through exposure to oil droplets suspended in the water column, resulting in increased toxicity. Populations of invertebrates that suffer high mortalities from oil and extensive clean-up activities may take many years to repopulate to their previous levels (NOAA 2011).

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6.3 Nearshore and Marine Habitats

Impacts on nearshore and marine habitats are described below. Impacts specific to EFH from the Proposed Action are described in full in the draft Biological Evaluation (Appendix G).

6.3.1 Impacts on Nearshore and Marine Habitats from Operations at the North Wing

Actions occurring at the North Wing include docking vessels, loading refined petroleum products, oily water collection, ballast water discharge, and dock maintenance activities. Impacts on nearshore and marine habitat from operations at the North Wing may stem from increased lighting, accidental releases of oil or other hazardous materials, and accidental discharge of ballast water. Annual preventive maintenance activities involving in-water, on-water, and underwater work are conducted under permits issued by the USACE and other appropriate state and federal agencies. Major maintenance activities at the North Wing are conducted periodically and may be permitted separately. Effects from operation of the North Wing would be limited to those habitats present in the general Cherry Point area, which include eelgrass beds, kelp beds, rocky and unconsolidated shores, estuaries and mudflats, rocky and unconsolidated subtidal habitats, the water column, and man-made structures.

Increased lighting at the BP Cherry Point dock would be associated with vessels unloading at night. Nearshore habitat would be affected temporarily because lights would be on only during unloading.

Ongoing operation and maintenance activities at the BP Chery Point dock could result in accidental spills of oil or other hazardous materials. The severity of the impact of a spill would depend on a variety of factors, including the characteristics of the oil itself. Natural conditions, such as water temperature and weather, also would influence the behavior of oil in the aquatic environment. The habitats present in the general Cherry Point area, ranging from highly resilient rocky shores to sensitive estuaries, would exhibit varying sensitivities to a spill. Potential impacts on the habitats present in the Cherry Point area from a large spill of crude or bunker oil or a spill of refined petroleum product are described in Sections 6.3.3 and 6.3.4, respectively. Instances of spills associated with unloading and loading operations and maintenance at the BP Cherry Point dock (described in Section 5.8) are not routine, and are not expected to occur with sufficient frequency or magnitude to adversely affect the habitats present in the general Cherry Point area.

Introduction of ANS through ballast discharge could result in alterations to the ecosystem that subsequently eliminates native species. This, in turn, could alter the food web and result in decreased populations of other native aquatic species. Vessels calling at the BP Cherry Point dock would comply with State of Washington and USCG regulations that require offshore ballast water exchange (discussed in Section 1.4.1). In the rare event that ballast water must be discharged from a cargo tank, the BP Cherry Point dock has reception facilities available for this type of ballast water, preventing it from entering the marine environment.

6.3.2 Impacts on Nearshore and Marine Habitats from Changes in Vessel Traffic

Impacts on nearshore and marine habitats from changes in vessel traffic in the study area would be limited to the water column, which would experience increased mixing of the surface layer in the area immediately surrounding the vessel path and wake. The surface layer is generally warmer, with an abundant neustonic[2] community and lower salinity than the subsurface layer. Mixing of the two layers would result in the surface layer experiencing a decrease in temperature and neustonic community abundance, and an increase in salinity. It is unknown whether vessel traffic in total has any significant

[2] *Neustonic organisms* are minute aquatic organisms living at or just below the surface of the water.

effect on surface water column habitat functional conditions and associated communities relative to natural processes and disturbances that drive this very dynamic system. Nevertheless, the increase in vessel traffic attributable to the Proposed Action is small, and Project-related vessels would stay within the USCG CVTS, an area that is already disturbed by vessel traffic. Therefore, changes in vessel traffic calling at the BP Cherry Point dock would not result in changes to surface waters in the study area compared to existing conditions.

6.3.3 Impacts on Nearshore and Marine Habitats from a Crude or Bunker Oil Spill

This discussion considers the potential impacts from a crude oil spill of any size, anywhere in the Project area. The probability of accidents and the potential oil spill in each location with and without operation of the North Wing are described in detail in Chapter 5. Results are summarized in Section 6.1.

The level of impact on marine habitats in the study area from an oil spill would be determined by the following factors (O'Sullivan and Jacques 2001):

- Extent to which oil can penetrate the substrate;
- Amount of natural wave energy available to disperse the oil;
- Length of time the oil will remain in the environment;
- Feasibility of clean-up operations; and
- Presence of sensitive populations or communities of plants or sessile animals.

Should a spill occur in the study area, most of the oil would be removed by natural processes and modern cleaning techniques, but some oily residues, if buried, could persist for long periods of time. Potential impacts on nearshore and marine habitat from an oil spill in the study area are described below.

6.3.3.1 Eelgrass Meadows

Several studies performed on eelgrass following oil spills have shown only temporary damage to blades if the oil contacts the blades in the air (Phillips 1984). If the leaf remains covered with water, there is no apparent damage. Rhizomes and roots do not appear to be damaged in either case. The most sensitive areas containing eelgrass may be sheltered locations that are poorly flushed. These areas would likely retain oil for longer periods. If a spill were to occur in late summer or winter, when leaf sloughing is at a peak, mats of drift blades would tend to capture and retain oil for later remobilization into the intertidal zone (Dean and Jewett 2001).

While eelgrass would remain almost unaffected by an oil spill, animal groups in this environment could be selectively (indirectly) affected. Stress-tolerant organisms, including polychaete worms, snails, and mussels, have been found to be more abundant at oiled sites (NOAA 2010a). This could be due to the species benefiting from the organic enrichment of the area from the oil or from reduced competition or predation due to other more sensitive species being depleted.

6.3.3.2 Kelp Beds

The impacts from an oil spill are generally a greater concern for the community of organisms associated with kelp beds than impacts on the kelp itself (NOAA 2010a). A mucous coating on kelp prevents oil from adhering directly to the vegetation on the water's surface. If a spill were to occur in the study area, oil could become trapped in the dense surface canopy, increasing the persistence of oil in the kelp environment. Oil persistence in kelp would increase the risks of exposure to organisms that are concentrated in the kelp forest habitat. Potential impacts on organisms from a spill in the study area are discussed in Section 6.2.3.

6.3.3.3 Rocky (Consolidated) Shores

Rocky shore habitats in the study area are a common and often dominant feature; they express a wide range of physical and chemical characteristics—from relatively protected and low-salinity estuaries to exposed oceanic marine habitats. This habitat type is exposed to the effects of an oil spill more than any other part of the marine environment (ITOPF 2011). However, given their exposure to wave action and the scouring effects of tidal currents, rocky shores are among the habitats that are most resilient to the effects of an oil spill, and they tend to self-clean relatively rapidly.

Rocky shores typically are dominated by several species of non-floating kelp, surfgrass, folione red algae, and corraline algae as well as several characteristic macroinvertebrates. If a spill were to occur in the study area, these "habitat-forming species and assemblages" could be removed, resulting in the loss of the dependent understory community until the dominant overstory was restored. This loss of habitat could indirectly affect other marine organisms in the area (see Section 6.2.3). Even after a heavy oiling, however, most seaweeds would be washed clean by the next high tide and would remain essentially undamaged (IPIECA 1996). If macroinvertebrates were destroyed by oil, seaweeds would rapidly settle, followed by the slow return of grazers via recolonization and new recruitment (Dicks 1998).

Damage incurred by rocky shore habitats would be recovered within 2–3 years (IPIECA 1996). Long-term changes to rocky shore habitat could occur if large quantities of oil were transported to a sheltered area and allowed to sit and adhere to the surrounding rocks and sediment to form an asphalt-like pavement. Such pavements can be persistent, although wave action eventually will undercut the edges and weather them (IPIECA 1999).

6.3.3.4 Sedimentary (Unconsolidated) Shores

The degree of oil retention by a shore considerably affects the short-term impact and duration of damage. Retention depends on the condition of the oil and the beach substrate type (e.g. sand, shingle, mudflats). More viscous oils tend to be retained in greater quantities as surface accumulations than less viscous oils. Broken, uneven, and gently sloping shorelines with a large tidal range can hold more oil than steep, smooth shores with a small tidal range (Dicks 1998). Areas that are relatively sheltered and therefore contain fine sediments would be more likely to retain oil, resulting in indirect effects on marine organisms.

Should a spill occur, light oil accumulations would be deposited as oily swashes or bands along the upper intertidal zone. Heavy oil accumulations would cover the entire beach surface, and oil would be lifted off the lower beach with the rising tide. Burial of oil layers by clean sand would be rapid and could reach a depth of 1 meter if the oil comes ashore during a depositional period (NOAA 2010a). If sediments are penetrated by oil, considerable quantities may be held, and the likelihood of long-term retention and longer-term impacts would increase. However, the more viscous nature of weathered oils may result in reduced penetration compared to fresh, less viscous crudes (Dicks 1998). As described above, asphalt-like pavements could be formed. Such pavements can be persistent, although wave action eventually would undercut the edges and weather them (IPIECA 1999).

6.3.3.5 Sandflats and Mudflats

Large-scale oil spills can cause large-scale deterioration of communities in intertidal and shallow subtidal sedimentary systems (UK Marine 2013a). Oil covering intertidal muds prevents oxygen transport to the substratum and produces anoxia, resulting in the death of species inhabiting those areas. Oil would not necessarily penetrate the water-saturated sediments but could penetrate burrows and desiccation cracks or other cervices in muddy sediments.

Oil does not usually adhere to the surface of sheltered tidal flats but rather moves across the flat and accumulates at the high-tide line—although deposition of oil on tidal flats could occur on a falling tide if concentrations are heavy. In areas of high suspended sediment concentration, oil and sediment could mix, causing the deposition of contaminated sediment in the flats. Pollutants that do penetrate fine sediments could persist for many years, increasing the likelihood of longer-term effects (NOAA 2010a; ITOPF 2011).

Impacts on sandflats from an oil spill would be less than impacts on mudflats, unless dispersants are used during clean-up operations or if wave action allowed for oil to become incorporated into sediment (UK Marine 2013a). Stranded oil in sand and mudflats could become a prolonged source for oil re-release to the water column.

6.3.3.6 Estuaries

Oil spills can cause dramatic adverse effects in estuaries because of the high natural resource values, the broad areas of potential exposure across mudflats and marshes, the low-energy water environment, and the complex shoreline. Riverine and estuarine currents make spills and slicks particularly difficult to contain because the oil is rapidly carried to shorelines, marshes, and flats. In the confines of an estuary, even relatively small oil spills can wipe out whole populations of certain organisms, thus upsetting the food chain there for years to come (Oberrecht n.d.).

Estuaries support large populations of migrating birds, and fish and shellfish species. They also function as nursery areas for numerous nearshore and offshore fish and shellfish species (see Sections 4.2 and 4.3 and Appendix F). While oil can exert immediate toxic and smothering effects on species present in this habitat (discussed in Section 6.2.3), penetration of the oil to deeper layers is rare—especially if sediments remain waterlogged during low tide. Oil could penetrate into animal burrows, however, and once oil is incorporated into the sediment, it could delay natural recovery (Dicks 1998; NOAA 2010a). In addition, stranded oil in nearby shorelines could become a prolonged source for oil re-release to the water column.

6.3.3.7 Rocky Subtidal

The extensive veneer of boulders and large cobble in rocky subtidal habitats is physically stable, even under high wave regimes. They provide habitat for a wide variety of organisms, in openings under, on, and around the cobble/boulders. Hard-bottom (and mixed) habitats are generally considered to have a low sensitivity to oil spills (NOAA 2010a). Oil in the water column seldom reaches toxic levels, minimizing exposure to benthic organisms. Should an oil spill occur in the study area, there would be little risk of deposition of oil or oiled sediments in this habitat. However, short-term exposure could occur as oiled sediments are transported through this habitat into deeper areas (NOAA 2010a).

6.3.3.8 Unconsolidated Subtidal

Unconsolidated (loose material) subtidal habitat, with its presence of fine-grained sediments, is not exposed to significant wave or tidal energy and therefore is not often exposed to spilled oil. Should an oil spill occur in the study area, the greatest risk of exposure would be from sinking oil or the incorporation of dispersed oil into suspended sediments that would then be deposited on the bottom. Direct toxicity of oil could cause changes in the abundance and species composition of plant and animal populations below lower tides. Potential impacts on marine organisms from an oil spill are discussed in Section 6.2.3

6.3.3.9 Water Column

Dispersion of spilled oil in the water column is controlled by wind, waves, and ocean current. Should an oil spill occur in the study area, most of the soluble and toxic components of the spilled oil would be lost through weathering within hours and days of the spill. Dissolved or dispersed oil concentrations would likely be greatest in the top few meters of the water column. However, concentrations of oil can occur at the interfaces between deeper water column strata and at the benthic interface.

Oil at the surface and in the water column could affect the marine organisms present. Organisms that would be the most vulnerable to exposure and effects would be poor or passive swimmers present in the surface layer (Dicks 1998). Species that utilize the subsurface and deep layers of the water column would be less vulnerable than those at the surface (NOAA 2010a; ITOPF 2011). See Section 6.2.3.4 for further discussion of impacts on various species and the life history stages of organisms potentially affected.

6.3.3.10 Salt Marshes

Oil spills have been known to cause acute and long-term damage to salt marshes (Zhu et al. 2004). Salt marshes are flooded at high tide, and their complex surface can trap large amounts of oil. The inherently low wave energy this habitat experiences makes it unable to effectively remove oil through wave action. Should an oil spill occur in the study area, salt marshes could experience a reduction in population and growth rate of vegetation, or abnormal growth and regrowth (after the initial impact). The degree of impact would depend on various factors, such as the type and amount of oil, the extent of oil coverage, the plant species, the season of the spill, the soil composition, and the flushing rate.

Various wetland plant species respond differently to oil spills; plants are more sensitive to oiling during the growing season than during other periods (Zhu et al. 2004). Sediment type also plays an important role. In general, oil remains longer in soils with higher organic matter and, therefore, has greater impact on resident plants. Some wetland sediment can act as a reservoir, absorbing oil and later releasing it into adjacent coastal habitats, causing chronic impacts on biota (Zhu et al. 2004). Salt marshes provide habitat for common insects that fish—particularly salmon—feed on. These fish species could be indirectly affected by a spill if their food source was affected (see Section 6.2.3).

6.3.3.11 Nearshore Riparian

Nearshore riparian habitats occur at the interface between terrestrial and aquatic ecosystems. Oil discharged offshore may reach the shoreline but would not be transported inland above the extent of tidally influenced waters. An oil spill in the study area could result in direct toxicity to riparian vegetation. Because this habitat is located at the upper extent of tidal influence, however, impacts would be limited and the effects of an oil spill on nearshore riparian habitat would be minimal.

6.3.3.12 Backshore Spray and Storm Debris Zone

The supratidal zone is above high tide; sediment deposits are exposed to the air most of the time, with flooding only during spring or storm tides. Subsurface oil deposits have been found to occur most frequently in the supratidal zones of high-energy shores composed of coarse-grained cobble/boulder sediments (Wells et al. 1995). If a spill were to occur in the study area, there would be minimal movement of oil into this habitat due to its location above high tide. Introduction of oil into this habitat would be limited to spring and storm tides.

6.3.3.13 Man-Made Modifications

Solid man-made structures such as seawalls, piers, and port facilities that are exposed to wave action generally have sparse to moderate attachment of plants and animals. Oil generally is held offshore by waves reflecting off the steep, hard surfaces in exposed settings. Oil would readily adhere to dry rough surfaces but would less readily adhere to wet substrates. The most resistant oil would remain as a patchy band at or above the high-tide line (NOAA 2010a).

Sheltered man-made structures such as piers and port facilities constructed of concrete, wood, or metal have the potential for dense attachments of animal and plant life. At these structures, oil would adhere readily to the rough surface, particularly along the high-tide line, forming a distinct oil band. The lower intertidal zone usually stays wet, minimizing the adherence of oil to the surface of man-made structures (NOAA 2010a).

Riprap structures used as revetment and groins for shoreline protection are generally sparse in biota. Deep penetration of oil between blocks would be likely. In these environments, oil would adhere readily to the rough surface of the blocks, and un-cleaned oil could cause chronic leaching until the oil hardens (NOAA 2010a).

Most man-made modifications have a substratum and biological community similar to what is found in rocky (consolidated) shores. Effects on man-made modifications from an oil spill in the study area would be similar to those described in Section 6.3.3.3.

6.3.3.14 Cherry Point Habitat

The Cherry Point area is comprised of several of the previously described habitat types, including eelgrass beds, kelp beds, rocky and unconsolidated shores, mudflats and estuaries, rocky and unconsolidated subtidal habitats, the water column, and man-made structures. Impacts on habitats in the Cherry Point area from an oil spill would be the same as described for the respective habitat types in the subsections above.

6.3.4 Impacts on Nearshore and Marine Habitats from a Refined Petroleum Product Spill

In contrast to a spill of crude or bunker oil, a spill of refined petroleum product in the study area would exhibit more rapid dissipation through evaporation and dispersion, and likely would result in less damage to marine habitats. In most habitat types found in the study area, refined petroleum product would be removed from the environment though natural processes within a short period of time. However, impacts from a refined petroleum product spill would be greater in areas where dilution is slowed or dilution capacity is reached, such as in salt marshes, mudflats, and shallow inshore waters. Poor water exchange in these habitats could result in high concentrations of the toxic components of oil that could affect marine vegetation and organisms (see Section 6.2.4).

6.3.5 Impacts on Nearshore and Marine Habitats from Oil Spill Cleanup

Potential impacts on nearshore and marine habitat from containment and clean-up actions in the study area are described below for each habitat type.

6.3.5.1 Eelgrass Meadows

In most cases, oil spill clean-up and containment options would cause more damage to eelgrass meadows than the spill itself. During a spill response, increased foot traffic and boat activity could result in suspended sediments becoming mixed with oil and disturbance of eelgrass roots and vegetation (NOAA 2010a). In areas of high suspended sediment concentration, oil and sediment could mix, causing deposition of contaminated sediment on the seafloor, where it could be leached into the environment at a later date. Increased turbidity at spill sites could decrease light levels, resulting in a reduced number of eelgrass shoots and flowers (WSDNR 2007). The use of dispersants directly over eelgrass meadows could facilitate the breakdown of the waxy leaf cuticle of eelgrass, allowing greater penetration of oil into eelgrass leaves and increasing phototoxicity (McKenzie et al. 2010).

In-situ burning is not recommend over eelgrass beds but could be considered outside the immediate vicinity of eelgrass to help protect sensitive intertidal environments (NOAA 2000a). Cutting eelgrass to remove oil also is not recommended, unless sea turtles or waterfowl are at a significant risk of contacting or ingesting the oil (NOAA 2010a). Vegetation removal would destroy habitat for many animals. If eelgrass were cut at the base of the plant stem, oil could penetrate the substrate, causing sub-surface contamination (NOAA 2010b).

6.3.5.2 Kelp Beds

As with eelgrass, oil spill clean-up and containment options would most often cause more damage to kelp beds than the spill itself. Cleanup is therefore usually limited to containment and collection of surface oil along the edges of kelp beds. Clean-up efforts in kelp forests often are hampered by the difficulty of removing oil from the dense kelp canopy. Cutting kelp would allow for access to and removal of oil; however, this would abruptly change the light regime to the seafloor below and indirectly affect all the organisms associated with this habitat. In addition, if kelp were cut at the base of the plant stem, oil could penetrate the substrate, causing sub-surface contamination (NOAA 2010b). During a spill response, anchoring of response vessels and booms could damage the kelp. The use of dispersants in kelp beds would likely cause a greater negative impact on the community of organisms associated with the kelp habitat than on the kelp itself (NOAA 2010a).

6.3.5.3 Rocky (Consolidated) Shores

If an oil spill were to occur in the study area, it is unlikely that clean-up efforts would take place in rocky shores, as access is often difficult and dangerous and these areas typically self-clean. Rocky shores are not priority targets for clean-up operations because most of these areas are exposed to moderately to highly abrasive wave action that would remove the oil from this habitat. Oil could remain in sheltered areas, however, if large quantities of oil were transported and allowed to adhere with the surrounding rocks and sediment to form an asphalt-like pavement. This material eventually would be eroded away by the natural erosive process (Horton n.d.).

Chemical dispersants and mechanical cleaning often cause more damage to the biota community associated with rocky shores than the oil itself (Jewett and Dean 1997). In many cases, the best course of action should oil reach a shore would be to allow it to disperse naturally (NOAA 2010a).

6.3.5.4 Sedimentary (Unconsolidated) Shores

Vehicular and foot traffic associated with clean-up activities on shorelines could facilitate mixing of oil deeper into the beach substrate. The use of heavy machinery to “scoop” oil off the beach could disturb the habitat and indirectly affect sedentary and slow-moving organisms that live in the area. Hot water/high-pressure hoses used to flush oil-contaminated beaches could wash away fine-grained sediments and harm plants and animals that were unaffected by the oil. Oil usually can be removed without difficulty from hard-packed sand beaches (ITOPF 2013), and any impacts on this habitat would be short term.

6.3.5.5 Sandflats and Mudflats

Oil spill cleanup in sandflats and mudflats would be very difficult because of their soft substrate. These habitats cannot support even light foot traffic in many areas; therefore, it is recommended that residual oil be left to weather and degrade naturally in these areas (ITOPF 2013). Human intervention at these types of habitats could disrupt the habitat and alter its ecological balance. If cleanup is required, activities should be well planned and carried out with specialist guidance (NOAA 2010a; Black Tides 2013).

6.3.5.6 Estuaries

Estuaries are highly productive ecosystems that could be severely affected by a spill and subsequent clean-up activities. Clean-up activities in an estuary could result in habitat disruption and alteration of the ecological balance. Estuaries consist of both intertidal and subtidal habitats, which require different clean-up activities if a spill were to occur. The intertidal zone is characterized by soft sediments that likely would limit clean-up options to low-pressure flushing, vacuuming, and deployment of sorbents from shallow draft boats. These clean-up options could result in direct physical disturbance of estuarine habitat and increased sedimentation, which could indirectly affect the biota. In areas of high suspended sediment concentration, oil and sediment could mix, causing deposition of contaminated sediment on the seafloor, where it could be leached into the environment at a later date. Impacts from clean-up activities in the subtidal portion of estuary habitat would be similar to those described below for unconsolidated subtidal habitats.

6.3.5.7 Rocky Subtidal

Natural cleansing of rocky subtidal habitats is expected to occur quickly, especially in higher energy areas. Even when sheltered from wave action, oiled rocky areas tend to clean up fairly well on their own. Where wave energy levels are low, the oil would be reduced by natural mechanisms other than physical abrasion, such as desiccation and clay-oil flocculation.

Dispersants and in-situ burning could be used in rocky subtidal habitat to protect more sensitive intertidal areas. The effects on biota from using dispersants would be reduced by the deeper water and high dilution rates in this habitat. In-situ burning could result in formation of sinkable residue; the effects of the residue would depend on the composition and amount of oil burned (NOAA 2010a).

6.3.5.8 Unconsolidated Subtidal

If a significant amount of oil were to sink and form mats or concentrations of tarballs on the sediment surface, removal could be required because natural degradation would be slow and the oil could serve as a continuing contamination source for an extended time (NOAA 2010a). Mechanical removal could disturb large areas of habitat and associated biota communities. Boom placement and maintenance could disrupt the physical environment; however, minimal disturbance would be expected (NOAA 2010b). Dispersants and in-situ burning could be used in unconsolidated subtidal habitat to protect more sensitive intertidal areas. The effects on biota from using dispersants would be reduced by the deeper water and high dilution rates in this habitat type. In-situ burning could result in formation of sinkable residue; the effects of the residue would depend on the composition and amount of oil burned (NOAA 2010a).

6.3.5.9 Water Column

Open-water oil spill response activities would be focused on removing oil from the water surface. Effects on the water column could result from the use of oil dispersants that break up slicks, enhancing the amount of oil that physically mixes into the water column. Using dispersants in the study area would increase the exposure of water column and sea floor life to spilled oil. Dispersed oil could accumulate in more stagnant areas or could be consumed by plankton in the water column and enter the food chain (NAS 2010). In-situ burning could change the effects on the water column. Depending on the extent to which in-situ burning was used, the volume of oil remaining to disperse would be reduced and some would be converted to sinkable combustion residues that would disperse into the water column and benthic environments. As noted above, the effects of the residue would depend on the composition and amount of oil burned (NOAA 2010a). Use of other clean-up methods such as booms and skimming would not result in direct effects on the water column; however, marine organisms in the vicinity of the clean-up activities could be indirectly affected.

6.3.5.10 Salt Marshes

Prior to commencing clean-up activities, the natural removal processes and rates of the salt marsh should be evaluated. Under light oiling, salt marshes are generally left to recover naturally (NOAA 2010a). If heavy oiling were to occur, pools of oil could be removed using vacuums, sorbents, or low-pressure flushing. These clean-up methods could transport oil to adjacent sensitive areas or along the shoreline, disturb vegetation in the area, and/or facilitate oil mixing into soft sediments. More aggressive clean-up methods could result in more damage to the salt marsh than the oil itself; therefore, these are not typically used unless other resources would be at a greater risk from the oiled vegetation being left in place (i.e., migratory birds or endangered species) (NOAA 2010a).

6.3.5.11 Nearshore Riparian

Riparian vegetation could be affected by clean-up activities. Because this habitat is located at the upper extent of tidal influence, however, impacts would be minimal.

6.3.5.12 Backshore Spray and Storm Debris Zone

These areas are rarely inundated with water and are exposed to air most of the time. If an oil spill were to occur in the study area, there would be minimal movement of oil into this habitat because of its location above high tide. Consequently, it is unlikely that clean-up activities would occur in this habitat.

6.3.5.13 Man-Made Modifications

Solid man-made modifications that are exposed to wave action would not generally require clean-up activities, while sheltered man-made modifications do not experience much wave action and likely would be cleaned to prevent the accumulation and leaching of oil back into the environment. Clean-up actions in these areas would most likely rely on the use of high-pressure water spraying at ambient water temperatures while the oil is fresh (NOAA 2010b). Pressure washing could dislodge any plants or animals that are attached to the structure.

Riprap structures may be cleaned using high-pressure spraying when oil is fresh and liquid. Heavy and weathered oils would be more difficult to remove and could require manual scraping in addition to high-pressure, hot-water flushing (NOAA 2010b). These clean-up activities could dislodge any plants or animals that are attached to the structure.

6.3.5.14 Cherry Point Habitat

The Cherry Point area is comprised of several of the previously described habitat types, including eelgrass beds, kelp beds, rocky and unconsolidated shores, mudflats and estuaries, rocky and unconsolidated subtidal habitats, the water column, and man-made structures. Impacts on habitats in the Cherry Point area from oil spill clean-up activities would be the same as described in the subsections above for the respective resources.

6.4 Water Quality

6.4.1 Impacts on Water Quality from Operations at the North Wing

Routine maintenance activities at the North Wing may result in accidental releases of small quantities of hazardous materials. However, it is not expected that such quantities would contribute to a reduction in water quality in waters adjacent to the North Wing. Major maintenance activities at the North Wing are conducted periodically and may be permitted separately.

Releases of potential pollutants, principally crude oil and refined petroleum product, to marine waters can occur during loading and unloading operations in port due to handling errors and equipment failure. Spill records from 1990 through 2010 indicate that incidents are infrequent (typically averaging 3.5 per year), and the volume of spills is usually small. Many of the incidents reported were in quantities of drops or sheen on the water, and the average spill volume was 37 liters (9.8 gallons). Between 2001(when the North Wing became operational) and 2010, the average spill volume at the BP Cherry Point dock decreased to 2.5 liters (0.65 gallon). Spills recorded at the dock are not expected to increase from current conditions; spills currently do not occur in sufficient magnitude or frequency to adversely affect water quality.

Exchange of ballast water at the BP Cherry Point dock could introduce ANS (see Sections 2.4.1 and 2.4.2 for a discussion of ballast water discharge and ballast water laws and regulations, respectively). Establishment of non-indigenous species does not necessarily result in serious negative consequences to water quality; however, ANS can negatively affect the aquatic environment by affecting water clarity and by altering food web dynamics. Vessels calling at the BP Cherry Point dock would comply with USCG and State of Washington regulations for ballast discharge, as described in Section 2.4.2, which would minimize or prevent impacts from ballast water exchange. In addition, should vessels require discharge of ballast water from their cargo tanks, the BP Cherry Point dock has reception facilities available.

6.4.2 Impacts on Water Quality from Changes in Vessel Traffic

Increased vessel traffic could increase water turbidity, which would be a minor impact on water quality. Vessels would move at low speeds, which would minimize this temporary and localized effect. Moving vessels also would increase mixing of the surface and subsurface layers of the water column in the area immediately surrounding the vessel path and wake. This mixing of the layers is not expected to affect water quality because the increase in vessel traffic attributable to the Proposed Action would be very small and those vessels would stay within the CVTS, an area that is already disturbed by vessel traffic.

6.4.3 Impacts on Water Quality from a Crude or Bunker Oil Spill

This discussion considers the potential impacts from a crude oil spill of any size, anywhere in the Project area. The probability of accidents and the potential oil spill in each location with and without operation of the North Wing are described in detail in Chapter 5. Results are summarized in Section 6.1.

Some water quality parameters (e.g., bacteria, DO, and toxic chemical concentrations [see Section 4.4]) are directly affected by spills of crude oil. The most immediate impact on water quality from crude oil spills is increased concentration of toxic chemicals in the water column. The water-soluble fraction of crude oil and petroleum derivatives contains a toxic mixture of PAHs (Rodrigues et al. 2010) and other chemicals. These chemicals have been associated with mortality and sublethal effects to many organisms (Section 6.2). In a study of the effects of the Exxon *Valdez* oil spill on water quality in Prince William Sound, Neff and Stubblefield (1995) found that PAH concentrations in the water column declined rapidly after the spill to essentially background concentrations within a few months. It is likely that, even with a large oil spill, the concentrations of toxic chemicals in the water column would decrease rapidly.

Plankton are an important component of water quality. Crude oil is phytoxic, causing suffocation and sublethal impacts on phytoplankton such as algae (Lewis and Pryor 2013). Zooplankton occupying the water column are particularly vulnerable to acute crude oil exposure (Almeda et al. 2013b). The decomposition of phytoplankton and zooplankton results in low DO within the water column (Biello 2010).

6.4.4 Impacts on Water Quality from a Refined Petroleum Product Spill

Refined petroleum product spills may consist of diesel, gasoline, kerosene, or fuel oil. These products tend to be significantly more volatile than crude oils and persist for much shorter durations in water. Some water quality parameters (e.g., bacteria, DO, and toxic chemical concentrations [see Section 4.4]) are directly affected by spills of refined petroleum product. The most immediate impact on water quality from spills of refined petroleum product is an increased concentration of toxic chemicals in the water column and on the surface. Very light oils such as gasoline contain high concentrations of toxic compounds that evaporate within 1–2 days (NOAA 2013a). Light oils such as diesel, No. 2 fuel oil, and light crudes are moderately volatile, moderately toxic, and may leave behind a residue (NOAA 2013a). The effects of refined petroleum products on bacteria and plankton are similar to those caused by crude oil.

6.4.5 Impacts on Water Quality from Oil Spill Cleanup

During clean-up activities, the use of dispersants would transfer oil and its associated toxic hydrocarbons into the water column, which would temporarily degrade water quality until the toxins were diluted to sufficiently low concentrations to reduce their accumulation in fish tissue. Concentrations of PAHs in water are difficult to measure, but limited data suggest that typical marine water column concentrations in Puget Sound are less than 0.0 µg/L (Ecology and King County 2011). PAHs tend to accumulate in the aquatic food web. Therefore, the Food and Drug Administration established levels of concern (LOCs) for human consumption of 13 PAHs in seafood from the Gulf of Mexico following the Deepwater Horizon oil spill. The LOCs differ among seafood types, among different PAHs, and among consumer classifications. This is because the toxicity of PAHs differs based on chemical structure (Rotkin-Ellman et al. 2012).

Following an oil spill in the Project area, the allowable concentrations of PAHs in the water would likely be evaluated based on the types of seafood species present. Dispersants can be toxic to aquatic life, particularly zooplankton occupying the water column. Alterations in zooplankton populations would affect the food web and may decrease water clarity following decomposition of the plankton and the resulting reduced DO in the water column.

Other clean-up methods that may be used, including booming, skimming, and mechanical removal, would not affect water quality. In-situ burning potentially would result in sinking of heavier pyrogenic products as a consequence of the high temperatures. These heavier components are left behind after the lighter components are consumed by the fire and can linger in sediments, occasionally re-suspending in the water column (ITOPF 2011).

6.5 Cultural Resources

6.5.1 Impacts on Cultural Resources from Operations at the North Wing

Potential impacts on cultural resources from operations at the North Wing include spills of refined petroleum product during loading and accidental releases of small quantities of hazardous materials during routine maintenance activities. Spills and releases of hazardous materials recorded at the dock are not expected to increase from current conditions. Spills and releases currently do not occur in sufficient volume or frequency to adversely affect water quality or to adversely affect archaeological sites or historic resources near the North Wing.

6.5.2 Impacts on Cultural Resources from Changes in Vessel Traffic

Increases in vessels associated with the Project may result in slight increases in the frequency of accidental release of small spills of crude oil or refined petroleum product during loading and unloading. Such small spills are not anticipated to cause a reduction in water quality or associated impacts on cultural resources in the area. In addition, as stated in Section 5.8, the average spill volume at the BP Cherry Point dock actually decreased between 2001 and 2010, even with an increase in the number of vessels calling at the dock.

6.5.3 Impacts on Cultural Resources from a Crude or Bunker Oil Spill

This discussion considers the potential impacts from a crude oil spill of any size, anywhere in the Project area. The probability of accidents and the potential oil spill in each location with and without operation of the North Wing are described in detail in Chapter 5. Results are summarized in Section 6.1.

A spill of crude or bunker oil can directly contaminate or alter the chemical composition of archaeological sites along the shoreline or below the water surface. The ability to conduct scientific studies on affected sites, such as radiocarbon and isotope analyses, could be compromised by contamination. Oil can be absorbed by the shells and other organic materials in an archaeological site along the shoreline, effectively contaminating the site (Borrell 2010; Reger et al. 1992). Although adjustments can be made in radiocarbon dating to account for contamination, some analyses could be permanently compromised (Borrell 2010; Reger et al. 1992). Oil spills are unlikely to greatly affect the pH level in sediments, which would not increase site degradation (Prince 1990). In addition, oil coating on sites (such as shell middens and weirs) and artifacts may impede their identification and protection during the subsequent clean-up response (Bergmann 1994).

A spill of crude or bunker oil could affect historic resources directly by coating the resource and damaging the structural building materials or siding.

A crude or bunker oil spill may affect archaeological sites or historic resources indirectly through visual and atmospheric alterations to the surrounding landscape. The shorelines can be fouled by oil, and the vapors from volatilization of the oil can affect the aesthetic quality of resources (Penn et al. 2003). Such impacts would occur until the spill is cleaned up. Cultural sites and properties of religious and cultural significance, including TCPs, could be affected by decreases in visitation from closures of some areas to the public, including the Indian tribes. Other effects on cultural sites could include changes to the visual, auditory, and atmospheric surroundings caused by a spill of crude or bunker oil.

6.5.4 Impacts on Cultural Resources from a Refined Petroleum Product Spill

Refined petroleum product spills may consist of diesel, gasoline, kerosene, or fuel oil. These products tend to be significantly more volatile (evaporate more quickly) than crude oils and persist in water for much shorter durations. The most immediate impact on water quality from spills of refined petroleum product is increased concentration of toxic chemicals in the water column and on the surface (see Section 6.4). This would interfere with the ability to conduct scientific studies on affected sites. In addition, coating archaeological sites such as lithic scatters and weirs may impede their identification.

A refined petroleum product spill could affect historic resources directly by coating the site and damaging the materials from which the resource is constructed, but to a lesser degree than a spill of crude or bunker oil because of the increased volatility of the refined product.

A spill of refined petroleum product may affect archaeological sites or historic resources indirectly through visual alterations to the surrounding landscape, although this would be of a much shorter duration than for a spill of crude or bunker oil. Cultural sites could be affected by decreases in visitation from closures of some areas to the public. Properties of religious and cultural significance, including TCPs, could be affected by decreases in visitation from closures of some areas to the public, including the Indian tribes—as well as impacts on visual, auditory, and atmospheric surroundings caused by a refined petroleum product spill.

6.5.5 Impacts on Cultural Resources from Oil Spill Cleanup

Shoreline clean-up operations have the potential to permanently damage important archaeological sites and historic resources. Authorized shoreline clean-up procedures also may uncover previously undiscovered archaeological features or artifacts (Regional Response Team 10 [2013]). Clean-up activities could affect cultural resources under the water surface or on the shoreline directly via ground-disturbing activities or the release of chemicals to disperse or remove oil. Ground-disturbing activities could result from hand tools or the use of heavy machinery to clean up spills. Driving heavy equipment on the shore, anchoring booms and airboats, and setting equipment on shore or nearshore areas may directly affect archaeological sites and historic resources. Compression to subsurface archaeological sites caused by heavy equipment may damage site stratigraphy and artifacts. Untrained clean-up crews, including volunteers, could inadvertently affect archaeological sites and historic resources through stomping, crushing, scraping, and shoveling these resources (Borrell 2010).

Methods used to clean cultural resources can include natural cleansing, cold and hot water washing, extensive use of hand tools (shovels, trowels, and scrapers) to remove oil, bioremediation, use of heavy mechanized equipment to remove oil, and application of harsh chemicals to break down the oil (Kurtz 1994:273). All of these methods have the potential to affect archaeological sites and historic resources. These methods would need to be approved prior to use and would need to be closely monitored, if used at all (Kurtz 1994; Regional Response Team 10 [2013]). Cleaning cultural resources may not be appropriate in some archaeological or culturally sensitive areas, such as subsurface midden deposits, petroglyphs, and burials (Regional Response Team 10 [2013]).

The use of response vessel traffic, such as skimmers, boom tenders, and work boats, could affect archaeological sites and historic resources directly through physical contact and indirectly through visual and atmospheric disturbance. Physical contact could be caused by loading and unloading equipment and personnel on the shore, and by anchoring booms and airboats in nearshore areas. Visual disturbance could be caused by the presence of cleanup equipment, and atmospheric disturbance could result from fumes and smoke caused by mechanized equipment.

Clean-up activities also have the potential to increase the visibility of archaeological sites and historic resources to the public, which can lead to an increase in looting, theft, and vandalism (Bittner 1996; Kurtz 1994). Long-term impacts could be caused by changes in the surrounding landscape that increase erosion and diminish shoreline stabilization (Penn et al. 2003).

Indirect and short-term impacts on archaeological sites and historic resources could result from noise or vibrations caused by heavy equipment, changes to the surrounding landscape, and smoke or fumes from burning. Historic resources also could be affected by decreases in visitation resulting from road or beach closures associated with cleanup or equipment staging.

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6.6 Land Use

6.6.1 Impacts on Land Use from Operations at the North Wing

Construction of the North Wing was completed in 2001, and BP does not seek to construct or modify any new facilities under the Proposed Action. The Proposed Action would not cause direct effects on land use beyond those identified in the previously prepared environmental reports (ENSR 1992, 1997). Indirect effects on land use primarily would be associated with oil spills and associated clean-up actions, as described below.

6.6.2 Impacts on Land Use from Changes in Vessel Traffic

Land use is not expected to be affected by changes in vessel traffic. Although vessels, especially large vessels such as tankers, are visible from shorelines, the small percentage of increase in total study area marine vessel traffic is not expected to measurably affect the overall aesthetics of viewing the water from shoreline areas.

Commercial shipping lanes are typically in the middle of waterways, where the channels are deepest, and not in waters close to shorelines—except in narrow waterways such as Rosario Strait and Guemes Channel and at points such as Turn Point on Stuart Island. Thus, there would be little to no expected effects of vessel wake on shoreline areas and no consequent effects on shoreline use or erosion. Finally, a change in vessel traffic in the study area is not expected to change recreational or other commercial boating patterns; therefore, no changes are expected in the use of shoreline facilities such as marinas by other recreational or commercial vessels.

6.6.3 Impacts on Land Use from a Crude or Bunker Oil Spill

The probability of accidents and the potential oil spill in each location with and without operation of the North Wing are described in detail in Chapter 5. Results are summarized in Section 6.1. The impacts discussed below pertain to a crude or bunker oil spill of any size, anywhere in the Project area.

While shoreline oiling would affect economic activities and short-term use of nearshore lands, it is not expected to change long-term land use from one category to another (such as residential to industrial), unless oiling caused long-term impairment to aesthetics or posed a long-term human health risk. Longer-term impairment may result if areas are left to natural recovery rather than actively restored. Although not expected, long-term impairment from oil spills would most affect residential and commercial land uses (due to the sight or odor from the oil, or the human health risk). Agricultural/natural/forest lands would largely remain unaffected because these resources occur above the high-water mark, where oil is unlikely to reach. Sight and smell of nearby oil would not affect these land uses.

An oil spill would most likely result in short-term effects of shoreline oiling on the use of shoreline lands caused by area closures and the sight and smell of oil. Residents in heavily oiled areas may need to temporarily evacuate during clean-up operations. Some commercial land uses, such as hotels, shops, and restaurants, may need to close or may experience a decline in visitors if they are situated sufficiently close to spilled oil. Industrial land use and associated activities in locations near a spill may be adversely affected if industries that draw seawater as part of their operations are at risk of oil entering water intakes and must cease or disrupt operations, or if any in-water or nearshore industrial facilities are oiled. For example, operations of shipyards, ports, and harbors could be disrupted through the presence of oil that can damage boats and other gears.

If an oil spill is limited to open waters, shoreline land use impacts of the spill itself are expected to be negligible, with the possible exception of changes in nearshore aquaculture operations.

6.6.4 Impacts on Land Use from a Refined Petroleum Product Spill

Impacts on land use from a refined petroleum product spill are similar to those described for a crude oil spill but would be less severe because refined petroleum products persist in water for shorter durations and therefore would be less likely to reach the shore.

6.6.5 Impacts on Land Use from Oil Spill Cleanup

Impacts on land use from oil spill clean-up activities are likely to be temporary, lasting as long as the clean-up operations, which would depend on the unique circumstances of a spill event. Clean-up operations may be staged in nearshore areas, temporarily shifting land use from its existing use to oil spill response uses. Cleanup may require closing shoreline areas from public access, removing nearshore structures affected by oiling, and closing industrial or commercial facilities to ensure that cleanup can proceed effectively and to safeguard public safety. Cleanup also may involve the use of chemical dispersants that may affect land uses in nearshore areas, even after cleanup has ceased due to possible environmental contamination. Such contamination, although likely short term, would primarily affect recreational, residential, aquaculture, and commercial land uses.

6.7 Recreation Resources

6.7.1 Impacts on Recreation Resources from Operations at the North Wing

Department of Homeland Security regulations have established security exclusion zones around facilities such as refinery docks when a vessel or barge is moored, and the public is precluded from these zones. The presence of the North Wing removes an area approximately 300 feet around the berth to recreation activities. Boating, fishing, and diving are prohibited in this area. Because the dock is approximately 1,000 feet offshore, this restriction would not preclude beach or most intertidal zone recreation in the Project area.

6.7.2 Impacts on Recreation Resources from Changes in Vessel Traffic

Vessels transiting to and from the North Wing include a 100-yard security zone that precludes public or commercial recreation. While underway, the security zone moves with the vessel and thus is a temporary exclusion. An increase in the number of vessels calling at the BP Cherry Point dock would increase the frequency of this temporary exclusion. However, the maximum increase from single-dock operations to operation with both wings is approximately 85 vessels per year (170 transits); thus, the increase of the temporary exclusion for a few hours would occur no more than once every 2 days. Further, since the vessels transit through the TSS-designated traffic lanes and then approach the dock from a similar path each time, the temporary impacts would be limited to a small area.

Vessels approaching, mooring, and departing from the dock would interact with recreationists in the Project area. Due to the small potential increase in the number of vessels that may occur under BP's upper-range traffic forecast scenario, operations at the North Wing are not expected to change existing effects on recreationists in the area. In the open ocean, recreational, fishing, and whale watching boats would move away from the larger cargo vessels and other crafts transiting through the Project area. A change in the number of large vessels may affect these avoidance measures; however, the act of maneuvering away from other marine traffic in the area is common practice and would occur for recreationists that encounter other marine traffic in the Project area. The forecasted change in vessel traffic in the Project area is generally not expected to change recreational or other commercial boating patterns.

Vessels—especially large vessels such as tankers—are visible from shorelines. However, the change in total marine vessel traffic in the Project area is not expected to measurably affect the overall aesthetics of viewing the water from shoreline recreation areas.

Changes in vessel traffic could indirectly affect recreationists by altering the behavior of wildlife, such as whales. If whales exhibited greater avoidance of the area as a result of increased shipping, recreational whale watching opportunities may decrease. Because the potential change in the total number of vessels under the Project would be small (up to 85 vessels) relative to existing conditions, the impact on recreationists in the Project area would be minimal.

6.7.3 Impacts on Recreation Resources from a Crude or Bunker Oil Spill

This discussion considers the potential impacts from a crude oil spill of any size, anywhere in the Project area. The probability of accidents and the potential oil spill in each location with and without operation of the North Wing are described in detail in Chapter 5 Results are summarized in Section 6.1. Potential impacts from a crude or bunker oil spill on the recreation resources described in Section 4.7 are described qualitatively in the subsections that follow.

6.7.3.1 Ferry Docks, Harbors, and Marinas

Depending on the amount of oil that reaches a dock, harbor, or marina, boating activities may be suspended; the economic and social consequences of suspended activities are discussed in Section 6.10. In areas with marsh habitats, petroleum residues would persist for long periods in sediments (Reddy et al. 2002). Watercraft may be stained and damaged by crude oil in the event of a spill (USCG 2013), further discouraging recreationists from using the area.

6.7.3.2 State Parks, Marine Parks, National Reserves, and Wildlife Sanctuaries

If oil were to reach a state park, marine park, national reserve, or wildlife sanctuary, the affected area would likely be closed until the area was sufficiently cleaned. Recreation in these areas would be suspended until the closure was lifted. Wildlife in these areas would be affected as described in Section 6.2.

6.7.3.3 Public Beaches and Boat Ramps

Because oil washed ashore can adhere to skin, clothing, and fur, public beaches and boat ramps would likely be closed in the event of an oil spill to prevent people and pets from coming into contact with oil and oil residue. In addition, watercraft may be stained and damaged by crude oil in the event of a spill (USCG 2013), further discouraging recreationists from using public boat ramps. Recreationists would likely avoid traveling to these areas, choosing to recreate elsewhere. The length of time that recreationists avoid areas affected by oil spills varies by the size of the spill and the degree of media coverage, which can substantially affect public perception of the safety of the spill site, even after cleanup has been completed (Cheong 2012).

6.7.3.4 Coves, Bays, and Open Water

The physical presence of crude oil appears as a sheen that tends to float on top of the water. In addition, the odor resulting from the volatile component of the spilled material is offensive to many people and could further discourage recreation activities. These effects could exist for days to months (depending on the size of the spill), until the slick is cleaned up or the oil is stranded on the shoreline. Recreationists would be excluded from affected areas. Potentially affected recreation activities in coves, bays, and open water include scuba diving, whale watching, kayaking, boating, and fishing.

Fishing and harvesting bans are likely to be imposed after an oil spill to prevent or minimize contamination of fishing gear and consumption of contaminated seafood. Concentrations of petroleum constituents such as PAHs that accumulate in the edible tissues of fish, crabs, and shellfish could pose a significant health threat to humans. Many PAHs are known to be toxic to humans, and some cause cancer. Following an oil spill, these resources would be declared unsafe for human consumption until health authorities determine that the edible tissues contain less chemical contaminants than the established level of concern (NOAA n.d. [b]). Banning fishing and harvesting would negatively affect tourism and recreation by decreasing the number of people recreating in the area. The length of time that recreationists avoid areas affected by oil spills varies by the size of the spill and the degree of media coverage, which can substantially affect public perception of the safety of the spill site, even after cleanup has been completed (Cheong 2012). One method of mitigating these negative impacts involves adopting a catch-and-release policy, which may prevent the complete closure of some areas to sport fishing. A reduction in fishing opportunities in the spill area may cause congestion at some uncontaminated areas, resulting in a reduction in fishing quality.

6.7.4 Impacts from a Refined Petroleum Product Spill

Potential impacts on the recreation resources described in Section 4.7 from a refined petroleum product spill are described qualitatively in the subsections that follow.

6.7.4.1 Ferry Docks, Harbors, and Marinas

Depending on the amount of refined petroleum product that reaches a dock, harbor, or marina, boating activities may be suspended; the economic and social consequences of suspended activities are discussed in Section 6.10. Watercrafts are less likely to be stained and damaged by a spill of refined petroleum products compared to a spill of crude oil. Marinas and harbors experience frequent chronic, low-level discharges of refined petroleum products from small craft spills, storm drains, and other land-based sources of contamination, resulting in higher levels of contamination of water and sediments overall compared to open water (Johnson 1998). When refined petroleum products enter confined areas such as marinas and harbor waters, they may persist longer due to poor tidal flushing (Hollin et al. 1998). Refined petroleum product spills would deter recreation while visible but would persist for a much shorter time than crude oil spills.

6.7.4.2 State Parks, Marine Parks, National Reserves, and Wildlife Sanctuaries

If refined petroleum products were to reach a state park, marine park, national reserve, or wildlife sanctuary, the affected area would likely be closed until the area was sufficiently cleaned. Recreation in these areas would be suspended until the closure was lifted. Wildlife in these areas would be affected as described in Section 6.2. Due to the volatility of many refined petroleum products, it is unlikely that long-term contamination of state parks, marine parks, national reserves, or wildlife sanctuaries would occur in the event of a spill.

6.7.4.3 Public Beaches and Boat Ramps

Refined petroleum products can be highly toxic to humans and animals. If refined petroleum products were to contaminate public beaches and boat ramps, these areas would be closed to prevent people and pets from coming into contact with refined petroleum products and their toxic constituents. Due to the volatility of many refined petroleum products, it is unlikely that long-term contamination of beaches and boat ramps would occur in the event of a spill.

6.7.4.4 Coves, Bays and Open Water

Fishing and harvesting bans can be imposed after a refined petroleum product spill to prevent consumption of contaminated seafood. Following a refined petroleum product spill, these resources would be declared unsafe for human consumption until health authorities determine that the edible tissues contain less chemical contaminants than the established level of concern (NOAA n.d. [b]). Banning fishing and harvesting would negatively affect tourism and recreation by decreasing the number of people recreating in the area. Due to the volatility of many refined petroleum products, however, it is unlikely that long-term impacts on coves, bays, and open water would occur in the event of a spill.

6.7.5 Impacts on Recreation Resources from Oil Spill Cleanup

During open water cleanup, recreationists would be excluded from using contaminated sites in open water. During beach cleanup, restrictions to access to shellfish and other edible animal and plant populations would prevent people from harvesting seafood. Depending on the type of clean-up activities, harvesting of seafood may be affected because use of dispersants may be a cause of contamination.

Invertebrates and fish are sensitive to dispersant chemicals, and mortality has been documented following exposure to dispersants and to dispersant-oil emulsions (Swedmark et al. 1973). Harvesting would not resume until the affected populations had recovered.

Agencies implement a variety of projects to enhance fishing after a contamination incident. These projects may include construction of fishing piers, enhancement of public parks to allow more access for anglers, or acquisition of areas for public use that might otherwise undergo private development (NOAA 2013a).

6.8 Air Quality and Climate Change

6.8.1 Impacts on Air Quality, Climate, and GHG from Operations at the North Wing

Annual maintenance of dock equipment at the North Wing would require the increased use of workboats, which could cause increased annual emissions, including GHGs—although maintenance emissions would be minor compared to operational emissions. The air quality and GHG effects from operation of marine diesel engines are described in Section 6.8.2.

6.8.2 Impacts on Air Quality, Climate, and GHG from Changes in Vessel Traffic

As described in Section 4.8.4, changes in vessel traffic under the Proposed Action may result in changes in the amount of criteria air pollutants and GHG released to the atmosphere. Deep draft vessels, such as the additional crude oil tankers and refined petroleum product tankers and barges expected to call at the BP Cherry Point dock under the Proposed Action, are powered by Category 3 marine engines. Category 3 engines traditionally have lacked stringent emission controls and burned fuel oil with high sulfur content, resulting in the release of substantial amounts of NO_X, SO_2, and $PM_{2.5}$. Other air pollutant emissions associated with the use of marine engines include CO_2, PM_{10}, CO, nitrogen compounds, sulfur compounds, and hydrocarbons. Individual components of hydrocarbons that are known to be toxic include benzene, 1,3 butadiene, and aldehydes (EPA 2009), also referred to as *HAPs* (hazardous air pollutants).

Although vessel traffic may increase, air pollutant emissions associated with vessel traffic to and from the BP Cherry Point dock are not expected to increase proportionally because of overall lower emission rates. EPA's emission standards for Category 3 marine diesel engines and diesel fuel sulfur limits (75 CFR 22896) are expected to gradually reduce the NO_X, SO_2, $PM_{2.5}$, CO, and hydrocarbon emissions generated by Category 3 engines on large ocean-going vessels, including those traveling within the Project area. The emission standards apply in two stages—near-term standards for newly built engines were implemented beginning in 2011; long-term standards requiring an 80-percent reduction in NO_X emissions will begin in 2016. As shown in Table 4.8-4, for the maximum future total of 420 vessel calls per year (BP's high-range traffic forecast), the estimated contribution of emissions for the marine vessel (ships) category would be approximately 0.7 percent for CO_2, 1.6 percent for CO, 1.8 percent for NO_X, 2.6 percent for SO_X, 3.4 percent for PM, and 2.4 percent for hydrocarbons (Ecology 2013). For an increase of up to 85 vessel calls per year (BP's medium-range traffic forecast), the contribution of emissions for the marine vessel (ships) category would be proportionally less, well under 1 percent for all pollutants.

The relatively small increased emissions of criteria air pollutants from an increase in vessel traffic are not expected to cause air quality in any portion of the study area to violate the NAAQS or the WAAQS. This conclusion is based on the strong onshore wind flow pattern (dispersion effects) and the number of vessel calls to the BP Cherry Point dock compared to the other vessels traveling through the Project area for other purposes.

The marine diesel fuel burned by the additional vessel traffic under the Proposed Action would result in the release of GHGs, including CO_2, CH_4, and N_2O. In 2011, total U.S. domestic GHGs emissions were 6,702 million metric tonnes CO_2e. International bunker fuels[3] accounted for 112 million metric tonnes CO_2e, or approximately 1.7 percent of the U.S. domestic total (EPA 2013a). An increase of 85 vessels would contribute approximately 0.005 million metric tons per year CO_2e, which would represent a very small fraction of all U.S. vessel traffic.

3 Not included in the U.S. domestic total.

6.8.3 Impacts on Air Quality, Climate, and GHG from a Crude or Bunker Oil Spill

The probability of accidents and the potential oil spill in each location with and without operation of the North Wing are described in detail in Chapter 5. Results are summarized in Section 6.1. The impacts discussed below pertain to a crude or bunker oil spill of any size, anywhere in the Project area.

The fate of an oil spill is determined by natural actions such as weathering, evaporation of hydrocarbons, oxidation, biodegradation, and emulsification. While the other physical actions affect the horizontal and vertical distribution of oil within a waterbody, evaporation is the process that affects air quality. Through evaporation, the lighter, more volatile components of the oil separate from the heavier components and become vapors that transfer VOCs from the water surface to the atmosphere (see Section 5.9).

Large amounts of VOCs released to the atmosphere during a spill event can exacerbate the formation of ground-level photochemical ozone in the presence of nitrogen oxides (NO_X) under certain atmospheric conditions (i.e., strong sunlight, light winds, and low-altitude temperature inversions). However, the study area is not prone to such phenomena, is presently in attainment with ozone NAAQS and WAAQS, and is expected to remain so for the foreseeable future. Thus, it is not anticipated that an oil spill would directly cause a violation of the NAAQS or WAAQS. If the spilled oil contained odorous sulfur compounds such as hydrogen sulfide and mercaptans, however, a substantial odor impact may occur–depending on wind speed and direction in relation to proximate receptors (i.e., populated areas)—thus causing a public nuisance.

A large spill of crude or bunker oil would release large quantities of VOC HAPs such as BTEX (EPA 2013b). Acute exposures to high levels of BTEX have been associated with central nervous system depression, skin and sensory irritation, and effects on the respiratory system (Great Lakes and Mid-Atlantic Center for Hazardous Substance Research n.d.). In addition, while not as volatile as VOCs, PAHs would be released into the atmosphere over a period of days or weeks. At elevated concentrations, prolonged exposure to VOCs and PAHs could cause cancer or other long-term health effects (EPA 2013b, 2013c). Because exposure times would be relatively short (days or weeks) compared to the risks of chronic long-term exposure (e.g., 40-year occupational or 70-year lifetime), the chronic public health risk from HAPs from a large spill of crude oil would not be substantial. Depending on weather conditions, short-term acute effects may become apparent, such as olfactory and pulmonary irritation.

Ozone acts as a GHG within the troposphere (the lowermost portion of the Earth's atmosphere), extending to approximately 55,000 feet (17,000 meters) altitude (EPA 2013d). A large oil spill would indirectly contribute to GHG emissions by releasing VOCs, which are ozone precursors that contribute to tropospheric ozone formation (EPA 2013b).

6.8.4 Impacts on Air Quality, Climate, and GHG from a Refined Petroleum Product Spill

Light- and middle-range refined petroleum products contain a greater proportion of volatile fractions than crude oil. Therefore, spills of refined petroleum product evaporate more readily than spills of heavy crude oil (NOAA 2013c). As the refined petroleum product evaporates, compounds such as BTEX can be released into the atmosphere, depending on product composition. As described previously, acute exposures to high levels of BTEX have been associated with central nervous system depression, skin and sensory irritation, and effects on the respiratory system (Great Lakes and Mid-Atlantic Center for Hazardous Substance Research n.d.). Residents in the study area are unlikely to be exposed to prolonged hazardous levels of BTEX from a spill of refined petroleum product because of the short duration before the BTEX would be almost completely lost through evaporation and dispersal. As described for spills of crude oil, exposure times would be relatively short (days or weeks) compared to the risks of chronic long-term exposure, and the chronic public health risk from HAPs from a spill of refined petroleum product would not be substantial. However, short-term acute effects may become apparent, such as olfactory and pulmonary irritation, depending on weather conditions.

A spill of refined petroleum product would indirectly contribute to GHG emissions releasing VOCs, which are ozone precursors that contribute to tropospheric ozone formation (EPA 2013b).

6.8.5 Impacts on Air Quality, Climate, and GHG from Oil Spill Cleanup

Air quality would be affected by oil spill clean-up activities if a large oil spill occurred in the study area. If in-situ burning operations commenced in response to a spill, heavy particulate matter containing PAHs would be released (EPA 2013e). Particulate matter can damage human health by entering the lungs and decreasing lung function, increasing respiratory symptoms, and aggravating cardiovascular disease. In addition, large amounts of particulate matter can reduce visibility in the surrounding area and change the pH of waterbodies (EPA 2013). At elevated concentrations, prolonged exposure to PAHs could cause cancer or other long-term health effects (EPA 2013c). Dioxins and furans also may be formed and released from burning oil in ocean water. Dioxins and furans are formed during combustion of fuels such as wood, coal, or oil and consist of several hundred compounds that comprise three chemical families: the chlorinated dibenzo-p-dioxins (CDDs), chlorinated dibenzofurans (CDFs), and certain polychlorinated biphenyls (PCBs). Long-term exposure to high levels of these compounds may increase the risk of cancer in humans and animals (EPA 2010). However, in-situ burning is a clean-up activity of short duration.

In-situ burning would contribute to climate change by releasing GHGs, including CO_2 and (in lesser amounts) CH_4 and N_2O. Approximately 930 pounds (422 kilograms) of CO_2-e GHG emissions are released per barrel of crude oil burned (Hodges and Coolbaugh 2009), which is equivalent to approximately 1,200 miles of everyday driving in a typical passenger car (EPA 2013a).

As described in Section 5.9, booming and skimming activities can involve a large number of diesel-powered vessels and turbine- powered aircraft (fixed or rotary-wing). The impacts on air quality and GHG emissions from the use of spill response vessels and aircraft are described in Section 4.8.

In some cases, chemical dispersants may be used to break up an oil spill. Key compounds of oil dispersants can include ethylene glycol monobutyl ether (2-butoxyethanol) and dipropylene glycol monobutyl ether. These ozone precursor VOCs are non-carcinogenic irritants that could drift into onshore air, thus creating a temporary public health risk under certain weather conditions (EPA 2013e; ARB 2013).

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6.9 Tribal/Subsistence Fishing

6.9.1 Impacts on Tribal/Subsistence Fishing from Operations at the North Wing

Routine maintenance activities at the North Wing may result in accidental releases of small quantities of hazardous materials. However, it is not expected that such amounts would contribute to a reduction in water quality and consequently affect fish and shellfish in the vicinity of the North Wing.

Introduction of ANS through ballast discharge could result in alterations to the ecosystem that eliminate native species, which in turn could alter the food web and result in decreased populations of native aquatic species. However, vessels calling at the BP Cherry Point dock would comply with State of Washington and USCG regulations that require offshore ballast water exchange (see Section 2.4.2). In the rare event that ballast water must be discharged from a cargo tank, the BP Cherry Point dock has reception facilities available for this type of ballast water, preventing it from entering the marine environment.

6.9.2 Impacts on Tribal/Subsistence Fishing from Changes in Vessel Traffic

A change in the number of transiting vessels may affect subsistence fishing by increasing interactions with fishing vessels in the traffic lane and maneuvering area adjacent to the BP Cherry Point dock. Tribal/subsistence fishing activities that would be most affected by changes in vessel traffic would most likely be troll vessels with drag-baited hooks or lures used offshore from May through November (depending on the species targeted). However, due to the small potential increase in the number of vessels that may occur under BP's upper-range traffic forecast, operations at the North Wing are not expected to change current effects on tribal/subsistence fishing in the study area.

With regard to potential impacts on tribes in the Project area, the Makah Nation would likely be unaffected by an increase in the number of vessels in transit to the BP Cherry Point dock because the change in vessel traffic would be a very small percentage of the overall traffic entering the Strait of Juan de Fuca and passing through their U&A. Makah Nation tribal salmon fishing is mostly carried out in the rivers of the Olympic Peninsula, which are outside the Project area; therefore, tribal fishing is unlikely to be directly affected by vessel movements. The Lower Elwha Klallam Tribe also concentrate their fishing efforts in freshwater, mostly in the Elwha River, although some is carried out in the Strait of Juan de Fuca. Similarly, while the Nooksack Indian Tribe retains the right to use their U&As, they fish mostly in the Nooksack River, which is outside the Project area. The Lummi Nation's harvest of Manila clams would not be affected by an increase in vessels because the clams are harvested from intertidal reservation beaches rather than from offshore.

6.9.3 Impacts on Tribal/Subsistence Fishing from a Crude or Bunker Oil Spill

The probability of accidents and the potential oil spill in each location with and without operation of the North Wing are described in detail in Chapter 5. Results are summarized in Section 6.1. The impacts discussed below pertain to a crude or bunker oil spill of any size, anywhere in the Project area.

Impacts from a spill of crude or bunker oil primarily would affect surface and near-surface fishing gear, facilities on the surface or that use surface water in operations (e.g., hatcheries and floating bivalve pens), and intertidal or shallow subtidal demersal and benthic species (e.g., clams, oysters, kelp and other edible algae [seaweed]), crabs, intertidal spawning fish such as sand lance and surf smelt, eelgrass and herring spawn, sea urchins; and similar organisms of subsistence value).

The impacts of a spill of heavy oil would result in some fish and shellfish becoming contaminated or acquiring an objectionable oil-derived taste called *tainting*. Filter-feeding animals such as bivalve mollusks (e.g., introduced Pacific oysters and native Olympia oysters; native littleneck, butter, and horse clams; and introduced Manila and softshell clams) are particularly vulnerable to tainting because they may easily ingest dispersed oil droplets and oiled particles suspended in the water column. Bivalves do not metabolize the hydrocarbons; therefore, they remain in the tissues for extended periods. Crabs (Dungeness and red rock crabs) may be tainted for a short time but they, like most crustaceans, tend to metabolize the hydrocarbons and quickly eliminate them as body waste. Other species with a high fat content in their flesh such as salmon (an important resource to some tribes) also metabolize hydrocarbons rapidly; therefore, tainting is a short-term impact in most cases. Bottomfish species that are harvested through tribal/subsistence fishing (e.g., halibut, rockfish, lingcod, cabezon, and perch) and other pelagic species primarily caught for bait (e.g., herring, smelt, sardines, and sand lance) would be unlikely to experience much exposure to the oil and would rapidly metabolize whatever oil they do ingest.

The perception or possibility of exposure to contamination and tainting may result in an official closure of the fisheries to harvesting seafood in certain areas, and tribal/subsistence fishing in these areas would be affected until the ban was lifted. The severity of these effects would depend on the location and amount of area affected, the resource affected, the season during which the spill occurred, and the length of the closure period.

Fishing and cultivation gear may become oiled, leading to the risk of previously non-affected catches becoming contaminated and of fishing being halted until gear is cleaned or replaced. Flotation equipment, lift nets, cast nets, and fixed traps extending above the sea surface are more likely to become contaminated by floating oil. Lines, dredges, bottom trawls, and the submerged parts of cultivation facilities are usually well protected, provided they are not lifted through an oily sea surface or affected by sunken oil. Interruption of tribal/subsistence fishing activity may be detrimental to those who rely on seafood as an important food source.

Tribal aquaculture facilities that are located in or close to the Project area may be affected in the event of a spill. It may not be possible to move some of this equipment from the area of impact. All of the tribal fish hatcheries in the Project area are on-land facilities and thus would not be directly affected by oil in the marine environment. However, if these facilities have marine water intakes, the intakes may need to be stopped or blocked to prevent contamination of the hatchery. The severity of these impacts would depend on the timing of the spill and the availability of a different adequate water source.

6.9.4 Impacts on Tribal/Subsistence Fishing from a Refined Petroleum Product Spill

Much of the more volatile fractions of refined petroleum products would evaporate and may result in little to no impact on tribal fisheries. The product that remains may strand on the shore or on structures in the water (e.g., pier pilings and docks). These products typically do not smother organisms or markedly affect their mobility, and they tend to not clog the filtering apparatus of worms, barnacles, bivalves, crustaceans, or other filter feeders. However, these remaining fractions tend to be more toxic to organisms and may result in relatively high mortalities in the intertidal and shallow subtidal areas, and would affect in-water structures such as pier pilings, net pens, and breakwaters. Because these remaining fractions are less viscous than crude or bunker oil, they may be transported deeper into cobble/gravel shorelines, marshlands, peaty sediments, and similar substrata that are porous—and may persist longer.

The middle-range refined petroleum products are readily taken up by exposed marine organisms important to tribal fisheries and may result in significant tainting until the product and the byproducts are metabolized or otherwise eliminated from the organisms. The tainting effects and processes for the middle-range refined petroleum products are similar to those described earlier for crude and bunker oils.

The light-range refined petroleum products such as gasoline are volatile and float with little dispersion in the water column, even with significant mixing energy, compared to heavy- or middle-range products. Gasoline and related products may be acutely toxic to tribal resources in the intertidal and surface layer of waterbodies, resulting in injury or mortality for exposed bivalves, crustaceans, algae, and other intertidal and very shallow subtidal benthic and demersal resources. If the product is drawn into the hatcheries or other facilities, it may result in hazardous conditions, including the potential for fire and significant acute toxic impacts on the aquaculture species.

6.9.5 Impacts on Tribal/Subsistence Fishing from Oil Spill Cleanup

Clean-up activities that affect shellfish and other shoreline species also would affect the ability to harvest seafood in these areas. The potential impacts of response activities include restriction or cessation of any tribal/subsistence or other fishing activity in a response zone defined by the USCG and other agencies. Closures or restrictions of activity in and out of harbors and launch ramps by subsistence fishers would limit access to their fishing grounds and prevent tribal/subsistence fishing activities in restricted off-shore areas.

Habitats or migratory pathways (particularly for salmon) may be disturbed because of an increase in activity in or on the water or shore zone. Tribal shellfish resources may be affected by clean-up actions on the shoreline. These impacts may be longer term if suitable habitat for shellfish is altered or removed. Injury to eelgrass beds, kelp beds, and similar habitats may occur from response vessel traffic, such as skimmers, boom tenders, and work boats moving through these areas.

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6.10 Socioeconomics and Environmental Justice

Potential impacts on socioeconomic resources addressed in this section include impacts on population, housing, tax revenues, jobs, income, economic activity, and quality of life. This section also addresses environmental justice impacts on minority and low-income populations.

6.10.1 Impacts on Socioeconomics and Environmental Justice from Operations at the North Wing

6.10.1.1 Socioeconomics

Operations of the North Wing at full capacity could generate direct and indirect employment and wages in the study area, as additional workers could be required at the terminal. However, such employment and income changes are expected to be minor, as few additional people are likely to be required at the terminal. Little to no change is expected in the total study area population or local demand for housing.

Residents in the surrounding Birch Bay community (north of the dock) and Lummi Bay (south of the dock) might be affected from increased noise, decreased air quality, lighting, and other aspects of overall dock and in-water activity associated with operating the North Wing at full capacity. However, since the North Wing is sufficiently remote from these residents and the operational hours of the North Wing are the same as the South Wing, any such impacts are expected to be minor. The overall frequency of vessel arrivals/departures and loading/unloading activities would change from slightly less to slightly more than one vessel per day on average. Therefore, no impacts are expected on refinery employment or income, or on the availability of refined oil products on the West Coast.

6.10.1.2 Environmental Justice

In the census block groups located immediately north and south of the BP Cherry Point dock, disproportionate[4] minority populations of Native Americans live on the Lummi Reservation, but no concentrations of disproportionally low-income populations were identified (see Section 4.10.4.2). The potential impacts on socioeconomics described above (potential minor employment and income changes from direct and indirect employment and wages in the study area; potential minor increases in noise, decreases in air quality, and lighting impacts) would therefore affect disproportionate minority populations.

6.10.2 Impacts on Socioeconomics and Environmental Justice from Changes in Vessel Traffic

6.10.2.1 Socioeconomics

Changes in vessel traffic may result in minor to negligible impacts on coastal residents and in-water and nearshore activities such as commercial vessel traffic, aquaculture, fishing, boating, and beach recreation. Such impacts likely would entail temporary disruption of commercial, recreational, or tribal/subsistence fishing and other in-water activities by tankers and barges in transit. Noise and entrainment described in Section 6.2 are not expected to adversely affect fish populations or the associated commercial and recreational fishing activities in the Project area.

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4 See definitions of *disproportionate* in Section 4.10.

Workers operating tankers and barges arriving at and departing the dock likely would not require accommodations. Because of their small number, negligible effects would be associated with changes in the number of non-local visitors in the study area.

6.10.2.2 Environmental Justice

As described above, socioeconomic impacts from a change in vessel traffic in the study area are expected to be minor and limited to in-water activities such as fishing (commercial, recreational, and tribal/subsistence) and boating. Minority populations, particularly Native Americans, may disproportionately participate in such local in-water activities as tribal/subsistence fishing and aquaculture. However, due to the small potential increase in the number of vessels that may occur under BP's upper limit traffic forecast scenario, operations at the North Wing are not expected to change current effects on tribal/subsistence fishing in the study area (see Section 6.9).

6.10.3 Impacts on Socioeconomics and Environmental Justice from a Crude or Bunker Oil Spill

This discussion considers the potential impacts from a crude oil spill of any size, anywhere in the Project area. The probability of accidents and the potential oil spill in each location with and without operation of the North Wing are described in detail in Chapter 5. Results are summarized in Section 6.1.

6.10.3.1 Socioeconomics

Depending on the location of a spill and the speed of containment, a crude oil spill may affect economic and social activities on beaches and shoreline areas. Adverse socioeconomic impacts of an oil spill can include reductions in activities such as fishing, boating, beach and shoreline recreation, aquaculture, port and marina activities, and marine transportation and shipping. Industries relying on affected waters as their water supply source, such as aquaculture facilities, likely also would be negatively affected by an oil spill.

Oil spills may result in property damage to boats and other in-water and shoreline structures, and potential temporary decreases in commercial and residential property values. All of these impacts may result in reduced economic activity, which would negatively affect employment, income, taxes, and overall quality of life. Furthermore, study area residents also might be affected by the real and perceived impacts from the spill on their community and the marine environment.

To provide context for socioeconomic impacts, this section summarizes the average daily value of several shoreline and in-water activities that might be disrupted or otherwise adversely affected by a crude oil spill.

The tourism industry is a major source of direct and indirect employment and wages in the study area. Oil spills may result in beach and recreational boating closures, adverse effects on wildlife populations for sportfishing and wildlife viewing, and closure of recreation locations and facilities along the shoreline. Through such potential impacts, an oil spill places at risk the economic benefits from tourism. For every day that an oil spill disrupts recreation and tourism in the study area, taxes, employment, and income may decline. An oil spill would jeopardize some of the $3.3 million per day spent by tourists (as estimated in 2009), which supports daily income of $934,000 in employment opportunities for almost 18,000 workers annually, and the $111,600 per day in state taxes and $28,250 per day in local taxes generated by tourism activities (Dean Runyan Associates 2009).

Commercial fishing and aquaculture activities are likely to be adversely affected by an oil spill. Adverse effects of an oil spill on shellfish and other aquaculture products could prevent people from harvesting seafood in public and private areas until populations recovered and were safe to consume. Fishing and harvesting bans could be imposed to prevent or minimize contamination and to prevent human consumption of contaminated seafood. In 2011 in the study area, commercial fishing vessels landed a gross ex-vessel value of almost $216,350 per day on average, while in 2007 aquaculture sales totaled $52,000 on average per day. At least some of this activity and this revenue could be jeopardized by an oil spill, either through fishery closure, contamination, or perceived reduction in seafood quality (PacFIN 2012).

Potential costs for delaying or diverting vessels in and around the study area could adversely affect business profit and wages for workers on vessels and at ports. A 1999 estimate found that the average daily expenditures on vessel and oil movements through Puget Sound at sea and in port was $252,000 (ERC 2005); at least some portion of this economic activity could be adversely affected by a spill. Furthermore, boats and gear may be directly damaged by an oil spill, leading to costs for cleanup and repair of such equipment. The beneficial impacts of an oil spill on socioeconomic resources include the ship building/repair industry that would experience short-term increases in demand for services and sales from oil-related boat damages.

6.10.3.2 Environmental Justice

Environmental justice populations might be disproportionately affected if a spill occurred in areas containing environmental justice populations (see Figure 4.10-2), particularly if oil were to wash ashore or if the spill resulted in commercial or tribal/subsistence fishing or aquaculture losses.

6.10.4 Impacts on Socioeconomics and Environmental Justice from a Refined Petroleum Product Spill

6.10.4.1 Socioeconomics

Impacts on socioeconomics from a spill of refined petroleum product are similar to those described above for a crude oil spill, but they would be less likely and less severe. Refined petroleum products persist for shorter duration in water and typically affect resources less than crude oil.

6.10.4.2 Environmental Justice

Impacts on environmental justice populations from a refined petroleum product spill are similar to those described above for a crude oil spill, but would be less likely and less severe. Refined petroleum products persist for shorter duration in water and typically affect resources less than crude oil.

6.10.5 Impacts on Socioeconomics and Environmental Justice from Oil Spill Cleanup

6.10.5.1 Socioeconomics

In general, the socioeconomic impacts of oil spill cleanup depend on the magnitude of the clean-up operation, including the number of non-local clean-up workers, the duration and location of their stay, and the type of clean-up activities conducted. If a cleanup is of a large magnitude, with extensive non-local response workers temporarily relocating to the study area, the local population could temporarily rise—with associated effects on the availability of short-term housing. Response workers entering communities might affect social cohesion, public services, traffic, and other local activities. Response workers could require temporary housing during their assignments, but most of this demand would likely be short term and a positive offset for local hotels/motels and other accommodations reliant on tourism.

Spill response would likely temporarily increase employment and wage opportunities, and state and local sales and use taxes in the study area, which could partially offset the negative impacts on the state and local economies from a spill event that were described previously. Non-local response workers would likely spend money at restaurants, retail establishments, and other businesses during their stay in shoreline communities.

6.10.5.2 Environmental Justice

Economic impacts on Native American populations from losses in commercial and tribal/subsistence fishing and other aquaculture activities might be partially offset by opportunities for employment and wages from clean-up activities in the open ocean and along the shoreline. Spill response vessels could inadvertently damage fish and aquaculture habitat in clean-up areas that are important for subsistence, but training prior to deployment would reduce the risk of such accidents. If response workers were required to enter tribal lands, or if clean-up crews encountered Native Americans in the open ocean or along shorelines, local cultures and attitudes could be temporarily affected. A spill response might also provide employment and wage opportunities for other environmental justice populations that could offset any economic losses from a spill.

6.11 Analysis of Alternatives

The purpose of this EIS is to examine the incremental environmental risk—principally from vessel traffic—related to operation of the North Wing. *Incremental environmental risk* is defined in this EIS as the change in environmental risk between operating the BP Cherry Point dock at maximum capacity with a single berth (the South Wing) and operating the dock with two berths (the North Wing and South Wing) at a level of utilization projected for the years 2025 and 2030.

The NEPA guidelines (40 CFR 1502.14) require that an EIS evaluate the Proposed Action, the No Action Alternative, and other reasonable alternatives to inform decision makers of the consequences of the agency's decision. To achieve the purpose of the EIS and to comply with NEPA guidelines, the alternatives considered have been aligned with the assessment of incremental environmental risk as evaluated in terms of vessel traffic calls at the BP Cherry Point dock combined with single-wing or two-wing operations (Table 6.11-1).

Table 6.11-1 Alignment of Alternatives and Dock Operational Configuration and Annual Vessel Calls

Alternative	BP Cherry Point Dock Operations	Annual Vessel Calls
No Action Alternative	Operation of the South Wing at maximum capacity	335
Proposed Action/ Alternative A	Operation of South and North Wings at low-range vessel traffic forecast	Less than or equal to 335
Proposed Action/ Alternative A	Operation of the South and North Wings at high-range vessel traffic forecast	335–420

The following alternatives are considered in this EIS:

- **Proposed Action.** Under the Proposed Action, BP would continue to operate the North and South Wings in their present configuration. The USACE would modify a DA permit for continued maintenance of the dock, with conditions including prohibiting the use of the North Wing for unloading or loading crude oil.
- **No Action Alternative.** Under the No Action Alternative, the current DA permit would be revoked and BP would be required to remove the North Wing facility.
- **Alternative A.** Alternative A would be identical to the Proposed Action except that the conditions on operations of the North Wing, including prohibiting unloading and loading crude oil would not be included.

More detailed descriptions of these alternatives are presented in Section 3.2.

The potential impacts of a spill of crude oil or refined petroleum product and associated clean-up actions are described in Sections 6.2 through 6.10 to provide context for the potential change in environmental risk from one-wing or two-wing operations and the variation in annual vessel calls, as described in Chapter 5.

6.11.1 Potential Impacts – Proposed Action

The Project is described in detail in Chapter 2. The Proposed Action would include a condition on the use of the North Wing for unloading crude oil. The North Wing of the Cherry Point dock could not be used for the purpose of loading or unloading crude oil.

Potential impacts from the Proposed Action on resources in the Project area are described in detail in Sections 6.2 through 6.10.

6.11.2 Potential Impacts – Alternative A

Potential impacts from Alternative A on resources in the Project area would be virtually the same as those identified for the Proposed Action. The North Wing is physically unable to unload and load crude oil because this wing was configured to load and unload only refined petroleum product. Unloading or loading crude oil at the North Wing would require modifications to the wing's existing piping, valving, and loading system. BP does not plan to make such modifications to the North Wing; however, if BP wishes to make modifications, it is required to submit a permit application to seek the USACE's approval for such changes. Therefore, no additional impacts on environmental resources are expected under Alternative A.

6.11.3 Potential Impacts – No Action Alternative

The No Action Alternative includes removal of the North Wing and the attendant construction-related impacts. Removal of the North Wing would result in longer vessel wait times and an elevated risk of spills from the additional transfers required with only one wing in operation. As described in Section 1.3.2, with single-wing dock operations, it was occasionally necessary to interrupt loading of refined petroleum product to allow unloading of crude oil, in order to maintain the supply of crude oil to the refinery. In these circumstances, the vessel loading refined petroleum product disconnected from the dock, moved offshore to an anchorage, and waited for completion of an intervening crude oil transfer before returning to the dock to resume loading. These interruptions increase the number of transfers (mooring and connecting, or unmooring and disconnecting), which increases the potential for small spills of hazardous materials. In addition, one-wing operations may increase vessel traffic maneuvering near the dock and increase vessel time at anchor.

Removal of the North Wing would eliminate associated maintenance activities at the North Wing, but these activities would continue at the South Wing. Impacts from maintenance activities are minor and are not expected to cause permanent adverse impacts on environmental resources (as described in Sections 6.2 through 6.10).

The GWU VTRA found that operation of a second wing reduced the potential for accidents, oil spills, and potential oil spill volume both at current and future traffic levels up to the maximum capacity of a single-wing dock—approximately 335 calls per year. Therefore, the No Action Alternative (which includes removal of the North Wing) would cause an increase in the probability of annual accident and oil spill potential. The consequences of oil spills on environmental resources are described in detail in Sections 6.2 through 6.10.

The following subsections describe the potential impacts on specific environmental resources from the No Action Alternative.

6.11.3.1 Nearshore and Marine Resources

Effects on nearshore and marine resources under the No Action Alternative from activities related to removal of the North Wing and continued operation as a single-wing dock would be limited to those resources present within the vicinity of the BP Cherry Point dock and are described below. An oil spill could affect resources throughout the study area, depending on the quantity and location of the spill. Because of the increase in potential frequency of accidents and associated oil spill under the No Action Alternative compared to the Proposed Action in some future scenarios, there would be an associated higher risk to nearshore and marine species from such a spill. Potential impacts from oil spills on nearshore and marine species, including federally and state-listed species, are described in Section 6.2.

Nearshore habitat in the vicinity of the BP Cherry Point dock provides refuge and prey base for many species occurring in the study area. Construction activity associated with dock removal would temporarily generate noise, increase human disturbance, and generate sediment in this area. Increased noise and human disturbance could temporarily displace fish, marine mammals, and avian species from the vicinity of the BP Cherry Point dock. Displacement of species from the dock area would diminish after work was completed, and displaced species would likely return to the area. A temporary increase in suspended sediment during removal of dock piles could increase turbidity and reduce productivity of the aquatic system, including ESA-listed species. Effects would be limited in load and duration, and are not expected to cause population-level effects. If the No Action Alternative is selected, the applicant could implement BMPs to offset effects on nearshore and marine resources from construction activities.

Removal of the dock support piles would result in a permanent loss of approximately 140,000 square feet of benthic substrate that has been colonized by aquatic organisms. Benthic habitat conditions and communities would regenerate after the piles were removed. Nearshore species assemblages associated with the support piles would experience a reduction in habitat; however, the newly available habitat would likely benefit nearshore and marine resources—although those effects are expected to be incremental and not measurable from the baseline.

Removal of the North Wing would not likely affect the risk of introducing aquatic invasive or nuisance species to the area because vessels calling at the BP Cherry Point dock would continue to comply with USCG regulations for ballast exchange and discharge.

Removal of the North Wing is expected to increase vessel wait times and associated mixing of the water column surface layers in the area immediately surrounding the vessel. Mixing of the two layers would result in the surface layer experiencing a decrease in temperature and neustonic community abundance, and an increase in salinity. It is unlikely that this would cause any meaningful change in surface waters relative to natural processes and disturbances that drive this very dynamic system. The increase in vessel wait times would be small and would occur within the CVTS, an area that is already disturbed. The critical habitat for bull trout, Chinook and chum salmon, juvenile canary rockfish, and southern resident killer whale that occurs in the vicinity of the BP Cherry Point dock could be affected by activities associated with dock removal. Effects on critical habitat from dock removal activities could include a decrease in prey population or habitat availability due to increased disturbance and turbidity. These effects would be limited in duration and are not expected to result in any long-term effect on critical habitat.

Under the No Action Alternative, there would be an associated higher risk of an oil spill in the study area in some future scenarios. Critical habitat that could be affected by a spill includes critical habitat for southern resident killer whale, leatherback turtle, bull trout, Chinook and chum salmon, green sturgeon, bocaccio rockfish, canary rockfish, and yelloweye rockfish. Effects from an oil spill on resources and critical habitats in the study area are described in Sections 6.2 and 6.3.

6.11.3.2 Nearshore and Marine Habitat

Removal of the dock's support piles would result in a loss of approximately 140,000 square feet of man-made benthic substrate. Removal would eliminate any lighting and minor shading effects on habitat in the vicinity of the dock. Permitting for removal likely would require restoration to pre-structure substrate conditions or other desired future conditions to enable regeneration of desired and sustainable ecological functions. Vegetated and non-vegetated benthic habitats as appropriate to site conditions are expected to regenerate over time.

Removal of the North Wing likely would result in increased vessel wait times and an associated increase in mixing water column surface layers in the area immediately surrounding the vessel path and wake. The increase would be small, however, and would occur within the CVTS, an area that is already disturbed.

Because of the increase in the potential frequency of accidents and associated oil spill under the No Action Alternative, there would be an associated higher risk to nearshore and marine habitat from such a spill. Potential impacts on nearshore and marine habitat from oil spills are described in Section 6.3.

6.11.3.3 Water Quality

Demolition of the North Wing would temporarily decrease water quality because of re-suspension of particulate materials and possible contamination by hazardous materials (e.g., diesel fuel, hydraulic fluid) from heavy machinery. These impacts would be temporary and would be minimized by implementing BMPs such as locating staging areas, refueling areas, and material and equipment storage areas away from the water.

The increase in the potential frequency of accidents and associated oil spill under the No Action Alternative, with associated impacts on water quality, is described in Section 6.4.

6.11.3.4 Cultural Resources

Under the No Action Alternative, the removal of structures in the water has the potential to affect archaeological sites along the shoreline and below the water surface in the vicinity of the dock. Impacts could occur through physical disturbance or by the introduction of contaminates that would alter the chemical composition of the sediment matrix comprising the archaeological sites. These impacts would be temporary and could be reduced with the use of screening, netting, and containment booms to restrict debris from falling into the water and implementation of other BMPs.

Indirect impacts from construction activities, including noise and vibration from construction equipment, also could affect historic resources, archaeological sites, and TCPs on the shoreline in the vicinity of the dock. These impacts would be temporary and could be minimized by implementation of BMPs.

Because of the increase in the potential frequency of accidents and associated oil spill under the No Action Alternative, there would be an associated higher risk on cultural resources from such a spill. Potential impacts on cultural resources from oil spills are described in Section 6.5.

6.11.3.5 Land Use

During dock removal, nearby residents may be temporarily affected by noise, road traffic, and heavy equipment use. However, this would be a short-term impact.

Because of the increase in the potential frequency of accidents and associated oil spill under the No Action Alternative, there would be an associated higher risk on land use from such a spill. Potential impacts on land use from oil spills are described in Section 6.6.

6.11.3.6 Recreation Resources

The No Action Alternative may result in potential short-term impacts on recreational fisherman and boaters during dock removal because of temporary exclusion from the construction area and construction noise. The small decrease in overall vessel traffic may reduce the necessity for recreation vessels to maneuver away from vessels to avoid interaction, which would be beneficial to boaters.

Because of the increase in the potential frequency of accidents and associated oil spill under the No Action Alternative, there would be an associated higher risk to recreation resources from such a spill. Potential impacts on recreation resources from oil spills are described in Section 6.7.

6.11.3.7 Air Quality and Climate Change

Removal of the dock's support piles would require the use of heavy machinery and work boats, which would cause some temporary increases in emissions, including GHGs. However, the impact would be short term and is not expected to cause air quality in any portion of the study area to violate the NAAQS or the WAAQS.

Single-berth operations could increase the number of transfers (mooring and connecting, or disconnecting and unmooring) at the BP Cherry Point dock, vessel traffic maneuvering near the BP Cherry Point dock, and vessel queuing time at anchor. This could result in increased air pollutant emissions (including GHG emissions) associated with burning marine diesel fuel in order to transfer at the BP Cherry Point dock and to restart engines after delays due to inadequate berthing space. Conversely, annual maintenance of dock equipment at the North Wing would be eliminated, which would eliminate minor emissions from workboats—although these emissions would still occur from maintenance activities at the South Wing.

Because of the increase in the potential frequency of accidents and associated oil spill under the No Action Alternative, there would be an associated higher risk to air quality and climate change from such a spill. Potential impacts on air quality and climate change from oil spills are described in Section 6.8.

6.11.3.8 Tribal/Subsistence Fishing

Demolition of the North Wing would result in disturbance of benthic habitat in the area and suspension of sediment. This would be localized and may cause temporary impacts on subsistence fishing resources in the area adjacent to the North Wing. Potential spills of hazardous materials (e.g., diesel fuel, hydraulic fluid) may occur from heavy machinery during demolition or from increases in transfer operations from single-wing operations. These would also be localized and temporary, and are not expected to affect subsistence fishing resources.

Because of the increase in the potential frequency of accidents and associated oil spill under the No Action Alternative, there would be an associated higher risk to subsistence fishing from such a spill. Potential impacts on tribal/subsistence fishing from oil spills are described in Section 6.9.

6.11.3.9 Socioeconomics and Environmental Justice

Dock removal likely would create short-term jobs that could generate local and non-local spending, and minor state and local sales and use taxes. During dock removal, nearby residents might be temporarily affected by noise, road traffic, and heavy equipment use.

In the census block groups located immediately north and south of the BP Cherry Point dock, disproportionate minority populations of Native Americans live near the Lummi Reservation, but no low-income populations are present. Potential short-term impacts on environmental justice populations may include temporary exclusion from the construction area and impacts from construction noise.

Because of the increase in the potential frequency of accidents and associated oil spill under the No Action Alternative, there would be an associated higher risk to socioeconomics and environmental justice populations from such a spill. Potential impacts on socioeconomics and environmental justice populations from oil spills are described in Section 6.10.

6.11.3.10 Soils and Geological Resources

Under the No Action Alternative, the removal of structures in the water has the potential to affect soils and geological features along the shoreline and below the water surface in the vicinity of the dock. The physical removal of dock pilings would temporarily disturb sediments and create additional benthic habitat in the area previously occupied by the dock's support piles, which would be a permanent impact. These areas would likely be colonized by benthic organisms after re-suspended sediments settled.

Potential spills of hazardous materials (e.g., diesel fuel, hydraulic fluid) may occur from heavy machinery during demolition, or from increases in transfer operations from single-wing operations. These spills would be localized and are not expected to affect sediments in the immediate area.

6.11.3.11 Aesthetic Resources

Under the No Action Alternative, the removal of structures in the water has the potential to ultimately improve aesthetic resources by removing part of the dock and associated vessels from the shoreline line of sight. The demolition process would cause negative visual impacts from the presence of temporary pilings of waste materials and increased heavy machinery traffic in the area. These impacts would be temporary and could be minimized by implementation of BMPs such as storing construction materials and waste away from the water.

Single-wing operations would result in longer vessel wait times and increased transfers, which may be viewed from marinas, parks, and public water access sites in the Project area. However, these vessels would not appreciably affect the overall water aesthetics as viewed from the shoreline.

6.11.3.12 Public Health

The demolition process for removing the North Wing would generate noise and vibration that could be experienced by local residents. This may be more of an annoyance than a public health issue. The presence of waste materials such as concrete or wood debris could cause injury if not secured. Implementation of BMPs, such as securing waste materials and heavy machinery and putting up signs to exclude the public from such areas, would reduce the potential for public health impacts.

Potential spills of hazardous materials (e.g., diesel fuel, hydraulic fluid) may occur from heavy machinery during demolition, or from increases in transfer operations from single-wing operations. These spills would be localized and are not expected to affect public health.

6.11.4 Summary of Impacts

Sections 6.2 through 6.10 discuss the impacts of the Proposed Action on specific environmental resources; and this alternatives summary discusses the impacts of the Proposed Action, Alternative A, and the No Action Alternative on environmental resources in the Project area. Table 6.11-2 provides a summary of these impacts.

Table 6.11-2 Potential Impacts on Resources in the Project Area from the Proposed Action, Alternative A, and the No Action Alternative

Resource Area	Proposed Action and Alternative A		No Action Alternative
	Incremental Impacts from Operations at the North Wing	Incremental Impacts from Changes in Vessel Traffic	Impacts from Removal of the North Wing
Nearshore and marine resources	Hazardous material spills at the BP Cherry Point dock are not expected to occur in sufficient magnitude or frequency to adversely affect nearshore and marine resources, including federally and state-listed species. Aquatic invasive or nuisance species could be introduced through ballast water discharge; however, the risk of introduction would be minimized by compliance with U.S. Coast Guard and State regulations. BP provides reception facilities for the discharge of cargo tank ballast. Maintenance activities would be limited in duration and magnitude, and are not expected to adversely affect nearshore or marine resources. Temporary effects on fish could result from lighting during loading.	Vessel collisions with marine mammals could occur; however, marine mammals generally detect and move away from vessels. Changes in vessel traffic would not significantly alter existing background noise levels. Birds and fish are likely to move out of the area when vessels are present, resulting in minimal impacts. Entrainment of eggs and larvae suspended in the water column would increase as vessel traffic increases; however, fish in the study area are not likely to be adversely affected. Changes in vessel traffic would not likely adversely affect federally and state-listed species	Increased noise and human disturbance could temporally displace fish, marine mammals, and avian species from the vicinity of the BP Cherry Point dock. Removal of the North Wing would result in the loss of approximately 140,000 square feet of man-made benthic substrate that has been colonized by aquatic organisms. Regeneration of natural benthic habitats, with associated benefit to aquatic species, is expected. A temporary increase in suspended sediment during removal of the piles would occur in the vicinity of the dock and may temporarily affect critical habitat for ESA-listed species through decreases in prey population or habitat availability from increased disturbance and turbidity.
Nearshore and marine habitat	Aquatic invasive or nuisance species could be introduced through ballast water discharge; however, the risk of introduction would be minimized by compliance with U.S. Coast Guard and State regulations. BP provides reception facilities for the discharge of cargo tank ballast. Temporary effects on nearshore habitat could result from lighting during loading. Accidental releases of small quantities of hazardous materials may occur, but in such small quantities that they are not likely to affect marine resources.	The water column would experience increased turbulent mixing of the surface layers in the area immediately surrounding the vessel path and wake. However, vessels would stay within the Cooperative Vessel Traffic System, an area that is already disturbed by existing vessel traffic.	Removal of the North Wing would eliminate any lighting and minor shading effects on habitat in the vicinity of the dock. Removal of the North Wing would result in the loss of approximately 140,000 square feet of man-made benthic substrate that has been colonized by aquatic organisms. Regeneration of natural benthic habitats with associated benefit to aquatic species is expected to occur.

Table 6.11-2 Potential Impacts on Resources in the Project Area from the Proposed Action, Alternative A, and the No Action Alternative (Continued)

	Proposed Action and Alternative A		No Action Alternative
Resource Area	Incremental Impacts from Operations at the North Wing	Incremental Impacts from Changes in Vessel Traffic	Impacts from Removal of the North Wing
Water quality	Accidental temporary releases of small quantities of hazardous materials may occur, but in such small quantities that they are not likely to contribute to a reduction in water quality at the North Wing.	Water quality is not expected to change as a result of changes in vessel traffic.	Removal of the North Wing could result in temporary decreases in water quality from re-suspension of particulate materials and possible contamination from hazardous materials.
Cultural resources	Spills and releases currently do not occur in sufficient volume or frequency to adversely affect archaeological sites and historic resources near the North Wing.	Cultural resources are not expected to be affected by a change in the number of calling vessels.	Removal of the North Wing could cause physical disturbance or introduction of contaminants, altering the chemical composition of the sediment matrix comprising archaeological sites. Indirect impacts from construction activities, including noise and vibration from construction equipment, could temporarily affect historic resources, archaeological sites, and traditional cultural properties on the shoreline in the vicinity of the dock.
Land use	Continued operations at the North Wing are not expected to affect land use in the study area.	A change in the number of vessels is not expected to affect land use in the study area.	Nearby residents may be temporarily affected by noise, road traffic, and heavy equipment use during dock removal.
Recreation resources	Continued operations at the North Wing are not expected to affect recreation resources in the study area.	Increased interactions between recreationists and vessels may occur with an increase in vessels; changes in behavior of wildlife may affect wildlife watching opportunities.	Potential short-term impacts on recreational fisherman and boaters during dock removal because of temporary exclusion from the construction area and construction noise.
Air quality and climate change	Decreasing vessels in the area by limiting queuing and waiting at anchor would reduce emissions (including greenhouse gases [GHGs]). Newer Category 3 engines would emit less NO_X, SO_2, and $PM_{2.5}$. U.S. Environmental Protection Agency standards for newly built Category 3 marine diesel engines apply beginning in 2011, and long-term standards will begin in 2016.	Combustion of marine fuel would result in the release of GHGs, including CO_2, CH_4, and N_2O. Air emissions are not expected to increase because of the overall lower emission rates associated with new standards for Category 3 marine diesel engines. No portion of the study area is likely to violate the national ambient air quality standards or the Washington ambient air quality standards.	Heavy machinery and work boats would cause some temporary increase in emissions, including GHGs.

Table 6.11-2 Potential Impacts on Resources in the Project Area from the Proposed Action, Alternative A, and the No Action Alternative (Continued)

	Proposed Action and Alternative A		No Action Alternative
Resource Area	Incremental Impacts from Operations at the North Wing	Incremental Impacts from Changes in Vessel Traffic	Impacts from Removal of the North Wing
Tribal/subsistence fishing	Continued operations at the North Wing are not expected to change existing effects on subsistence fishing in the study area.	The presence of deep draft vessels could interrupt troll vessel and gillnet fishing; crab and shrimp pots placed in transit lanes and maneuvering areas could be damaged.	Disturbance of man-made benthic habitat and temporary suspension of sediment may cause temporary impacts on subsistence fishing resources in the area adjacent to the North Wing.
Socioeconomics and environmental justice	Minor potential increase in employment and income from increased dock operations. No impacts on environmental justice populations are expected.	Changes in vessel traffic may cause minor to negligible impacts on coastal residents and in-water and nearshore activities, such as commercial vessel traffic, aquaculture, fishing, boating, and beach recreation. An increase in sales and taxes is possible if the number of vessels sold and registered in the State of Washington increases. Minor and limited potential impacts on environmental justice populations related to in-water activities such as fishing and boating may occur.	Dock removal could create short-term jobs that could generate local and non-local spending, and minor state and local sales and use taxes.

6.11.5 Comparison of Alternatives – Incremental Environmental Risk

Table 6.11.3 compares the No Action Alternative to the Proposed Action and Alternative A. The incremental environmental risk of the Proposed Action and Alternative A associated with two ranges of annual vessel calls are summarized below.

- **Proposed Action/Alternative A – Less Than or Equal to 335 Annual Vessel Calls.** The GWU VTRA (van Dorp et al. 2008) found that operation of a second wing reduces the potential for accidents, oil spill, and potential oil spill volume both at current and future traffic levels (up to the maximum capacity of a single-wing dock—approximately 335 calls per year). Thus, the incremental effect on environmental resources is likely to be decreased with operation of the North Wing.
- **Proposed Action/Alternative A – between 335 and 420 Annual Vessel Calls.** The TGA VTA (TGA 2013) found a potential for an increase in accidents and oil spills irrespective of the dock configuration at future traffic levels at the high-range forecast for operation of the BP Cherry Point dock (420 calls per year). The potential increase in accidents and spills was greater at 420 vessel calls than at 335 vessel calls.

As discussed in Section 5.6, the number of future tanker and barge calls is uncertain, but vessel calls are more likely to continue in BP's current conditions forecast (mid-range) or possibly low-range forecast rather than increase to 420 calls per year. Therefore, the likelihood of any increase in spill frequency or volume would be reduced with operation of the North Wing under the low-range or medium-range traffic forecast scenarios. Should the number of vessel calls increase to the annual maximum of 420 calls, the potential frequency of accidents and spills may be slightly increased.

Table 6.11-3 Comparison of Alternatives to the No Action Alternative

Alternative	BP Cherry Point Dock	Annual Vessel Calls	Compared to No Action Alternative
No Action Alternative	Operation of the South Wing at maximum capacity	335	Not applicable
Proposed Action/ Alternative A	Operation of the South and North Wings at low-range vessel traffic forecast	Less than or equal to 335	Potential frequency of accident and spill is reduced
Proposed Action/ Alternative A	Operation of the South and North Wings at high-range vessel traffic forecast	335–420	Potential frequency of accident and spill may be slightly increased

Potential impacts on resources in the study area under Alternative A would be the same as those identified for the Proposed Action.

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6.12 Cumulative Effects

Although the maximum potential increase in traffic calling at the BP Cherry Point dock may be up to 85 vessels, NEPA requires that the cumulative effect of this increase and other increases in vessel traffic that may occur in the future be considered in a cumulative effects analysis. *Cumulative effects* are defined as the impact on the environment that results from the incremental impact of an action (in this case, the Proposed Action) when added to the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes the actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

The purpose of a cumulative effects analysis is to alert decision makers to potential effects that, although not significant from the Proposed Action alone, could become significant if combined with the development of other projects or the continued or future implementation of plans and programs. By alerting decision makers to the potential for future significant effects, actions can be taken to respond to the potential for such effects.

The identification of reasonably foreseeable future actions and trends involves some uncertainty, as does the assessment of the potential level of effects now and in the future. The cumulative effects analysis is designed to identify the range of potential cumulative effects, recognizing that uncertainty.

6.12.1 Methodology

Because the focus of this EIS is comparison of the operation of the BP Cherry Point dock with one wing versus two wings and the potential for increased accidents and spills resulting from such operations, the cumulative effects analysis focuses on projects, plans, or programs with the potential to change deep draft vessel traffic transiting through Puget Sound that may interact with traffic calling at the BP Cherry Point dock.

The analysis of cumulative effects involved a series of steps, beginning with defining the spatial (geographic) and temporal (time) boundaries appropriate for analysis of the environmental issue or resource. The geographic and temporal scope of this analysis is described in Section 6.12.2. Next, past and present actions were identified. Northern Economics, Inc. (NEI) (2013) forecasted the future volume of baseline traffic in the study area, which represents an increase in traffic (without the addition of major proposed projects) and is described in Section 6.12.4. Finally, reasonably foreseeable future actions that could cause a cumulative direct or indirect effect on issues or resources of concern were identified. A review of the main ports in the region—Ports of Seattle, Everett, Tacoma, and Olympia—was undertaken to identify any future potential projects. No additional projects were identified from this review. A forecast from NEI was used to identify other projects in the area with potential cumulative effects when added to those of the Proposed Action. The NEI project team conducted interviews with project stakeholders to assess regional activity that could change historical vessel traffic volumes or patterns. The study team conducted interviews with local ports, shipping companies, refineries, and small boat harbors. The results of this research identified four potential events that could significantly change projected tanker and tug vessel traffic volumes in the future. These are:

- Oil production from the Alaska North Slope with substantial volumes by 2016;
- Expansion of Kinder Morgan's Transmountain pipeline to export oil to Asia by 2016;
- Oil production from the Alaska Outer Continental Shelf beginning in 2024; and
- Bulk carrier and tug traffic calling at the Gateway Pacific Terminal by 2030.

In addition to the projects identified by NEI, BP is in the process of constructing facilities for unloading unit trains that would transfer crude oil to the BP Refinery. With regard to plans and programs in the area, WSDNR published the Cherry Point Aquatic Reserve Management Plan in November 2010 (WSDNR 2010). The analyses of these projects and the plan are described in Section 6.12.5.

6.12.2 Geographic and Temporal Scope

6.12.2.1 Geographic Scope

The Project area for the Proposed Action is described in Chapter 2, and the study areas for the environmental resources analyzed are specified within the respective discussions in Chapter 4. The cumulative effects study area includes the entire Puget Sound region, including ports in the Strait of Georgia such as Vancouver, British Columbia because projects identified in this area may contribute additional vessels to those analyzed for the Proposed Action.

6.12.2.2 Temporal Scope

The temporal scope of the cumulative effects analysis is projected to 2030. A study carried out by NEI (2013) as part of the TGA VTA study (attached as Appendix D) forecasted future traffic in the year 2030 and represents the best available data with which to assess cumulative effects.

6.12.3 Past and Present Actions

NEI (2013) forecasted the future volume of baseline traffic in the study area without the addition of major proposed projects. Traffic in the baseline vessel traffic projection for 2010 included tank barges and bulker, cargo, and “other” vessels—tugs, passenger vessels, fishing vessels, and Port Metro Vancouver (Canadian) vessels. In 2030, tanker and tank barge traffic in the study area is expected to experience a slight decrease, while bulker, cargo, and other traffic is expected to increase. Bulker traffic increase would occur primarily in Juan de Fuca West, Juan de Fuca East, Guemes Channel, and Saddlebag. An increase in cargo ship traffic would primarily occur in Juan de Fuca West and Juan de Fuca East. Large fishing vessels are expected to decline while tugs and passenger vessels are expected to increase, which indicates an overall increase in “other” vessel traffic.

The Cherry Point Aquatic Reserve is located close to the BP Cherry Point dock and therefore is included in this cumulative effects discussion.

6.12.4 Reasonably Foreseeable Future Actions

Reasonably foreseeable future actions include those federal and non-federal activities not yet undertaken but likely to occur. Federal and non-federal activities that must be taken into account in the analysis of cumulative effects under NEPA include, but are not limited to, activities for which there are existing decisions, funding, or proposals. Reasonably foreseeable future actions do not include those actions that are highly speculative or indefinite. The events that could significantly change projected tanker and tug vessel traffic volumes in the future were identified and are described in the subsections that follow.

6.12.4.1 Alaska North Slope Shale Oil Production

The State of Alaska has leased more than one-half million acres of land to exploration companies for further development. A USGS report released in February 2012 assessing the Alaska North Slope’s shale rock resources estimated that up to 2 billion bbl of oil and 80 trillion cubic feet of gas are technically recoverable in the region (Eilperin 2012 as cited in NEI 2013).

Production from the Alaska North Slope is estimated at 190,000 bbl of oil per day. It is estimated that this would add approximately one additional tanker every 5 days, or 73 additional tankers in 2030 (NEI 2013) into the cumulative effects study area.

6.12.4.2 Kinder Morgan Pipeline

Kinder Morgan operates a pipeline system that ships Canadian crude oil via the Transmountain Pipeline from the oil sands area in Alberta to the Port of Vancouver, British Columbia. Kinder Morgan proposes to expand the Edmonton-to-Burnaby, Canada segment of this pipeline, thereby increasing the pipeline's capacity for crude oil deliveries by 550,000 bbl a day (Hamilton 2012 as cited in NEI 2013). Kinder Morgan further proposes to expand its terminal capacity at Port Metro Vancouver to increase exports of crude oil by tanker. The pipeline expansion and terminal modifications are forecasted to be operational in 2017. This expansion would increase tanker vessel traffic by approximately 348 additional tankers per year (29 tankers per month) (NEI 2013). These tankers would most likely transit to and from Port Metro Vancouver through Haro Strait and Boundary Pass in the study area.

6.12.4.3 Alaska Outer Continental Shelf Oil Production

As oil production in the existing fields of the Alaska North Slope continues to decline, plans to develop Alaska Outer Continental Shelf (OCS) resources have been announced by several oil companies. The Alaska OCS, under the Beaufort and Chukchi Seas, is believed to contain a large undiscovered amount of oil and natural gas. It has been estimated that this area contains 27 billion bbl of oil and 122 trillion cubic feet of natural gas, which is greater than the combined current estimates for the Atlantic and Pacific OCSs. Since 2005, the federal government has held several Alaska OCS lease sales; approximately 30 exploration wells have been drilled in the Beaufort Sea and five in the Chukchi Sea (NEI 2013).

Future production from the Alaska OCS is estimated at 300,000 bbl of oil per day that would be delivered to Puget Sound area refineries. It is estimated that this would increase tanker traffic into Puget Sound in 2030 by approximately 112 additional tankers per year (one additional tanker every 3.25 days) (NEI 2013).

6.12.4.4 Gateway Pacific Terminal

The GPT proposed at Cherry Point is a multi-commodity, dry bulk, cargo-handling facility adjacent to the BP Cherry Point Refinery. This terminal would include both deep draft bulk cargo vessel traffic and tug traffic in the vicinity of the BP Cherry Point dock. The GPT is projected to be operational in 2016. It is estimated that the project would increase bulk vessel traffic in 2030 by 487 vessels per year. These vessels would likely transit into Puget Sound and to the GPT site via Rosario Strait. In some instances, some traffic could take the Haro Strait/Boundary Pass route.

6.12.4.5 BP Rail Logistics Facility

BP recently constructed a Rail Logistics Facility (RLF), and operation of the facility began on December 26, 2013. The RLF is designed to receive and unload crude oil and other feedstock transported by rail for processing at the BP Cherry Point Refinery. The RLF has been constructed to process up to one unit train per day (on average), with each train having a capacity of approximately 60,000–75,000 bbl of crude oil. BP states that it has no plans to use the RLF to receive crude oil for export from the BP Cherry Point dock (BP 2014a) and the refinery would have to expand its crude oil storage capacity to accommodate an export operation (BP 2014b).

Operation of the RLF will allow BP to access crude oil sources from the Midwestern United States and further diversify the available sources of refinery feedstock. Use of the RLF to deliver crude oil to the refinery may displace crude oil deliveries by pipeline and/or ship. If all potential crude oil delivery by rail at the RLF (at a current presumed maximum average of 75,000 bbl per day, as noted above) displaced marine crude oil deliveries, it is possible that the number of crude oil tanker calls at the BP Cherry Point dock could be reduced by up to 46–58 vessel calls annually (assuming daily rail deliveries and depending on the average tanker crude oil cargo size that is displaced). It should be noted that use of the RLF for receipt of domestically sourced refinery feedstock would depend on market conditions (price and availability) that are unpredictable. While it is reasonable to assume that a portion of the current tanker delivery of crude would be displaced by rail deliveries, it is speculative to forecast the amount that would actually occur.

6.12.5 Cherry Point Aquatic Reserve

The WSDNR published the Cherry Point Aquatic Reserve Management Plan in November 2010 (WSDNR 2010). A number of species and habitats at the reserve have experienced declines over the past 40 years. For example, the Cherry Point herring stock has shrunk from approximately 15,000 tons to between 800 and 2,100 tons over the last 10 years. Other key species in decline include Puget Sound Chinook salmon; bull trout; and certain species of rockfish, surf scoter, and southern resident killer whales. The plan includes actions related to protection, enhancement, and restoration of marine resources as well as allowed and prohibited uses within the Reserve. The North Wing of the BP Cherry Point dock was constructed prior to implementation of the plan, and the plan states that the existing industrial uses at Cherry Point do not conflict with aquatic reserve status (WSDNR 2010). The Proposed Action therefore is not expected to cumulatively affect the Cherry Point Aquatic Reserve. The management plan for the reserve will be reviewed and updated at least every 10 years.

6.12.6 Results of Cumulative Effects Analysis

The change in future environmental risk with operation of two wings and new traffic generated by future cumulative projects was analyzed in the TGA VTA study (see Section 5.7.5.1). The cumulative projects considered included expansion of Kinder Morgan terminal facilities in Vancouver, additional Alaskan tanker traffic port facilities, other facilities in the Vancouver area, and the GPT at Cherry Point. The analysis assumed that all identified projects would proceed and become operational by 2030. However, these projects would not all begin operations at the same time, thus whatever cumulative impacts occur, they would not be concurrent. These cumulative impacts would occur irrespective of vessel traffic calling at the BP Cherry Point dock.

The TGA VTA Case 5 (2030 with both wings – general traffic only) was compared to the TGA VTA Case 7 (2030 with both wings – general traffic plus cumulative traffic); the results are shown in Table 5-34. The results of the comparison show that the addition of cumulative projects in the region would likely increase the number of incidents and spills by approximately 34 percent. They also would increase the size of the 50^{th}-percentile spill volume by 101 percent and the 95^{th}-percentile spill volume by 65 percent. These increases would be irrespective of any changes in risk resulting from traffic calling at the BP Cherry Point dock.

6.13 Relationship between Local Short-Term Uses of Man's Environment and Maintenance and Enhancement of Long-Term Productivity

NEPA regulations (40 CFR 1502.16) require that an EIS consider the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity—that is, whether the Proposed Action or alternatives would result in short-term environmental effects (adverse or beneficial) to the detriment of achieving or maximizing the productivity of these resources. Short-term uses of the environment may include consumption of non-renewable resources or commitment of resources to a specific use. Long-term productivity may be considered the continued sustainability of the resource.

6.13.1 Proposed Action

The Proposed Action continues operation of the BP Cherry Point dock in the same manner as it is currently being operated, including utilization of both the North and South Wings. Resources directly consumed in these operations consist primarily of electrical energy for operation of pumps and equipment used in loading and unloading liquid cargos. Operations also include consumption of distillate fuels to operate vehicles and vessel machinery, and use of lubricants and solvents. Limited amounts of paint, cleaning materials, and construction materials would be used during routine dock operations and maintenance. Operation of internal combustion engines (such as ships engines) use air and water resources for combustion and cooling.

To the extent that electrical energy supplied for dock operations are fossil fueled, consumption of non-renewable resources would occur and would affect the long-term productivity of these resources. However, some portion of the Pacific Northwest electrical energy supply is known to be generated by non-fossil resources, including wind and hydroelectric, and therefore is not resource consumptive.

Continued operation of the BP Cherry Point dock under the Proposed Action is not expected to affect the long-term productivity of environmental resources because potential effects on these resources have been found to be minimal, or resources have been determined to not be affected by the Proposed Action (as discussed in earlier sections of this chapter).

6.13.2 Alternative A

Operations of the BP Cherry Point dock under Alternative A would be the same as those for the Proposed Action, except that crude oil could be transferred at either or both wings of the BP Cherry Point. Because this alternative would not change the amounts of crude oil or refined petroleum product that would be transported across the BP Cherry Point dock and would not change the number of vessels calling at the dock, the impacts would be the same as those described for the Proposed Action (Section 6.11). Therefore, the effects of short-term use of resources on long-term productivity under Alternative A would be the same as those for the Proposed Action.

6.13.3 No Action Alternative

The No Action Alternative would result in removal of the North Wing of the BP Cherry Point dock. This would require the use of workboats, barges, and tugs that would consume fuel while in operation. Removal of the North Wing would result in a loss of approximately 140,000 square feet of benthic substrate that has been colonized by aquatic organisms. Over time, the area would be restored to a productive state. The extent of this short-term loss and eventual recovery of habitat within the context of the overall benthic habitat available in the Cherry Point area would be minimal.

Implementation of the No Action Alternative would not substantially change the overall operations of the BP Cherry Point dock, other than longer vessel wait times which would require consumption of fuel to power the vessels. The additional fuel consumption would be minor and would not substantially change the use or commitment of resources. Therefore, the effect on the long-term productivity of resources under the No Action Alternative would be approximately the same as under the Proposed Action and Alternative A.

6.14 Irretrievable and Irreversible Commitment of Resources with Implementation of the Proposed Action

Regulations in 40 CFR 1502.16 require that an EIS must identify, consider, and disclose any irreversible and irretrievable commitments of resources that would occur with implementation of the Proposed Action. Irreversible and irretrievable resource commitments are related to the use of non-renewable resources and the potential effects of such uses on future generations. *Irreversible* effects result primarily from use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable time frame. *Irretrievable* resource commitments involve the loss in value of an affected resource that cannot be restored (e.g., extinction of a species listed as threatened or endangered, or disturbance of a cultural resource).

The Proposed Action continues operation of the BP Cherry Point dock in the same manner as it is currently being operated, including utilization of both the North and South Wings. Resources consumed in these operations consist primarily of electrical energy for operation of pumps and equipment used in loading and unloading liquid cargos. The consumption of electrical energy represents consumption of non-renewable resources, except to the extent that renewable energy sources are used. It also includes consumption of distillate fuels to operate vehicles and vessel machinery. Lubricant and solvents would be used in operations. Limited amounts of paint, cleaning materials, and construction materials would be used during routine operations and maintenance. The consumption of fuels, lubricants, solvents, and maintenance materials would constitute an irretrievable and irreversible commitment of resources.

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6.15 Adverse Environmental Impacts That Cannot Be Avoided if the Proposed Action Is Implemented

Regulations in 40 CFR 1502.1 and 1502.16 require disclosure of significant environmental issues that cannot be avoided after implementation of mitigation measures. As described in earlier sections of the chapter, continued normal operations of the North Wing under the Proposed Action would not cause significant impacts on any environmental resource. Should a crude oil or refined petroleum product spill occur, impacts on resources—especially marine resources—could occur on a wide scale, depending on the size of the spill, its location, and the success of spill response measures. As discussed in Chapter 5, inadvertent oil spills are extremely unlikely to occur as the result of vessel operations or from loading and unloading at the BP Cherry Point dock.

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7 MITIGATION

7.1 INTRODUCTION

NEPA requires that impacts on the environment from the proposed action be avoided, minimized, or mitigated. At issue in this EIS are the incremental impacts from operation of the North Wing of the BP Cherry Point dock making two berths available for operation rather than one. The impact analysis shows that:

- Risk of incident and spill is decreased with operation of the North Wing under current and future projected operations under existing market conditions (up to approximately 335 vessel calls per year (see Section 2.3).
- In the range of 335 to 420 calls, the risk of accident and spill is increased modestly. In this case:
    1. Most likely type of accident – allisions
    2. Type of accident with greatest oil outflow – grounding

Under two of the three future scenarios forecasted by BP, annual calls would be below or approximately at 335 calls per year; thus, operation of the North Wing is in and of itself a risk minimization measure. Further, these two scenarios, rather than the higher forecast scenario, are more likely to occur due to changes in the amount of crude oil transported by rail and pipeline from increased availability of product from the Bakken and Alberta Tar Sands regions.

Although operation of the North Wing generally reduces risk of accident and oil spill, the addition of other future projects that will increase deep draft traffic in Puget Sound may increase risk. In the cumulative effects analysis, projects under development include expansion of Kinder Morgan terminal facilities in Vancouver, other facilities in the Vancouver area, and the GPT at Cherry Point. The analysis assumed that all identified projects would proceed and become operational by 2030. However, these projects would not all begin operations at the same time, thus whatever cumulative impacts occur, they would not be concurrent. These cumulative impacts would occur irrespective of vessel traffic calling at the BP Cherry Point dock. The addition of this “cumulative” traffic could increase potential risk of accident and oil spill by up to 34 percent. These increases would be irrespective of any changes in risk resulting from traffic calling at the BP Cherry Point dock.

The risk of accident and oil spill from vessel traffic moving throughout the Puget Sound region is currently subject to a number of risk avoidance, risk minimization, and risk mitigation measures. These measures have been in place in some cases for a number of years and have proved effective in reducing the number of incidents, accidents, and spills in Puget Sound.

Risk mitigation typically starts with examination of the entire risk sequence, starting with the design and operation of the vessel and proceeding through the planning for, equipment pre-positioning, and cleanup of any spills. The two primary aspects of the system of risk mitigation that are most relevant to BP operations in Puget Sound are current measures to avoid and minimize accidents and oil spills, and to respond to spills if and when they occur.

7.2 CURRENT RISK AVOIDANCE AND MINIMIZATION

The following sections discuss programs, regulations, and operating systems designed (1) to limit the opportunity for incidents between vessels to occur; (2) to reduce the opportunity for allisions and groundings to occur; (3) in the case where a collision, allision, or grounding occurs, to minimize the potential for the release of cargos (including petroleum cargo) and fuel; and (4) to prepare for, respond to, and cleanup accidental releases.

7.2.1 Vessel Certification

All commercial vessels entering Puget Sound must meet certain minimum standards for design, construction, and operation as required by federal statute (46 USC §3303). This inspection and certification process verifies that a vessel meets the structural and equipment requirements for the intended service, such as transporting liquid bulk cargos. A vessel must be inspected by the USCG at 5-year intervals to receive its Certificate of Inspection. The inspection requirements apply to foreign and domestic flag vessels.

7.2.2 Oil Pollution Act 1990 – Vessel Configuration and Operation

Federal legislation adopted in 1990, the Oil Pollution Act (OPA 90) instituted requirements for equipment, training, and financial liability to owners for operation of vessels carrying petroleum cargos. These requirements include:

- By 2010, all vessels carrying crude oil or refined product must be double hulled. Therefore, all cargo vessels currently calling or that will call in the future at the BP Cherry Point dock will be double hulled. Double hulling has the effect of reducing the risk of oil outflow should a vessel be involved in a collision, allision, or grounding.
- Operators of vessels carrying petroleum cargos in the Puget Sound region must have an oil spill contingency and response plan on board the vessel; and the vessel must be operated by crew who are trained in, and practice, oil spill response.
- Operators of vessels carrying petroleum cargos and the owner of petroleum cargos are held strictly liable for any damage and the cleanup of material spilled. This strict liability requirement includes requiring the companies to maintain adequate financial resources (including insurance) to respond to a potential oil spill regardless of fault. Placement of financial responsibility on the vessel and cargo owner is intended to create significant financial incentives for compliance with all required and any self-imposed risk mitigation measures that are available.

7.2.3 Limitation of Vessel Size

In 1975, the State of Washington's legislature adopted RCW 8.16.190, which limited tankers greater than 125,000 dwt from entering Puget Sound. This statute was invalidated and was subsequently replaced by USCG regulations that established the same prohibition but at the federal level. USCG regulations limit certain vessels in Puget Sound as follows:

- 33 CFR 165.1303 prohibits the transit of "oil tankers" carrying a petroleum cargo (crude oil or refined petroleum product) of greater than 125,000 dwt easterly of a line from New Dungeness Light (located on Dungeness Spit) to Discovery Island (located off of the city of Victoria on the southeastern shore of Vancouver Island). This regulation effectively prohibits tankers greater than 125,000 dwt from transiting to any of the refineries or terminals located in the U.S. waters of the greater Puget Sound.

- U.S. flagged tank vessels of greater than 125,000 dwt may enter Puget Sound and transit past the line described above only if an additional load line has been established on the vessel's hull indicating the waterline with a loaded cargo of up to 125,000 dwt (33 CFR 165.1303).

These regulations effectively limit petroleum cargos in Puget Sound to 125,000 dwt. The cargo capacities of the larger very large crude carrier (VLCC) often used in world trade range from 160,000 to 319,000 dwt. The cargo capacity of the ultra large crude carrier (ULCC) ranges from 160,000 to 549,999 dwt. These carriers do not call in Puget Sound.

7.2.4 Pilotage

Both U.S. and Canadian regulations require that a certified pilot be on board all commercial deep draft vessels during all transits in U.S. and Canadian waters in the greater Puget Sound and Strait of Georgia. In U.S. waters, pilots are certified by the State of Washington and the USCG, and belong to Puget Sound Pilots. In Canadian waters, pilots are certified through the Pacific Pilotage Authority and are employed through British Columbia Coast Pilots, Ltd. Trained pilots embark and disembark inbound and outbound vessels at the Port Angeles and Victoria pilot stations, respectively. Except under certain circumstances, a single pilot is assigned to each vessel. Beginning in October 2013, two pilots are now required for all bulk liquid tanker vessels greater than 40,000 dwt in Boundary Pass and Haro Strait transiting to and from Canadian ports.

7.2.5 USCG Captain of the Port Authority

Regulations in 33 CFR 6 grant the Captain of the Port exceptionally broad and comprehensive authorities to protect and secure vessels, harbors, and waterfront facilities in their designated Captain of the Port Zone. Section 6.04-8 "Possession and Control of Vessels" is particularly pertinent to this section:

> *The Captain of the Port may supervise and control the movement of any vessel and shall take full or partial possession or control of any vessel or any part thereof, within the territorial waters of the United States under his jurisdiction, whenever it appears to him that such action is necessary in order to secure such vessel from damage or injury, or to prevent damage or injury to any vessel or waterfront facility or waters of the United States, or to secure the observance of rights and obligations of the United States.*

33 CFR 6.04-11 also authorizes the Captain of the Port to "enlist the aid and cooperation of Federal, State, county, municipal, and private agencies to assist in the enforcement of regulations issued…." The Harbor Safety Committee and its Harbor Safety Plan were created under this authority.

7.2.6 Vessel Traffic Management in Puget Sound

Although the ultimate responsibility for safe navigation of a vessel always rests with the Master or person in charge, the Vessel Traffic Service Puget Sound (VTSPS) was established under the authority of the Ports and Waterways Safety Act to "…facilitate the safe, secure and efficient transit of vessel traffic to assist in the prevention of collisions or groundings…." VTSPS uses the concept of a "continuum of traffic management," including "Monitoring, Informing, Recommending and Directing to safely manage the traffic in the Salish Sea" (33 CFR 161). The VTSPS User's Manual contains the VTS regulations.

In 1979, the Canadian and U.S. governments reached an agreement to establish and jointly operate a vessel traffic management system throughout the greater Puget Sound, including the Strait of Georgia. The preamble to this agreement states that:

> *Such arrangements are desirable for marine safety in light of increasing oil tanker and other vessel traffic in the west coast waters of Canada and the United States. The world-wide trend towards large tankers and other vessels, and the possibility of their presence in coastal areas where they might add to the existing traffic, greatly strengthen the need for such cooperation.*

From this agreement, the USCG and the CCG have developed and continue to operate the Cooperative Vessel Traffic System (CVTS) and the VTSPS. These systems, similar to the air traffic control system operated nationwide for aircraft, are based on a region-wide radar surveillance system, Automated Identification System (AIS) transponders, designated vessel traffic lanes, and an integrated command and control structure. The CVTS region is subdivided into two Canadian and one U.S. control zone in both U.S. and Canadian waters. All vessels, regardless of nationality, are required to observe the International Regulations for Prevention of Collisions at Sea, 1972 (72 COLREGS), are subject to orders that may be issued by the CVTS, and must observe all other practices of safe navigation and prudent seamanship.

All CVTS user class vessels in the control area are required to participate at some level in the CVTS system. While some smaller vessels above 20 meters in length may be required only to maintain a radio watch on the designated CVTS frequency and respond if hailed, other larger vessels (generally above 40 meters in length) also must make required reports[1].

Full participation vessels in U.S. waters include:

- All power-driven vessels 40 meters (130 feet) or greater in length;
- All vessels 8 meters (26 feet) in length when towing; and
- All passenger vessels capable of carrying 50 or more passengers.

Passive participation vessels in U.S. waters include:

- All power-driven vessels 20 meters (65 feet) or greater in length;
- All vessels 100 gross tons or more carrying 1 or more passengers for hire; and
- All dredges or floating plants.

Full participation vessels in Canadian waters include:

- Commercial power-driven vessels 20 meters (65 feet) or greater in length;
- Pleasure craft 30 meters (97.5 feet) or greater in length;
- Fishing vessels 24 meters (78 feet) or greater in length and 150 gross tons; and
- Vessels 20 meters (65 feet) in length when towing.

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[1] Reports are limited to information that is essential to achieve the objectives of the Vessel Movement Reporting System. These reports are consolidated into four reports (sailing plan, position, sailing plan deviation and final). (USCG 2003).

Full participation vessels include all deep draft commercial vessels (tankers, container ships, bulk carriers) ferries, and large fishing and fish processing vessels. Vessels operating under passive or minimal participation rules include smaller fishing vessels, recreational vessels, and work boats.

Designated Traffic Lanes

A series of traffic lanes (see Figure 5-2) have been designated by the International Maritime Organization (IMO) for inbound and outbound traffic to each region within the Salish Sea, including the Strait of Juan de Fuca, Puget Sound, and the Strait of Georgia.

- These traffic lanes are separated by a separation zone, much like a freeway median strip.
- Traffic lanes for smaller vessels are located adjacent to the primary traffic lanes, to separate larger faster traffic from slower traffic.
- The intersection of traffic lanes areas have precautionary areas designated for turning or crossing traffic.

Special Operating Areas

Two areas in the CVTS system have been designated as *special operating areas* because of unique conditions that require additional operating rules. These are the Turn Point Special Operating Area and the Eastern San Juan Island Archipelago VTS Special Area.

- **Turn Point Special Operating Area.** Vessels travelling in the northern segment of Haro Strait may have their forward view obstructed by the west end of Stuart Island at Turn Point. The special rules at Turn Point restrict multiple vessels of 100 meters (325 feet) from transiting the area at the same time unless they are moving in the same direction; the rules establish certain separation distances between vessels.
- **Eastern San Juan Island Archipelago VTS Special Area.** This area includes narrower channels with higher currents than other areas in the system. Special operating rules have been established for this area that restrict, and essentially create a one-way traffic zone for, vessels 100 meters (325 feet) in length and vessels of 40,000 dwt or greater. (33 CFR 161.12 and 55 [b-c]).

Tank Ship Security Zone

All tank ships (but not tank barges) are surrounded by a security zone of 500 yards (1,500 feet). All other vessels operating within this zone must operate at a minimum speed and course as directed by an onsite official. No vessel is allowed within 100 yards (300 feet) of a tank vessel without the permission of a responsible official (vessel master, for example).

Vessels approaching the Strait of Juan de Fuca must “check in” with the CVTS prior to entering the strait, to announce their arrival and to verify that they have the required documentation and certifications for entering U.S. or Canadian waters. They are then logged into the CVTS, and their movements are controlled throughout their transit of the system. While in transit, vessels in full or passive participation will be in communication with a traffic control center that will inform them of other vessel traffic in the vicinity and other special conditions they should be aware of. Now that all commercial vessels are equipped with AIS transponders, the location, speed, and course of each vessel can be tracked by two systems, radar, and AIS for redundancy. Vessel traffic operators monitor the movement of all vessels in the system and, whenever a situation begins to develop that could lead to an incident, direct the vessels to maneuver in order to avoid a hazardous situation.

When a vessel nears its destination and must depart the designated traffic lane, it is again in communication and directed by the CVTS operator. Similarly, when a vessel under CVTS control prepares to initiate a transit, communication with the CVTS takes place and vessel traffic advisories are provided from the CVTS operator prior to the vessel leaving the dock. In addition, vessels wishing to anchor must request permission from a CVTS operator.

Implementation of the CVTS places all vessels of any reasonable size while operating in Puget Sound under active traffic management, reducing the potential for incidents that could lead to collision and grounding and subsequent oil spill.

7.2.7 Tug Escort/Assist

Tankers are required to have a tug in escort under certain conditions and in certain areas to provide assistance to tankers in the event of a loss of propulsion or steering that may lead to collision or grounding.

- An escort is required for all laden oil tankers 40,000 dwt or greater when in transit in Puget Sound east of a line from Discovery Island to New Dungeness Light.
- An escort tug and two pilots are required for vessels of 40,000 dwt (summer) transiting Haro Strait and Boundary Pass to Canadian ports.
- In certain closely confined areas, tankers with redundant propulsion and steering systems also are required to have the escort tug tethered to the tanker.
- In addition to the confined areas noted above, tankers without redundant propulsion and steering are required to have a tethered tug when transiting Rosario Strait, Haro Strait, and Boundary Pass.
- An emergency response towing vessel (ERTV) or ocean-going tug has been stationed at Neah Bay during the winter period starting in 1999 and all year beginning in 2010 to assist vessels in distress, primarily with the loss of propulsion and/or steering in Washington coastal waters and in the western reach of the Strait of Juan de Fuca. This tug has assisted approximately 49 vessels during that time. Most of the vessels assisted were outside or near the west entrance to the Strait of Juan de Fuca.

7.2.8 Limitation of Vessel Speed

In certain locations and conditions, vessel speed limits have been established to provide adequate room to maneuver in an emergency. These include:

- Whenever a vessel is accompanied by a required escort, the vessel may not proceed at a greater speed than the service speed of the escort(s);
- Vessel speed may not exceed 10 knots in Rosario Strait; and
- Vessels escorted under the authority of the Canadian Pacific Pilotage Authority may not exceed 10 knots. This would primarily occur in Haro Strait and Boundary Pass.

7.2.9 Vessel Vetting/Operations

Vessels entering U.S. waters must meet certain standards of crewing, equipment, and contingency planning as required by the USCG. In addition, tankers and barges calling at the BP Cherry Point dock must meet certain standards to be permitted to moor and discharge or load cargo.

The requirements are as follows:

- Ninety-six hours prior to arrival in Puget Sound, the USCG requires that an "Advanced Notice of Vessel Arrival" be submitted. This notice describes the vessel, its registration, its specific destination, its five previous ports of call, the individual crew members, the type and amount of cargo it is carrying, its security status, and contact information. This information is used in part by the USCG to determine whether the vessel is qualified to enter and whether the USCG should inspect the vessel prior to entering.
- BP requires that all vessels calling at its dock must certify prior to vessel arrival that all means by which spills could enter the water (scuppers, for example) are closed, that clean-up equipment is positioned for immediate operations, and that certain other operations of the vessel are curtailed or prohibited.
- BP also requires that the vessel have an approved spill prevention plan onboard.

7.2.10 USCG Captain of the Port – Harbor Safety Plan

As stated earlier, operation of all vessels in the U.S. waters of Puget Sound is under the authority of the USCG Captain of the Port. The Captain of the Port is responsible for operation of the VTSPS which directs traffic and vessel movements. The USCG Captain of the Port advises the committee that establishes the Harbor Safety Plan and periodically reports to the incident data collected and maintained by the USCG.

The Harbor Safety Plan was developed, and is periodically updated, by a committee that includes members of the maritime industry, the pilots, the USCG, and other stakeholders. It was most recently updated in April 2013. The Harbor Safety Plan includes a set of Standards of Care (SOCs) or operating procedures that all members of the industry have agreed to abide by when operating in Puget Sound. Included in the SOCs are procedures for anchoring, bridge management, bunkering, equipment failures, heavy weather, hot work, lightering, line handling, propulsion loss prevention, restricted visibility, tanker escort, towing, and under-keel clearance.

7.2.11 Bunkering and Cargo Transfer Operations

Bunkering with residual fuel oil or heavy oil is currently not allowed by BP at the BP Cherry Point dock. However, vessels calling at BP may require bunkers while in the Puget Sound region. Included in the Harbor Safety Plan is an SOC for bunkering that:

- Requires advanced notification to Ecology of an oil transfer;
- Sets limits of the weather conditions under which bunkering can occur;
- Requires specific manning responsibilities;
- Requires tug availability in certain weather conditions;
- Sets pre-booming or boom availability requirements;

- Requires a Vessel Response Plan and certain response equipment for spills; and
- Sets flow rate criteria.

The BP Cherry Point dock maintains a *Port Information & Terminal Manual* that governs the transfer of crude oil and refined products at the BP dock. These requirements include:

- Preparation of the vessel for transfer operations, including positioning spill equipment and firefighting equipment;
- The use of specific equipment, including marine loading arms for transfer;
- Pre-positioning of an oil spill containment boom;
- Restrictions on the flow rate of transfer; and
- Safety and emergency shutdown procedures in the case of fire or spill.

As discussed in Section 2.5.3, BP intends to begin providing low-sulfur fuels to vessels that would otherwise be calling at the BP Cherry Point dock to deliver crude oil or load refined petroleum product. The low-sulfur fuel (diesel) would be delivered to the vessels using the same dock equipment loading arms that are currently used for loading refined petroleum product and would not constitute a change in routine loading operations. Spill prevention and control procedures that already are required, including pre-booming for transfer operations, would be implemented.

7.3 SPILL RESPONSE

In the event of an accident and spill, a comprehensive system for responding to the spill and minimizing any damage to environmental resources has been established. This system includes federal and state requirements for spill response planning on the part of the terminal and vessel operators, pre-positioning of spill response and clean-up equipment by both governmental agencies and companies with operations that may generate spills, and continuous training of spill responders.

7.3.1 Spill Response Planning

Company spill response planning is regulated by both federal and state agencies to ensure a constant preparedness to effectively respond to accidents and oil spills. Federal and state regulations require vessels and facilities handling petroleum products to operate with an approved spill response plan. Section 4202 of OPA 90 amended Section 311(j) of the Federal Water Pollution Control Act to require the preparation and submission of response plans by the owners or operators of certain oil-handling facilities (Facility Response Plans –FRPs) and for all vessels defined as “tank vessels” under 46 USC §2101 (Vessel Response Plans – VRPs). Further regulations in 33 CFR 154.1035 and 155.1035 require plan holders that operate within a pre- authorization zone to submit a response plan that includes dispersant capability.

Under federal jurisdiction, the EPA reviews and approves Spill Prevention, Control, and Countermeasure Plans submitted by individual oil-handling facilities. These prevention plans are designed to avoid oil spills in U.S. waters and shorelines, and require an established FRP demonstrating preparedness to respond to a worst-case spill. Additionally, oil-handling facilities and vessels are required to maintain prevention and contingency plans approved by Ecology that demonstrate the ability to contain and clean up spill incidents.

These plans must include:

- Spill management team organization and detailed job descriptions for a worst-case spill;
- Contracts with approved primary responders to provide response equipment and personnel; and procedures to ensure that response teams are activated immediately;
- Detailed descriptions of petroleum product types and properties, and the potential size of a worst-case spill;
- Descriptions of all topography, drainage systems, oil processing sites and operations, and geographical areas that could be impacted by a spill;
- Procedures to track and account for the entire volume of oil spills;
- A concise process to manage oil spill liability claims; and
- Annual review of the entire plan and submission of updates as necessary.

Company contingency plans must also be operable and in compliance with established national and regional plans that are regularly updated to ensure coordinated, efficient, and effective support in the instance of an emergency. The national plan for response to a hazardous material spill is contained in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The plan was initiated in 1968 and has been continuously updated to bring it in compliance with ensuing federal regulations, including OPA 90. The NCP also mandates regional response plans to be developed. Cherry Point, Washington, is incorporated under the Northwest Area Contingency Plan (NWACP) developed by the USCG, Ecology, and the EPA. The NWACP stands as the official response plan for Washington and is updated annually. The NWACP established a regional response team and Geographic Response Plans (GRPs) tailored to specific regional geographical and environmental conditions. GRPs ensure support from local expert personnel and volunteer organizations, staging, operations, storage and containment areas, air support, wildlife rehabilitation centers, and vessel assistance. Oil-handling facility compliance is overseen by Ecology.

Separately, petroleum-laden vessels operating in Washington waters are required to have response plans and are subject to screening and inspection by the USCG to ensure compliance with current state and federal regulations regarding oil spill prevention and response contingency plans.

7.3.2 Pre-Positioning Spill Response Equipment

Oil spill response plans must also identify and ensure by contract or other approved means (e.g., a letter of intent) the availability of personnel and equipment necessary to remove, to the maximum extent practicable, a worst-case discharge—including a discharge resulting from fire or explosion—and to mitigate or prevent a substantial threat of such a discharge.

The system for assembling, mobilizing, and controlling response resources is extremely complex. To meet the statutory requirements, therefore, each response plan holder must identify the means for accomplishing these tasks.

Plan holders that arrange for the services of a USCG-classified oil spill removal organization (OSRO) do not need to list the specific response resources of the OSRO in their plans.

Measures taken by the maritime industry and government agencies to ensure rapid prevention and containment of potential spills include:

- Mandatory spill response equipment that complies with federal and state standards aboard each vessel and at each oil-handling facility;
- A towing vessel (ERTV) stationed in Neah Bay dedicated to emergency response;
- An established Incident Command System (ICS) designed with pre-established comprehensive roles and responsibilities for all responders in the event of a spill; and
- Pre-packaged, mobile response equipment caches throughout the region containing oil spill containment boom and absorbent materials. The location of the primary pre-deployed response equipment is shown in Figure 7-1.

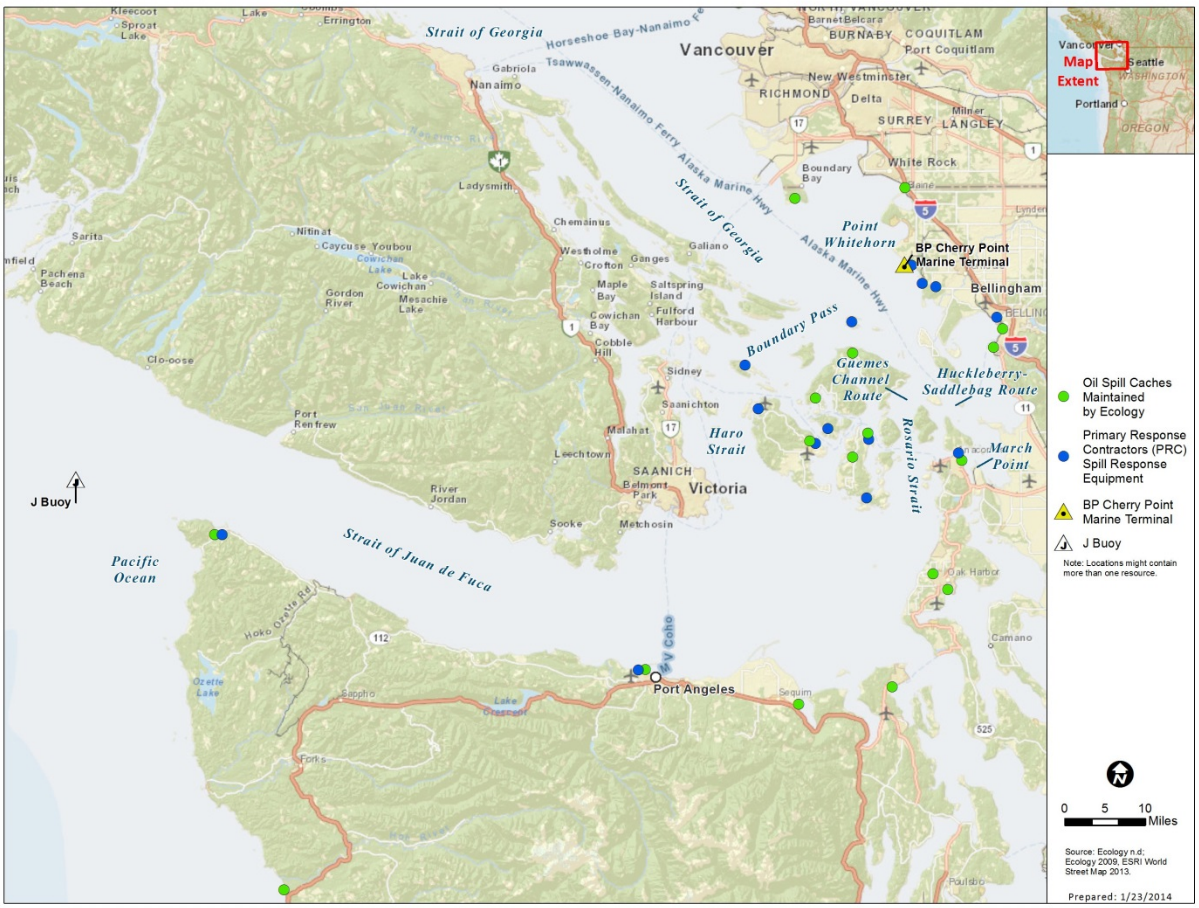

Figure 7-1 Location of Oil Spill Equipment Caches

Source: Ecology n.d.

7.3.3 Spill Response Training

According to Ecology, more than 1,000 people statewide have been trained to operate the spill response equipment stowed in the oil spill equipment caches (Ecology n.d.). Ecology also requires drills to be conducted on a 3-year cycle to examine and strengthen the effectiveness of company spill contingency plans. The types of drills conducted include:

- Tabletop drills conducted at least once every 3 years to test worst-case spill scenario response;
- Deployment drills conducted twice per year (six per cycle) including at least two GRPs to assess a variety of equipment in various environmental conditions; and
- Unscheduled drills initiated by Ecology to test any component of a plan.

Both the FRP and VRP regulations require that plan holders conduct annual equipment deployment exercises involving the OSROs listed in their response plans stipulated in 33 CFR 154.1055 and 155.1060.

7.4 MITIGATION CONCLUSIONS

As noted in the description of the Proposed Action, BP does not create any new operations or variation in its current operations with operation of both wings versus a single wing at its dock. The same types and range of vessel calls; the same sequence of events for mooring, loading or unloading, and departure; and the same routes for transiting into and out of Puget Sound are expected to occur. The incremental risk analysis indicates that the risk of accident and oil outflow would be reduced with operation of the North Wing at traffic levels up to approximately 335 calls per year and could be increased to some small degree at traffic levels between 335 and 420 calls per year.

The present system of vessel configuration requirements (especially double hulls), vessel traffic control, escort requirements, vessel vetting, materials handling, and spill planning and response provide routinely reviewed procedures, processes, and practices that significantly mitigate risk. Other than spills at the dock during material transfer operations and dock maintenance vessels calling at BP, vessels in transit to BP within Puget Sound have not had any accidents or spills during the post-OPA 90 time period (1995–2010). This statistic does not imply that an accident or spill could not occur, only that the present system within which vessels calling at BP operate experience an extremely low probability of accident potential and any resulting spill.

As part of the USCG’s Prevention mission, it constantly collects information about reported incidents and casualties involving vessels operating in Puget Sound. These data regarding traffic movements are analyzed to identify trends or patterns of incidents that may indicate some change in the density of traffic, vessel behavior, or the configuration of traffic operating in Puget Sound that may lead to a change in the risk profile in certain geographic areas or of certain vessel types. When such potential changes in risk are identified, the USCG—working in cooperation with CCG, the State, or port partners—will study such situations and, if required, revise the applicable regulations, rules, or the CVTS/VTSPS. An example of such a need was development of the Turn Point Special Operating Area.

While the cumulative effects analysis estimates an increase in potential accidents and spill volume due to the addition of other projects in the region, these project would not all occur in the same time frame. Therefore any changes in system-wide risk would be incremental. To the extent that cumulative traffic incrementally increases risk in the system, the USCG’s Prevention mission and system for monitoring incident patterns, identifying potential changes in risk, and responding with appropriate modifications to minimize the risk is expected to manage such changes in risk.

In addition to risk minimization and minimization efforts already implemented, a reduction in risk is predicted to occur under the current and low future traffic scenario forecasted by BP with operation of the North Wing. Should traffic increase to BP’s less likely high scenario range, the current risk mitigation systems are capable of recognizing the risk and modifying or incorporating new procedures to minimize the small increase in potential risk.

7.5 LITERATURE CITED

USCG. See U.S. Coast Guard.

U.S. Coast Guard. 2003. Vessel Traffic Service Puget Sound User Manual, March.

8 REPORT PREPARERS AND CONTRIBUTORS

8.1 OWNER

- BP West Coast Products, LLC – Owner

8.2 NEPA LEAD AND COOPERATING AGENCIES

- U.S. Army Corps of Engineers – Lead Agency
- U.S. Coast Guard – Cooperating Agency

8.3 OTHER FEDERAL AGENCIES AND SOVEREIGN NATIONS WITH INTEREST

- National Oceanic and Atmospheric Administration, National Marine Fisheries Service
- Lummi Nation
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service

8.4 EIS TEAM

The USACE contracted with Cardno ENTRIX to prepare the EIS. The names and expertise of each contributor is provided below.

Clifford, Katie, Senior Policy Analyst and Economist

- BA, Environmental Studies
- Seven years of experience in NEPA compliance; environmental permitting and regulatory compliance; public health and safety, land use, and public services impact analysis; and natural resource economics

Clouse, Adele, Assistant Staff Scientist

- B.A., Biological Anthropology
- Two years of experience in data management, organization, quality assurance and analysis, research, editing, and technical report writing.

Demuth, Kimberly, Technical Director – Cultural Resources Management/ Principal, Vice President

- MS, Historic Preservation of Architecture
- Thirty-one years of experience in historic preservation of architecture; cultural resource management; and visual resource management, project management, and planning

Ferris, Jennifer, Project Archaeologist

- MA, Anthropology
- Eleven years of experience in archaeology and cultural resource management

Flathman, Jennifer, Project Architectural Historian

- MS, Historic Preservation
- Nine years of experience in historical preservation, historical structures, planning/design, cultural resources management, and technical writing

Hancock, N. Joel, Senior Staff Scientist

- MCRP, Environmental Planning
- Seven years of experience in GIS; GPS; and land use, socioeconomics, and environmental justice impact analysis

Klungle, Melissa, Senior Staff Scientist

- BS, Fisheries and Wildlife Management
- Ten years of experience in aquatic and terrestrial ecological risk assessment, fisheries biology, habitat conservation plans, and compliance with the ESA and NEPA

Robinson, John, Senior Consultant

- BA, Architecture
- Thirty years of experience in energy facility siting, licensing, permitting and environmental planning, impact analysis, and environmental documentation

Uno, Alison, Project Scientist

- MSC, Sustainable Environmental Management
- Eight years of experience in NEPA compliance, environmental management, terrestrial biology, marine and freshwater biology, ornithology, sustainability, and GIS

Graeber, William, Senior Consultant

- MS, Fisheries Science
- Thirty-five years of experience in aquatic ecology and fisheries biology, specializing in evaluating the responses of salmon and marine species populations to changes in ecological processes and conditions. A recognized expert in salmon and nearshore ecology in the Northwest.

Koppel, Emily, Senior Staff Scientist

- MS, Biology
- Seven years of experience in freshwater, marine, terrestrial, and wetland ecology; parasitology; invasive species biology; fisheries and wildlife; and ecotoxicology

Lecky, James, Senior Consultant

- BA, Biology
- Thirty-six years of experience; an expert in marine mammals, marine fishes, salmon and steelhead. Recently retired as Director, Office of Protected Resources for National Marine Fisheries Service in Washington, D.C.

Wyse, Barbara, Senior Consultant / Senior Economist

- BA, Environmental Sciences & Policy
- Ten years of experience as a natural resource economist, with expertise in water resources, agriculture, recreation, valuation of ecosystem services, comprehensive land use analysis, and modeling of tradeoffs

8.5 DISTRIBUTION LIST

The following agencies, organizations, and individuals will receive the EIS.

8.5.1 Federal Agencies

- National Marine Fisheries Service
- U.S. Coast Guard, Seattle Sector
- U.S. Environmental Protection Agency, Aquatic Resources Unit, EIS Review Coordinator, and Office of Ecosystems, Region 10
- U.S. Fish and Wildlife Service, Lacey

8.5.2 Tribal Government

- Elwha Tribe
- Lummi Nation
- Makah Tribe
- Nooksack Tribe
- Skagit River System Coop
- Suquamish Tribe
- Swinomish Tribe
- Upper Skagit Tribe

8.5.3 State Agencies

- Washington State Department of Ecology
- Washington State Department of Natural Resources
- Washington State Department of Fish and Wildlife

8.5.4 Canadian Governments and Agencies

- Greater Vancouver Regional District
- Port Metro Vancouver

8.5.5 Libraries

- Bellingham Public Library
- San Juan Island Library
- Blaine Public Library
- North Olympic Library System, Port Angeles Main
- Ferndale Public Library
- North Olympic Library System, Sequim Branch
- Anacortes Public Library
- Jefferson County Library, Port Hadlock Main
- Seattle Public Library, Central Branch
- Island County Library, Coupeville

8.5.6 Other Institutions and Associations

- Puget Sound Harbor Safety Committee
- Marine Exchange of Puget Sound
- North Pacific Fishing Vessels Owners Associations
- Passenger Vessels Association
- Western States Petroleum Association
- Puget Sound Pilots
- Washington Public Ports Association
- Washington State Ferries
- Pacific Merchant Shipping Association
- American Waterways Operators
- Puget Sound Partnership
- The George Washington University, School of Engineering and Applied Science