UNITED STATES
DEPARTMENT
OF THE NAVY

NAVAL BASE KITSAP
AT BANGOR
SILVERDALE, WA

COOPERATING AGENCIES:

United States Army
Corps of Engineers

National Oceanic and
Atmospheric Administration,
National Marine
Fisheries Service

TRIDENT SUPPORT FACILITIES EXPLOSIVES HANDLING WHARF (EHW-2)

FINAL ENVIRONMENTAL IMPACT STATEMENT

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LEAD AGENCY:	United States Department of the Navy
COOPERATING AGENCIES:	U.S. Army Corps of Engineers Seattle, Washington
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ABSTRACT:

This final environmental impact statement (FEIS) evaluates the environmental effects of constructing and operating a second Explosives Handling Wharf (EHW-2) on Naval Base Kitsap at Bangor. It has been prepared by the United States Department of the Navy (Navy) in accordance with the requirements of the National Environmental Policy Act of 1969. The proposed action is needed because the existing EHW alone will not be able to support TRIDENT program requirements. Five action alternatives and the No-Action Alternative are evaluated. The action alternatives consist of combinations of two access trestle layouts (separate and combined) and three wharf configurations (conventional pile-supported, large pile, and floating). The project would also include construction of an upland road, an abutment where the trestles connect to the shore, and an upland construction staging area. Approximately 20 existing facilities and/or structures in proximity to the proposed structure would be modified or demolished to comply with Department of Defense Explosives Safety Board and Naval Ordnance Safety and Security Activity requirements. Four new buildings would be constructed to house the functions of some of the buildings to be demolished or vacated. One new building would be located approximately 1 mile south of the EHW-2 site; three new buildings would be located inland approximately 2.2 miles south of the EHW-2 site. The marine and terrestrial construction would occur over approximately 4 years. In-water work would be subject to timing and seasonal restrictions to avoid and minimize impacts. The preferred alternative is the Combined Trestle, Large Pile Wharf Alternative.

This FEIS evaluates direct, indirect, and cumulative impacts to the environment. All alternatives would result in the same types of environmental impacts; the magnitude of these impacts would vary among the alternatives. The principal types of impacts during project construction would include pile driving noise (and its effects on marine biota), turbidity, and air

pollutant emissions. In the long term, impacts would include loss and shading of marine habitat including eelgrass, macroalgae and the benthic community; and interference with migration of juvenile salmon, some species of which are protected under the Endangered Species Act (ESA). All action alternatives would have the potential to adversely affect fish and bird species protected under the ESA, and marine mammals (behavioral harassment only) protected under the ESA and the Marine Mammal Protection Act (MMPA). Upland impacts would be essentially the same for all alternatives. Upland construction would result in permanent and temporary vegetation disturbance. There would be loss of 0.20 acre of wetland, which would be mitigated. Wildlife would be disturbed by construction noise, especially pile driving; measures are proposed to mitigate these impacts. No terrestrial animals or plants protected under the ESA, Migratory Bird Treaty Act, or Bald and Golden Eagle Protection Act would be affected. Residential and recreational areas would be affected by construction noise, primarily from pile driving. Openings of the Hood Canal Bridge for construction vessels would result in delays of traffic crossing this bridge.

The Navy is working with the National Marine Fisheries Service (NMFS) through the MMPA permitting process to ensure compliance regarding Level B exposures to marine mammals. In accordance with the ESA, the Navy has concluded consultation with the U.S. Fish and Wildlife Service and NMFS regarding impacts to federally listed species and designated critical habitat. In addition, the Navy has completed consultation with NMFS regarding impacts to Essential Fish Habitat. In accordance with the Coastal Zone Management Act, the Navy submitted a Phase I Coastal Consistency Determination (CCD) to the Washington Department of Ecology (WDOE) in June 2011, and received concurrence from WDOE in August 2011. The Navy will submit an updated Phase II CCD to WDOE in spring 2012. In December 2011, the State Historic Preservation Officer concurred with the Navy's determination of no adverse effect on historic properties under the National Historic Preservation Act (NHPA). The Navy consulted with the affected American Indian tribes under Section 106 of the NHPA. Pursuant to Executive Order 13175 and Department of Defense Policy, the Navy is in Government-to-Government consultation with affected American Indian tribes.

Following a 60-day public comment period on the draft environmental impact statement (DEIS), the Navy reviewed and responded to comments in writing and/or as changes in this FEIS. This FEIS also incorporates public comments on a Supplement to the DEIS that the Navy prepared to address project changes that occurred after publication of the DEIS. The FEIS is being circulated for a 30-day wait period (no-action period). Following the 30-day wait period, the Navy will sign the Record of Decision (ROD) formally documenting the selected alternative, publish a Notice of Availability of the ROD in the Federal Register, and proceed with implementation of the proposed action.

EXECUTIVE SUMMARY

INTRODUCTION

The United States (U.S.) Department of the Navy (Navy) proposes to construct and operate a second Explosives Handling Wharf (EHW) at Naval Base Kitsap at Bangor (NBK at Bangor) to support the OHIO Class Ballistic Missile submarines, hereafter referred to as TRIDENT submarines (Figure ES–1). The second EHW (EHW-2) would be adjacent to but separate from the existing EHW. NBK at Bangor, located on Hood Canal approximately 20 miles west of Seattle, Washington, provides berthing and support services to TRIDENT submarines. The entirety of NBK at Bangor, including the land areas and adjacent waters in Hood Canal, is restricted from general public use. Access is granted by permission to non-Department of Defense (DoD) personnel. The action proponent is the Navy Strategic Systems Programs (SSP). SSP directs research, development, manufacturing, test, evaluation, and operational support of the TRIDENT Fleet Ballistic Missile (TRIDENT) program. The U.S. Army Corps of Engineers (USACE) and the National Marine Fisheries Service (NMFS) are cooperating agencies pursuant to Title 40 of the Code of Federal Regulations, Parts 1501.6 and 1508.5 (40 CFR 1501.6 and 1508.5).

Development on NBK at Bangor over the past 40 years was analyzed in the TRIDENT Facilities Environmental Impact Statement (EIS), which was prepared for construction of the ballistic missile submarine support portion of the base (Navy 1974). That EIS was supplemented in 1976 and 1978 (Navy 1976, 1978). The TRIDENT Facilities EIS addressed the need for three EHWs on NBK at Bangor for long-term support of the TRIDENT program. Subsequent environmental analyses on NBK at Bangor focused on specific development actions at the base and adjacent waterfront. A 1989 Environmental Assessment for the TRIDENT D5 Facilities Upgrade Program included consideration of the construction of a second EHW (Navy 1989). Although the original TRIDENT Facilities EIS identified the need for three EHWs, only one EHW was built during construction of the TRIDENT base. Subsequent analyses (most recently, the Navy Waterfront Functional Plan, 2009 Update [Navy 2009c]) determined that only two EHWs are needed on NBK at Bangor.

PURPOSE AND NEED

The Navy proposes to construct and operate the EHW-2 adjacent to the existing EHW on NBK at Bangor. The purpose of the proposed action is to support future TRIDENT program requirements for the eight TRIDENT submarines currently homeported at the Bangor waterfront of NBK and the TRIDENT II (D5) Strategic Weapons System. The proposed action is needed because the existing EHW alone will not be able to support TRIDENT D5 program requirements. The Navy has no plans at this time to change the number of TRIDENT submarines on NBK at Bangor, and the proposed action is not intended to support an increase in TRIDENT submarines. In an analysis to determine future TRIDENT program needs,[1] the Navy concluded that EHW facility support would be required for approximately 400 operational days per year[2] due to changing operational and weapons system requirements. Several different scenarios on how to fulfill this requirement were analyzed in a business case analysis, and the only feasible solution was two EHWs.

[1] Explosives Handling Wharf-2 Business Case Analysis & Risk Assessment, November 6, 2008, Secret/Formerly Restricted Data.

[2] An EHW operational day is any day that supports fleet and missile requirements. The requirement for approximately 400 operational days per year takes into account New Strategic Arms Reduction Treaty (START) requirements.

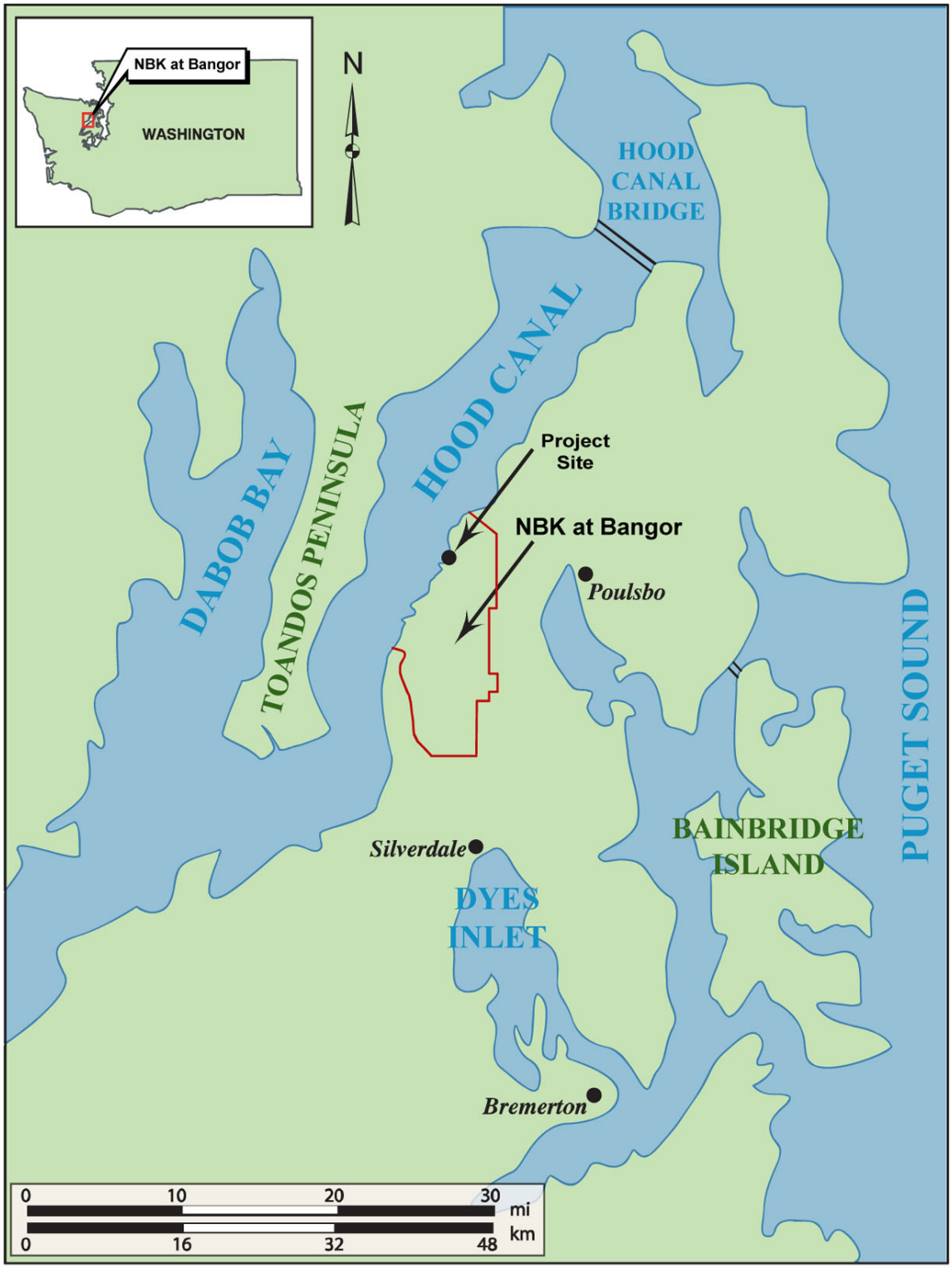


Figure ES–1. Site Location Map for NBK at Bangor

The existing EHW was constructed in the late 1970s to handle the TRIDENT I C4 missile (C4). In the 1990s, this missile was replaced by the TRIDENT II D5 missile (D5). The D5 is larger, more complex, and requires more time to handle and maintain than the C4. In 2001, the Navy began the TRIDENT II (D5) Life Extension Program, which will extend the life of the current TRIDENT weapons systems through 2042. Life extension is accomplished through upgrades to missiles (primarily electronics) to address technological obsolescence. As the systems age, these upgrades will require more frequent and longer handling and maintenance. Although some upgrades and maintenance can be performed at locations other than the EHW, the submarines must still dock at the EHW to remove components that are transported to other work locations.

The existing EHW can currently only provide approximately 200 operational days per year due to required facility preventative maintenance and pile replacement. The Navy anticipates that after pile replacement concludes in 2024, the existing EHW will provide approximately 300 operational days per year. With the existing EHW alone, therefore, there would be a shortfall of approximately 200 operational days until 2024, and a shortfall of approximately 100 operational days thereafter. A single EHW would not meet TRIDENT program needs of approximately 400 operational days per year.

The proposed EHW-2 would provide 300 operational days per year. Two EHWs would provide an available capacity of approximately 500 to 600 operational days per year. Although there would be an excess of operational days with both EHWs, one EHW alone would not provide enough operational days to support the TRIDENT mission through 2042. The EHW-2 would be designed to meet all TRIDENT program requirements, with the minimum structure.

ALTERNATIVES

The Navy evaluated a wide range of alternative designs for the EHW-2 using the following criteria:

- Capability to meet TRIDENT mission requirements,
- Ability to avoid or minimize environmental impacts,
- Siting requirements including proximity to existing infrastructure,
- Availability of waterfront property,
- Constructability of essential project features, and
- Explosives safety restrictions.

All of the action alternatives analyzed in this EIS would meet the above criteria.

The EHW-2 would consist of two components: (1) the wharf proper (or Operations Area), including the warping wharf; and (2) access trestle(s). The wharf proper would be either pile-supported or floating. Two types of pile-supported wharf are being considered: a conventional pile-supported wharf and a large-pile wharf. The access trestles would be pile-supported and would be either completely separate or combined for part of their spans. The trestles under either option would come ashore at the same location and tie into existing roads. All piles would be hollow steel pipe piles.

As part of the proposed action, approximately 20 existing facilities and/or structures in proximity to the proposed structure would be modified or demolished to comply with DoD

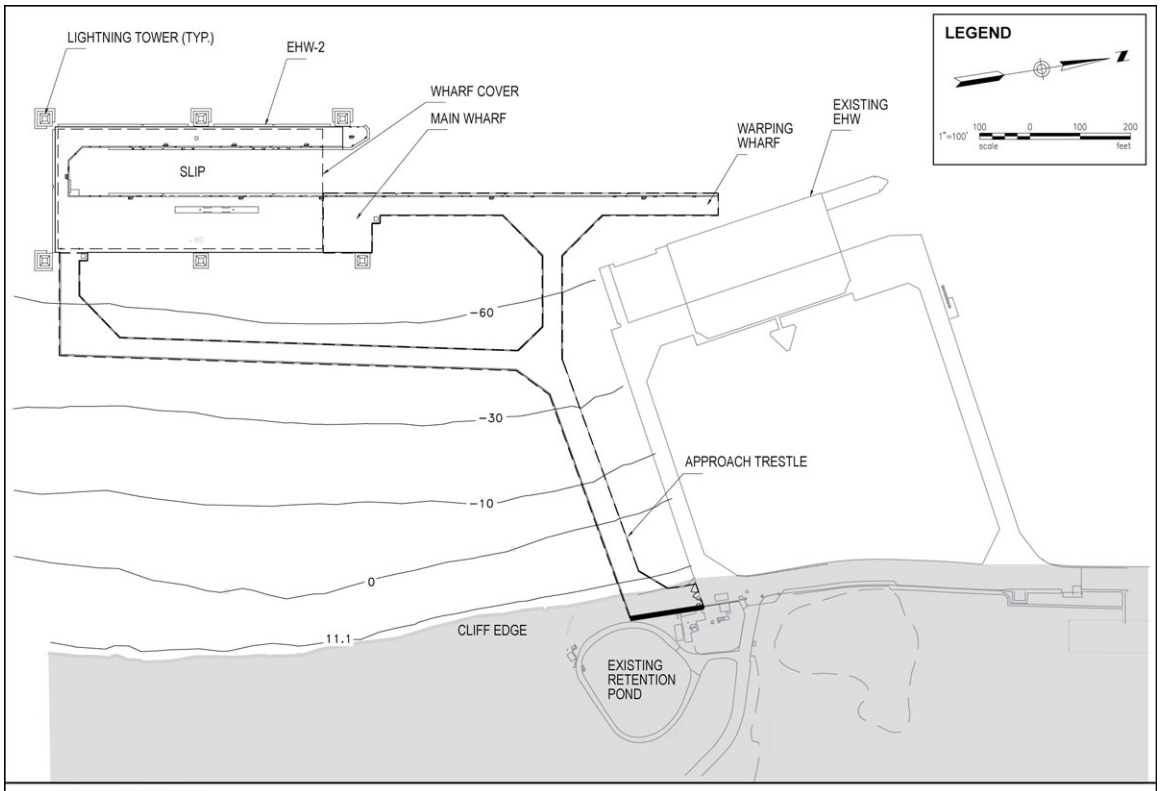
Explosives Safety Board (DDESB) and Naval Ordnance Safety and Security Activity (NOSSA) requirements.

This EIS addresses five action alternatives that are combinations of the wharf and trestle components, and a No-Action Alternative. Dimensions and other details of the five action alternatives are provided below and summarized in Table ES–1 (at the end of this Executive Summary).

- *Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative).* Under this alternative, the access trestles would be combined over shallow water to reduce impacts to shallow-water habitat and resources. The wharf would be supported primarily on large (up to 48-inch diameter) piles, along with some smaller (24-inch diameter) piles. Figure ES–2 shows the EHW-2 layout with the combined trestle.
- *Alternative 2: Combined Trestle, Conventional Pile Wharf.* This alternative would have the same combined trestles as Alternative 1, but would use a conventional pile wharf supported on a larger number of smaller (24- to 36-inch diameter) piles than the Large Pile Wharf. Otherwise, the dimensions of the Conventional Pile Wharf would be the same as those of the Large Pile Wharf. Pile driving would take longer than for Alternative 1.
- *Alternative 3: Separate Trestles, Large Pile Wharf.* Unlike Alternatives 1 and 2, this alternative would have completely separate access trestles. As a result, there would be more trestle piles and overwater area, including more area over shallow water. This Large Pile Wharf would be the same as Alternative 1. Figure ES–3 shows the EHW-2 layout with separate trestles.
- *Alternative 4: Separate Trestles, Conventional Pile Wharf.* This alternative would have the same separate trestles as Alternative 3 and the same Conventional Pile Wharf as Alternative 2.
- *Alternative 5: Combined Trestle, Floating Wharf.* This alternative would employ a floating wharf rather than a pile-supported wharf. The wharf would be supported on large concrete pontoons and connected to mooring dolphins. This alternative would use combined trestles similar to Alternatives 1 and 2. The floating wharf would be larger than the pile-supported wharves. This alternative would entail considerably fewer piles than the other alternatives. Figure ES–4 shows the Alternative 5 layout.
- *No Action.* Under this alternative, no EHW-2 would be built, and the Navy would not have the required facilities to perform routine operations and upgrades required to maintain the current fleet of TRIDENT submarines on NBK at Bangor through 2042.

PROJECT COMPONENTS

The wharf proper would lie approximately 600 feet offshore at water depths of 60 to 100 feet, and would consist of a main wharf, a warping wharf, and lightning protection towers. It would include a slip for submarines surrounded on three sides by the operational wharf area. The warping wharf would extend out from the main wharf. The warping wharf would be used to line up submarines to move into the slip and would provide a safety barrier between submarines and EHW-1 during berthing. The main wharf would include an operations support building providing office and storage space and mechanical/electrical system component housing. Additional facility support at the wharf would include heavy duty cranes supported by the structure that encloses the wharf, power utility booms, six large lightning protection towers, and camels (operational platforms that float next to a moored vessel). The six lightning towers would be steel frame structures. Specific dimensions of project components are detailed in Table ES–1.



Source: BergerABAM 2010

Figure ES–2. Plan View of Combined Trestle Alternatives 1 and 2

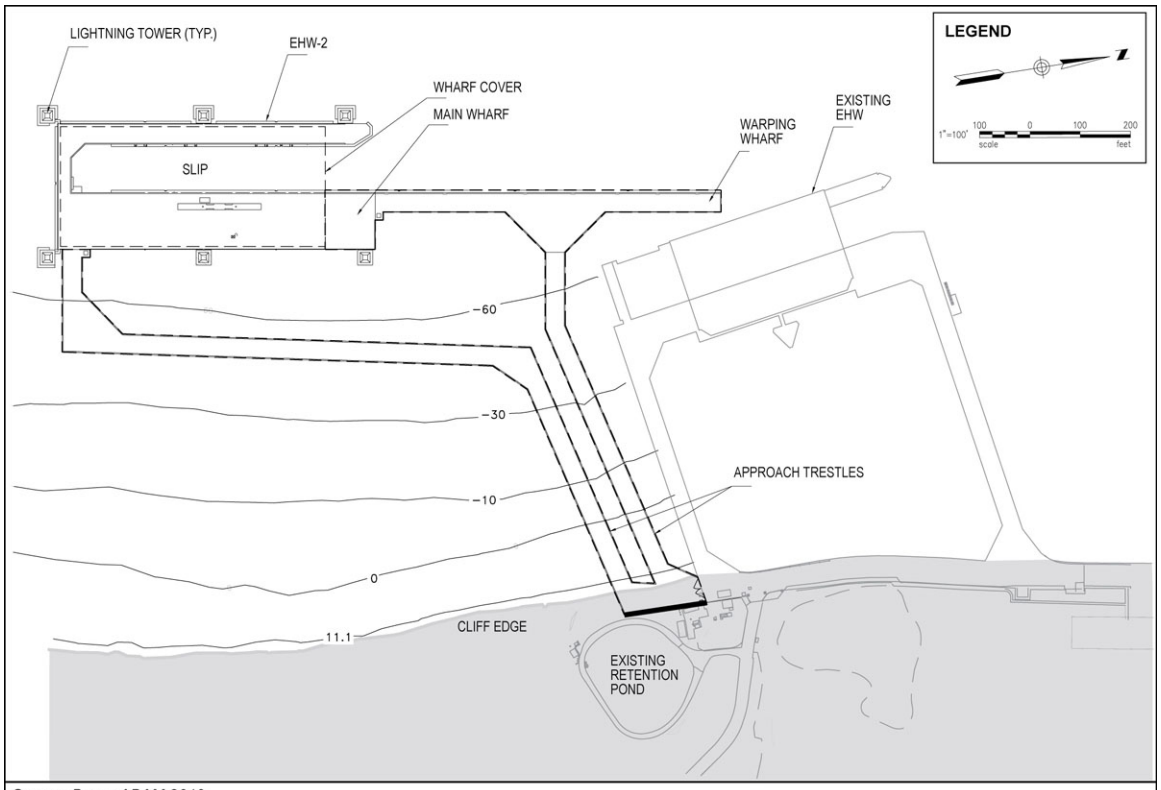


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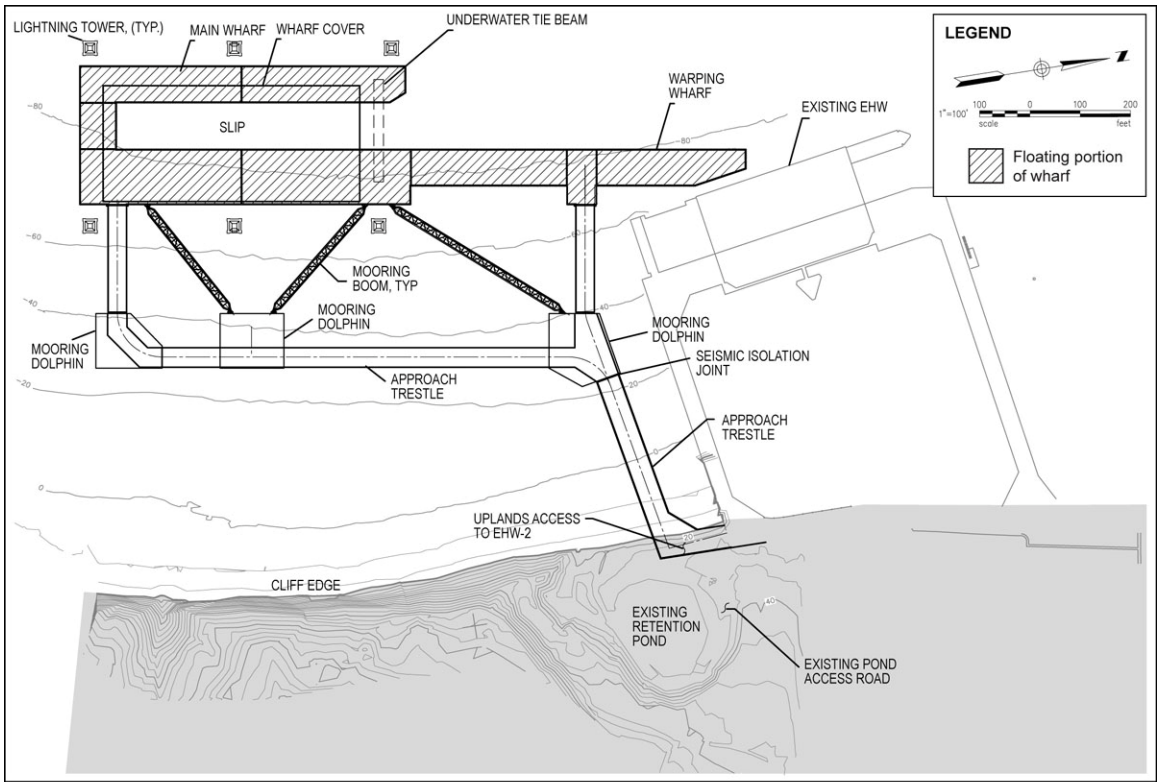
Figure ES–3. Plan View of Separate Trestle Alternatives 3 and 4



Source: BergerABAM 2010

Figure ES–4. Plan View of Floating Wharf Alternative 5

Entrance and exit trestles would connect the wharf to the shore. The trestles would be pile-supported. Concrete pile caps would be cast in place and would support pre-cast concrete deck sections.[3] A grated steel pedestrian ramp (80 by 3.5 feet) and floating platform (35 by 18 feet, likely concrete) will provide access for Navy divers.

Pile installation would involve the use of vibratory pile drivers to the greatest extent possible for all alternatives. It is anticipated that most piles would be vibratory driven to within several feet of the required depth. If difficult subsurface driving conditions (i.e., cobble/boulder zones) are encountered, it may be necessary to use an impact hammer to drive some piles for the remaining portion of their required depth. Up to three vibratory rigs would operate concurrently during construction of the EHW-2, but only one impact hammer rig would operate at a time. However, the construction schedule would require the operation of the impact rig at the same time as the vibratory rigs. Measures to reduce the environmental impacts of pile driving and other project actions are described below under Mitigation Measures.

The in-water work season for pile driving and other in-water construction on NBK at Bangor is July 16 through February 15, as established by the regulatory agencies to protect juvenile salmon. Construction would occur 6 days per week. Impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding

[3] Pile caps are constructed by placing wooden forms and reinforcing steel bars around the top of the piles, and pouring concrete into the forms. Once the concrete has cured, the forms are removed. Pre-cast components are formed and poured at an offsite location. They are brought to the site in their finished form and placed with a crane in their final location.

season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). Upland construction activities would occur between 7:00 AM and 10:00 PM in accordance with the Washington Administrative Code (WAC) noise guidelines.

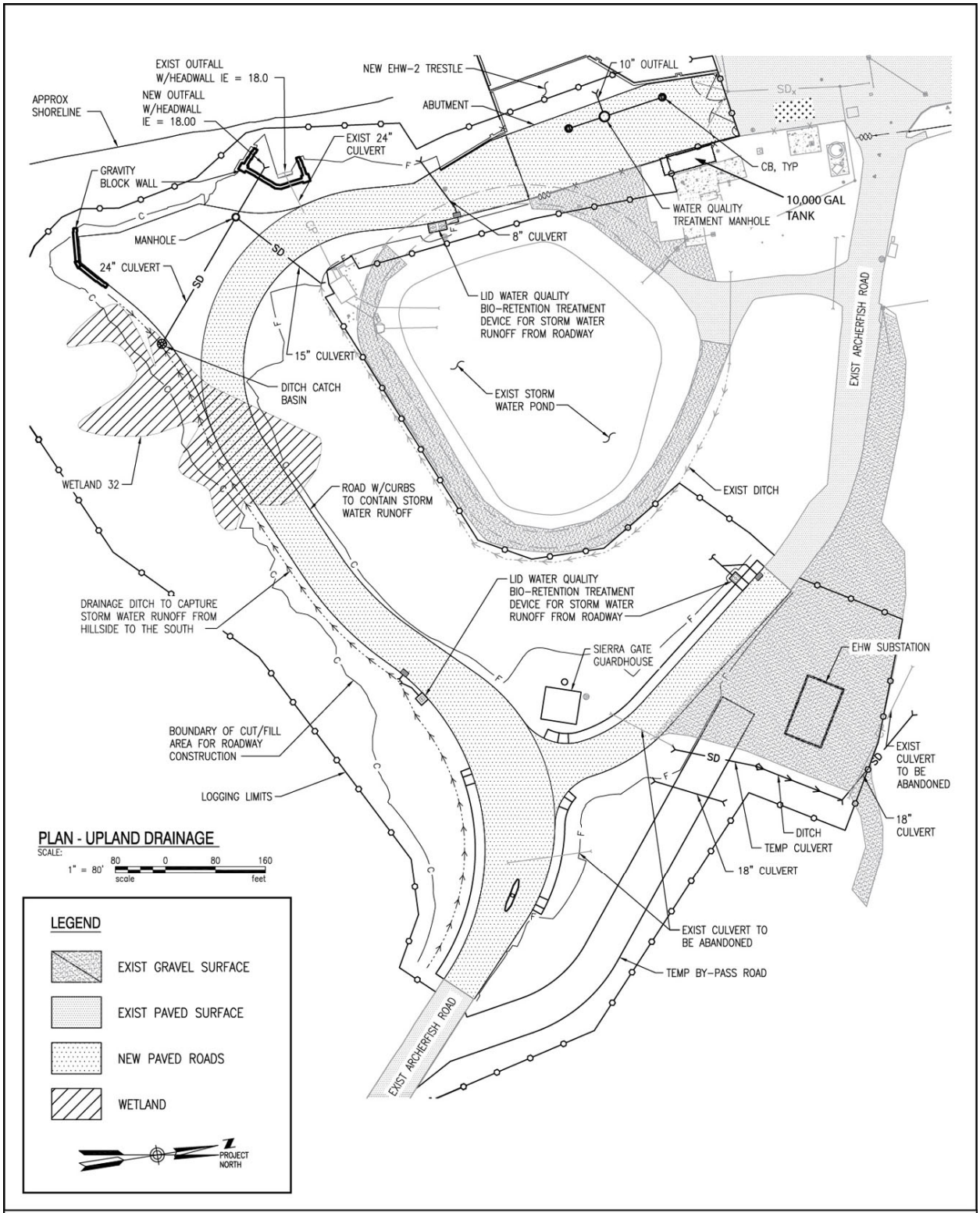
The following upland features would be the same for all alternatives (Figure ES–5). (Upland features are defined as those located inland of marine waters and above the mean higher high water [MHHW] line.) A permanent access road would be built to provide access from Archerfish Road to the upland construction area along the shoreline, while avoiding the nearby detention pond. An extension would be added to the existing Tang Road to connect and allow access to the new trestle(s) from the existing roadway. A security fence would run the length of this road and onto the trestle(s). A gate and guard house would be installed at the intersection of the new access road with Archerfish Road. A total area of approximately 3.0 acres would be disturbed in this area for the various facilities, including utility projects (see below). Of this area, 1.4 acres would remain permanently occupied by the new facilities, while the rest (1.6 acres) would be revegetated. Trees (not stumps) within 10 feet of the top of existing steep slopes on the north and south sides of the access road (area of 1.0 acre) would be cut/removed at the beginning of the project when clearing and grubbing is performed.

A 5-acre laydown area approximately 4,000 feet south of the project site would be needed for the upland construction. Storage of material and equipment (such as roof and siding materials and construction tools), parking of construction vehicles, and soil stockpiling would occur within the laydown area. Following construction, this area would be revegetated with native forest species. No new parking lots for construction parking or operational parking would be needed. Archerfish Road would be the primary haul route for construction.

A concrete abutment would be built at the face of the shore cliff, under the trestle(s) where the trestle(s) comes ashore. The abutment would be pile-supported, constructed from the land side, and lie above MHHW, although excavation below MHHW would be needed for construction. Abutment construction would include installation of piles using the same methods as in-water pile driving.

New utility facilities and modifications for all alternatives would include the following (dimensions and sizes are approximate):

- Two new 12-inch diameter water lines, for domestic use and fire suppression, approximately 200 feet long to connect to an existing water line on Archerfish Road.
- Two new 20- by 20-foot backflow preventer vaults, to prevent backflow into the Navy domestic water system. One would be added at the northwest corner of the new access road and Archerfish Road intersection. The second would be located approximately 5 feet west of the existing paved access road on the project site.
- One new underground 6-inch diameter Sanitary Sewer Forced Main for wharf sewer discharge. The main would extend approximately 220 feet, terminating at an existing manhole located approximately 40 feet east of the existing EHW and the end of Archerfish Road.
- One new underground 4-inch diameter Ship's Overboard Discharge main. The main would be approximately 100 feet in length and would connect to the new underground 10,000-gallon tank (see next item).



Source: BergerABAM 2010

Figure ES–5. Key Upland Project Features

- Removal of an aboveground 10,000-gallon oily wastewater tank and installation of a new underground 10,000-gallon oily wastewater tank at the same site to make room for the new security fence.
- One new 8-inch diameter storm drain to collect water runoff from the wharf, warping wharf, and trestle structures. The storm drain would be connected to approximately 18 catch basins with filter cartridges. The storm drain and catch basin would be located solely on the proposed structure.
- A new 40- by 15-foot steel utility building to replace an existing utility building. The new utility building would be located within the project site between the southeast corner of the existing EHW and the existing retention pond.
- Two new double-ended substations located on the wharf structure. One substation would contain two 2,500-kilovolt-ampere (kVA) transformers, and the second would contain two 2,000 kVA transformers. Approximately 10 smaller transformers required to meet the energy needs of the new facility would be located on the wharf structure. The substation switchgear would be provided with circuit breakers with substation controls co-located with the transformers. One 200-kilowatt (kW) generator and one 125-kW generator would be located on the wharf structure. The exact dimensions of the substations would be determined during the final design stage.
- Approximately 1,200 feet of new duct bank (an assembly of electrical and communication conduits encased in concrete ducting) that would replace 500 feet of existing ducting. Demolition of the old and installation of the new ducting would be confined between Archerfish Road, the existing retention pond, and the proposed project.
- Three new 8- by 10-foot utility manholes. Two of the new manholes would be located adjacent to the new utility building on the east side. The third would be located on the south side of the end of Archerfish Road.

For all alternatives, the number of construction workers for all project components would vary between approximately 100 and 260 during the construction period. Most of the upland construction would occur in the first 10 months of project construction. General construction (except pile driving) would typically occur between 7:00 AM and 10:00 PM 6 days per week. Construction materials would arrive via truck and barge. Construction debris would be hauled off the site to an approved disposal facility.

As part of the proposed action, approximately 20 existing facilities and/or structures in proximity to the EHW-2 would be modified or, in the case of five buildings (including the existing pure water facility), demolished to comply with DDESB and NOSSA requirements to protect buildings located in the vicinity of explosives handling operations. The scope of facility modifications would primarily include replacement of doors and windows and possibly the modification or addition of building structural components such as walls, interior and exterior columns, beams, and joists and the replacement of existing roof systems. These modifications would not affect vegetated or undeveloped areas near the buildings to be modified. Three new buildings would be constructed to house the functions of four of the buildings to be demolished. These buildings and replacement parking spaces would be at a 2.6-acre site in an existing industrial area of the Lower Base, away from the waterfront (Figure 2–1). Another facility, the pure water facility, would be relocated from a site adjacent to the northern trestle to Delta Pier to a 0.5-acre site adjacent to the southern trestle to Delta Pier (Figure 2–1). After construction of

all upland facilities, including the three new buildings, replacement parking spaces, and pure water facility, there would be 3.6 acres of new impervious surface while 6.9 acres would be revegetated with native forest and shrub species (Table ES–1).

The site of the replacement pure water facility is approximately 600 feet from the closest part of Delta Pier itself. Wastewater from the new pure water facility would be the same as from the existing facility and would be discharged to the base wastewater (sanitary) system. Stormwater from the facility site would be discharged to the existing stormwater system, which is treated prior to discharge to Hood Canal. All wastewater connections would be constructed in existing disturbed areas.

OPERATIONS

Operation of the EHW-2 would not result in an increase in boat traffic at the Bangor waterfront. Rather, a portion of the ongoing operations and boat traffic at the existing EHW and other facilities within the Waterfront Restricted Area (e.g., Delta Pier and Marginal Wharf) would be diverted to the EHW-2. The EHW-2 may be used as a backup explosives handling facility for OHIO-class guided missile submarines currently homeported at the Bangor waterfront when there are no TRIDENT operations at the existing EHW. The EHW-2 may also provide temporary berthing when no ordnance handling operations are occurring at either wharf. No increase in boat traffic would be required to achieve planned operations. The increase in future operations at the waterfront would only require that boats remain at an EHW longer when in port for maintenance and upgrades. Operation of the EHW-2 may require approximately 20 additional military and civilian personnel. The EHW-2 would be staffed 24 hours a day, 7 days a week. Operation of the four relocated facilities would not change from existing operations.

ENVIRONMENTAL IMPACTS

All alternatives would have the same types of environmental impacts; the magnitude of these impacts would vary among the alternatives. The principal types of impacts during project construction would include pile driving noise (and its effects on marine biota), turbidity, and air pollutant emissions. In the long term, impacts would include loss and shading of marine habitat including eelgrass, macroalgae and the benthic community, and interference with the migration of juvenile salmon, some species of which are protected under the Endangered Species Act (ESA). Certain fish species are more susceptible to injury during impact pile driving activities. ESA-listed fish species that may be adversely affected include Hood Canal summer-run chum salmon, Puget Sound Chinook salmon, Puget Sound steelhead, bocaccio, yelloweye rockfish, and canary rockfish. Because they are unlikely to occur in the waters of NBK at Bangor, ESA-listed bull trout all not likely to be adversely affected. All action alternatives may result in behavioral disturbance of marine mammals (Steller sea lion) and bird species (marbled murrelet) protected under the ESA, as well as behavioral harassment of marine mammals protected under the Marine Mammal Protection Act (MMPA). Injury is not expected to any marine mammal, including the Steller sea lion, nor to the marbled murrelet. Marine mammals potentially affected by behavioral harassment would include the ESA-listed Steller sea lion and the following non-ESA-listed species: harbor seals, California sea lions, Dall's porpoises, harbor porpoises, and transient killer whales. ESA-listed southern resident killer whales may be affected indirectly through effects on their prey (salmon). Depending on the species, the appropriate ESA effect determination is either "no effect," "may affect, not likely to adversely affect" or "may affect, likely to adversely affect." Mitigation measures would be implemented to minimize impacts from pile driving noise. Impacts to marine habitats and species would be mitigated by actions proposed in the Mitigation Action

Plan (Appendix F). The Navy consulted with NMFS and the U.S. Fish and Wildlife Service (USFWS) under the ESA, and with NMFS under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). NMFS and USFWS issued Biological Opinions on September 29, 2011, and November 16, 2011, respectively. Regarding MMPA compliance, the Navy has submitted an Incidental Harassment Authorization (IHA) application for the first year of construction and will prepare and submit additional MMPA authorization applications to cover subsequent years of the project. No Incidental Take Statement (ITS) for marine mammals was included in the NMFS Biological Opinion because NMFS Headquarters has not yet authorized incidental take under the MMPA. Following issuance of authorizations for marine mammals under the MMPA, NMFS may amend the ESA Biological Opinion to include an ITS for marine mammals.

Upland impacts would be essentially the same for all alternatives. Upland construction would result in disturbance of approximately 10.3 vegetated acres (plus 1.0 acre in which only trees, not stumps, would be removed) under all alternatives, with 6.9 acres of this being revegetated following construction. The sites of the five demolished buildings would be revegetated with native forest and shrub species. There would be a permanent loss of 0.20 acre of wetland, which would be mitigated. Wildlife would be disturbed by construction noise, especially pile driving. With best management practices (BMPs), replacement of the aboveground 10,000-gallon oily wastewater tank with an underground tank would not adversely affect soils or water resources. No terrestrial animals or plants protected under the ESA, Migratory Bird Treaty Act (MBTA), or Bald and Golden Eagle Protection Act would be affected. Pursuant to the Clean Water Act (CWA), the Navy has submitted a Joint Aquatic Resources Permit Application (JARPA) seeking a Section 404 permit from USACE for impacts to wetlands and fill at the shoreline, and a Section 401 water quality certification from the Washington Department of Ecology (WDOE). The remaining features of the project including the piles, over-water structure, and trestles would be permitted by USACE under Section 10 of the Rivers and Harbors Act (also through the JARPA process). In accordance with the Coastal Zone Management Act (CZMA), the Navy submitted a Phase I Coastal Consistency Determination (CCD) to WDOE on June 14, 2011. WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will submit a Phase II CCD to WDOE in spring 2012. The Phase I CCD is included in Appendix I of this final environmental impact statement (FEIS).

Social impacts would also be similar for all alternatives, except for differences in the duration of construction including pile driving noise. Recreational and residential areas would be disturbed by pile driving noise. Air pollutant emissions would not exceed thresholds for a major source for any alternative. Nearby residential and recreational areas would experience increased noise during construction, but temporary construction noise is exempt from state limitations. Under all action alternatives, the settings of the existing EHW, Delta Pier, and the Shelton-Bangor Railroad Mainline, which are eligible for listing under the National Register of Historic Places, would not be adversely affected by the EHW-2. In December 2011, the State Historic Preservation Officer concurred with the Navy's determination of no adverse effect on historic properties under the National Historic Preservation Act (Appendix I). There would be a small potential for disturbance of archaeological resources during construction; if any such resources were encountered, the Navy would coordinate with the State Historic Preservation Officer and tribes. The project is located in a restricted area, which was established pursuant to 33 CFR 334.1220. Access to tribal fishing areas, the closest of which is approximately 5,000 feet south of the proposed site for the EHW-2 and 1,000 feet south of the proposed pure water facility, would not be affected by any alternative. Implementation of the proposed action would adversely affect fish, which include tribal treaty-reserved resources. A net loss of tribal resources is not anticipated, but pile driving noise during construction may cause the

salmon and steelhead to move to a different location within Hood Canal. This could increase the time allocated to observe the tribes' fishing rights. Tribal divers engaged in resource harvest within this area could experience increased underwater noise levels. Mitigation is included as part of the proposed action to address the impacts to aquatic resources and tribal fisheries.

The Navy has invited and is in government-to-government consultation with the five federally recognized American Indian tribes that have Usual and Accustomed (U&A) areas in the vicinity of the project area: the Skokomish, Port Gamble S'Klallam, Lower Elwha Klallam, Jamestown S'Klallam, and Suquamish Tribes. The proposed action would be consistent to the maximum extent practicable with the Washington State Shoreline Management Act, and would be consistent with the Trident Support Site Master Plan (Trident Joint Venture 1975) for NBK at Bangor and the Kitsap County Comprehensive Plan. Aesthetically, the EHW-2 would add a large industrial structure to the Bangor shoreline of NBK; this structure would be larger for the Floating Wharf Alternative (Alternative 5) than for the other alternatives. The proposed action would not have disproportionate adverse effects on minority or disadvantaged populations. For every $100 million spent by the Navy in construction expenditures, an estimated 874 direct jobs would be created, as well as an estimated 394 indirect and induced jobs. Indirect or induced jobs would be concentrated in the following industries: food services and drinking places, real estate establishment, health care, architectural engineering, wholesale trade, and retail stores. The project cost is estimated to be in excess of $500 million, representing the total economic impact of 4,370 direct jobs and 1,970 indirect and induced jobs. Total economic output to the region would be in excess of $722 million. Based on the economic analysis for the proposed action, the action would provide a substantial economic benefit to the local and regional economy. Existing utility capacity would be sufficient to support the EHW-2, with only minor new connections and stormwater facilities required. Construction and operational impacts to marine and upland transportation would be minor from all aspects of the project, except for delays for traffic crossing the Hood Canal Bridge during construction. Operation of the EHW-2 would result in no increased danger to the public, including children and sensitive receptors in the area. Should any hazardous materials be found during demolition or modification of existing facilities, procedures for proper handling and disposal of the specific materials would be put into place.

The preferred alternative (Alternative 1) combines the less-impacting combined trestles with the less-impacting large-pile wharf. The primary difference in impacts between the Combined Trestle Alternatives (1 and 2) and Separate Trestle Alternatives (3 and 4) would be the greater overwater coverage in shallow water for the Separate Trestle Alternatives. As a result, Alternatives 3 and 4 would have a somewhat greater impact to eelgrass, marine algae, the benthic community, and shallow-water fish habitat than Alternatives 1 and 2. The Large Pile Alternatives (1 and 3) would have somewhat fewer piles (1,250–1,290) and a shorter duration of pile driving (200–420 days) than the Conventional Pile Alternatives (2 and 4), which would entail 1,460–1,500 piles and 275–570 pile driving days. As a result, Alternatives 1 and 3 would have less of an impact from pile driving noise than would Alternatives 2 and 4. Overall construction duration would be shorter for Alternatives 1 and 3 than for Alternatives 2 and 4, resulting in less seafloor disturbance, less noise, and less of an impact to water quality, air quality, and transportation.

Compared to the other action alternatives, the Floating Wharf Alternative (Alternative 5) would have lower construction impacts but greater long-term impacts to marine habitat. Alternative 5 would entail considerably fewer piles than the other alternatives, resulting in less of an impact to marine biota from pile driving noise and less displacement of soft-bottom habitat, as

well as shorter duration of noise impacts to residential and recreational areas. However, Alternative 5 would result in more total overwater coverage than the other alternatives, resulting in generally greater long-term impacts to marine habitats than the other alternatives.

Environmentally Preferable Alternative

Analysis of the alternatives that meet the purpose and need established that the Combined Trestle, Large Pile Wharf Alternative (Alternative 1) is the Environmentally Preferable Alternative. Alternative 1 would have fewer nearshore habitat impacts and less overwater coverage than Alternatives 3, 4, and 5, and would have fewer piles than Alternatives 2, 3, and 4. Alternative 1 would have more piles than Alternative 5. While Alternative 1 would have more temporary construction impacts than Alternative 5, Alternative 1 would have fewer long-term impacts to nearshore habitat than Alternative 5.

Clean Water Act Section 404(b)(1) Analysis

Section 404(b)(1) of the Clean Water Act stipulates that no discharge of dredged or fill materials into waters of the U.S., which include wetlands, shall be permitted if there is a practicable alternative that would have less adverse impact to the aquatic ecosystem, so long as the alternative does not have other significant environmental consequences. Compliance with Section 404(b)(1) guidelines and alternatives analysis has been incorporated into compliance with the National Environmental Policy Act (NEPA) for the proposed action. Accordingly, the Navy considered all practicable alternatives for the proposed action and then considered which alternative best meets the 404(b)(1) criteria.

Based on the existing environmental conditions and analysis of potential impacts to the environment, the Navy designed the preferred alternative to avoid and minimize impacts to the aquatic ecosystem to the greatest extent practicable. Design features include minimizing trestle coverage and width, minimizing the number of pilings, and minimizing building size, as discussed in Section 2.2.8.

The preferred alternative would result in impacts to riparian wetlands and non-wetland waters. As discussed in Section 2.2.1.2, there was no practicable alternative that would meet the Navy's access road requirements and avoid impacts to riparian wetlands. Impacts to non-wetland waters were minimized by combining trestles for the preferred alternative. This reduced the footprint of the shoreline abutment required to support the trestles.

Compensatory mitigation, as detailed in Appendix F, Mitigation Action Plan, would provide mitigating measures for any unavoidable permanent project impacts to waters of the U.S. The project design has been adjusted to the greatest extent possible, to minimize impacts to riparian wetlands and fill in non-wetland waters of the U.S.

The environmental impacts of the alternatives are compared in more detail in Section 2.3 and Table 2–2.

CUMULATIVE IMPACTS

Construction and operation of the EHW-2 would contribute to regional cumulative impacts to marine resources such as shallow-water habitat, including loss of eelgrass, macroalgae, and habitat for juvenile salmon and other fish and invertebrate species. The project would also contribute to cumulative impacts to the marine environment. However, through the implementation of proposed actions in the Mitigation Action Plan, the project's contribution to cumulative impacts would be insignificant.

It is possible that construction of the EHW-2 would overlap in time with construction of other waterfront structures on NBK at Bangor, including pile replacement at EHW-1, the Service Pier barge mooring replacement, Service Pier Extension, Land Water Interface, and Electromagnetic Range projects. In this case, pile driving for the multiple projects could result in cumulative noise impacts. If more than one construction project occurred at the same time, the predominant noise impact would be expansion of the geographic area affected by maximum sound levels. In limited areas where the noise spheres of influence would overlap, the total sound levels would increase by up to 3 A-weighted decibels (dBA). As a result, more individuals of marine species (fish, marine mammals, and marine birds) would be affected, but it is unlikely the population-level effects of the cumulative sound levels would be greater than those of the EHW project alone. Noise impacts to nearby residential and recreational areas would also increase slightly. There are expected to be no major marine construction projects outside of NBK at Bangor with which the NBK at Bangor projects could have cumulative noise impacts. The Test Pile Program did not overlap in time with the EHW-2 project, but it did add an additional season (August to October 2011), during which marine biota on NBK at Bangor were exposed to pile driving noise. A total of 21 days of pile driving were needed to complete this program.

The other strictly construction impacts of the proposed action, such as air and water quality effects, would be minor and highly localized, and thus would not contribute significantly to cumulative impacts in the region.

Impacts to upland habitats and species would be minimal, and all but 3.4 vegetated acres would be revegetated, so there would be little contribution to cumulative upland impacts. As discussed above under Environmental Impacts, the construction and operational impacts of the proposed action to other resources would be minimal, and so would have little potential to contribute to cumulative impacts in the region.

CURRENT PRACTICES, BEST MANAGEMENT PRACTICES, MITIGATION MEASURES, AND REGULATORY COMPLIANCE

The following are the principal measures proposed to avoid, minimize, or compensate for the environmental impacts of the proposed action:

Current Practices and Best Management Practices

- Floating debris barriers and oil booms would be used to minimize water quality impacts during construction.
- Tugboat operations would be managed to minimize suspension of bottom sediments from propeller wash.
- To prevent impacts to the seafloor and benthic community, barges and other construction vessels will not be allowed to run aground.
- In-water construction would observe the Puget Sound Marine Area 13 (northern Hood Canal) in-water work window (July 16 to February 15) as outlined in Washington Administrative Code (WAC) 220-110-271 and posted by the USACE Seattle District (USACE 2010a) to minimize in-water project impacts to potentially occurring juvenile salmonids that would otherwise be exposed to construction activities, including underwater noise produced during pile driving.

- BMPs would be implemented to control runoff and siltation and minimize impacts to surface water, per the *Stormwater Management Manual for Western Washington* (WDOE 2005a).

Mitigation Measures

- During pile driving, acoustic monitoring would be performed to confirm or revise noise predictions.
- During pile driving, the area adjacent to the pile driving site would be monitored by trained observers for the presence of marine mammals and marbled murrelets. Pile driving would be suspended while these species were close enough to be injured.
- It is expected that most pile driving would be done using vibratory rather than impact methods, which would reduce noise levels by 20 decibels root-mean-square (dBRMS) at 33 feet from the source.
- During impact hammer pile driving, air bubble curtains or other noise attenuating devices would be used to minimize noise impacts.
- During both impact and vibratory driving, a soft-start approach to pile driving would be used to induce marine mammals and birds to leave the immediate area. This soft-start approach requires contractors to initiate noise from hammers at reduced energy, followed by a waiting period.
- Impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). Upland construction would occur between 7:00 AM and 10:00 PM.
- The Navy would, as part of the proposed action, undertake marine habitat mitigation in accordance with the Mitigation Action Plan (Appendix F). This habitat mitigation action, including mitigation of eelgrass impacts, would compensate for the impacts of the proposed action to marine habitat and species.
- Following construction, areas not permanently paved or otherwise used for the proposed action (including any affected wetlands) would be revegetated with native forest and shrub species.

Regulatory Compliance

The Navy must comply with a variety of other federal environmental laws, regulations, and Executive Orders (EOs). These include (among other applicable laws and regulations) the following:

- National Environmental Policy Act (NEPA)
- Federal Water Pollution Control Act (CWA)
- Rivers and Harbors Act
- Endangered Species Act (ESA)

- Marine Mammal Protection Act (MMPA)
- Magnuson-Stevens Fishery Conservation and Management Act (MSA)
- Migratory Bird Treaty Act (MBTA)
- Bald and Golden Eagle Protection Act
- Clean Air Act (CAA)
- Coastal Zone Management Act (CZMA)
- National Historic Preservation Act (NHPA)
- Executive Order (EO) 13175, Consultation and Coordination with Indian Tribal Governments
- EO 11593, Protection and Enhancement of the Cultural Environment
- Native American Graves Protection and Repatriation Act (NAGPRA)
- DoD Native American and Alaska Native Policy
- Energy Independence and Security Act (EISA), Section 438
- EO 12898, Environmental Justice
- EO 13045, Children's Health and Safety
- Public Law 85-725, Federal Aviation Act of 1958

In addition, laws and regulations of the state of Washington applicable to Navy actions are identified and addressed in this EIS.

The Navy has completed consultations and/or permit processes associated with the ESA, MSA and NHPA, and is in ongoing consultation regarding the MMPA, CWA, CZMA, and Rivers and Harbors Act. The Navy will comply with conservation measures, reasonable and prudent measures, and/or terms and conditions issued by the responsible agencies to the extent practicable. Government-to-Government consultation with affected American Indian tribes is ongoing.

Table ES–1. Physical Features of the Action Alternatives for the EHW-2

Facility Feature[1]	Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	Alternative 2: Combined Trestle, Conventional Pile Wharf	Alternative 3: Separate Trestles, Large Pile Wharf	Alternative 4: Separate Trestles, Conventional Pile Wharf	Alternative 5: Combined Trestle, Floating Wharf
Total Overwater Area (wharf, access trestle, lightning towers)	273,108 sq ft (6.3 acres)	Same as Alternative 1	288,956 sq ft (6.6 acres)	Same as Alternative 3	371,000 sq ft (8.5 acres)
Overwater Area Shallower than -30 feet MLLW	17,859 sq ft (0.41 acre)	Same as Alternative 1	32,880 sq ft (0.75 acre)	Same as Alternative 3	34,000 sq ft (0.78 acre)
Total Number of Permanent In-Water Piles	Up to 1,250	Up to 1,460	Up to 1,290	Up to 1,500	Up to 440
Number of Piles Shallower than -30 feet MLLW	Approximately 90	Same as Alternative 1	Approximately 160	Same as Alternative 3	Approximately 140
Total Area of Seafloor Displaced by Piles	9,015 sq ft (0.21 acre)	9,050 sq ft (0.21 acre)	9,175 sq ft (0.21 acre)	9,210 sq ft (0.21 acre)	3,360 sq ft (0.08 acre)
Total Area Shallower than -30 feet MLLW Displaced by Piles	361 sq ft (0.008 acre)	Same as Alternative 1	642 sq ft (0.015 acre)	Same as Alternative 3	1,068 sq ft (0.025 acre)
Duration of In-Water Construction [2]	2 to 3 in-water work seasons, including 200 to 400 pile driving days	3 to 4 in-water work seasons, including 275 to 550 pile driving days	2 to 3 in-water work seasons, including 210 to 420 pile driving days	3 to 4 in-water work seasons, including 290 to 570 pile driving days	2 in-water work seasons, including 135 to 175 pile driving days
Total Construction Duration	42 – 48 months	54 – 64 months	42 – 49 months	54 – 64 months	42 – 44 months

Table ES–1. Physical Features of the Action Alternatives for the EHW-2 (continued)

Facility Feature[1]	Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	Alternative 2: Combined Trestle, Conventional Pile Wharf	Alternative 3: Separate Trestles, Large Pile Wharf	Alternative 4: Separate Trestles, Conventional Pile Wharf	Alternative 5: Combined Trestle, Floating Wharf
Main Wharf Dimensions and Area	632 x 250 ft	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	684 x 284 ft
	Total area: 158,000 sq ft, including 43,500 sq ft slip Covered overwater area: 152,200 sq ft				Total area: 194,256 sq ft, including 48,000 sq ft slip Covered overwater area: 184,000 sq ft
Lightning Tower Dimensions and Area	Six, each 30 x 30 ft	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
	Total area: 5,400 sq ft.				
Warping Wharf Dimensions and Area	688 x 40 ft	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	687 x 75 ft
	34,300 sq ft, including connection to access trestle				54,000 sq ft
Trestle Dimensions and Area	1,849 ft long x 40–48 ft wide	Same as Alternative 1	2,280 ft long x 40 ft wide	Same as Alternative 3	Trestles: 325 x 48 ft 664 x 40 ft 440 x 38 ft Dolphin width varies (included in the total) Mooring Booms: 15,500 sq ft (included in total)
	81,208 sq ft		97,056 sq ft		117,000 sq ft

Table ES–1. Physical Features of the Action Alternatives for the EHW-2 (continued)

Facility Feature[1]	Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	Alternative 2: Combined Trestle, Conventional Pile Wharf	Alternative 3: Separate Trestles, Large Pile Wharf	Alternative 4: Separate Trestles, Conventional Pile Wharf	Alternative 5: Combined Trestle, Floating Wharf
Mooring Dolphin Dimensions and Area	N/A	N/A	N/A	N/A	150 x 104 ft 131 x 112 ft 136 x 112 ft Total Area = 45,500 sq ft
Pontoon Dimensions	N/A	N/A	N/A	N/A	Main pontoon: 604 x 114 ft Outer pontoon: 557 x 75 ft End pontoon: 284 x 75 ft Warping wharf pontoon: 688 x 75 ft, with 60 x 38 ft ramp landing
Wharf Deck Top Elevation	20.5 feet above MLLW	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Varies with tide; 12 feet above water surface
Wharf Deck Bottom Elevation	13 feet above MLLW	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	20 feet below water surface
Trestle Deck Top Elevation	20.5 to 28 feet above MLLW	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	22 to 28 feet above MLLW
Trestle Deck Bottom Elevation	15.2 to 22.7 feet above MLLW	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	16.7 to 22.7 feet above MLLW
Number and Size of Main Wharf Piles	140 24-inch 157 36-inch 263 48-inch	140 24-inch 520 36-inch	Same as Alternative 1	Same as Alternative 2	0

Table ES–1. Physical Features of the Action Alternatives for the EHW-2 (continued)

Facility Feature[1]	Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	Alternative 2: Combined Trestle, Conventional Pile Wharf	Alternative 3: Separate Trestles, Large Pile Wharf	Alternative 4: Separate Trestles, Conventional Pile Wharf	Alternative 5: Combined Trestle, Floating Wharf
Number and Size of Warping Wharf Piles	80 24-inch 190 36-inch	80 24-inch 300 36-inch	Same as Alternative 1	80 24-inch 255 36-inch	0
Number and Size of Lightning Tower Piles	40 24-inch 90 36-inch	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Number and Size of Trestle Piles	57 24-inch 233 36-inch	Same as Alternative 1	82 24-inch 248 36-inch	Same as Alternative 3	52 24-inch 143 36-inch
Number and Size of Mooring Dolphin Piles	N/A	N/A	N/A	N/A	115 48-inch
Falsework Piles (temporary)	Up to 150 18-inch to 24-inch	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Number of Upland Abutment Piles (all 24-inch)	55 24-inch (11 additional pile driving days)	Same as Alternative 1	80 24-inch (16 additional pile driving days)	Same as Alternative 3	Same as Alternative 1
New Impervious Surface (new roads, buildings, parking, sidewalks)	3.6 acres	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Construction Laydown Area (temporary)	5 acres	5 acres	5 acres	5 acres	5 acres

Table ES–1. Physical Features of the Action Alternatives for the EHW-2 (continued)

Facility Feature[1]	Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	Alternative 2: Combined Trestle, Conventional Pile Wharf	Alternative 3: Separate Trestles, Large Pile Wharf	Alternative 4: Separate Trestles, Conventional Pile Wharf	Alternative 5: Combined Trestle, Floating Wharf
Upland Area Disturbed (new roads, buildings, parking, utilities, stormwater facilities, construction laydown area)	Temporary: 9.0 acres Permanent: 3.6 acres Total: 12.6 acres	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Trestle Abutment at Shore	103 ft long with 69 ft wing wall on north end Excavation: 2,760 cu yd (300 cu yd below MHHW) Armor rock: 520 cu yd	Same as Alternative 1	160 ft long with two 35 ft wing walls Excavation: 3,560 cu yd (550 cu yd below MHHW) Armor rock: 700 cu yd	Same as Alternative 3	Same as Alternative 1

cu yd = cubic yards; ft = foot/feet; MLLW = mean lower low water; MHHW = mean higher high water; sq ft = square feet

1. Numbers of piles, all categories, are based on the preliminary design.
2. In-water work season is July 16 to February 15.

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
µg/kg	micrograms per kilogram
µg/m^3	micrograms per cubic meter
AAQS	ambient air quality standards
AIRFA	American Indian Religious Freedom Act
APE	Area of Potential Effect
AQI	air quality index
ASI	Archaeological Site Inventory
BMP	best management practice
BOD	biochemical oxygen demand
C4	TRIDENT I C4 missile
CAA	Clean Air Act
CCD	Coastal Consistency Determination
CDP	Census Designated Place
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COMNAVREGNWINST	Commander Navy Region Northwest Instruction
CP	current practice
CSL	Cleanup Screening Level
cu yd	cubic yard
CV	coefficient of variation
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Program
D5	TRIDENT II D5 missile
DAHP	Department of Archaeology and Historic Preservation
dB re 1µPa	decibels referenced to 1 micropascal
dB re 20µPa	decibels referenced to 20 micropascals
dB	decibel
dBA	A-weighted decibel
dbh	diameter at breast height
DDESB	Department of Defense Explosives Safety Board

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

DEIS	draft environmental impact statement
DO	dissolved oxygen
DoD	Department of Defense
DPS	distinct population segment
dw	dry weight
EA	Environmental Assessment
EFH	Essential Fish Habitat
EHW	Explosives Handling Wharf
EIS	environmental impact statement
EISA	Energy Independence and Security Act
ELWS	extreme low water of spring tides
EO	Executive Order
EQ	Extraordinary Quality
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FEIS	final environmental impact statement
FEMA	Federal Emergency Management Agency
FMC	Fishery Management Council
FMP	Fisheries Management Plan
FR	Federal Register
ft	foot/feet
FY	fiscal year
g	gravitational acceleration
GHG	greenhouse gas
GIS	Geographic Information System
gpd	gallons per day
gpm	gallons per minute
GWP	global warming potential
HAP	hazardous air pollutants
HAPC	Habitat Areas of Particular Concern
HCCC	Hood Canal Coordinating Council
HCDOP	Hood Canal Dissolved Oxygen Program
HLUC	Historic Land Use Complexes
HPAH	high molecular weight polycyclic aromatic hydrocarbon
Hz	hertz
IHA	Incidental Harassment Authorization
ILF	in-lieu fee
IMPLAN	Impact Analysis for Planning

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

INRMP	Integrated Natural Resources Management Plan
ITS	Incidental Take Statement
JARPA	Joint Aquatic Resources Permit Application
KB	Keyport/Bangor
KCDNR	King County Department of Natural Resources
kHz	kilohertz
km	kilometer
kV	kilovolt
kVA	kilovolt-ampere
kW	kilowatt
LID	low impact development
LOA	Letter of Authorization
LOS	level of service
LPAH	low molecular weight polycyclic aromatic hydrocarbon
m	meter
MBTA	Migratory Bird Treaty Act
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mgd	million gallons per day
MHHW	mean higher high water
MHWS	mean high water of spring tides
mi	mile
mL	milliliters
MLI	minority and low-income
MLLW	mean lower low water
mm	millimeter
MMPA	Marine Mammal Protection Act
mph	miles per hour
MPN	most probable number
MSA	Magnuson-Stevens Fishery Conservation and Management Act
msec	millisecond
MSF	Magnetic Silencing Facility
MSGP	Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity
MSL	mean sea level
MTCA	Model Toxics Control Act
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

NAVFAC	Naval Facilities Engineering Command
NAVOSH	Navy Occupational Safety and Health
Navy	U.S. Department of the Navy
NBK at Bangor	Naval Base Kitsap at Bangor
NCP	National Oil and Hazardous Substances Contingency Plan
ND	not detected
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOC	Notice of Construction
NOI	Notice of Intent
NOSSA	Naval Ordnance Safety and Security Activity
NO_x	nitrous oxides
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRHP	National Register of Historic Places
NSWCCD	Navy Surface Warfare Center Carderock Division
NTU	Nephelometric Turbidity Units
O_3	ozone
OPNAVINST	Chief of Naval Operations Instruction
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PCE	Primary Constituent Element
PFC	properly functioning condition
PFMC	Pacific Fishery Management Council
PGA	peak ground acceleration
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PNPTT	Point No Point Treaty Tribes
PNPTC	Point No Point Treaty Council
ppm	parts per million
ppt	parts per thousand
PSAMP	Puget Sound Ambient Monitoring Program

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

PSAT	Puget Sound Action Team
PSCAA	Puget Sound Clean Air Agency
PSD	prevention of significant deterioration
PSTRT	Puget Sound Technical Recovery Team
PSU	practical salinity unit
PTRCIT	Property of Traditional Religious and Cultural Importance to an Indian Tribe
PTS	permanent threshold shift
Qva	advanced outwash
Qvt	Vashon till
RCW	Revised Code of Washington
RMS	root-mean-square
ROD	Record of Decision
ROI	Region of Influence
SAIC	Science Applications International Corporation
SARA	Superfund Amendments and Reauthorization Act
SDEIS	Supplement to the DEIS
SECNAVINST	Secretary of the Navy Instruction
SEL	Sound Exposure Level
SEPA	State Environmental Policy Act
SHPO	State Historic Preservation Officer
SL	source level
SMA	Shoreline Management Act
SMP	Shoreline Management Master Program
SMS	Sediment Management Standards
SO_2	sulfur dioxide
SOx	sulfur oxides
SPCC	Spill Prevention, Control, and Countermeasure
SPL	sound pressure level
sq ft	square feet
sq mi	square mile
SQS	sediment quality standards
SR	State Route
SSBN	OHIO Class Ballistic Missile submarines
SSP	Strategic Systems Programs
SUBASE	Naval Submarine Base
SWPPP	Stormwater Pollution Prevention Plan
TCP	Traditional Cultural Property
TL	transmission loss

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

TMDL	total maximum daily load
TOC	total organic carbon
TRIDENT	TRIDENT Fleet Ballistic Missile
T-ROC	Thorndyke Resources Operation Complex
TSS	total suspended solids
TTS	temporary threshold shift
U&A	Usual and Accustomed
U.S.	United States
UCNI	Unclassified Controlled Nuclear Information
USACE	U.S. Army Corps of Engineers
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
W	Watts
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WDOE	Washington Department of Ecology
WDOH	Washington Department of Health
WRA	Waterfront Restricted Area
WSDOT	Washington State Department of Transportation
ZOI	zone of influence

CHAPTER 1

INTRODUCTION

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1.0 INTRODUCTION

Naval Base Kitsap at Bangor (NBK at Bangor), located on Hood Canal approximately 20 miles west of Seattle, Washington (Figure 1–1), provides berthing and support services to United States (U.S.) Department of the Navy (Navy) OHIO Class Ballistic Missile submarines (SSBN), hereafter referred to as TRIDENT submarines. The entirety of NBK at Bangor, including the land areas and adjacent water areas in Hood Canal, is restricted from general public use.

The Navy is proposing to construct and operate a second Explosives Handling Wharf (EHW) on NBK at Bangor to support the TRIDENT Fleet Ballistic Missile (TRIDENT) program. The action proponent is the Navy Strategic Systems Programs (SSP). SSP directs research, development, manufacturing, testing, evaluation, and operational support of the TRIDENT program. The U.S. Army Corps of Engineers (USACE) and the National Marine Fisheries Service (NMFS) are cooperating agencies pursuant to Title 40 of the Code of Federal Regulations, Parts 1501.6 and 16 1508.5 (40 CFR 1501.6 and 1508.5). Section 1501.6 of the Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) provides that: "Upon request of the lead agency, any other Federal agency which has jurisdiction by law shall be a cooperating agency. In addition, any other Federal agency which has special expertise with respect to any environmental issue, which should be addressed in the statement may be a cooperating agency upon request of the lead agency. An agency may request the lead agency to designate it a cooperating agency." Pursuant to this section, the Navy invited USACE and NMFS to participate in development of this Environmental Impact Statement (EIS) as cooperating agencies, and both agencies accepted. USACE regulates activities in the Nation's waters for the protection and utilization of water resources under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act (CWA). NMFS administers the National Oceanic and Atmospheric Administration's (NOAA) fisheries service programs. NMFS' principal responsibilities are implementation of the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA).

As part of the Nation's sea-based strategic deterrence mission, TRIDENT submarines play a critical role of great strategic importance for the United States. The TRIDENT program consists of submarine-launched ballistic missiles, which have been a vital part of the Navy's strategic deterrence mission since 1956 and are an integral component of the Navy's ability to defend the nation. NBK at Bangor is the Pacific homeport for the Navy's TRIDENT submarine fleet.

NBK at Bangor is the only naval installation on the west coast with the specialized infrastructure able to support the TRIDENT program. The specialized infrastructure includes buildings, utilities, and systems used to support missile production shops, missile maintenance, missile component storage, and missile handling cranes, in addition to providing security and operational port facilities. These facilities support every aspect of the TRIDENT program operations, services, and systems.

Development on NBK at Bangor over the past 40 years was analyzed in the TRIDENT Facilities EIS, which was prepared for construction of the ballistic missile submarine support portion of the base (Navy 1974). That EIS was supplemented in 1976 and 1978 (Navy 1976, 1978). The TRIDENT Facilities EIS addressed the need for three EHWs on NBK at Bangor for long-term support of the TRIDENT program. Subsequent environmental analyses on NBK at Bangor focused on specific development actions at the base and adjacent waterfront.

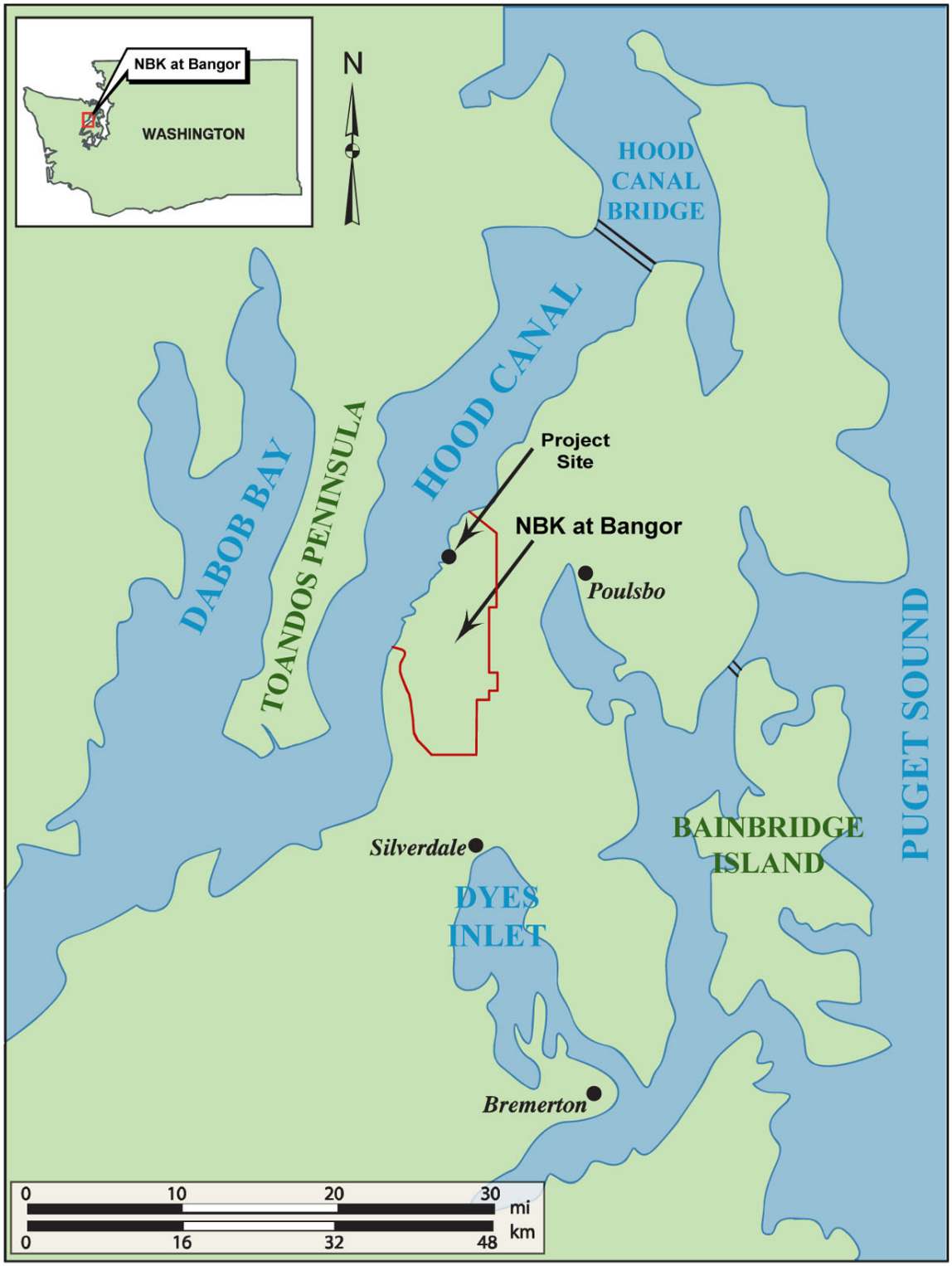

Figure 1–1. Site Location Map for NBK at Bangor

A 1989 Environmental Assessment (EA) for the TRIDENT D5 Facilities Upgrade Program included consideration of the construction of a second EHW (Navy 1989). Although the original TRIDENT Facilities EIS identified the need for three EHWs, only one EHW was built during construction of the TRIDENT base. Subsequent analyses (most recently, the Navy Waterfront Functional Plan, 2009 Update [Navy 2009c]) determined that only two EHWs are needed on NBK at Bangor.

1.1 PROJECT LOCATION

The proposed location for the second EHW (EHW-2) is immediately south of the existing EHW and its adjacent land areas, at the Bangor waterfront of NBK (referred to as the Bangor waterfront throughout this EIS). Two restricted areas are associated with NBK at Bangor: Naval Restricted Areas 1 and 2 (33 CFR 334.1220) (Figure 1–2). Naval Restricted Area 1 covers the area to the north and south along Hood Canal encompassing the Bangor waterfront. The regulations associated with Naval Restricted Area 1 state that no person or vessel shall enter this area without permission from the Commander, Naval Submarine Base Bangor, or his/her authorized representative. Naval Restricted Area 2 encompasses the waters of Hood Canal within a circle 1,000 yards (3,000 feet) in diameter centered at the north end of NBK at Bangor and partially overlapping Naval Restricted Area 1.

The regulations associated with Naval Restricted Area 2 state that navigation will be permitted within that portion of this circular area not lying within Restricted Area 1 at all times except when magnetic silencing operations are in progress. These operations would not interfere with the proposed action.

"Bedlands" are those aquatic lands that are submerged at all times and that include navigable salt/fresh waters of the state. The bedlands adjacent to NBK at Bangor are state lands under the jurisdiction of the Washington Department of Natural Resources. Nevertheless, the Navy retains a navigational servitude in all navigable waters regardless of the ownership of submerged lands. Thus, the U.S. Navy may take actions concerning navigation over any navigable channel such as Hood Canal, to include the submerged lands beneath the water column. On NBK at Bangor, restrictions on access to the waters immediately adjacent to the base are a valid exercise of the navigational servitude, as would be the construction of any facility relating to navigation, such as the existing EHW and the EHW-2. The Coastal Zone Management Act (CZMA) establishes national policy to protect resources in the coastal zone. Under the CZMA, any Navy activities affecting land or water use or natural resources of the coastal zone must be consistent to the maximum extent practicable with the enforceable policies of the state coastal management programs.

Hood Canal is considered a navigable water as defined by the Rivers and Harbors Act. Section 10 of the Rivers and Harbors Act regulates structures and works in, over, under, or affecting navigable waters of the U.S. The role of USACE with respect to navigation is to provide safe, reliable, and efficient waterborne transportation systems (channels, harbors, and waterways) for movement of commerce, national security needs, and recreation.

There are seven major structures along the Bangor waterfront (Figure 1–2). Nevertheless, much of the Bangor shoreline is in relatively natural condition, with only 6 percent classified as "modified" by the Kitsap County Nearshore Habitat Assessment (Judd 2009). The substrate ranges from sand and gravel to cobble and rock in intertidal and shallow subtidal areas, with silty or muddy substrate being predominant in deeper zones.

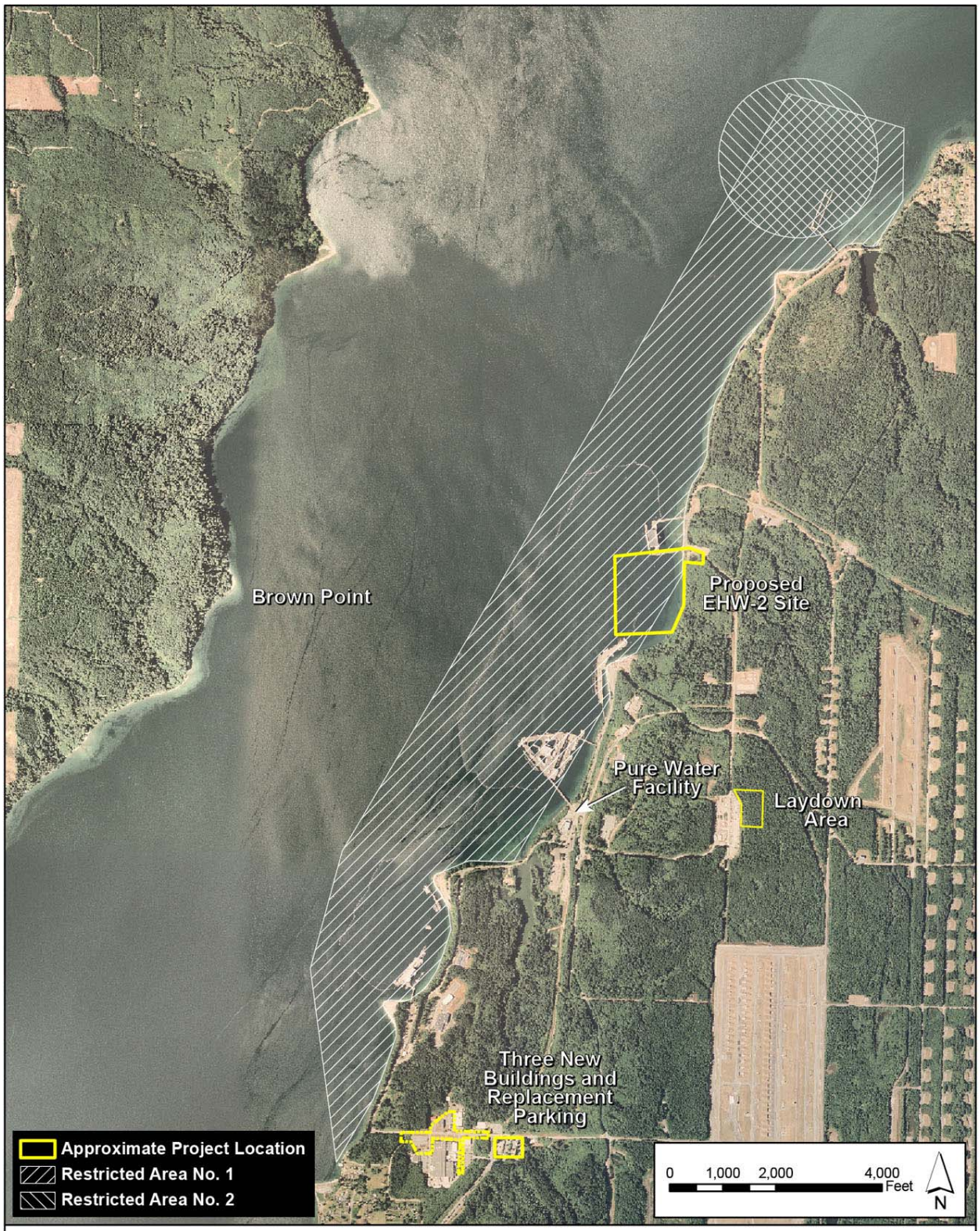

Figure 1–2. NBK at Bangor Restricted Areas

Beds of macroalgae and eelgrass are present along much of the shoreline to depths of approximately 20 feet below mean lower low water (MLLW), although some species of macroalgae occur sparsely as deep as 60 feet below MLLW. A shoreline cliff ranging from a few feet to over 20 feet in height separates the marine from the terrestrial environment. The upland area of the base is primarily forested (68 percent of the base), while 27 percent is developed. There are numerous wetlands, as well as surface water drainages discharging to Hood Canal.

NBK at Bangor is surrounded by private communities along its north, south, and east borders (see Figure 3.21–1 in Section 3.21, Land Use and Recreation). The closest off-base communities are approximately 1.5 miles north of the general project area; the exception is an off-base residential area located approximately 0.1 mile from an outlying site (for the three new buildings) of the proposed action. The closest community west of the base across Hood Canal is over 1.5 miles away, and the closest on-base residential community is approximately 4 miles south of the proposed EHW-2 site and 2 miles southeast of the outlying site.

The project area is also within the Usual and Accustomed (U&A) fishing area of several American Indian tribes, including the Skokomish, Lower Elwha Klallam, Port Gamble S'Klallam, Jamestown S'Klallam, and Suquamish Tribes.

In the cooperative agreement of 1997, signed between the Navy and the Point No Point Treaty Council (Skokomish, Port Gamble S'Klallam, Lower Elwha Klallam, and the Jamestown S'Klallam Tribes), the Navy permitted tribal access to the intertidal beach south of Delta Pier for the "enhancement, perpetuation, and harvest of shellfish" (Navy 1997). The tribal access area is approximately 5,000 feet south of the proposed EHW-2 site and 1,000 feet south the proposed pure water facility.

1.2 PURPOSE AND NEED

The Navy proposes to construct and operate the EHW-2 adjacent to the existing EHW on NBK at Bangor. The purpose of the proposed action is to support future TRIDENT program requirements for the eight TRIDENT submarines currently homeported at the Bangor waterfront and the TRIDENT II (D5) Strategic Weapons System. The proposed action is needed because the existing EHW alone will not be able to support TRIDENT D5 program requirements. The Navy has no plans at this time to change the number of TRIDENT submarines on NBK at Bangor, and the proposed action is not intended to support an increase in TRIDENT submarines. In an analysis to determine future TRIDENT program needs,[1] the Navy concluded that EHW facility support would be required for approximately 400 operational days per year[2] due to changing operational and weapons system requirements. Several different scenarios on how to fulfill this requirement were analyzed in a business case analysis, and the only feasible solution was two EHWs.

The existing EHW was constructed in the late 1970s to handle the TRIDENT I C4 missile (C4). In the 1990s, this missile was replaced by the TRIDENT II D5 missile (D5). The

[1] Explosives Handling Wharf-2 Business Case Analysis & Risk Assessment, November 6, 2008, Secret/Formerly Restricted Data.

[2] An EHW operational day is any day that supports fleet and missile requirements. The requirement for approximately 400 operational days per year takes into account New Strategic Arms Reduction Treaty (START) requirements.

D5 is larger, more complex, and requires more time to handle and maintain than the C4. In 2001 the Navy began the TRIDENT II (D5) Life Extension Program, which will extend the life of the current TRIDENT weapons systems through 2042. Life extension is accomplished through upgrades to missiles (primarily electronics) to address technological obsolescence. As the systems age, these upgrades will require more frequent and longer handling and maintenance. Although some upgrades and maintenance can be performed at locations other than the EHW, the submarines must still dock at the EHW to remove components that are transported to other work locations.

The existing EHW can currently only provide approximately 200 operational days per year due to required facility preventative maintenance and pile replacement. The Navy anticipates that after pile replacement concludes in 2024, the existing EHW will provide approximately 300 operational days per year. As depicted below, the existing EHW under current conditions can only provide 185 (or approximately 200) operational days per year; once pile replacement is completed in 2024, the existing EHW can only provide 305 (or approximately 300) operational days per year of support. The Navy has determined that the TRIDENT fleet will need EHW facility support approximately 400 days per year to support the TRIDENT mission through 2042.

The proposed EHW-2 would provide 300 operational days per year. The proposed EHW-2 would provide approximately 300 operational days per year. Two EHWs would provide an available capacity of approximately 500 operational days until 2024 and 600 operational days per year thereafter. Although there would be an excess of operational days with two EHWs, one EHW alone would not provide enough operational days to support the TRIDENT mission through 2042. For example, in a given year:

Existing EHW: Current Conditions		**Existing EHW: Pile Replacement Complete (2024)**	
365	days/year	365	days/year
- 180	days (120 days for pile replacement and 60 days for maintenance)*	- 60	days (for maintenance)
= 185	operational days (approximately 200 operational days per year)	= 305	operational days (approximately 300 operational days per year)

*Refer to Section 1.2.2 for more information on the condition of the existing EHW and pile replacement.

With only the existing EHW, there would be a shortfall of approximately 200 operational days until 2024 when pile replacement is complete, and a shortfall of approximately 100 operational days thereafter. A single EHW cannot provide the 400 days per year needed to meet TRIDENT program requirements.

The EHW-2 would be designed to meet all TRIDENT program requirements, with the minimum structure. Figure 1–3 depicts EHW capabilities and future program needs.

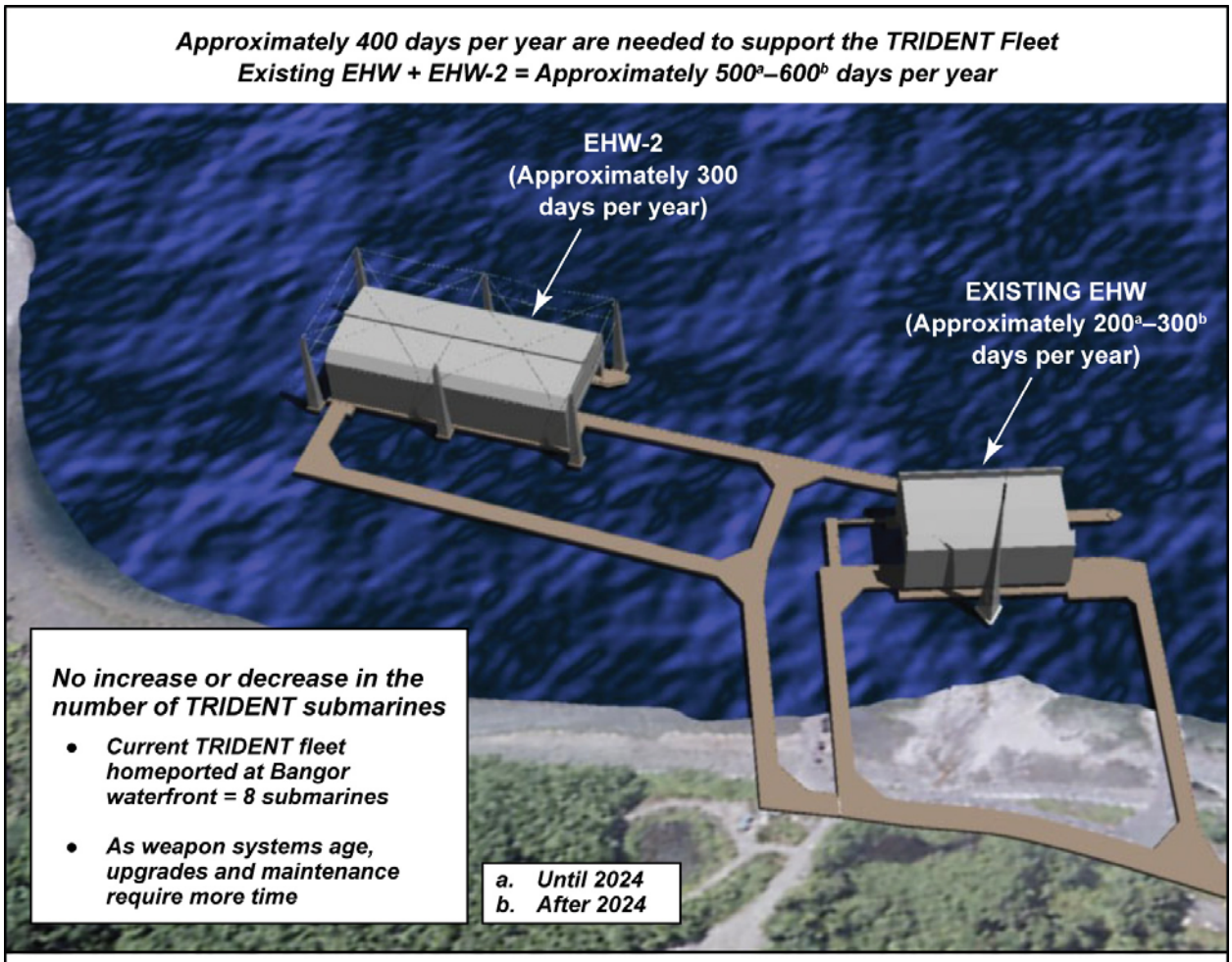

Figure 1–3. TRIDENT Program, Existing EHW Capability and Program Requirements

1.2.1 Changing Operational and Weapons System Requirements

Operating and maintaining the current fleet of TRIDENT submarines homeported at the Bangor waterfront through 2042 requires offloading and loading missiles, performing routine operations, and upgrading systems. Proper maintenance and upgrades are needed to ensure that the TRIDENT submarine program remains a vital part of the nation's sea-based strategic deterrence mission.

All phases of maintenance and testing rely on the load/offload capability of the EHW facilities servicing the fleet. The TRIDENT mission requires more frequent, longer handling and maintenance than previously for the following reasons: D5 Life Extension Program, fleet reconfigurations, and engineered refueling overhauls.

- The D5 Life Extension Program involves work on missile and guidance electronics to extend the D5 system through 2042. Under this program, all D5 missiles must be removed from each submarine, modernized, and reinstalled into the submarine. Although some modernization work can be performed at locations other than the existing EHW, the submarines must still dock at the existing EHW to remove components that are transported to other work locations.

- Fleet Reconfigurations. Unlike the previous C4 missile, which had only one configuration for the entire program, the D5 missile configuration is reviewed and revised annually. The revised configuration requires the missiles to be removed and replaced with missiles with different configurations.
- Engineered Refueling Overhauls. These overhauls require full on/offload of missiles, and will occur through FY2021. These overhauls replace the fuel in the submarine's power plant and are done at locations other than NBK at Bangor.

1.2.2 Condition of the Existing EHW

The existing EHW is a 30-year-old offshore facility that, due to age and historic use, requires increasing intervals of planned facility maintenance and structural and mechanical upgrades, not unlike other aging port facilities. The piles that support the EHW are deteriorating due to exposure to the marine environment and are being replaced on a planned schedule that extends until 2024. The mechanical systems, like the wharf structure, have been in service for 30 years and require more planned maintenance as they age. When maintenance is performed on the mechanical systems, notably the cranes, the existing EHW is unavailable for operations.

The availability of the existing EHW will be limited due to pile replacement and mechanical system maintenance. The EHW is unavailable for operations approximately 120 days per year due to pile replacement, and cranes are not available for use at least 60 days per year due to maintenance. There is only limited opportunity to work on pile replacement at the same time mechanical systems are being maintained. For example, cranes cannot be load-tested while pile replacement is under way. To protect migrating salmon, pile replacement can only occur between mid-July and mid-February, further complicating the EHW operating schedule. Once pile replacement is complete in 2024, the existing EHW will be available approximately 300 operational days per year. The TRIDENT fleet will need EHW facility support approximately 400 operational days per year, which is more than the number of days the current EHW facility would be able to provide once pile replacement has been completed.

1.2.3 Summary

The Navy has relied on a single EHW to support the TRIDENT program on NBK at Bangor since the late 1970s, when the existing EHW was built. The existing EHW is a 30-year-old offshore facility that requires planned maintenance and upgrades. Ongoing and planned facility maintenance and upgrades significantly limit the number of days the existing EHW is available to support the TRIDENT submarines. The changing operational and weapons systems requirements, coupled with the condition of the existing EHW, requires Navy action to ensure that NBK at Bangor has the necessary facilities to support and maintain its current fleet of TRIDENT submarines and missile system. The Navy's proposed action is to construct and operate the EHW-2 on NBK at Bangor. The EHW-2 is essential to maintaining TRIDENT program capabilities and is therefore essential to national security.

Appendix A, *Purpose and Need Supplemental Information, TRIDENT Support Facilities Explosives Handling Wharf* (marked Department of Defense [DoD] Unclassified Controlled Nuclear Information [UCNI]), provides additional information about the proposed action's

purpose and need.[3] All non-UCNI information regarding the purpose and need for the proposed action is presented above.

1.3 EIS SCOPE

Table 1–1 is a summary of the comments received during the scoping process that are within the scope of this EIS. These comments are addressed in this EIS. Commenters included private citizens, tribes, regulatory agencies, and elected officials. Comments received during scoping that are beyond the scope of this EIS are related to abolishment of nuclear weapons, cost of the project, and operational details of the TRIDENT program.

Table 1–1. Summary of Comments Received During Scoping [1]

CATEGORY	COMMENT SUMMARY
Purpose and Need	• Need for a second Explosives Handling Wharf (EHW)
Alternatives	• Consideration of alternative locations for the EHW-2 • Consideration of an alternative site on NBK at Bangor • Consideration of combining trestles with existing EHW • Consideration of demolishing existing EHW • Consideration of minimizing the number of trestles and pilings • Consideration of the floating wharf alternative • Construction duration differences between the alternatives • Reasons the preferred alternative is preferred
General Impacts	• Need for the environmental analysis for the EHW-2 to consider lessons learned from the existing EHW • Mitigation and restoration measures • Health and human safety concerns • Air quality concerns • Concern about appearance of new structure
Water Quality	• Potential for discharge of fuels and other contaminants • Potential for propeller wash impacts • Potential for contaminated sediments to be exposed
Marine Life	• Impacts to intertidal zone and shallow-water habitat • Impacts to eelgrass and shellfish • Impacts to fish, marine mammals, and birds • Impacts to threatened and endangered species • Impacts from pile driving noise • Impacts from lighting • Impacts from invasive species • Impacts to littoral drift • Means to minimize impacts to the marine environment

[3] This document contains DoD UCNI information about security measures for the physical protection of DoD Special Nuclear Material equipment or facilities. Due to the sensitive nature of DoD UCNI, this information is not available for public dissemination. Chief of Naval Operations Instruction (OPNAVINST) 5570.2, *Department of Defense Unclassified Controlled Nuclear Information (DoD UCNI)* allows for requests for special access to DoD UCNI information. Persons granted access to DoD UCNI must have a need to know the specific information, and must meet OPNAVINST 5570.2 requirements.

Table 1–1. Summary of Comments Received During Scoping [1] (continued)

CATEGORY	COMMENT SUMMARY
Noise	• Impacts of pile driving on marine species • Impacts of noise on residential areas and recreation • Means to minimize noise impacts
Cultural Resources	• Impacts to traditional resources such as shellfish and salmon • Consultation with American Indian tribes
Transportation	• Impacts to commercial and recreational marine traffic
Cumulative Impacts	• Need to consider the impacts of the EHW-2 in conjunction with other projects in the region

1. Comments in this table are those within the scope of this EIS.

Comments were received during scoping about the potential impact of the project on the Navy's Swimmer Interdiction Security System, which includes Navy military working marine mammals at the Bangor waterfront. In accordance with a protocol approved by the Space and Naval Warfare Systems Center Pacific Senior Scientist for Animal Care, the Navy would use protective measures to ensure the health and welfare of Navy marine mammals during construction of the EHW-2. These measures have been used in San Diego and other deployment locations to protect Navy marine mammals from adverse effects of pile driving and other noise sources. Because the Navy marine mammals are not part of the existing natural environment, they are not further addressed in this EIS.

This EIS presents alternatives that meet the purpose and need of the proposed action, describe existing baseline conditions, and evaluate impacts of the alternatives to the resources listed below. These resources were identified based on their potential to be affected by the proposed action and on their potential for public interest (reflected in part by comments received during scoping). The cumulative impacts of the proposed action (in combination with past, present, and future actions) will also be reviewed.

1.3.1 Marine Environment

- Hydrography (currents and tides)
- Water Quality
- Sediment
- Underwater Noise
- Marine Vegetation
- Plankton
- Benthic Communities and Shellfish
- Marine Fish
- Marine Mammals
- Marine Birds

1.3.2 Upland Environment

- Geology and Soils
- Surface Water and Groundwater
- Vegetation

- Wetlands
- Wildlife

1.3.3 Social Environment

- Noise
- Air Quality
- Cultural Resources
- American Indian Traditional Resources
- Coastal and Shoreline Management
- Land Use and Recreation
- Aesthetics
- Socioeconomics
- Utilities and Energy
- Transportation
- Public Safety

1.4 REGULATORY CONSIDERATIONS

The Navy must comply with a variety of other federal environmental laws, regulations, and Executive Orders (EOs). These include (among other applicable laws and regulations) the following:

- National Environmental Policy Act (NEPA)
- Federal Water Pollution Control Act (Clean Water Act [CWA])
- Rivers and Harbors Act
- Endangered Species Act (ESA)
- Marine Mammal Protection Act (MMPA)
- Magnuson-Stevens Fishery Conservation and Management Act (MSA)
- Migratory Bird Treaty Act (MBTA)
- Bald and Golden Eagle Protection Act
- Clean Air Act (CAA)
- Coastal Zone Management Act (CZMA)
- National Historic Preservation Act (NHPA)
- EO 13175, Consultation and Coordination with Indian Tribal Governments
- EO 11593, Protection and Enhancement of the Cultural Environment
- Native American Graves Protection and Repatriation Act (NAGPRA)
- DoD Native American and Alaska Native Policy
- Energy Independence and Security Act (EISA), Section 438
- EO 12898, Environmental Justice
- EO 13045, Children's Health and Safety
- Public Law 85-725, Federal Aviation Act of 1958

In addition, laws and regulations of the state of Washington applicable to Navy actions are identified and addressed in this EIS.

1.5 ENVIRONMENTAL REVIEW PROCESS

NEPA requires that environmental information be made available to the public, agencies, and other stakeholders before decisions are made. The Navy's public involvement process for the proposed action is designed to inform stakeholders of the Navy's proposed action early in the NEPA process, to provide stakeholders with the opportunity to comment on the Navy's proposed action, and to keep stakeholders informed throughout the NEPA process. The Navy's public involvement plan includes:

- **Publish Notice of Intent (NOI).** An NOI was published on May 15, 2009, in the *Federal Register* (FR) announcing the Navy's intent to prepare an EIS. Additional public notice occurred in several local newspapers (e.g., Kitsap Sun, Seattle Times).
- **Develop Mailing List.** A mailing list was developed to ensure stakeholders receive NEPA documentation and related information. The mailing list will be updated throughout the NEPA process.
- **Establish and Sustain Regulatory Communication and Coordination.** The Navy will continue to meet with key regulatory agencies, including USACE, NMFS, the Washington Department of Ecology (WDOE), the Department of Archaeology and Historic Preservation (DAHP), and the U.S. Fish and Wildlife Service (USFWS).
- **Ensure Government-to-Government Consultation.** The Navy has invited and is in government-to-government consultation with the five federally recognized American Indian tribes that have U&A areas in the vicinity of the project area: the Skokomish, Port Gamble S'Klallam, Lower Elwha Klallam, Jamestown S'Klallam, and Suquamish Tribes.
- **Conduct Scoping.** Scoping provides an early and open process for determining the scope of issues and for identifying the significant issues related to a proposed action. The scoping period for this EIS was May 15 through July 17, 2009. Throughout the scoping period, the Navy solicited public and agency comments through press releases; newspaper advertisements; and letters to the public, local governments, federal and state agencies, and American Indian tribes. Scoping meetings were held on June 23, 24, and 25, 2009, in Poulsbo, Port Ludlow, and Seattle, Washington, respectively. Written and oral comments were sought during scoping. Comments were also accepted by mail and email. Comments received during the scoping period (Table 1–1) were considered in preparing the Draft Environmental Impact Statement (DEIS). The Scoping Summary Report is provided as Appendix G.
- **Prepare a DEIS.** The DEIS describes the project purpose and need, explains the proposed action and alternatives considered, presents the existing conditions in the region potentially affected, and provides an analysis of the environmental consequences (including short-term, long-term, and cumulative impacts) of the proposed action and each alternative, including a No-Action Alternative. To ensure the widest dissemination possible, the DEIS was distributed to agencies, tribes, local libraries, members of the public who requested copies, and all stakeholders on the mailing list; it was also made available on the project website. The 45-calendar-day public comment period began when the U.S. Environmental Protection Agency's (USEPA's) Notice of Availability (NOA) for the DEIS was published in the FR on March 18, 2011.

- **Allow for Public/Agency Review.** The DEIS was made available on March 18, 2011, for public, government agency, American Indian, and other stakeholder review and comment for 45 calendar days upon FR publication of the USEPA's NOA for the DEIS. The comment period was extended through May 17, which brought the length of the public comment period to 60 days. Public hearings were held during the DEIS comment period on April 19, 20, and 21, 2011, in Poulsbo, Chimacum, and Seattle, Washington, respectively. The hearings allowed the public and agencies an opportunity to provide both oral and written comments on the DEIS. Comments received during the DEIS public comment period were considered in preparing this Final Environmental Impact Statement (FEIS). All comments submitted at the public hearing and those received by email, U.S. mail, or posting to the project website were given equal consideration in preparation of this FEIS. A summary of the comments on the DEIS is provided in Table 1–2. Appendix G provides a summary of the public review process. Appendix M includes all of the public comments received on the DEIS as well as responses to those comments.
- **Prepare a Supplement to the DEIS.** A Supplement to the DEIS (SDEIS) was prepared to present new project and environmental information that became available after the publication of the DEIS. The SDEIS was made available for public, government agency, American Indian, and other stakeholder review and comment. The Navy's NOI was published in the FR on October 3, 2011. The 45-day public comment period began with the FR publication of the USEPA's Notice of Availability for the SDEIS on October 7, 2011, and ended on November 21, 2011. Comments received during the SDEIS public comment period (summarized in Table 1–3) were considered in preparing the FEIS, and the SDEIS analyses have been incorporated into the FEIS. All comments received by email or U.S. mail, or posted to the project website were given equal consideration in preparation of the FEIS. Appendix N includes all of the public comments received on the SDEIS as well as responses to those comments.
- **Prepare Responsiveness Summary.** A responsiveness summary, consisting of the Navy's response to each substantive public comment on the DEIS and SDEIS, was prepared. Where appropriate, FEIS sections were revised to respond to public comments. The summary, as well as transcripts of the DEIS public hearings, are included as appendices to this FEIS.
- **Prepare an FEIS.** This FEIS was prepared to reflect public and agency comments, the Navy's responses, and additional information received from reviewers. The FEIS provides the decision maker with a comprehensive review of the potential environmental consequences of selecting the preferred alternative and other alternatives. This FEIS is being circulated in the same manner as the DEIS. EPA's publication of the NOA for the FEIS begins the 30-day wait (no action) period.
- **Issue a Record of Decision.** The final step in the NEPA process is signing of the Record of Decision (ROD). The U.S. Navy signs the ROD and publishes the NOA of the ROD in the FR. The ROD will state the Navy's decision, identify alternatives considered, address any additional substantive comments received that were not addressed in the FEIS, and discuss other considerations influencing the decision. The ROD will also describe efforts planned to avoid or minimize environmental impacts resulting from the Navy's decision.

Table 1–2. Summary of Public Comments on the DEIS

CATEGORY	COMMENT SUMMARY
General/Process	• Compliance with DEIS public review requirements of NEPA • Withholding of UCNI and classified information from the public • Strategic defense policy of the U.S. • Impacts to the health of Hood Canal
Purpose and Need	• Need for a second EHW considering current efforts toward disarmament • Need for a second EHW considering one has sufficed for many years • Justification of the purpose and need in the EIS
Proposed Action	• Size of the EHW-2 • Seismic design of the EHW-2
Alternatives	• Alternative sites other than Bangor • Alternative locations at Bangor • Alternative designs to reduce environmental impacts • Upgrading existing EHW • Removing existing EHW once EHW-2 is built • Serious consideration of No-Action Alternative
Hydrography, Water Quality and Sediment Quality	• Impacts to littoral drift (longshore sediment transport) • Changes in sediment accumulation and erosion patterns • Impacts to dissolved oxygen and turbidity • Other impacts to water and sediment quality
Underwater and Airborne Noise	• Impacts of pile driving noise on fish, marine birds, and marine mammals • Impacts of construction noise to nearby residents
Marine Vegetation, Plankton and Benthic Community	• Impacts to eelgrass and other marine vegetation from turbidity and overwater shading • Mitigation of eelgrass impacts • Impacts to commercially important shellfish
Marine Fish	• Impacts from pile driving noise • Impacts to migration of juvenile salmon • Loss of fish habitat • Impacts to forage fish
Marine Birds and Mammals	• Impacts from pile driving noise and measures to minimize such impacts • Impacts to fish prey
Geology, Soils, Surface and Groundwater	• Impacts to the project and surrounding community from earthquakes and tsunamis
Cultural Resources and American Indian Traditional Resources	• Impacts to tribal access to fishing areas • Impacts to tribal traditional resources, primarily salmon
Land Use, Recreation, and Coastal Zone Management	• Aesthetic impacts of a large new structure • Compliance with the Coastal Zone Management Act

Table 1–2. Summary of Public Comments on the DEIS (continued)

CATEGORY	COMMENT SUMMARY
Transportation	• Impacts to marine vessel traffic • Impacts to traffic on the Hood Canal Bridge
Public Safety	• Increased risks to public safety from operation of a second EHW • Risks from earthquakes and tsunamis
Compensatory Habitat Mitigation	• Early development status of the In-Lieu Fee Program and completion in time for final project review • Consideration of alternative strategies for habitat mitigation • Inclusion of all relevant parties in the compensatory habitat mitigation process
Cumulative Impacts	• Significance and mitigation of project's contribution to cumulative impacts in Hood Canal • Scale of the Navy's analysis of cumulative impacts

Table 1–3. Summary of Public Comments on the Supplement to the DEIS

CATEGORY	COMMENT SUMMARY
General/Process	• Withholding of UCNI and classified information from the public • Tribe wishes to participate in Essential Fish Habitat (EFH) analysis • Strategic defense policy of the United States • Impacts to the health of Hood Canal • Federal "green" requirements • Project should be delayed
Purpose and Need	• Need for a second EHW considering current efforts toward disarmament • Need for a second EHW considering one has sufficed for many years • Justification of the purpose and need in the EIS
Proposed Action	• Size of the EHW-2 • Impacts from operations • Additional information needed on the new upland components • Environmental impacts from remodeling and removal of 20 buildings addressed
Alternatives	• Alternative that would provide the needed operational days without requiring two EHWs • Alternative sites other than Bangor • Upgrading existing EHW
Hydrography, Water Quality and Sediment Quality	• Monitoring plan needed for water quality, sediment quality, circulation patterns, and restoration of sediment disturbance • Potential for spills or releases • Impacts to littoral drift (longshore sediment transport) • Changes in sediment accumulation and erosion patterns • Other impacts to water and sediment quality
Underwater and Airborne Noise	• Impacts of pile driving noise on fish, marine birds, and marine mammals

Table 1–3. Summary of Public Comments on the Supplement to the DEIS (continued)

CATEGORY	COMMENT SUMMARY
Marine Vegetation, Plankton and Benthic Community	• Impacts to marine vegetation and benthic community need to be more clearly defined • Habitat fragmentation not addressed • Impacts to marine vegetation deeper than 30 feet MLLW • Mitigation of eelgrass impacts • Monitoring plan needed for aquatic vegetation and benthic communities • Impacts to commercially important shellfish • Geoduck survey recommended
Marine Fish	• Impacts from pile driving noise • Work window not adequate to protect adult wild Chinook salmon • Impacts to adult salmonids • Impacts from nearshore shadow from structure • Impacts from vessel wakes, propulsion, and cooling systems • Habitat fragmentation not addressed • Impacts to migration of juvenile salmon • Loss of fish habitat
Marine Birds and Mammals	• Impacts from pile driving noise and measures to minimize such impacts • Impacts to fish prey • Marbled murrelet foraging habitat • Mitigation actions should include potential impacts to the range of marine birds in the EIS and not just marbled murrelet
Geology, Soils, Surface and Groundwater	• Low Impact Development methods recommended for redevelopment of the upland buildings
Cultural Resources and American Indian Traditional Resources	• Tribal treaty rights • Impacts to tribal access to fishing areas • Impacts to tribal traditional resources, primarily salmon but also shellfish • Area of Potential Effect (APE) not properly identified • Submerged, intertidal, and nearshore cultural resource sites • Identification/recognition of traditional cultural properties • Impacts to historic sites such as the Shelton-Bangor Railroad
Utilities and Energy	• Impacts of increased energy use demands from construction/operation of a new wharf
Transportation	• Increase in marine vessel traffic
Public Safety	• Increased risks to public safety from operation of a second EHW

Table 1–3. Summary of Public Comments on the Supplement to the DEIS (continued)

CATEGORY	COMMENT SUMMARY
Compensatory Habitat Mitigation	• Early development status of the In-Lieu Fee Program and completion in time for final project review • Consideration of alternative strategies for habitat mitigation • Mitigation table (Table 4-1) does not include the full range of impacts identified in the DEIS • A table or summary for mitigation of indirect impacts should be included • Consideration of alternative habitat mitigation sites, particularly in Kitsap County (e.g., Port Gamble Bay) • Proposed mitigation sites would not adequately compensate for all of the impacts from the EHW-2 project • Inclusion of all relevant parties in the compensatory habitat mitigation process • FEIS should disclose the methods and results of the feasibility analysis for compensatory mitigation sites and describe the evaluation process • Dosewallips State Park mitigation funding and reimbursement of the Wild Fish Conservancy for development of the alternative • Mitigation plan should be finished before start of the project
Cumulative Impacts	• Indirect and cumulative effects not adequately addressed • Potential for cumulative impacts of pile driving during EHW-2 construction and EHW-1 pile replacement

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CHAPTER 2

DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

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2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

This section describes the proposed action (the EHW-2) and the alternatives considered for implementing the proposed action.

2.1 PROPOSED ACTION

The Navy proposes to construct and operate the EHW-2 adjacent to, but separate from the existing EHW at the Bangor waterfront. The proposed action consists of in-water and land-based construction and operations. Some project elements would affect the surrounding upland landscape. Figure 2–1 provides the general location of the proposed action on NBK at Bangor.

Construction of the EHW-2 would not result in an increase in boat traffic at the Bangor waterfront. Rather, a portion of the operations and boat traffic currently occurring at the existing EHW and other facilities within the Waterfront Restricted Area (e.g., Delta Pier, Marginal Wharf) would be diverted to the EHW-2. No increase in boat traffic would be required to achieve planned operations. The increase in future operations at the waterfront would only require that boats remain at an EHW longer when in port for maintenance and upgrades. The overall level of traffic and activity at the Bangor waterfront would not increase as a result of operating the EHW-2. Additional information on operations is included in Appendix A, which is marked DoD UCNI. For reasons of national security, UCNI cannot be included in a public document. Non-UCNI information regarding construction and operation of the proposed action is presented in this chapter (Chapter 2) of the EIS. The design life of the EHW-2 is 50 years.

2.2 ALTERNATIVES

The Navy has identified five action alternatives for constructing the EHW using the following criteria:

- Capability to meet TRIDENT mission requirements,
- Ability to avoid or reduce environmental impacts,
- Siting requirements including proximity to existing infrastructure,
- Availability of waterfront property,
- Constructability of essential project features, and
- Explosives safety restrictions.

All of the action alternatives carried forward for analysis in this EIS satisfy these criteria.

The EHW-2 would consist of two components: (1) the wharf proper (or Operations Area), including the warping wharf; and (2) two access trestles.[1] The Operations Area would include a support building and wharf cover. The warping wharf would be a long, narrow wharf extension used to position submarines prior to moving into the Operations Area. Access trestles would allow vehicles to travel between the Operations Area and the shore.

[1] A trestle is a framework of vertical, slanted supports and horizontal crosspieces supporting a bridge or road.

Figure 2–1. Location of the Proposed Project at the Bangor Waterfront

The wharf proper would be either pile-supported[2] or floating. Two types of pile-supported wharf are being considered: a large pile wharf and a conventional pile-supported wharf. The access trestles would either be combined for part of their spans or completely separate.

This EIS addresses five action alternatives that involve combinations of these components, as well as a No-Action Alternative:

- Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)
- Alternative 2: Combined Trestle, Conventional Pile Wharf
- Alternative 3: Separate Trestles, Large Pile Wharf
- Alternative 4: Separate Trestles, Conventional Pile Wharf
- Alternative 5: Combined Trestle, Floating Wharf
- No-Action Alternative

Figure 2–2 shows cross-sections of the pile-supported and floating wharf concepts. The cross-section views presented in this figure are only schematic and do not represent actual piling locations. Detailed section views of the proposed facility are DoD UCNI and cannot be included in a public document for reasons of national security. Each alternative would include an upland component: roads, construction laydown areas, utility upgrades, and stormwater facilities. Operations would be the same for all action alternatives (Section 2.2.9). No alternative would require dredging. Table 2–1 (at the end of Section 2.2.7) summarizes the dimensions and key physical characteristics of the action alternatives.

Section 2.2.1 describes the common components for all of the action alternatives, followed by descriptions of each of the action alternatives (Sections 2.2.2 through 2.2.6) and the No-Action Alternative (Section 2.2.7). Section 2.2.8 lists current practices and best management practices (BMPs) that would be implemented as part of the selected alternative. Section 2.2.9 describes operation of the EHW-2. Alternatives considered but not carried forward for detailed analysis are discussed in Section 2.2.10. The environmental impacts of the alternatives analyzed in detail are compared in Section 2.3.

2.2.1 Common Components for All Alternatives

The wharf proper would lie approximately 600 feet offshore at water depths of 60 to 100 feet, and would consist of a main wharf, a warping wharf, and lightning protection towers. It would include a slip (docking area) for submarines surrounded on three sides by the operational wharf area. The warping wharf would extend out from the main wharf. The warping wharf would be used to line up submarines to move into the slip and would provide a safety barrier between submarines and EHW-1 during berthing. The main wharf would include an operations support building (25,700 square feet [sq ft]) providing office and storage space and mechanical/electrical system component housing. In accordance with *Facility Design Criteria for P-990 Explosives Handling Wharf Number 2 (Covered)* (Lockheed Martin 2010), marked DoD UCNI, hereafter referred to as *Facility Design Criteria*, the support building must provide offices and facilities for mission-essential personnel and security forces, including visual access (line of sight) to the wharf and space for operational equipment. Therefore, the operations support building could not be located upland.

[2] A pile is a long, substantial pole of wood, concrete, or metal that is driven into the earth or sea bed to serve as a support or protection. Piles for this project would be made of steel pipe.

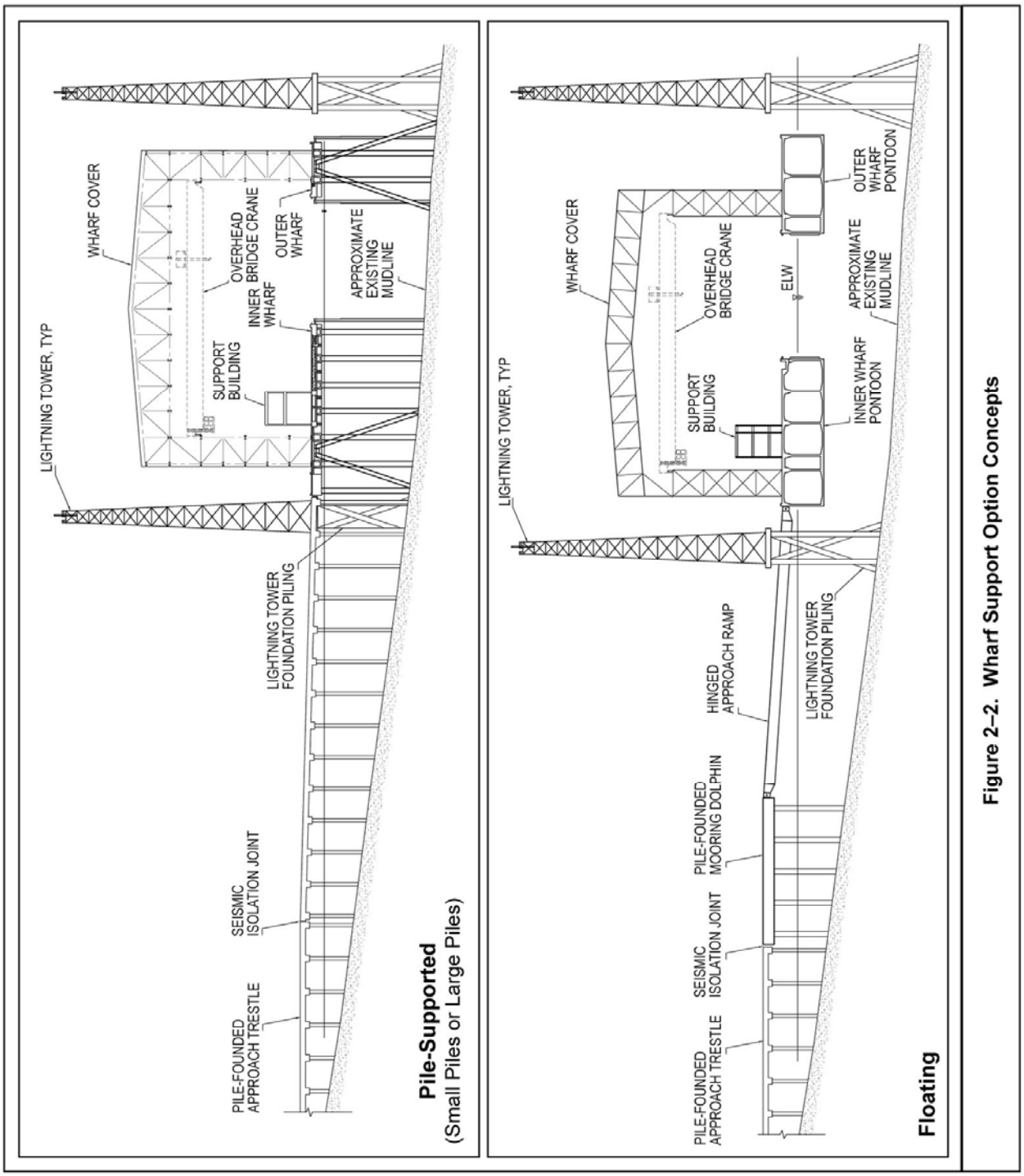


Figure 2–2. Wharf Support Option Concepts

Additional facility support at the wharf would include heavy duty cranes suspended from the cover, power utility booms, six large lightning protection towers, and camels (operational platforms that float next to a moored vessel). The elevation of the top of the pile-supported wharf deck would be 20.5 feet above MLLW, and the bottom of the wharf deck would be 13 feet above MLLW. The elevation of the wharf deck for the floating wharf would vary with the tide (Section 2.2.6).

The six lightning towers would be steel frame structures, each 30 by 30 feet (total of 5,400 sq ft). The cover of the operations area (total height 135 feet) and the lightning towers (total height 207 feet) would be steel frame structures.

The access trestles would connect the wharf to the shore. There would be an entrance trestle and an exit trestle. The trestles would be supported on 24-inch and 36-inch steel pipe piles driven approximately 30 feet into the seafloor, depending on location. Spacing between bents (rows of piles) would be 25 feet. Concrete pile caps would be cast in place and would support pre-cast concrete deck sections.[3] The top elevation of the trestle deck would vary between 20.5 feet above MLLW at the connection to the wharf to 28 feet above MLLW at the shore. The bottom deck elevation would vary between 15.2 feet above MLLW at the connection to the wharf to 22.7 feet above MLLW at the shore. A grated steel pedestrian ramp (80 by 3.5 feet) and floating platform (35 by 18 feet, likely concrete) would provide access for Navy divers. The floating platform would be anchored to four steel pilings, which are included in the overall number of pilings below. The upper end of the ramp would be attached to the trestle; the lower end would rest on the floating platform.

The use of grating in construction of the trestles was considered to allow additional light to penetrate to the water. Through the design process, the Navy determined that grating would be ineffective at transmitting light, due to the weight and thickness of grating required to support the operational vehicle load as required by the *Facility Design Criteria* (Lockheed Martin 2010). Additionally, it would not be possible to control stormwater runoff into Hood Canal if grating was used. Therefore, grating is not proposed for the EHW-2.

The EHW-2 has been designed to meet the most current seismic design criteria. The seismic criteria used in the design account for the low probability worst-case scenario event of 2 percent exceedance in a 50-year period, or an approximate scenario of once in 2,475 years. The main wharf facility, wharf, and wharf cover are designed to be structurally stable if this event occurs. This is in accordance with ASCE 7-05 (American Society of Civil Engineers design guide) and MOTEMS (Marine Oil Terminal Engineering and Maintenance Standards), which are approved standards for such a design. Both design guides are based on United States Geological Survey (USGS) data and are intended to account for the worst-case scenario.

2.2.1.1 Pile Installation

The total number of permanent in-water piles (steel pipe) would vary between 440 and 1,500 depending on the alternative. Sacrificial aluminum anodes (devices to protect metal piles from corrosion) would be attached to each pile. Construction would involve, for all alternatives, temporary installation of up to 150 falsework piles used as an aid to guide permanent piles to

[3] Pile caps are constructed by placing wooden forms and reinforcing steel bars around the top of the piles, and pouring concrete into the forms. Once the concrete has cured, the forms are removed. Pre-cast components are formed and poured at an offsite location. They are brought to the site in their finished form and placed with a crane in their final location.

their proper locations (used like a template). Falsework piles would likely be steel pipe piles and would be driven and removed using a vibratory driver. Typically, falsework piles would be driven, extracted, and used as falsework at another location. At the end of their use on this project, the piles would be reused or recycled. These temporary falsework piles would be removed upon installation of the permanent piles and would not increase the area of seafloor occupied by piles. The falsework piles are accounted for in the overall construction schedule and pile driving duration, as described below, and in the analysis of impacts from pile installation to noise, seafloor disturbance, and water quality.

The Navy anticipates using two types of equipment to install piles: a vibratory pile driver and an impact hammer.[4] Pile installation would occur using vibratory pile drivers to the greatest extent possible for all alternatives. It is anticipated that most piles would be vibratory driven to within several feet of the required depth. If difficult subsurface driving conditions (i.e., cobble/boulder zones) render the vibratory equipment ineffective, it may be necessary to use an impact hammer to drive some piles for the remaining portion of their required depth. One scenario is that a pile would be driven for its entire length using an impact hammer. The number of strikes in that case could range from about 1,000 to 2,000 strikes per pile. Up to three vibratory rigs could operate concurrently, but only one impact hammer rig would operate at a time. However, the construction schedule would require the operation of the impact rig at the same time as the vibratory rigs.

Unless difficult driving conditions are encountered, an impact hammer would be used only to verify ("proof") the load-bearing capacity of approximately every fourth or fifth pile. Proofing involves striking a driven pile with an impact hammer to verify that it provides the required load-bearing capacity, as indicated by the number of hammer blows per foot of pile advancement. It is assumed that on most days, a single impact hammer would be used to proof up to five piles, with each pile requiring a maximum of 200 strikes. This likely scenario would require up to 1,000 impact strikes per day.

It is estimated that the likely scenario would result in less than 1,000 impact strikes per day as described above. A less likely but possible scenario assumes driving three piles full length (2,000 strikes per pile) and proofing an additional two piles at 200 strikes each with an impact hammer. This scenario would result in up to 6,400 impact strikes per day.

Depending on the type of piles being driven and the number of rigs operating, between one and eight piles would be driven per day. The number of in-water pile driving days would range from 200–400 to 290–570, depending on the alternative and pile driving scenario (minimum and maximum impact driving days). Pile production rate (number of piles driven per day) is affected by factors such as size, type (vertical vs. angled), and location of piles; weather; the number of rigs operating; equipment reliability; geotechnical conditions; and work stoppages for security or environmental reasons. The minimum pile-driving-days scenario conservatively assumes up to three rigs operating at once; the maximum pile-driving-days scenario conservatively assumes no more than two rigs operating at once. Table 2–1 provides a range of the total number of pile driving days for each alternative, based on pile driving scenarios. Pile driving would typically occur 6 days per week. Impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before

[4] Vibratory pile drivers use hydraulically powered weights to vibrate a pile until the surrounding sediment liquefies, enabling the pile to be driven into the ground using the weight of the pile plus the pile driver. Impact hammers use a rising and falling piston to repeatedly strike a pile and drive it into the ground.

sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). Upland construction would occur between 7:00 AM and 10:00 PM.

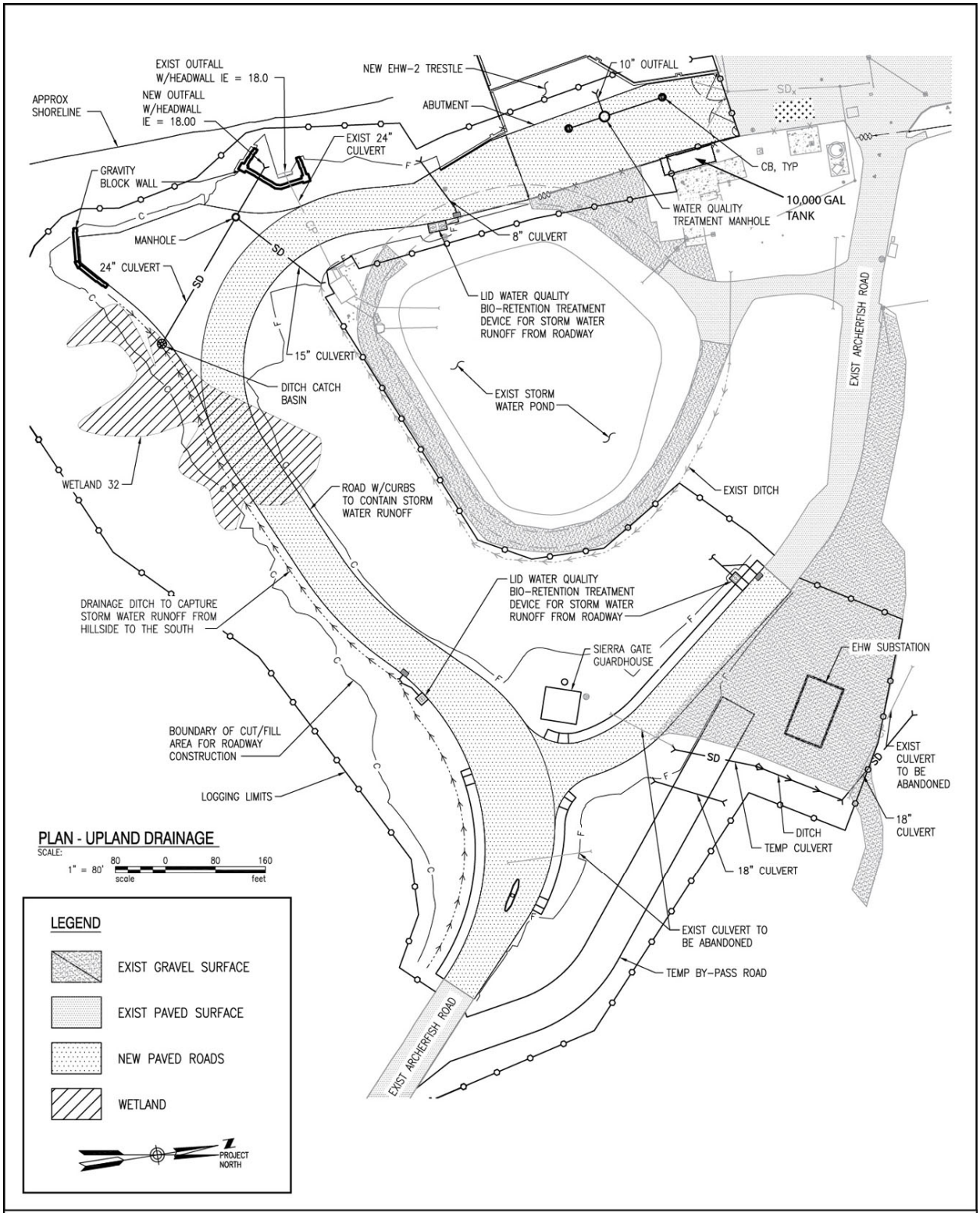
Pile driving equipment anticipated to range from a 4,400 inch-pound to a 13,000 inch-pound vibratory driver, and a 288,400 foot-pound impact hammer, or other equivalent equipment. The pile driving conditions encountered, as well as the size of the pile being driven, would determine the specific equipment to be used.

The number of construction barges (derrick and material) on site at any one time would vary between two and eight depending on the alternative and the type of construction taking place (see Sections 2.2.2 through 2.2.6). Tug boats would tow barges to and from the construction site and position the barges for construction activity. Tug boats would leave the site once these tasks were completed and thus would not be on site for extended periods; there would be no more than two tug boats on site at any one time. Up to six smaller skiff-type boats (less than 30 feet in length) would be on site performing various functions in support of construction and sensitive-species monitoring. Measures would be implemented to ensure that mooring lines did not drag on the seafloor or entangle vegetation. The in-water work season, including pile driving, on NBK at Bangor is July 16 through February 15.

2.2.1.2 Upland Features

The following upland features would be the same for all alternatives (Figure 2–3). (Upland features are defined as those located inland of marine waters and above the mean higher high water [MHHW] line.) An extension would be added to the existing Tang Road to connect and allow access to the new trestle(s) from the existing roadway. This road would be 50 feet wide and vary in length between 140 and 170 feet depending on the alternative. A security fence would extend the length of this road and out onto the trestle(s).

Another paved road (construction access road) would be built to provide access from Archerfish Road to the upland construction area along the shoreline, while avoiding the nearby retention pond. A gate and guard house (80 sq ft) would be installed at the intersection of this access road with Archerfish Road. During operations at the existing EHW, portions of Archerfish Road are open only to vehicles and personnel associated with EHW operations. In accordance with security restrictions, construction vehicles and workers would not be allowed to use these portions of the construction access road during EHW operations. Due to topography, the only available access route crosses Wetland 32. There are no other feasible routes to the site over land, and a shore access route would have much greater environmental impacts. The road width is based on the requirement for two-way construction vehicle access to and from the project site and the turning radius required for a 60-foot long standard delivery truck. The slope adjacent to the access road area would be regraded in accordance with recommendations in the geotechnical evaluation (Hart Crowser 2010). This construction access road would be approximately 610 feet long and typically between 28 and 32 feet wide, but expanding to 130 feet wide in the turnaround area at the southern curve.



Source: BergerABAM 2010

Figure 2–3. Key Upland Project Features

Following construction, the access road would be left in place to support security operations and provide maintenance access to water lines and other facilities. A third, gravel road would provide a bypass of the construction area to the existing EHW electrical substation north of Archerfish Road. This road would be approximately 280 feet long and 20 feet wide. Following construction, this road would be left in place to provide access to the substation and electrical duct banks. A concrete culvert would be installed under this road to recreate natural flow in the area, which will not require treatment.

Three concrete culverts would be installed under the construction access road to provide drainage from the access road and a seep south of the road to the top of the cliff, near the existing outfall from the retention pond. The water conveyed in the new culverts would be treated using low impact development (LID) Water Quality Catch Basins prior to discharge. The culverts would come together before discharging through a new outfall (Figure 2–3). A new retaining wall, 80 feet long and 7 to 8 feet high, would be built to retain the slope at this outfall and its riprap discharge apron. An additional retaining wall, 50 feet long and 7 to 8 feet high, would be built at the southwest corner of the site to stabilize the proposed cut at that site. Together, the two retaining walls would occupy less than 0.01 acre.

A total of approximately 1.4 acres would be permanently occupied by new roads, culverts, retaining walls, and utility structures (described below).

An additional 1.6 acres would be temporarily disturbed for cut and fill for the access road and for work on stormwater facilities and other utility work. This 1.6-acre area would be revegetated with native forest and shrub species following construction. Trees (not stumps) within 10 feet of the top of existing steep slopes on the north and south sides of the access road (area of 1.0 acre) would be cut/removed at the beginning of the project when clearing and grubbing is performed. “Steep slope” is defined as any existing slope that is steeper than 3:1. Felled trees would be cut into lengths suitable for removal from the site; no heavy equipment would be used within the tree removal area in order to reduce site disturbance and the potential for slope failure. Stumps of cut trees would remain in place unless the stumps are within clearing and grubbing limits, in which case they would be removed for roadway construction. Upland construction would use standard construction techniques, equipment, current practices, and BMPs (Section 2.2.8).

A concrete abutment would be built at the face of the shore cliff under the trestle(s) where the trestle(s) comes ashore. This abutment would be 10 feet high and, depending on the alternative, would range between 170 and 230 feet long and require between 520 and 700 tons of armor rock. Excavation would range from 2,760 to 3,560 cubic yards; all of this material would be used for backfill either at the abutment or at another part of the adjoining upland construction site. The abutment would be pile-supported and constructed from the land side. The exposed part of the abutment would lie above MHHW, although excavation and pile installation below MHHW would be needed for construction. The abutment would be supported by 55 to 80 24-inch steel piles, depending on the alternative.

The abutment piles are not included in the total number of in-water piles, but would be installed in the same manner as the in-water piles as discussed above. The pile driving rig for the abutment piles would be included in the group of one impact hammer rig and three vibratory rigs described above; an additional driver would not be used. Abutment construction would take about 20 days including 11 to 16 days for pile installation.

A 5-acre laydown area would be needed for the upland construction. The proposed site is vegetated, has no wetlands, and is situated on the east side of Archerfish Road approximately 4,000 feet south of the proposed EHW (Figure 2–1). Storage of material and equipment (such as roof and siding materials and construction tools), parking of construction vehicles, and soil stockpiling would occur within the laydown area. The construction laydown area is sized for storage of equipment and materials as well as location of contractor administrative trailers. Other areas along the Bangor waterfront were considered for use as a laydown area but were not suitable due to existing uses, inadequate size, or operational restrictions. The laydown area could not be located closer to the project site due to the steep, unsuitable terrain. Following construction, this area would be revegetated with native forest species. No new parking lots for operational parking would be needed. Archerfish Road would be the primary haul route for construction.

New utility facilities and modifications for all alternatives would include the following (sizes and dimensions are approximate):

- Two new 12-inch diameter water lines, for domestic use and fire suppression, approximately 200 feet long to connect to an existing water line on Archerfish Road.
- Two new 20- by 20-foot backflow preventer vaults, to prevent backflow into the Navy domestic water system. One would be added at the northwest corner of the new access road and Archerfish Road intersection. The second would be located approximately 5 feet west of the existing paved access road on the project site.
- One new underground 6-inch diameter Sanitary Sewer Forced Main for wharf sewer discharge. The main would extend approximately 220 feet, terminating at an existing manhole located approximately 40 feet east of the existing EHW and the end of Archerfish Road.
- One new underground 4-inch diameter Ship's Overboard Discharge Main. The main would be approximately 100 feet in length and would connect to the new underground 10,000-gallon tank (see next item).
- Removal of an aboveground 10,000-gallon oily wastewater tank and installation of a new underground 10,000-gallon oily wastewater tank at the same site to make room for the new security fence. Tank removal would consist of emptying the tank, disconnecting utility and service connections, unbolting the tank from the pad, and removing and disposing of the tank. Installation of the new tank would entail excavation and removal of approximately 62 cubic yards of earth material.
- One new 8-inch diameter storm drain to collect water runoff from the wharf, warping wharf, and trestle structures. The storm drain would be connected to approximately 18 catch basins with filter cartridges. The storm drain and catch basin would be located solely on the proposed structure.
- New 40- by 15-foot steel utility building that would replace an existing utility building. The new utility building would be located within the project site between the southeast corner of the existing EHW and the existing retention pond.
- Two new double-ended substations would be located on the wharf structure. One substation would contain two 2,500-kilovolt-ampere (kVA) transformers and the second would contain two 2,000 kVA transformers. Approximately 10 smaller transformers required to meet the energy needs of the new facility would be located on the wharf structure. The substation switchgear would be provided with circuit breakers with

substation controls co-located with the transformers. One 200-kilowatt (kW) generator and one 125 kW generator are required and would be located on the wharf structure. The exact dimensions of the substations would be determined during the final design stage.

- Approximately 1,200 feet of new duct bank (an assembly of electrical and communication conduits encased in concrete ducting) that would replace 500 feet of existing ducting. Demolition of the old and installation of the new ducting would be confined between Archerfish Road, the existing retention pond, and the proposed project.
- Three new 8- by 10-foot utility manholes. Two of the new manholes would be located adjacent to the new utility building on the east side. The third would be located on the south side of the end of Archerfish Road.

All of the utility actions would occur within the 1.6 acres of temporary ground disturbance described above.

Most of the upland construction would occur in the first 10 months of project construction. Construction would typically occur 6 days per week. Non-pile driving construction activities could last until 10:00 PM in accordance with the Washington Administrative Code noise guidelines. For all alternatives, the number of construction workers for all project components is estimated to range between approximately 100 and 260 during the construction period. Construction of the entire project (both in-water and upland components) is estimated to begin in 2012 and end in 2016 or 2017, depending on the alternative.

Construction materials would arrive via truck and barge. Construction debris would be hauled off of the site to an approved disposal facility.

2.2.1.3 Modification and Demolition of Existing Structures

As part of the proposed action, approximately 20 existing facilities and/or structures in proximity to the EHW-2 would be modified or, in the case of five buildings, demolished to comply with DoD Explosives Safety Board (DDESB) and Naval Ordnance Safety and Security Activity (NOSSA) requirements to protect buildings located in the vicinity of explosives handling operations. The scope of facility modifications would primarily include replacement of doors and windows and possibly the modification or addition of building structural components, such as walls, interior and exterior columns, beams, and joists, and the replacement of existing roof systems. These modifications would not affect vegetated or undeveloped areas near the buildings to be modified.

Three new buildings totaling 22,191 square feet would be constructed to house the functions of four buildings (7053, 7064, 7068, and 7408) that would be demolished. The buildings to be demolished are further described in Table 3.18–3. Demolition would include isolation and disconnection of building utilities, demolition of the buildings, hauling of debris, and revegetation of the sites with native forest and shrub species. Debris would be hauled to the Olympic View Landfill, located in Port Orchard approximately 23 miles south of NBK at Bangor. Two of the new buildings would house industrial functions, and one building would be administrative. The industrial buildings would likely be pre-engineered metal buildings. The administrative building would likely be constructed on site using typical materials. The buildings would be at a single site in an existing industrial area of the Lower Base where maintenance and repair activities occur (Figure 2–1). The buildings, paved and fenced storage areas, associated roads, parking, and sidewalks would cover 2.6 acres and be constructed on an existing parking lot (0.09 acre) and adjacent vegetated area (1.7 acres) (Figure 2–4). Parking and

staging areas lost as a result of the new facilities would be replaced by expanding (adding additional paved area to) existing parking lots in other industrial areas of the Lower Base (Figure 2–1). New impervious surface created would be approximately 1.7 acres. Construction equipment storage and staging would occur on existing pavement within the construction site limits. Construction is anticipated to take one year. After construction, the three new buildings would be used for offices, storage, a rigging shop, and a refit (repair, preservation, and inspection) support facility currently located in buildings 7053, 7064, 7068, and 7408. After construction, existing stormwater systems at the sites would be upgraded in accordance with an NPDES permit.

NAVSEA OP5 Volume 1, *Ammunition and Explosives Safety Ashore*, provides criteria for establishing the distance from given types and quantities of explosives within which activities and facilities are restricted to assure protection to life and property in the event of an accident. This distance, plotted as a circle with the location of the explosives handling operation at the center, provides an arc that designates the area in which restrictions apply. Arcs for the existing EHW and the proposed EHW-2 are shown in Appendix C, *Explosives Safety Arcs for Existing EHW and Proposed EHW-2*, marked DoD UCNI. For reasons of national security, UCNI information cannot be included in a public document.

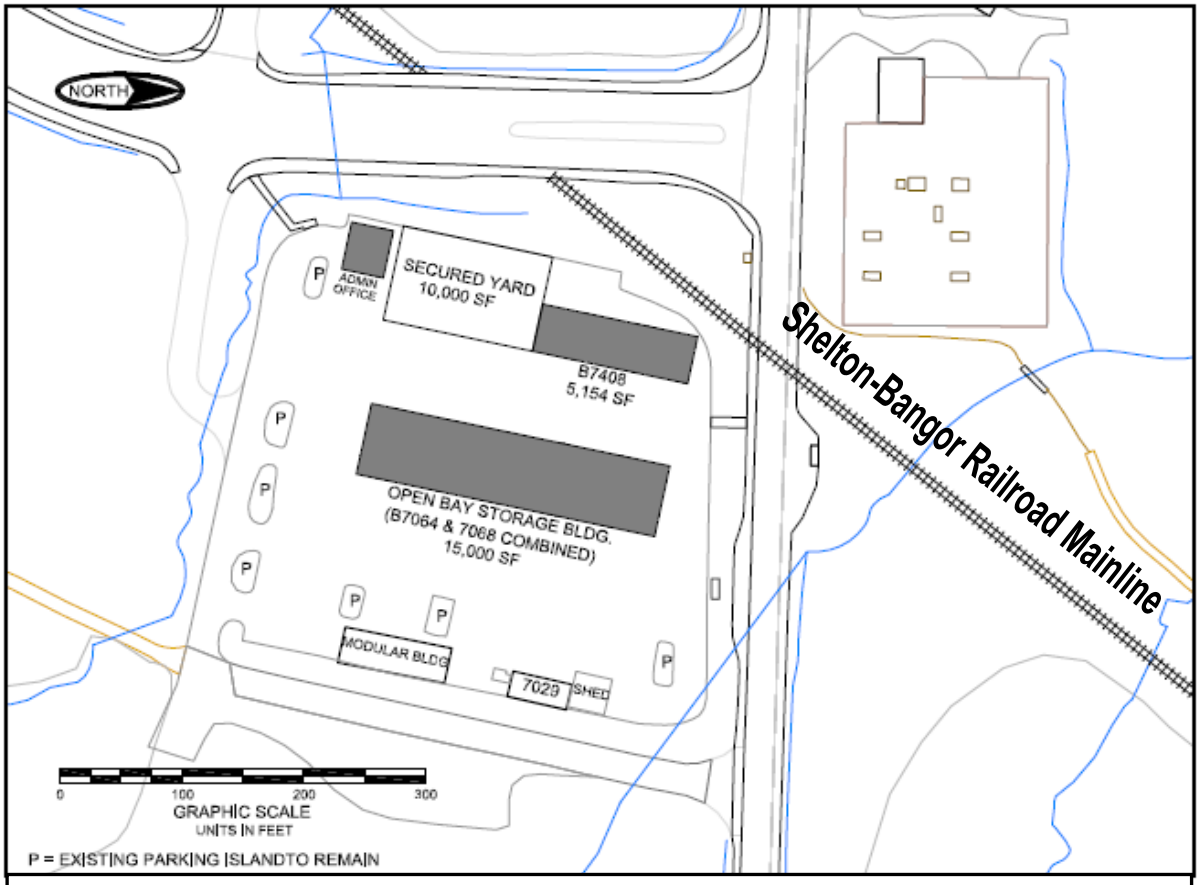


Figure 2–4. Three New Buildings

2.2.1.4 Pure Water Facility

A new pure water facility would be constructed along the Bangor shoreline to replace Building 7604, which would be demolished. The function of the pure water facility is to provide treated water to the submarines. The new facility would be located at the landward end of the southern trestle to Delta Pier, about a mile south of the existing EHW (Figure 2–1). The new facility would cover approximately 0.5 acre and would consist of a treatment building (50 by 64 feet, pre-engineered metal building), an auxiliary water storage tank (footing 9 by 20 feet), liquid nitrogen storage tank (footing 10 by 28 feet), sewage tank and pump, loading aprons and parking areas (70 by 58 feet), and a new water line between the facility and Delta Pier. Construction would consist of building the foundation; erecting structural steel; attaching the metal skin; installing interior partitions; installing electrical, plumbing, and mechanical utilities; and commissioning the building. Standard construction equipment would be used. Construction would disturb a total of approximately 2.0 acres, 0.6 acre of which is currently vegetated; the remaining 1.4 acres are paved, gravel, or otherwise disturbed. Following construction, 0.3 acre would be revegetated with native forest and shrub species, while the rest of the area would be paved or gravel.

Two water line routes for the pure water facility are being considered (Figure 2–5). Water line route 1 would be constructed parallel to the existing roadway and railroad bed from the new pure water facility to the northern trestle of Delta Pier, approximately 1,200 feet long. The water line would be installed above ground. Water line route 2 would be installed above ground from the pure water facility to the southern trestle of Delta Pier, where it would be attached to the trestle and pier sidewall using an appropriate anchoring system, at an elevation approximately 9 feet above the high tide line. The water line would be installed from the trestle and pier deck; installation would not result in discharges to surface waters.

Wastewater from the new pure water facility would be the same as from the existing facility and would be discharged to the base wastewater (sanitary) system. Stormwater from the facility site would be discharged to the existing stormwater system, which is treated prior to discharge to Hood Canal. All wastewater connections would be constructed in existing disturbed areas. Operation of the facility including transfer of pure water to submarines at Delta Pier would remain unchanged from current operations.

Construction equipment storage and staging would occur on existing pavement within the construction site limits (Figure 2–5). Construction is anticipated to take one year.

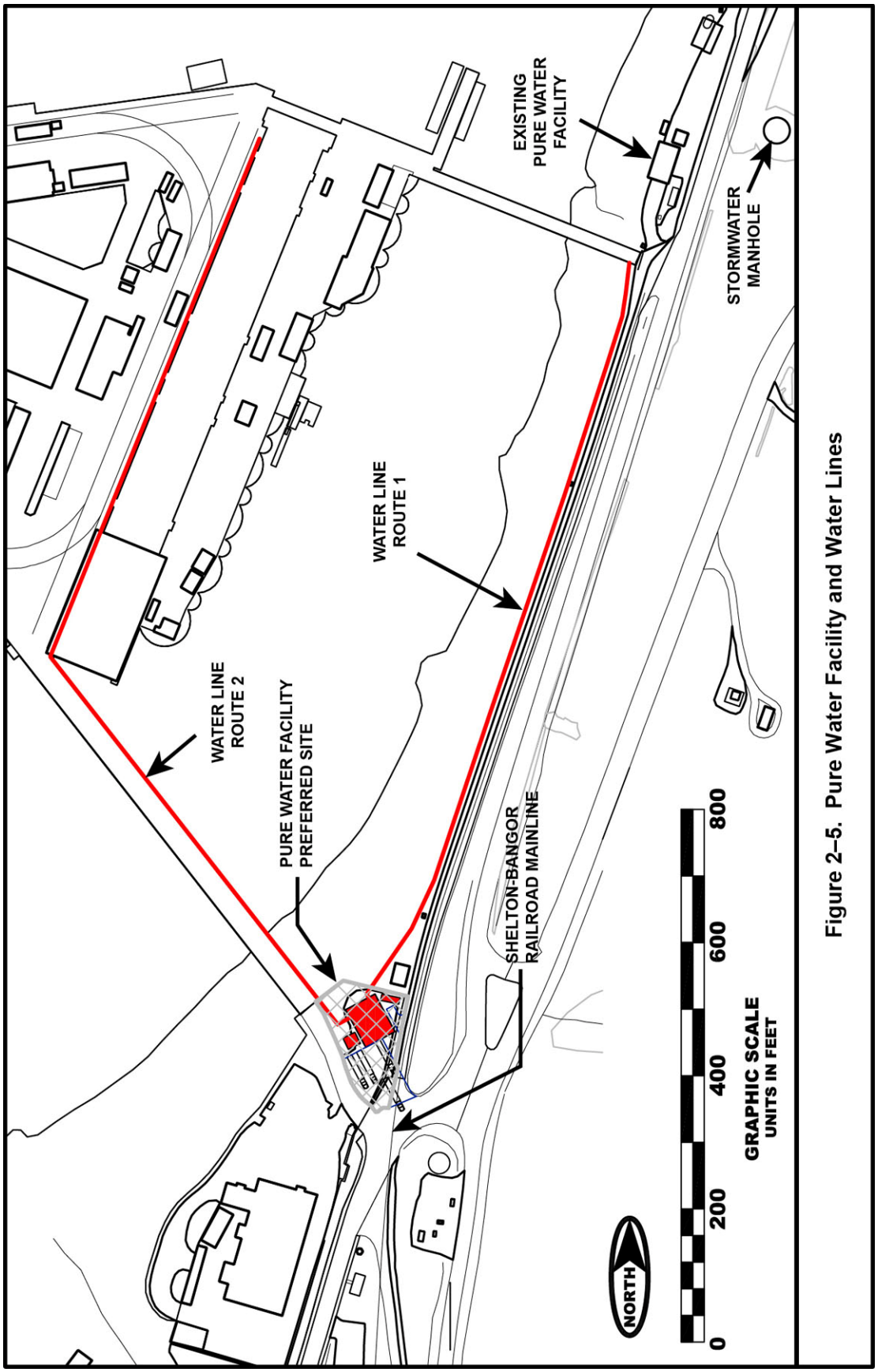


Figure 2–5. Pure Water Facility and Water Lines

2.2.2 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)

Under this alternative, the entrance and exit trestles would be combined over shallow water to minimize the size of structures over shallow water (less than 30 feet); in deeper water the trestles would be separate (Figure 2–6). Total trestle length would be 1,849 feet. Approximately 1,400 feet of this would be 40 feet wide (trestles separate) and 449 feet would be 48 feet wide (trestles combined). Total overwater area would be 81,208 feet (1.9 acres). The length of trestle lying above -30 feet MLLW would be approximately 407 feet, for an area of 17,859 sq ft (0.4 acre).

A total of approximately 290 trestle piles would be required, approximately 90 of which would lie in water shallower than 30 feet below MLLW (Table 2–1). The primary pile driving method would be a vibratory driver, but an impact hammer would also be needed. Pile driving would require one large derrick barge (70 by 200 feet) and one pile barge (50 by 200 feet); deck construction would require one smaller derrick barge (50 by 150 feet) and one material barge (50 by 200 feet).

The wharf would be pile-supported, using larger piles (48 inches in diameter) than a conventional pile-supported wharf. The main wharf would be approximately 632 by 250 feet (158,000 sq ft, of which 152,200 sq ft would be covered overwater area), including 43,500 sq ft for the slip (Figure 2–6). The warping wharf would be approximately 688 by 40 feet (34,300 sq ft including the wider connection to the access trestle). The total overwater area of the wharf would be approximately 186,500 sq ft (4.3 acres). The wharf deck would consist of pre-cast concrete sections, supported on cast-in-place concrete pile caps.

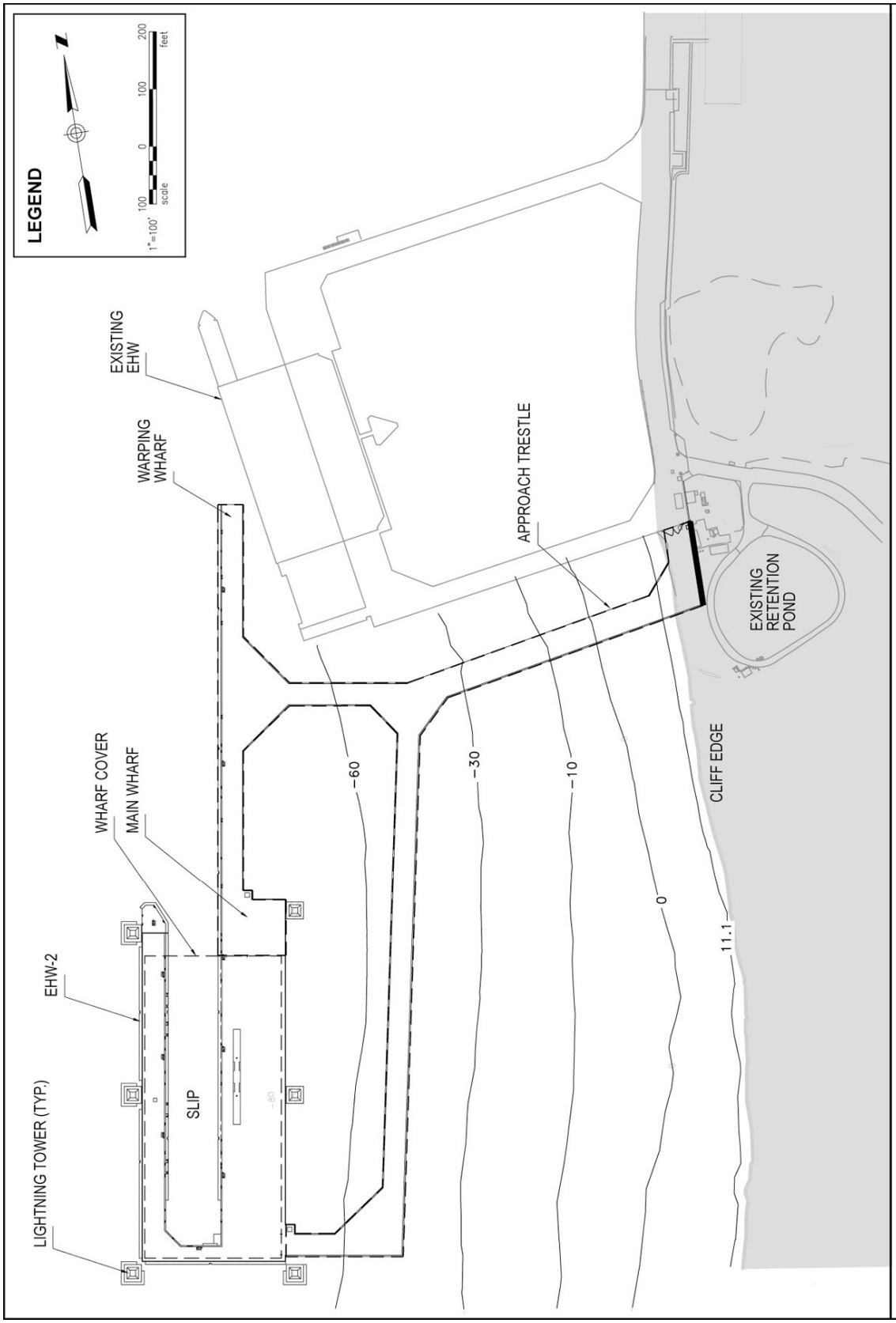
The wharf would be supported on a combination of large-diameter (48-inch) plumb (vertical) piles, and smaller (24- to 36-inch) plumb and batter (angled) piles, all of which would be located in greater than 60 feet of water (Figure 2–6). A total of approximately 960 piles would be driven for the main wharf, warping wharf, and lightning towers combined (Table 2–1). Those piles would be driven to a depth of approximately 60 feet below the seafloor. Spacing between the bents (rows of piles) would range from 25 to 26 feet. The primary pile driving method would be vibratory driver. Impact hammer pile driving would also be needed.

Pile driving for the wharf portion would require one to two large derrick barges and one to two pile barges for the duration of pile driving. Wharf deck construction would require one derrick barge and two material barges; lightning tower construction would require one derrick barge and one material barge.

For the access trestles, wharf and lightning towers combined, total overwater area would be 273,108 sq ft (6.3 acres) including the lightning towers. A total of up to 1,250 piles would displace approximately 0.21 acre of seafloor. The combined duration of in-water pile driving would be 200 to 400 days. The range of pile driving days is based on assumptions listed in Section 2.2.1. The overall duration of project construction would be 42 to 48 months, including two to three in-water construction seasons.

Lighting on the wharf and access trestles would range from 100-Watt (W) metal halide lights to 1,500 W quartz lights. Lights over the surrounding water would consist of pulse-start metal halide lights, plus 1,500 W quartz backup lights.

The wharf would be provided with full hotel service capability including power, potable water, fire protection, sewage connections, Ship's Overboard Discharge collection, telephone, cable, and Local Area Network service.



Source: BergerABAM 2010

Figure 2–6. Plan View of Combined Trestle Alternatives 1 and 2 (Large Pile Wharf and Conventional Pile Wharf are the Same in Plan View)

The upland component (Figure 2–3) would include a paved onshore road approximately 50 feet wide and 140 feet long. New impervious surface would be 7,000 sq ft. A pile-supported (55 piles) abutment would be needed at the base of the shore as retaining structure for landfall of the access trestles. This abutment would be 103 feet long, plus a 69-foot wing wall at the north end. Construction of the abutment would require excavation of 2,760 cubic yards, including some excavation and refilling below the MHHW line (approximately 300 cubic yards over an area of approximately 1,400 sq ft). Approximately 520 tons of armor rock would be placed along the abutment above MHHW. Following construction, including replacement of the same excavated material, the exposed portions of the abutment would lie above MHHW. Pile driving for the abutment would last approximately 11 to 16 days.

Common components for all alternatives are addressed in detail in Section 2.2.1.

2.2.3 Alternative 2: Combined Trestle, Conventional Pile Wharf

This alternative would include the same combined trestle as Alternative 1, but would entail a conventional pile-supported wharf that would differ from the large pile wharf in using a larger number of smaller piles to support the wharf, requiring smaller pile driving equipment and longer construction duration.

All other features and construction methods for the wharf would be the same for both alternatives, including total overwater area (4.3 acres) and the upland component. The wharf (including the main wharf, warping wharf, and lightning towers) would entail a total of approximately 1,170 steel pipe piles (a mixture of plumb and batter) ranging from 24 to 36 inches in diameter. All of these piles would lie in greater than 60 feet of water. The primary pile driving method would be vibratory driver. Impact hammer pile driving would also be needed. Construction barges would be the same as for the large pile wharf.

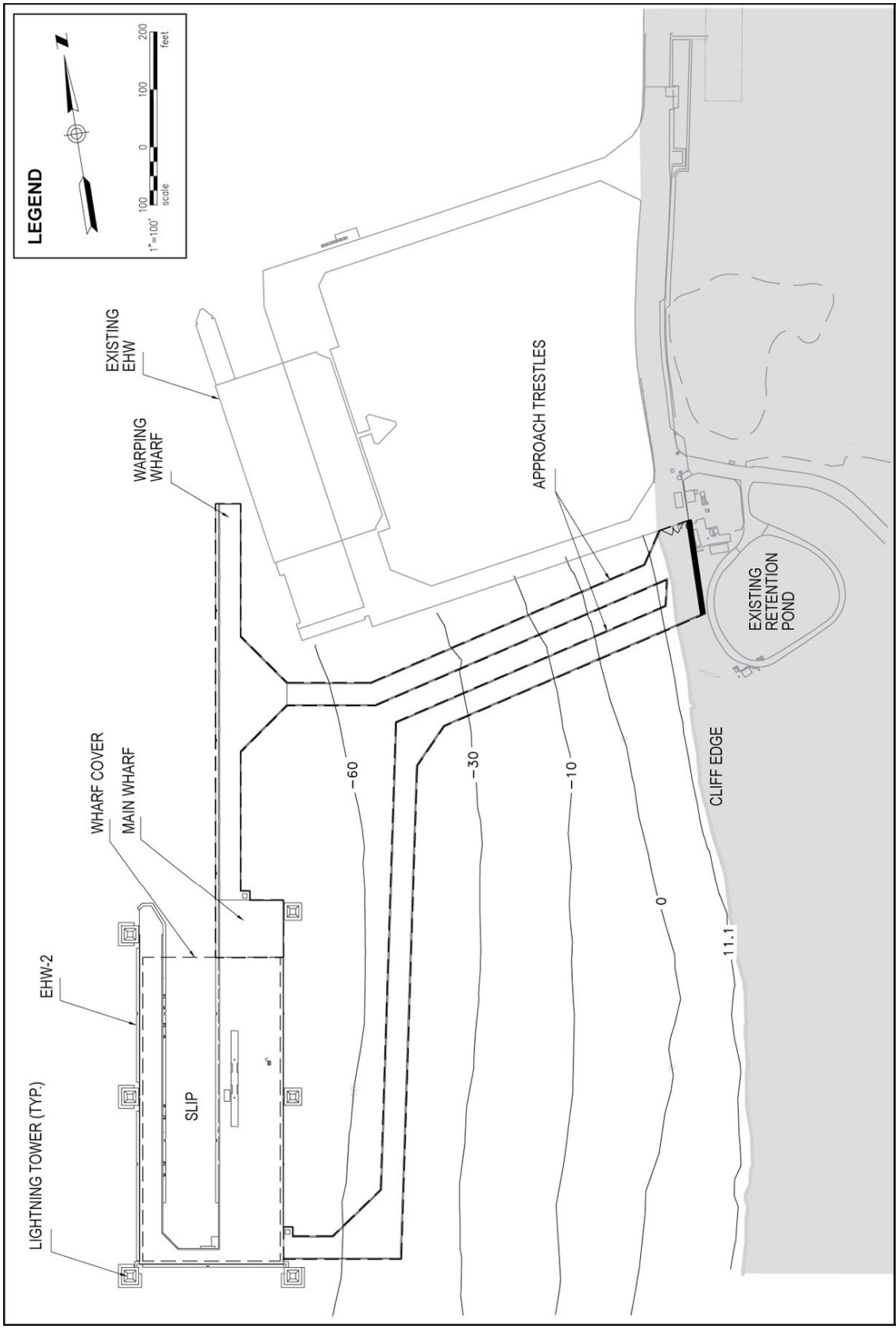
For the access trestles, wharf and lightning towers combined, total overwater area would be 273,108 sq ft (6.3 acres). A total of up to 1,460 piles would displace approximately 0.21 acre of seafloor (Table 2–1). The combined duration of in-water pile driving would be 275 to 550 days. The range of pile driving days is based on assumptions listed in Section 2.2.1. The overall duration of project construction would be 54 to 64 months, including three to four in-water work seasons.

Common components for all alternatives are addressed in detail in Section 2.2.1.

2.2.4 Alternative 3: Separate Trestles, Large Pile Wharf

Under this alternative, the entrance and exit trestles would be entirely separate (Figure 2–7). This would result in greater total trestle length (2,280 feet) and overwater area (97,056 sq ft, or 2.2 acres) than for the combined trestle. Trestle width would be 40 feet throughout. The length of trestle lying above -30 feet MLLW would be 822 feet, or an area of 32,880 sq ft (0.8 acre). The total number of trestle piles would be approximately 330, approximately 160 of these lying above -30 feet MLLW. Construction barges would be the same as for Alternative 1. The wharf for this alternative would be the large pile wharf as described for Alternative 1 (Section 2.2.2).

For the access trestles, wharf, and lightning towers combined, total overwater area would be 288,956 sq ft (6.6 acres). The trestle and wharf combined would have up to 1,290 piles displacing approximately 0.21 acre of seafloor. The combined (wharf and trestles) duration of in-water pile driving would be 210 to 420 days. The range of pile driving days is based on assumptions listed in Section 2.2.1. The overall duration of project construction would be 42 to 49 months including two to three in-water work seasons.



Source: BergerABAM 2010

Figure 2–7. Plan View of Separate Trestle Alternatives 3 and 4 (Large Pile Wharf and Conventional Pile Wharf are the Same in Plan View)

For the upland component, this alternative would require a paved onshore road 50 feet wide and 170 feet long. New impervious surface would be 8,500 sq ft. The abutment at the shore end of the trestles (above MHHW) would be similar to the abutment for Alternatives 1 and 2, but 160 feet long with 35-foot wing walls at each end. There would be 80 support piles for the abutment, 3,560 cubic yards of excavation, and 700 tons of armor rock. Excavation and refilling below MHHW would be approximately 550 cubic yards over an area of approximately 1,900 sq ft. Pile driving for the abutment would last approximately 16 days. Otherwise, the upland component of this alternative would be the same as for Alternative 1 (Section 2.2.2).

Common components for all alternatives are addressed in detail in Section 2.2.1.

2.2.5 Alternative 4: Separate Trestles, Conventional Pile Wharf

This alternative would include the separate trestles as described in Section 2.2.4, and the conventional pile wharf as described in Section 2.2.3. For the wharf and trestles combined, a total of up to 1,500 piles would displace approximately 0.21 acre of seafloor. The combined duration of pile driving would be 290 to 570 days. The range of pile driving days is based on assumptions listed in Section 2.2.1. The overall duration of project construction would be 54 to 64 months, including three to four in-water work seasons. The upland component of this alternative would be the same as for Alternative 3 (Section 2.2.4).

Common components for all alternatives are addressed in detail in Section 2.2.1.

2.2.6 Alternative 5: Combined Trestle, Floating Wharf

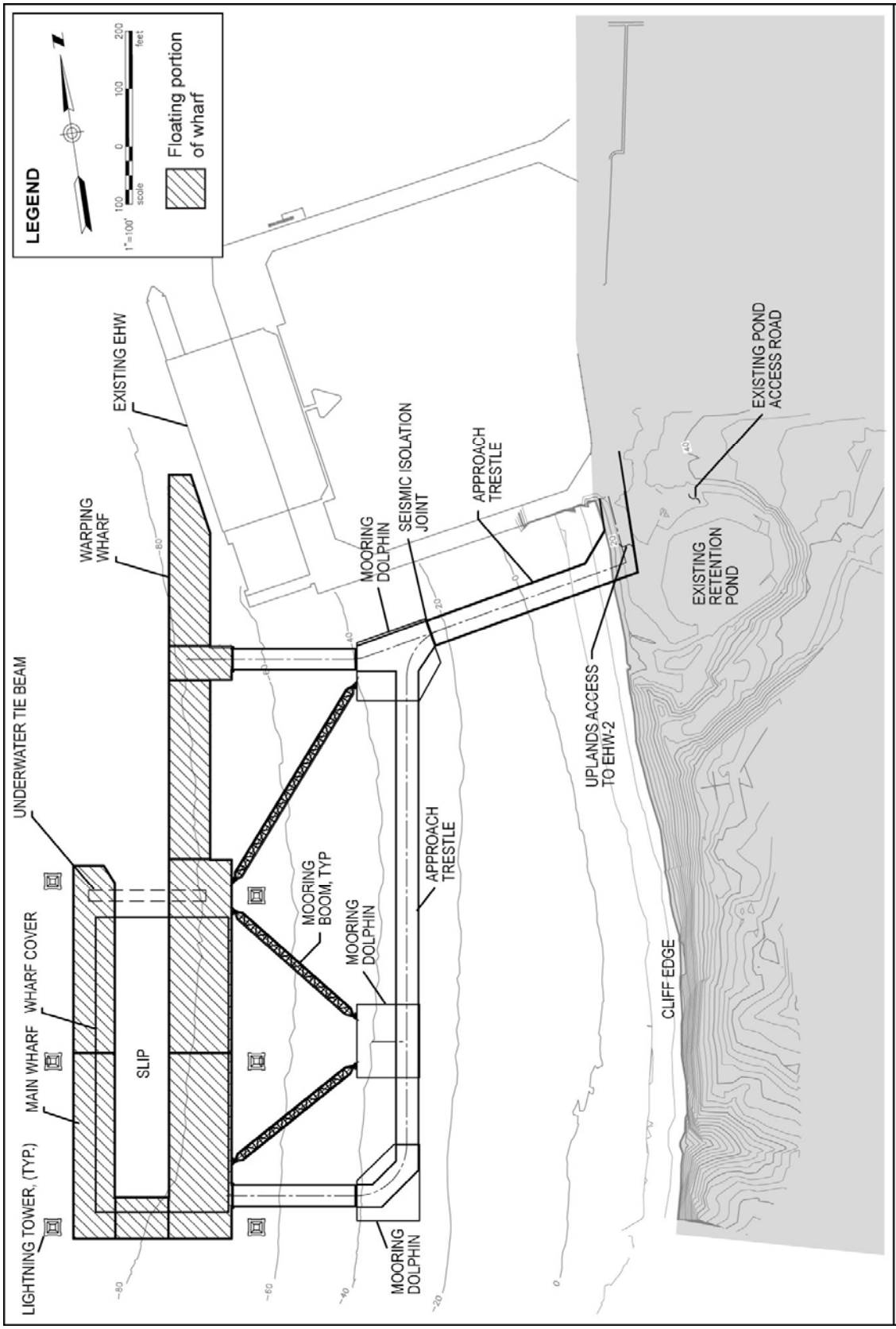
Under this alternative, the main wharf and warping wharf would be supported on large, hollow, floating pontoons made of concrete (Figures 2–2 and 2–8). The main wharf would be larger than for the other alternatives, approximately 684 by 284 feet (194,256 sq ft, of which 184,000 sq ft would be covered overwater area), including 48,000 sq ft for the slip. The warping wharf would also be larger than for the other alternatives, approximately 687 by 75 feet, or an area of 54,000 sq ft. The six lightning towers would be the same as for the other alternatives, with a total area of 5,400 sq ft. Total overwater area for the wharf under this alternative would be 254,000 sq ft (5.8 acres).

There would be a total of seven pre-cast pontoons, and concrete pontoon tie-ins would be cast in place. The wharf deck would consist of pre-cast concrete sections. The pontoons would draw approximately 20 feet of water, with 12 feet of freeboard (height of deck above the water surface). Pontoons would be constructed at an offsite graving facility and towed to the project site.

The combined access trestle would be used for this alternative, although the configuration would be slightly different from that for Alternatives 1 and 2. The trestles, including mooring dolphins,[5] would cover approximately 117,000 sq ft (2.7 acres).

This alternative would involve far fewer piles for the wharf than would the other alternatives. Bent spacing would be 25 feet. Pile driving for the wharf would require one to two large derrick barges and one to two pile barges for the duration of pile driving. One derrick barge and one material barge would be needed for the other construction activities. Barge sizes would be the same as for the other alternatives.

[5] "Dolphins" are independent marine structures for mooring ships or wharves. The structures typically consist of a number of piles driven into the seafloor and connected together above the water level to provide a platform or fixing point.



Source: BergerABAM 2010

Figure 2–8. Plan View of Floating Wharf Alternative 5

For the floating wharf, combined access trestles, and lightning towers, total overwater area would be 371,000 sq ft (8.5 acres). A total of up to 440 piles would displace approximately 0.08 acre of seafloor. The combined duration of pile driving would be 135 to 175 days over two in-water work seasons. The range of pile driving days is based on assumptions listed in Section 2.2.1. The overall duration of project construction would be 42 to 44 months, including two in-water work seasons.

Lighting fixtures would be of the same type as those for the other alternatives. Because the floating wharf is larger than the pile-supported wharf, overall the lighted area would be more for Alternative 5 than for Alternative 1.

The upland component would be the same as that for Alternative 1 (Section 2.2.2). The abutment at the shore end of the access trestle would also be the same as that for Alternative 1.

Common components for all alternatives are addressed in detail in Section 2.2.1.

2.2.7 No-Action Alternative

Under the No-Action Alternative, the EHW-2 would not be built. Operations would continue at the existing EHW. Unless a second EHW were built, the Navy would not have the required facilities to perform routine operations and upgrades required to maintain the current fleet of TRIDENT submarines on NBK at Bangor through 2042. Therefore, the No-Action Alternative would not meet the purpose and need of the proposed action, and the Navy's mission would not be met.

Table 2–1. Physical Features of the Action Alternatives for the EHW-2

Facility Feature [1]	Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	Alternative 2: Combined Trestle, Conventional Pile Wharf	Alternative 3: Separate Trestles, Large Pile Wharf	Alternative 4: Separate Trestles, Conventional Pile Wharf	Alternative 5: Combined Trestle, Floating Wharf
Total Overwater Area (wharf, access trestle, lightning towers)	273,108 sq ft (6.3 acres)	Same as Alternative 1	288,956 sq ft (6.6 acres)	Same as Alternative 3	371,000 sq ft (8.5 acres)
Overwater Area Shallower than -30 ft MLLW	17,859 sq ft (0.41 acre)	Same as Alternative 1	32,880 sq ft (0.75 acre)	Same as Alternative 3	34,000 sq ft (0.78 acre)
Total Number of Permanent In-Water Piles	Up to 1,250	Up to 1,460	Up to 1,290	Up to 1,500	Up to 440
Number of Piles Shallower than -30 ft MLLW	Approximately 90	Same as Alternative 1	Approximately 160	Same as Alternative 3	Approximately 140
Total Area of Seafloor Displaced by Piles	9,015 sq ft (0.21 acre)	9,050 sq ft (0.21 acre)	9,175 sq ft (0.21 acre)	9,210 sq ft (0.21 acre)	3,360 sq ft (0.08 acre)
Total Area Shallower than -30 ft MLLW Displaced by Piles	361 sq ft (0.008 acre)	Same as Alternative 1	642 sq ft (0.015 acre)	Same as Alternative 3	1,068 sq ft (0.025 acre)
Duration of In-Water Construction [2]	2 to 3 in-water work seasons, including 200 to 400 pile driving days	3 to 4 in-water work seasons, including 275 to 550 pile driving days	2 to 3 in-water work seasons, including 210 to 420 pile driving days	3 to 4 in-water work seasons, including 290 to 570 pile driving days	2 in-water work seasons, including 135 to 175 pile driving days
Total Construction Duration	42 – 48 months	54 – 64 months	42 – 49 months	54 – 64 months	42 – 44 months

Table 2–1. Physical Features of the Action Alternatives for the EHW-2 (continued)

Facility Feature [1]	Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	Alternative 2: Combined Trestle, Conventional Pile Wharf	Alternative 3: Separate Trestles, Large Pile Wharf	Alternative 4: Separate Trestles, Conventional Pile Wharf	Alternative 5: Combined Trestle, Floating Wharf
Main Wharf Dimensions and Area	632 x 250 ft	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	684 x 284 ft
	Total area: 158,000 sq ft, including 43,500 sq ft slip Covered overwater area: 152,200 sq ft				Total area: 194,256 sq ft, including 48,000 sq ft slip Covered overwater area: 184,000 sq ft
Lightning Tower Dimensions and Area	Six, each 30 x 30 ft	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
	Total area: 5,400 sq ft				
Warping Wharf Dimensions and Area	688 x 40 ft	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	687 x 75 ft
	34,300 sq ft, including connection to access trestle				54,000 sq ft
Trestle Dimensions and Area	1,849 ft long x 40 – 48 ft wide	Same as Alternative 1	2,280 ft long x 40 ft wide	Same as Alternative 3	Trestles: 325 x 48 ft 664 x 40 ft 440 x 38 ft Dolphin width varies (included in the total) Mooring Booms: 15,500 sq ft (included in total)
	81,208 sq ft		97,056 sq ft		117,000 sq ft

Table 2–1. Physical Features of the Action Alternatives for the EHW-2 (continued)

Facility Feature [1]	Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	Alternative 2: Combined Trestle, Conventional Pile Wharf	Alternative 3: Separate Trestles, Large Pile Wharf	Alternative 4: Separate Trestles, Conventional Pile Wharf	Alternative 5: Combined Trestle, Floating Wharf
Mooring Dolphin Dimensions and Area	N/A	N/A	N/A	N/A	150 x 104 ft 131 x 112 ft 136 x 112 ft Total Area = 45,500 sq ft
Pontoon Dimensions	N/A	N/A	N/A	N/A	Main pontoon: 604 x 114 ft Outer pontoon: 557 x 75 ft End pontoon: 284 x 75 ft Warping wharf pontoon: 688 x 75 ft, with 60 x 38 ft ramp landing
Wharf Deck Top Elevation	20.5 ft above MLLW	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Varies with tide; 12 ft above water surface
Wharf Deck Bottom Elevation	13 ft above MLLW	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	20 ft below water surface
Trestle Deck Top Elevation	20.5 to 28 ft above MLLW	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	22 to 28 ft above MLLW
Trestle Deck Bottom Elevation	15.2 to 22.7 ft above MLLW	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	16.7 to 22.7 ft above MLLW
Number and Size of Main Wharf Piles	140 24-inch 157 36-inch 263 48-inch	140 24-inch 520 36-inch	Same as Alternative 1	Same as Alternative 2	0

Table 2–1. Physical Features of the Action Alternatives for the EHW-2 (continued)

Facility Feature [1]	Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	Alternative 2: Combined Trestle, Conventional Pile Wharf	Alternative 3: Separate Trestles, Large Pile Wharf	Alternative 4: Separate Trestles, Conventional Pile Wharf	Alternative 5: Combined Trestle, Floating Wharf
Number and Size of Warping Wharf Piles	80 24-inch 190 36-inch	80 24-inch 300 36-inch	Same as Alternative 1	80 24-inch 255 36-inch	0
Number and Size of Lightning Tower Piles	40 24-inch 90 36-inch	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Number and Size of Trestle Piles	57 24-inch 233 36-inch	Same as Alternative 1	82 24-inch 248 36-inch	Same as Alternative 3	52 24-inch 143 36-inch
Number and Size of Mooring Dolphin Piles	N/A	N/A	N/A	N/A	115 48-inch
Falsework Piles (temporary)	Up to 150 18 to 24-inch	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Number of Upland Abutment Piles (all 24-inch)	55 24-inch (11 additional pile driving days)	Same as Alternative 1	80 24-inch (16 additional pile driving days)	Same as Alternative 3	Same as Alternative 1
New Impervious Surface (new Roads, Buildings, Parking, sidewalks)	3.6 acres	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Construction Laydown Area (temporary)	5 acres	5 acres	5 acres	5 acres	5 acres

Table 2–1. Physical Features of the Action Alternatives for the EHW-2 (continued)

Facility Feature [1]	Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	Alternative 2: Combined Trestle, Conventional Pile Wharf	Alternative 3: Separate Trestles, Large Pile Wharf	Alternative 4: Separate Trestles, Conventional Pile Wharf	Alternative 5: Combined Trestle, Floating Wharf
Upland Area Disturbed (new roads, buildings, parking, utilities, stormwater facilities, construction laydown area)	Temporary: 9.0 acres Permanent: 3.6 acres Total: 12.6 acres	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Trestle Abutment at Shore	103 ft long with 69 ft wing wall on north end Excavation: 2,760 cu yd (300 cu yd below MHHW) Armor rock: 520 cu yd	Same as Alternative 1	160 ft long with two 35 ft wing walls Excavation: 3,560 cu yd (550 cu yd below MHHW) Armor rock: 700 cu yd	Same as Alternative 3	Same as Alternative 1

cu yd = cubic yards; ft = foot/feet; sq ft = square feet

1. Numbers of piles, all categories, are based on the preliminary design.
2. In-water work season is July 16 to February 15.

2.2.8 Design Measures, Current Practices, and BMPs

Integrated into the project are design features and measures to avoid environmental impacts. Where avoidance is not possible, the design has been modified to minimize those impacts. Design features include the following:

- Trestles are aligned to minimize impacts and overwater coverage to shallow nearshore areas.
- Trestles are the minimum width required to allow two large vehicles to pass on one trestle, and allow adequate space for turning, as required in the *Facility Design Criteria* (Lockheed Martin 2010).
- The number of pilings to support the proposed facility has been minimized to meet structural, operational, safety, and security requirements in the *Facility Design Criteria* (Lockheed Martin 2010), while also reducing costs. For example, Alternatives 1 and 3 include piles up to 48 inches in diameter to reduce the overall number of piles required.
- The support building is sized to support the functions required by the *Facility Design Criteria* (Lockheed Martin 2010).

Current practices (CPs) are physical, structural, or managerial practices that decrease the potential for impacts, particularly related to water quality. BMPs are required to ensure compliance with the USEPA general permit for stormwater discharges from construction sites. CPs and BMPs are further described in Appendix F (Mitigation Action Plan). To minimize environmental impacts, the following current practices and BMPs will be implemented as part of the selected alternative:

- Measures will be implemented to avoid anchor dragging and line dragging during construction including: preparation of a mooring and anchoring plan; placement of anchors outside of special status areas, to the extent feasible; placement and retrieval of any anchors required within special status areas using a secondary work boat and/or vertical lift system to avoid/minimize dragging; and use of a buoy(s) (surface or subsurface) along the lower portion of mooring lines required within special status areas to avoid/minimize dragging.
- Vessel operators will be instructed to avoid using excess engine thrust in waters less than 30 feet.
- Vessel operators will be instructed to avoid bottoming out (running aground) in shallow areas.
- Construction vessels will be excluded from shallow areas (less than 30 feet in depth) outside the immediate construction site (within 150 feet of the trestle or wharf).
- All areas of in-water and above-water work will be surrounded by floating debris barriers and a floating oil absorbent boom.
- The Navy will be required to develop Debris Management Plans and Spill Response Plans, and to retrieve and clean up any accidental spills and construction debris.
- Following completion of in-water construction activities, an underwater survey will be conducted to remove any lost construction materials.

- In-water construction will observe the in-water work window (July 16 to February 15) to minimize in-water impacts to juvenile salmonid fish.
- A Stormwater Pollution Prevention Plan (SWPPP) will be implemented for construction and operation.
- Measures to control stormwater will include installation of a temporary runoff capture and discharge system, and installation of temporary siltation barriers, such as straw wattles, below the excavation/construction zone.
- Culverts and weep pipes will be required to divert seepage where the access road is constructed.
- During clearing, grading, and maintenance (including the laydown area), the following will be employed as needed to control erosion and sedimentation: possible use of benched surfaces, downdrain channels, diversion berms and ditches, erosion control blankets or turf reinforcement mats, plastic coverings, silt fences and check dams, and straw bales.
- Water-spraying on soil will be used to control dust generation during earthmoving and hauling activities.
- Drainage structures along the margins of the access road will remain in place to control runoff.
- The area surrounding the access road and the construction of the abutment will be revegetated to protect against erosion or other soil movement in this vicinity; the laydown area would also be revegetated with native forest species.
- Gravel will be installed at construction area access points to prevent tracking of soil onto paved roads.
- BMPs will be implemented to control runoff and siltation and minimize impacts to surface water, per the *Stormwater Management Manual for Western Washington* (WDOE 2005a).
- Roof material will consist of inert non-leachable material in accordance with the *Stormwater Management Manual for Western Washington* (WDOE 2005a).

2.2.9 Operations

Operation of the EHW-2 would not result in an increase in boat traffic at the Bangor waterfront. Rather, a portion of the ongoing operations and boat traffic at the existing EHW and other facilities within the Waterfront Restricted Area (e.g., Delta Pier and Marginal Wharf) would be diverted to the EHW-2. The EHW-2 may be used as a backup explosives handling facility for OHIO-class guided missile submarines (SSGNs) currently homeported at the Bangor waterfront when there are no TRIDENT operations at the existing EHW. The EHW-2 may also provide temporary berthing when no ordnance handling operations are occurring at either wharf. No increase in boat traffic would be required to achieve planned operations. The increase in future operations at the waterfront would only require that boats remain at an EHW longer when in port for maintenance and upgrades. The overall level of boat traffic and activity at the Bangor waterfront would not increase as a result of operating the EHW-2. Operation of the EHW-2 may require approximately 20 additional military and civilian personnel. The EHW-2 would be

staffed 24 hours per day, 7 days per week. Operation of the four relocated facilities would not change from existing operation of these facilities.

Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components as required. Fouling organisms would not be removed from piles or pontoons. The installed piles for the EHW-2 are designed to not require replacement during the design life of the structure. A cathodic protection system, consisting of a protective coating and cathodic anodes to prevent corrosion, would be installed on all EHW-2 piles to ensure that the piles would not need replacement. Annual inspections of the piles would verify the integrity of the structure. In addition, annual maintenance would be performed on the cathodic protection system to ensure it continues to operate as designed. Annual maintenance would include, as necessary, replacing the cathodic anodes and repairing any damage to the coatings. BMPs would be used during these routine maintenance activities. Other actions would involve repairing the pile coating if it becomes worn or possibly damaged during anode replacement. There is also a protective wrap, which is planned to protect the interface between the pile and concrete deck and which would require maintenance on a 3–5 year cycle.

2.2.10 Alternatives Considered But Not Carried Forward For Detailed Analysis

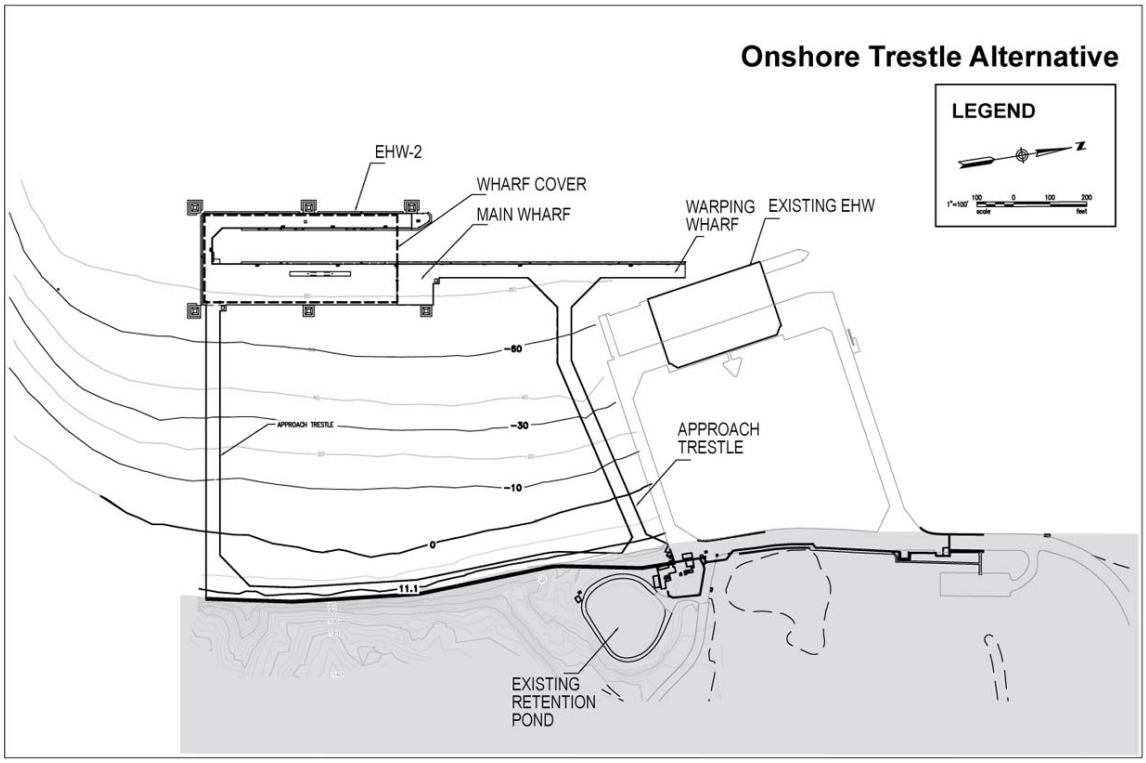
The future location of the EHW-2 must comply with explosives safety requirements. In accordance with criteria in NAVSEA OP5, *Ammunition and Explosives Safety Ashore*, NBK at Bangor includes designated restricted areas to protect life and property in the event of an accident (further discussed in Section 1.1 and Appendix C, *Explosives Safety Arcs for Existing EHW and Proposed EHW-2*, marked DoD UCNI). The proposed location for the EHW-2 is the only available location along the Bangor waterfront that ensures designated restricted areas remain within Navy property boundaries and required separation distances between facilities are maintained. Minimum water depth for operability and maximum water depth for constructability greatly constrain the EHW-2's proposed location along the shore to the east and west. Similarly, minimum separation distances between facilities and the requirement to keep restricted areas within base boundaries constrain the proposed location of the EHW-2 along the shore to the north and south. Therefore, all alternatives are located in the same project area.

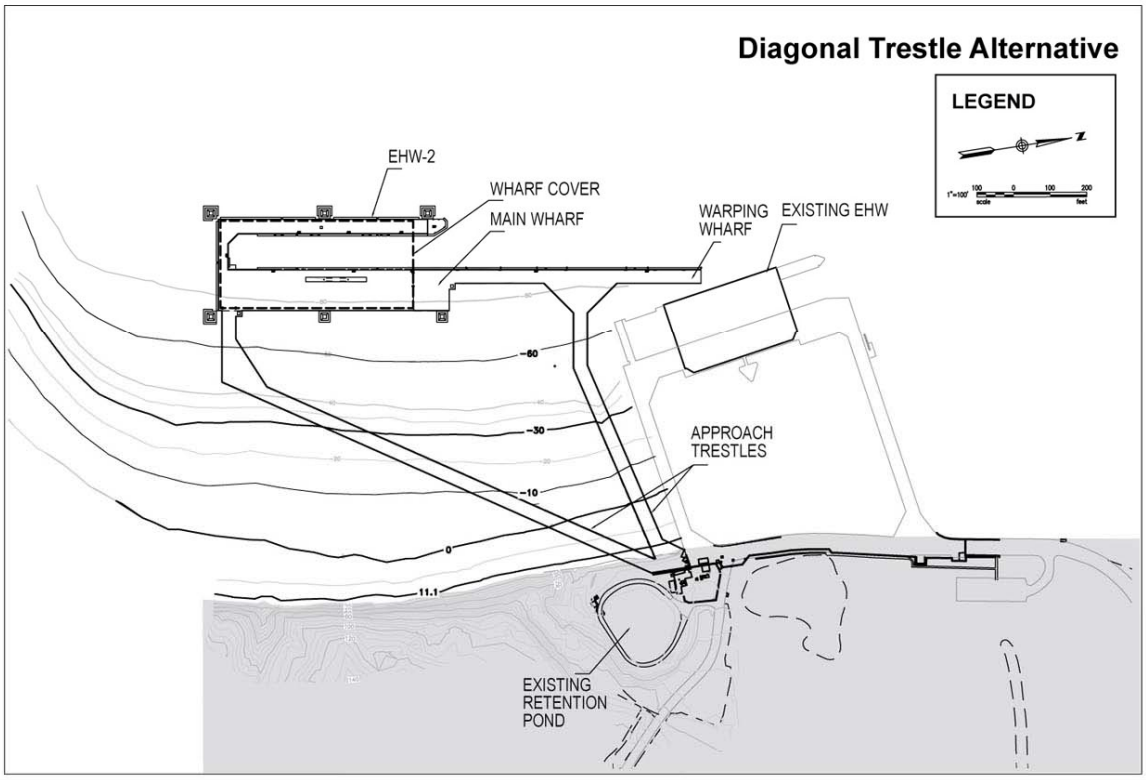
2.2.10.1 Alternatives Identified by the Navy

2.2.10.1.1 ALTERNATIVE TRESTLE LAYOUTS

The Navy considered two additional trestle layouts that were not carried forward for detailed analysis in this EIS: the Onshore Trestle Layout and the Diagonal Trestle Layout (Figure 2–9).

With the Onshore Trestle Layout, the southern trestle would come directly ashore from the wharf, and an on-land road would be built to connect to existing roads near the existing EHW. The purpose of considering this trestle layout was to minimize impacts to the marine environment. However, the steep and unstable terrain over which the on-land road would be built would require extensive earthwork, including a large retaining wall. A variation of this layout was considered, with the "onshore" trestle running along the beach at the base of the cliff. This option would require extensive earthwork to address steep and unstable terrain, and would result in extensive impacts to shallow water and intertidal habitat. Neither of these options would meet the following central selection criterion: the ability to avoid or reduce environmental impacts. Therefore, these options were not carried forward for further analysis.





Source: BergerABAM 2010

Figure 2–9. Alternatives Considered but Not Carried Forward

With the Diagonal Trestle Layout, the southern trestle would run diagonally from the southern end of the wharf to the point where both trestles come ashore. This trestle would cover more shallow-water habitat than either the Combined Trestle or Separate Trestle Alternatives, with a greater number of shallow-water piles, greater overwater coverage, and adverse impacts to habitat including eelgrass. This layout also would not meet the following selection criterion: the ability to avoid or reduce environmental impacts. Therefore, this layout was not carried forward for further analysis.

2.2.10.1.2 TERMINAL CONCEPT

The Navy considered this concept as an alternative to the pile-supported deep-water explosives handling wharves currently utilized on NBK at Bangor and Naval Submarine Base Kings Bay. Under the terminal concept, operations would be performed in a building constructed on shore and the missile would be transported to/from the wharf by an overhead crane. The process would be reversed for offloading. This proposal would reduce the size of the wharf and the size of the access trestle, but would add a requirement for a large structural causeway between the terminal and the wharf to support the overhead crane. Detailed investigation of the concept identified several disadvantages, including severe technical challenges for transportation of the missile by crane, the requirement to develop and implement new safety procedures for the EHW-2 while continuing to follow current procedures for the existing EHW, absence of a site with suitable topography and geology for the onshore facility, and a determination that the concept would not meet minimum explosives safety requirements. This proposal would not meet the following selection criteria: ability to avoid or reduce environmental impacts and explosives safety restrictions. For these reasons, the terminal concept was not carried forward for further analysis. More detailed information about the Terminal Concept is presented in Appendix B, *Alternatives Considered for the TRIDENT Support Facilities Explosives Handling Wharf Environmental Impact Statement* (DoD UCNI).

2.2.10.1.3 OPTIONS FOR MEETING TRIDENT MISSION REQUIREMENTS

In a business case analysis,[6] the Navy considered several options for meeting TRIDENT mission requirements without constructing the EHW-2. These options focused on actions that would expedite repairs at the existing EHW. Options considered include totally shutting down the existing EHW for expedited repairs and temporarily relocating operations until repairs are complete. One such option would temporarily transit submarines to facilities located on the east coast during the shutdown period. Other options would modify existing facilities on NBK at Bangor to support operations until repairs at the existing EHW were completed. The Navy also considered an option that would not expedite repairs but would continue with the current EHW repair programs as is, while increasing operations at the existing EHW. These options would not meet the following selection criterion: capability to meet TRIDENT mission requirements. Therefore, these options were not carried forward for further analysis. More detailed information about these options is presented in Appendix B, *Alternatives Considered for the TRIDENT Support Facilities Explosives Handling Wharf Environmental Impact Statement* (DoD UCNI).

2.2.10.1.4 ALTERNATIVE BUILDING RELOCATION SITES CONSIDERED BUT NOT CARRIED FORWARD

The Navy considered alternative sites for the three new buildings and pure water facility that are not carried forward in this analysis. Selection criteria included:

[6] Explosives Handling Wharf-2 Business Case Analysis & Risk Assessment, November 6, 2008, Secret/Formerly Restricted Data.

- Size of the site location,
- Existing land use,
- Proximity to existing operations,
- Environmental impacts,
- Compliance with DDESB and NOSSA requirements,
- Controlled area access requirements,
- Proximity to existing utilities, and
- Constructability.

Three New Buildings and Replacement Parking. Two additional sites for the three new buildings and associated replacement parking were considered. Alternative site A is a disturbed site approximately 4,000 feet southeast of the existing EHW (Figure 2–10). This site would not comply with DDESB and NOSSA requirements and was not considered further. Alternative site B is a forested and sloped site adjacent to existing structures (Figure 2–10). This site was eliminated from further consideration because construction would result in greater environmental impacts than the preferred site, due to removal of existing forest and significant earthwork required to create a level building site.

Pure Water Facility. Two additional sites for the pure water facility were considered. Alternative site A is immediately south of the existing pure water facility, along the railroad bed (Figure 2–11). This site would have greater environmental impacts due to its narrow configuration in close proximity to the shoreline bank. Any new facilities in this location could require shoreline armoring or other alteration to the shoreline to ensure stability of the shoreline bank. Therefore, this site was not considered further. Alternative site B is approximately 900 feet inland from the shoreline (Figure 2–11). This site was eliminated from further consideration because it would not be compatible with controlled area access requirements, due to the waterfront security fence and gate system.

2.2.10.2 Alternatives Identified through Scoping Comments

2.2.10.2.1 LOCATING EHW-2 AT A DIFFERENT SITE

As stated in Section 1.2, the proposed action is to support future TRIDENT program requirements for the submarines currently homeported at the Bangor waterfront. NBK at Bangor is the only naval base on the west coast with the specialized infrastructure dedicated to supporting the TRIDENT submarine program. The base infrastructure includes numerous facilities that support every aspect of TRIDENT program operations and services. EHWs provide an interface between highly specialized land-based support facilities and submarines at sea. Accordingly, for security and logistics reasons, EHWs are necessarily located in very close proximity to existing dedicated land-based infrastructure. NBK at Bangor is the only location on the west coast possessing the necessary supporting infrastructure. Operating from the only other such dedicated facility on the east coast would not meet critical mission requirements. This option would not meet the following selection criterion: siting requirements including proximity to existing infrastructure. Therefore, this option was not carried forward for further analysis.

Figure 2–10. Site Alternatives for Three New Buildings

Figure 2–11. Site Alternatives for Pure Water Facility

2.2.10.2.2 LOCATING EHW-2 WEST AND PARALLEL TO EXISTING EHW

To comply with DDESB and NOSSA requirements, the future location of the EHW-2 is very constrained. This option would not meet the following selection criterion: explosives safety restrictions. Therefore, this option was not carried forward for further analysis.

2.2.10.2.3 COMBINING TRESTLES WITH EXISTING EHW

The Navy considered several options to reduce overwater coverage of trestles. Combining trestles with the existing EHW was determined not to be feasible because the existing EHW and EHW-2 could not support concurrent independent operations if the same trestle served both EHWs. This option would not meet the following selection criterion: capability to meet TRIDENT mission requirements. Therefore, this option was not carried forward for further analysis.

2.2.10.2.4 DEMOLISHING EXISTING EHW AFTER COMPLETION OF EHW-2

As discussed in Section 1.2 and depicted in Figure 1–3, the EHW-2 alone would not provide sufficient capacity to support TRIDENT program requirements. This option would not meet the following selection criteria: capability to meet TRIDENT mission requirements. Therefore, this option was not carried forward for further analysis.

2.3 COMPARISON OF ALTERNATIVES

All alternatives would have the same types of environmental impacts; the magnitude of these impacts would vary among the alternatives (Table 2–2). The principal types of impacts during project construction would include pile driving noise (and its effects on marine and terrestrial biota), turbidity, and air pollutant emissions. In the long term, impacts would include loss and shading of marine habitat, including eelgrass, macroalgae and the benthic community, and interference with the migration of juvenile salmon, some species of which are protected under the ESA. Certain fish species are more susceptible to injury during impact pile driving activities. ESA-listed fish species that may be adversely affected include Hood Canal summer-run chum salmon, Puget Sound Chinook salmon, Puget Sound steelhead, bocaccio, yelloweye rockfish, and canary rockfish. Based on their lack of prevalence in the waters of NBK at Bangor, ESA-listed bull trout would not likely be adversely affected. All action alternatives may result in behavioral disturbance of marine mammals (Steller sea lion) and bird species (marbled murrelet) protected under the ESA, as well as behavioral harassment of marine mammals protected under the MMPA. Injury is not expected to any marine mammal, including the Steller sea lion, or to the marbled murrelet. Marine mammals potentially affected by behavioral harassment would include the ESA-listed Steller sea lion and the following non-ESA-listed species: harbor seals, California sea lions, Dall's porpoises, harbor porpoises, and transient killer whales. ESA-listed southern resident killer whales may be affected indirectly through effects on their prey (salmon). Depending on the species, the appropriate ESA effect determination is either "no effect," "may affect, not likely to adversely affect" or "may affect, likely to adversely affect." Mitigation measures would be implemented to minimize impacts from pile driving noise (Table 2–2). Impacts to marine habitats and species would be mitigated by actions proposed in the Mitigation Action Plan (Appendix F). The Navy has completed consultations with NMFS and USFWS under the ESA and MSA. NMFS issued a Biological Opinion and Essential Fish Habitat (EFH) conservation recommendations on September 29, 2011, and USFWS issued a biological opinion on November 16, 2011. The Navy will comply with the terms and conditions and conservation measures (see Sections 3.8.2.7, 3.9.2.7, and 3.10.2.7 of this FEIS and Mitigation Action Plan,

Appendix F, for terms and conditions). Regarding MMPA compliance, the Navy has submitted an Incidental Harassment Authorization (IHA) application for the first year of construction and will prepare and submit additional MMPA authorization applications to cover subsequent years of the project. No Incidental Take Statement (ITS) for marine mammals was included in the NMFS Biological Opinion because NMFS Headquarters has not yet authorized incidental take under the MMPA. Following issuance of authorizations for marine mammals under the MMPA, NMFS may amend the ESA Biological Opinion to include an ITS for marine mammals.

Upland impacts would be essentially the same for all alternatives. Upland construction would result in disturbance of approximately 10.3 vegetated acres under all alternatives, with 6.9 acres being revegetated following construction. The sites of the five demolished buildings would be revegetated with native forest and shrub species. There would be a permanent loss of 0.20 acre of wetland, which would be mitigated. Wildlife would be disturbed by construction noise, especially pile driving. With BMPs (Section 2.2.8), replacement of the aboveground 10,000-gallon oily wastewater tank with an underground tank would not adversely affect soils or water resources. No terrestrial animals or plants protected under the ESA, MBTA, or Bald and Golden Eagle Protection Act would be affected. Pursuant to the CWA, the Navy has applied for Section 404 permits from USACE for impacts to wetlands and fill at the shoreline, and an associated Section 401 water quality certification from WDOE. The remaining features of the project including the piles, over-water structure, and trestles would be permitted by USACE under Section 10 of the Rivers and Harbors Act. In accordance with the CZMA, the Navy submitted a Phase I Coastal Consistency Determination (CCD) to WDOE (included in Appendix I of this FEIS) and WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD in spring 2012.

Social impacts would also be similar for all alternatives, except for differences in the duration of construction including pile driving noise (see below). Recreational and residential areas would be disturbed by pile driving and other construction noise. Air pollutant emissions would not exceed thresholds for a major source for any alternative. Under all action alternatives, the settings of the existing EHW, Delta Pier, and Shelton-Bangor Railroad mainline, which are eligible for the National Register of Historic Places (NRHP), would not be adversely affected by the EHW-2; the State Historic Preservation Officer (SHPO) has concurred with these findings (Appendix I). There would be a small potential for disturbance of archaeological resources during construction; if any such resources were encountered, the Navy would coordinate with the SHPO and tribes. Access to tribal fishing areas, the closest of which is approximately 5,000 feet south of the proposed site for the EHW-2 and 1,000 feet south of the pure water facility, would not be affected by any alternative. Implementation of the proposed action would adversely affect fish, which include tribal treaty-reserved resources. A net loss of tribal resources is not anticipated, but pile driving noise during construction may cause the salmon and steelhead to move to a different location within Hood Canal. This could increase the time allocated to observe the tribes' fishing rights. Tribal divers engaged in resource harvest within this area could experience increased underwater noise levels. Mitigation is included as part of the proposed action to address the impacts to aquatic resources and tribal fisheries and tribal divers. Government-to-Government consultation with affected American Indian tribes is ongoing.

The proposed action would be consistent to the maximum extent practicable with the Washington State Shoreline Management Act (SMA), and would be consistent with the Trident Support Site Master Plan (Trident Joint Venture 1975) for NBK at Bangor and the Kitsap County

Comprehensive Plan. Aesthetically, the EHW-2 would add a large industrial structure to the Bangor waterfront; this structure would be larger for the Floating Wharf Alternative (Alternative 5) than for the other alternatives. The proposed action would not have disproportionate adverse effects on minority or disadvantaged populations. For every $100 million spent by the Navy in construction expenditures, an estimated 874 direct jobs would be created, as well as an estimated 394 indirect and induced jobs. Indirect or induced jobs would be concentrated in the following industries: food services and drinking places, real estate establishment, health care, architectural engineering, wholesale trade, and retail stores. The project cost is estimated to be in excess of $500 million, representing the total economic impact of 4,370 direct jobs and 1,970 indirect and induced jobs. Total economic output to the region would be in excess of $722 million. Based on the economic analysis for the proposed action, the action would provide a substantial economic benefit to the local and regional economy. Existing utility capacity would be sufficient to support the EHW-2, with only minor new connections and stormwater facilities required. Construction and operational impacts to marine and upland transportation would be minor for all aspects of the project, except for delays in traffic crossing the Hood Canal Bridge during EHW-2 construction. Operation of the EHW-2 would result in no increased danger to the public, including children and sensitive receptors in the area. Should any hazardous materials be found during demolition or modification of existing facilities, procedures for proper handling and disposal of the specific materials would be implemented.

Alternative 1, Combined Trestle, Large Pile Wharf, is the preferred alternative because it has:

- Fewer nearshore habitat impacts than Alternatives 3, 4, and 5;
- Less overwater coverage than Alternatives 3, 4, and 5;
- Fewer piles than Alternatives 2, 3, and 4; and
- Less upfront and life-cycle costs than Alternative 5 (Navy 2010d, DoD UCNI).

Table 2–2. Comparison of Environmental Impacts of Alternatives

Resource Area	Alternative 1 (Preferred Alternative)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	No Action
Hydrography	• Permanent alteration to current patterns over 6.3 acres	• Same as Alternative 1	• Permanent alteration over 6.6 acres	• Permanent alteration over 6.6 acres	• Permanent alteration over 8.5 acres	No change
Water Quality	• Temporary sediment resuspension (42–48 months) • BMPs applied to minimize impacts	• Temporary sediment resuspension (54–64 months) • BMPs applied to minimize impacts	• Temporary sediment resuspension (42–49 months) • BMPs applied to minimize impacts	• Temporary sediment resuspension (54–64 months) • BMPs applied to minimize impacts	• Temporary sediment resuspension (42–44 months) • BMPs applied to minimize impacts	No change
Sediment	• Temporary sediment resuspension (42–48 months) • Accretion of sediments around new structure • BMPs applied to minimize impacts	• Temporary sediment resuspension (54–64 months) • Accretion of sediments around new structure • BMPs applied to minimize impacts	• Temporary sediment resuspension (42–49 months) • Accretion of sediments around new structure • BMPs applied to minimize impacts	• Temporary sediment resuspension (54–64 months) • Accretion of sediments around new structure • BMPs applied to minimize impacts	• Temporary sediment resuspension (42–44 months) • Accretion of sediments around new structure. • BMPs applied to minimize impacts	No change

Table 2–2. Comparison of Environmental Impacts of Alternatives (continued)

Resource Area	Alternative 1 (Preferred Alternative)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	No Action
Marine Vegetation	• Temporary shallow water construction impacts 3.7 acres • Loss of 0.09 acre of eelgrass • Long-term shading of eelgrass (0.09 acre), green macroalgae (0.13 acre) • Mitigation Measures applied to offset impacts	• Same as Alternative 1	• Temporary shallow water construction impacts 3.8 acres • Loss of 0.16 acre of eelgrass • Long-term shading of eelgrass (0.16 acre), green macroalgae (0.17 acre) • Mitigation Measures applied to offset impacts	• Temporary shallow water construction impacts 3.8 acres • Loss of 0.16 acre of eelgrass • Long-term shading of eelgrass (0.16 acre), green macroalgae (0.17 acre) • Mitigation Measures applied to offset impacts	• Temporary shallow water construction impacts 6.5 acres • Loss of 0.09 acre of eelgrass • Long-term shading of eelgrass (0.09 acre), green macroalgae (0.20 acre), red macroalgae (0.06 acre), kelp (0.02 acre) • Mitigation Measures applied to offset impacts	No change
Plankton	• Minor localized impacts	• Minor localized impacts	• Minor localized impacts	• Minor localized impacts	• Minor localized impacts	No change
Benthic Communities Including Shellfish	• Temporary construction impacts 25.7 acres • Benthic habitat loss 0.2 acre • Long-term benthic habitat shading 6.3 acres • Mitigation Measures applied to offset impacts	• Same as Alternative 1	• Temporary construction impacts 25.8 acres • Benthic habitat loss 0.2 acre • Long-term benthic habitat shading 6.6 acres • Mitigation Measures applied to offset impacts	• Temporary construction impacts 25.8 acres • Benthic habitat loss 0.2 acre • Long-term benthic habitat shading 6.6 acres • Mitigation Measures applied to offset impacts	• Temporary construction impacts 29.5 acres • Benthic habitat loss 0.08 acre • Long-term benthic habitat shading 8.5 acres • Mitigation Measures applied to offset impacts	No change

Table 2–2. Comparison of Environmental Impacts of Alternatives (continued)

RESOURCE AREA	ALTERNATIVE 1 (PREFERRED ALTERNATIVE)	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5	NO ACTION
Threatened and Endangered Species	• May affect, likely to adversely affect ESA-listed fish: Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, bocaccio, yelloweye rockfish, canary rockfish • May affect, likely to adversely affect ESA-listed Steller sea lion. Harassment potential exposures: 400–800 • May affect, likely to adversely affect ESA-listed marbled murrelet. Harassment potential exposures: - Jul 16–Oct 31: 2,300–4,600 - Nov 1–Feb 15: 4,200–8,400 • May affect, not likely to adversely affect southern resident killer whale (indirect effect) and bull trout	• May affect, likely to adversely affect ESA-listed fish: Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, bocaccio, yelloweye rockfish, canary rockfish • May affect, likely to adversely affect ESA-listed Steller sea lion. Harassment potential exposures: 550–1,100 • May affect, likely to adversely affect ESA-listed marbled murrelet. Harassment potential exposures: - Jul 16–Oct 31: 3,174–6,325 - Nov 1–Feb 15: 5,754–11,550 • May affect, not likely to adversely affect southern resident killer whale (indirect effect) and bull trout	• May affect, likely to adversely affect ESA-listed fish: Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, bocaccio, yelloweye rockfish, canary rockfish • May affect, likely to adversely affect ESA-listed Steller sea lion. Harassment potential exposures: 420–840 • May affect, likely to adversely affect ESA-listed marbled murrelet. Harassment potential exposures: - Jul 16–Oct 31: 2,415–4,830 - Nov 1–Feb 15: 4,410–8,820 • May affect, not likely to adversely affect southern resident killer whale (indirect effect) and bull trout	• May affect, likely to adversely affect ESA-listed fish: Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, bocaccio, yelloweye rockfish, canary rockfish • May affect, likely to adversely affect ESA-listed Steller sea lion. Harassment potential exposures: 580–1,140 • May affect, likely to adversely affect ESA-listed marbled murrelet. Harassment potential exposures: - Jul 16–Oct 31: 3,335–6,555 - Nov 1–Feb 15: 6,090–11,970 • May affect, not likely to adversely affect southern resident killer whale (indirect effect) and bull trout	• May affect, likely to adversely affect ESA-listed fish: Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, bocaccio, yelloweye rockfish, canary rockfish • May affect, likely to adversely affect ESA-listed Steller sea lion. Harassment potential exposures: 270–350 • May affect, likely to adversely affect ESA-listed marbled murrelet. Harassment potential exposures: - Jul 16–Oct 31: 1,564–2,024 - Nov 1–Feb 15: 2,814–3,654 • May affect, not likely to adversely affect southern resident killer whale (indirect effect) and bull trout	No change

Table 2–2. Comparison of Environmental Impacts of Alternatives (continued)

RESOURCE AREA	ALTERNATIVE 1 (PREFERRED ALTERNATIVE)	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5	NO ACTION
	• Critical habitat: - Puget Sound Chinook salmon: likely to adversely affect - Hood Canal summer run chum salmon: likely to adversely affect - Puget Sound steelhead: NA (not designated) - Bull trout: no effect - Bocaccio, canary and yelloweye rockfish: NA (not designated) - Steller sea lion: no effect - Southern resident killer whale: no effect - Marbled murrelet: no effect • Mitigation Measures applied to minimize and offset impact, developed in consultation with USFWS and NMFS	• Critical habitat: - Puget Sound Chinook salmon: likely to adversely affect - Hood Canal summer run chum salmon: likely to adversely affect - Puget Sound steelhead: NA (not designated) - Bull trout: no effect - Bocaccio, canary and yelloweye rockfish: NA (not designated) - Steller sea lion: no effect - Southern resident killer whale: no effect - Marbled murrelet: no effect • Mitigation Measures applied to minimize and offset impact, developed in consultation with USFWS and NMFS	• Critical habitat: - Puget Sound Chinook salmon: likely to adversely affect - Hood Canal summer run chum salmon: likely to adversely affect - Puget Sound steelhead: NA (not designated) - Bull trout: no effect - Bocaccio, canary and yelloweye rockfish: NA (not designated) - Steller sea lion: no effect - Southern resident killer whale: no effect - Marbled murrelet: no effect • Mitigation Measures applied to minimize and offset impact, developed in consultation with USFWS and NMFS	• Critical habitat: - Puget Sound Chinook salmon: likely to adversely affect - Hood Canal summer run chum salmon: likely to adversely affect - Puget Sound steelhead: NA (not designated) - Bull trout: no effect - Bocaccio, canary and yelloweye rockfish: NA (not designated) - Steller sea lion: no effect - Southern resident killer whale: no effect - Marbled murrelet: no effect • Mitigation Measures applied to minimize and offset impact, developed in consultation with USFWS and NMFS	• Critical habitat: - Puget Sound Chinook salmon: likely to adversely affect - Hood Canal summer run chum salmon: likely to adversely affect - Puget Sound steelhead: NA (not designated) - Bull trout: no effect - Bocaccio, canary and yelloweye rockfish: NA (not designated) - Steller sea lion: no effect - Southern resident killer whale: no effect - Marbled murrelet: no effect • Mitigation Measures applied to minimize and offset impact, developed in consultation with USFWS and NMFS	

Table 2–2. Comparison of Environmental Impacts of Alternatives (continued)

Resource Area	Alternative 1 (Preferred Alternative)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	No Action
Marine Mammals	• Behavioral disturbance exposures: - Steller sea lions, 400–800 - CA sea lion, 5,200–10,400 - Harbor seal, 10,800–21,600 - Transient killer whale, 400–800 - Dall's porpoise, 200–400 - Harbor porpoise, 2,000–4,000 • Mitigation Measures applied to minimize and offset impact, developed in consultation with NMFS	• Behavioral disturbance exposures: - Steller sea lions, 550–1,100 - CA sea lion, 7,150–14,300 - Harbor seal, 14,850–29,700 - Transient killer whale 550–1,100 - Dall's porpoise, 275-550 - Harbor porpoise, 2,750–5,500 • Mitigation Measures applied to minimize and offset impact, developed in consultation with NMFS	• Behavioral disturbance exposures: - Steller sea lions, 420–840 - CA sea lion, 5,460–10,920 - Harbor seal, 11,340–22,680 - Transient killer whale, 420–840 - Dall's porpoise, 210–420 - Harbor porpoise, 2,100–4,200 • Mitigation Measures applied to minimize and offset impact, developed in consultation with NMFS	• Behavioral disturbance exposures: - Steller sea lions, 580–1,140 - CA sea lion, 7,540–14,820 - Harbor seal, 15,660–30,780 - Transient killer whale, 580–1,140 - Dall's porpoise, 290–570 - Harbor porpoise, 2,900–5,700 • Mitigation Measures applied to minimize and offset impact, developed in consultation with NMFS	• Behavioral disturbance exposures: - Steller sea lions, 270–350 - CA sea lion, 3,510–4,550 - Harbor seal, 7,290–9,450 - Transient killer whale, 270–350 - Dall's porpoise, 135–175 - Harbor porpoise, 1,350–1,750 • Mitigation Measures applied to minimize and offset impact, developed in consultation with NMFS	No change
Essential Fish Habitat	• May adversely affect Essential Fish Habitat • The Navy consulted with NMFS on EFH.	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	No change

Table 2–2. Comparison of Environmental Impacts of Alternatives (continued)

Resource Area	Alternative 1 (Preferred Alternative)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	No Action
Marine Fish	• Pile driving noise impacts (200–400 days) • Temporary construction impacts, 25.7 acres • Partial barrier to juvenile salmon migration • Noise and Habitat Mitigation Measures applied to minimize and offset impact	• Pile driving noise impacts (275–550 days) • Temporary construction impacts, 25.7 acres • Partial barrier to juvenile salmon migration • Noise and Habitat Mitigation Measures applied to minimize and offset impact	• Pile driving noise impacts (210–420 days) • Temporary construction impacts 25.8 acres • Partial barrier to juvenile salmon migration • Noise and Habitat Mitigation Measures applied to minimize and offset impact	• Pile driving noise impacts (290–570 days) • Temporary construction impacts 25.8 acres • Partial barrier to juvenile salmon migration • Noise and Habitat Mitigation Measures applied to minimize and offset impact	• Pile driving noise impacts (135–175 days) • Temporary construction impacts 29.5 acres • Partial barrier to juvenile salmon migration • Noise and Habitat Mitigation Measures applied to minimize and offset impact	No change
Marine Birds	• Pile driving noise impacts (200–400 days for underwater noise; 211–411 days for airborne noise) [1] • Noise and Habitat Mitigation Measures applied to minimize and offset impact	• Pile driving noise impacts 275–550 days for underwater noise; 286–561 days for airborne noise) [1] • Noise and Habitat Mitigation Measures applied to minimize and offset impact	• Pile driving noise impacts (210–420 days for underwater noise; 226–436 days for airborne noise) [1] • Noise and Habitat Mitigation Measures applied to minimize and offset impact	• Pile driving noise impacts (290–570 days for underwater noise; 306–586 days for airborne noise) [1] • Noise and Habitat Mitigation Measures applied to minimize and offset impact	• Pile driving noise impacts (135–175 days for underwater noise; 146–186 days for airborne noise) [1] • Noise and Habitat Mitigation Measures applied to minimize and offset impact	No change
Geology and Soils	• 12.6 acres of land clearing • BMPs and Mitigation Measures applied to minimize and offset impacts	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	No change

1. Airborne noise has greater duration due to time needed to drive upland (abutment) piles.

Table 2–2. Comparison of Environmental Impacts of Alternatives (continued)

Resource Area	Alternative 1 (Preferred Alternative)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	No Action
Surface Water and Groundwater	• 6.3 acres of new impervious surface over water • 3.6 acres new impervious surface on land • BMPs applied to minimize impacts	• Same as Alternative 1	• 6.6 acres of new impervious surface over water • 3.6 acres new impervious surface on land • BMPs applied to minimize impacts	• 6.6 acres of new impervious surface over water • 3.6 acres new impervious surface on land • BMPs applied to minimize impacts	• 8.5 acres of new impervious surface over water • 3.6 acres new impervious surface on land • BMPs applied to minimize impacts	No change
Vegetation	• 10.3 acres of vegetation cleared • Revegetation of 6.9 acres • Removal of trees (not stumps) from an additional 1.0 acre	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	No change
Wetlands	• 0.2 acre of wetland filled • 0.032 acre of excavation/fill below MHHW • Mitigation Measures applied to offset impact, developed in consultation with USACE	• Same as Alternative 1	• 0.2 acre of wetland filled • 0.044 acre of excavation/fill below MHHW • Mitigation Measures applied to offset impact, developed in consultation with USACE	• 0.2 acre of wetland filled • 0.044 acre of excavation/fill below MHHW • Mitigation Measures applied to offset impact, developed in consultation with USACE	• Same as Alternative 1	No change

Table 2–2. Comparison of Environmental Impacts of Alternatives (continued)

Resource Area	Alternative 1 (Preferred Alternative)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	No Action
Wildlife	• 10.3 acres of habitat cleared • Revegetation of 6.9 acres	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	No change
Air Quality	• Temporary construction emissions would not exceed threshold for major source (42–48 months) • Area in attainment • Construction compliant with national and state standards • BMPs applied to minimize impacts	• Temporary construction emissions would not exceed threshold for major source (54–64 months) • Area in attainment • Construction compliant with national and state standards • BMPs applied to minimize impacts	• Temporary construction emissions would not exceed threshold for major source (42–29 months) • Area in attainment • Construction compliant with national and state standards • BMPs applied to minimize impacts	• Temporary construction emissions would not exceed threshold for major source (54–64 months) • Area in attainment • Construction compliant with national and state standards • BMPs applied to minimize impacts	• Temporary construction emissions would not exceed threshold for major source (42–44 months) • Area in attainment • Construction compliant with national and state standards • BMPs applied to minimize impacts	No change
Cultural Resources	• No adverse effect on historical properties • Potential disturbance to archaeological resources during construction • No mitigation measures required.	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	No change

Table 2–2. Comparison of Environmental Impacts of Alternatives (continued)

Resource Area	Alternative 1 (Preferred Alternative)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	No Action
American Indian Traditional Resources	• No change to the status quo regarding tribal access to traditional resources • No significant impacts to overall quantity of available tribal resources • Potential increased time to observe tribes' fishing rights. Tribal divers engaged in resource harvest could experience increased underwater noise levels. • Navy would notify tribes of anticipated construction vessel traffic. • The Navy would implement actions detailed in the Mitigation Action Plan to address tribal concerns.	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	No change

Table 2–2. Comparison of Environmental Impacts of Alternatives (continued)

Resource Area	Alternative 1 (Preferred Alternative)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	No Action
Coastal and Shoreline Management	• Localized, temporary construction impacts to fish, wildlife, and water quality; erosion and increased turbidity and sedimentation; localized, temporary noise impacts to adjacent recreational areas • Loss and shading of marine habitat, benthic changes; impacts to fish, marine mammals, and birds; adverse impact to historical integrity (visual setting) of existing EHW	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	No change

Table 2–2. Comparison of Environmental Impacts of Alternatives (continued)

Resource Area	Alternative 1 (Preferred Alternative)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	No Action
Land Use and Recreation	• Compatible with base master plan • Pile driving noise disturbance to residences along Hood Canal and recreation (211–411 days) • Construction during daylight only; Navy to notify public prior to construction; Navy will request U.S. Coast Guard to issue notice to mariners	• Compatible with base master plan • Pile driving noise disturbance to residences along Hood Canal and recreation (286–561 days) • Construction during daylight only; Navy to notify public prior to construction; Navy will request U.S. Coast Guard to issue notice to mariners	• Compatible with base master plan • Pile driving noise disturbance to residences along Hood Canal and recreation (226–436 days) • Construction during daylight only; Navy to notify public prior to construction; Navy will request U.S. Coast Guard to issue notice to mariners	• Compatible with base master plan • Pile driving noise disturbance to residences along Hood Canal and recreation (306–586 days) • Construction during daylight only; Navy to notify public prior to construction; Navy will request U.S. Coast Guard to issue notice to mariners	• Compatible with base master plan • Pile driving noise disturbance to residences along Hood Canal and recreation (146–186 days) • Construction during daylight only; Navy to notify public prior to construction; Navy will request U.S. Coast Guard to issue notice to mariners	No change
Aesthetics	• Temporary disturbance of existing visual landscape during construction • New structures compatible with industrial waterfront; no adverse impact to historical integrity (visual setting) of existing EHW and Shelton-Bangor Railroad mainline	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	• Temporary disturbance of existing visual landscape during construction • Larger structure than Alternative 1; compatible with industrial waterfront; no adverse impact to historical integrity (visual setting) of existing EHW	No change

Table 2–2. Comparison of Environmental Impacts of Alternatives (continued)

Resource Area	Alternative 1 (Preferred Alternative)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	No Action
Socioeconomics	• Local and substantial beneficial economic impacts from construction activities • No disproportionately high and adverse effects to environmental justice populations	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	No change
Utilities and Energy	• Additional demand for electricity, water, sewer, and telecommunications • Energy conservation measures included	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	No change

Table 2–2. Comparison of Environmental Impacts of Alternatives (continued)

Resource Area	Alternative 1 (Preferred Alternative)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	No Action
Transportation	• Increased vehicle and marine vessel traffic during construction (42–48 months) • Delays in traffic crossing the Hood Canal Bridge during construction • Minimal increased long-term vehicle traffic; 20 additional employees • Navy to issue notice to mariners • Barge trips scheduled to avoid commuting hours to maximum extent • Navy would notify tribes of anticipated construction vessel traffic	• Increased vehicle and marine vessel traffic during construction (54–64 months) • Delays in traffic crossing the Hood Canal Bridge during construction • Minimal increased long-term vehicle traffic; 20 additional employees • Navy to issue notice to mariners • Barge trips scheduled to avoid commuting hours to maximum extent • Navy would notify tribes of anticipated construction vessel traffic	• Increased vehicle and marine vessel traffic during construction (42–29 months) • Delays in traffic crossing the Hood Canal Bridge during construction • Minimal increased long-term vehicle traffic; 20 additional employees • Navy to issue notice to mariners • Barge trips scheduled to avoid commuting hours to maximum extent • Navy would notify tribes of anticipated construction vessel traffic	• Increased vehicle and marine vessel traffic during construction (54–64 months) • Delays in traffic crossing the Hood Canal Bridge during construction • Minimal increased long-term vehicle traffic; 20 additional employees • Navy to issue notice to mariners • Barge trips scheduled to avoid commuting hours to maximum extent • Navy would notify tribes of anticipated construction vessel traffic	• Increased vehicle and marine vessel traffic during construction (42–44 months) • Delays in traffic crossing the Hood Canal Bridge during construction • Minimal increased long-term vehicle traffic; 20 additional employees • Navy to issue notice to mariners • Barge trips scheduled to avoid commuting hours to maximum extent • Navy would notify tribes of anticipated construction vessel traffic	No change

Table 2–2. Comparison of Environmental Impacts of Alternatives (continued)

Resource Area	Alternative 1 (Preferred Alternative)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	No Action
Public Health and Safety	• No increased danger or change from current operations. • No environmental health and safety impacts on children • Potential for spills (fuels or hazardous materials) • Construction noise impact to residential and recreational uses including divers • Comply with existing facility response and prevention plans • Prepare/implement Debris Management Plan and spill response plan • Construction during daylight only; Navy to notify public prior to construction	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1	No change

Table 2–3. Compensatory Mitigation for Impacts to Aquatic Habitat and Waters of the U.S.

IMPACT (RANGE FOR ALL ALTERNATIVES)	ALTERNATIVE 1 AREA	ALTERNATIVE 2 AREA	ALTERNATIVE 3 AREA	ALTERNATIVE 4 AREA	ALTERNATIVE 5 AREA	ANTICIPATED MITIGATION
Habitat displaced by piles in shallow water (< 30 ft)	361 sq ft (0.008 acre)	361 sq ft (0.008 acre)	642 sq ft (0.015 acre)	525 sq ft (0.015 acre)	1,068 sq ft (0.025 acre)	Mitigation for loss of aquatic resources will be provided in accordance with the Compensatory Mitigation for Losses of Aquatic Resources, Final Rule. A final Mitigation Action Plan demonstrating no net loss of aquatic resources will be submitted prior to issuance of a USACE permit.
Habitat displaced by piles in deep water (> 30 ft)	8,654 sq ft (0.20 acre)	8,689 sq ft (0.20 acre)	8,533 sq ft (0.20 acre)	8,568 sq ft (0.20 acre)	2,292 sq ft (0.05 acre)	Mitigation for loss of aquatic resources will be provided in accordance with the Compensatory Mitigation for Losses of Aquatic Resources, Final Rule. A final Mitigation Action Plan demonstrating no net loss of aquatic resources will be submitted prior to issuance of a USACE permit.
Overwater area (shading) in shallow water	17,859 sq ft (0.41 acre)	17,859 sq ft (0.41 acre)	32,880 sq ft (0.75 acre)	32,880 sq ft (0.75 acre)	34,000 sq ft (0.78 acre)	Mitigation for loss of aquatic resources will be provided in accordance with the Compensatory Mitigation for Losses of Aquatic Resources, Final Rule. A final Mitigation Action Plan demonstrating no net loss of aquatic resources will be submitted prior to issuance of a USACE permit.
Overwater area (shading) in deep water	255,249 sq ft (5.9 acres)	255,249 sq ft (5.9 acres)	256,076 sq ft (5.9 acres)	256,076 sq ft (5.9 acres)	337,000 sq ft (7.7 acres)	Compensatory mitigation is not anticipated for this impact as no habitat or plant communities will be significantly altered by the shading in deep water.
Partial shading in shallow water due to the trestle structure	8,015 sq ft (0.18 acre)	8,015 sq ft (0.18 acre)	19,470 sq ft (0.45 acre)	19,470 sq ft (0.45 acre)	18,160 sq ft (0.42 acre)	Mitigation for loss of aquatic resources will be provided in accordance with the Compensatory Mitigation for Losses of Aquatic Resources, Final Rule. A final Mitigation Action Plan demonstrating no net loss of aquatic resources will be submitted prior to issuance of a USACE permit.

Table 2–3. Compensatory Mitigation for Impacts to Aquatic Habitat and Waters of the U.S. (continued)

IMPACT (RANGE FOR ALL ALTERNATIVES)	ALTERNATIVE 1 AREA	ALTERNATIVE 2 AREA	ALTERNATIVE 3 AREA	ALTERNATIVE 4 AREA	ALTERNATIVE 5 AREA	ANTICIPATED MITIGATION
Partial shading in deep water	65,340 sq ft (1.5 acres)	65,340 sq ft (1.5 acres)	67,910 sq ft (1.6 acres)	67,910 sq ft (1.6 acres)	82,800 sq ft (1.9 acres)	Compensatory mitigation is not anticipated for this impact as no habitat or plant communities will be significantly altered by the shading in deep water.
Eelgrass shading (Full shading only)	2,640 sq ft (0.06 acre)	2,640 sq ft (0.06 acre)	4,580 sq ft (0.11 acre)	4,580 sq ft (0.11 acre)	2,640 sq ft (0.06 acre)	Mitigation will be included as a component of the mitigation for aquatic resources.
Fill in freshwater wetland due to site improvements	7,840 sq ft (0.18 acre)	7,840 sq ft (0.18 acre)	7,840 sq ft (0.18 acre)	7,840 sq ft (0.18 acre)	7,840 sq ft (0.18 acre)	Mitigation for loss of aquatic resources will be provided in accordance with the Compensatory Mitigation for Losses of Aquatic Resources, Final Rule. A final Mitigation Action Plan demonstrating no net loss of aquatic resources will be submitted prior to issuance of a USACE permit.
Fill in non-wetland waters of the U.S. (trestle abutment)	1,400 sq ft (0.03 acre)	1,400 sq ft (0.03 acre)	1,900 sq ft (0.04 acre)	1,900 sq ft (0.04 acre)	1,400 sq ft (0.03 acre)	Mitigation for loss of aquatic resources will be provided in accordance with the Compensatory Mitigation for Losses of Aquatic Resources, Final Rule. A final Mitigation Action Plan demonstrating no net loss of aquatic resources will be submitted prior to issuance of a USACE permit.

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CHAPTER 3

EXISTING ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

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MARINE ENVIRONMENT

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3.0 EXISTING ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the existing environment (baseline) and environmental consequences (impacts) of environmental resources and conditions potentially affected by the proposed action. For this description, the environmental resources are grouped into three major categories: the marine environment, the upland environment, and the social environment. The introductions to each of these three main sections of the chapter highlight the most important resources within each category. Because the proposed action takes place primarily in the marine environment, marine resources receive the greatest level of treatment in this chapter.

This chapter also evaluates the environmental impacts of five action alternatives and a No-Action Alternative: Alternative 1: Combined Trestle, Large Pile Wharf; Alternative 2: Combined Trestle, Conventional Pile Wharf; Alternative 3: Separate Trestles, Large Pile Wharf; Alternative 4: Separate Trestles, Conventional Pile Wharf; Alternative 5: Combined Trestle, Floating Wharf; and the No-Action Alternative. Within each resource, environmental impacts are separated into construction and operation and include a discussion of mitigation measures and compliance with regulations. The impacts of all the alternatives are addressed within each resource section; this is intended to facilitate comparison of impacts across alternatives.

Impacts are defined in this final environmental impact statement (FEIS) to the extent possible based on details of the alternatives available at the time the FEIS was prepared. Where alternative details are not defined precisely, conservative scenarios are assumed for impact assessment. Impacts are characterized as either permanent or temporary. Temporary impacts are defined as those that occur during construction. Depending on the alternative, construction duration varies from 42 to 44 months and from 54 to 64 months (see Table 2–1).

The five action alternatives would have similar impacts to the marine, upland, and social environments because many of the design aspects for each alternative are similar. Since all of the action alternatives would require in-water work and placing a large number of piles in the intertidal and subtidal zones, impacts to the marine environment from construction and operation would be comparable. Important concerns regarding the marine environment include: loss of eelgrass habitat, overwater shading of marine vegetation and resulting loss of productivity, adverse impacts of pile driving noise on threatened fish and bird species, and changes in habitat conditions.

Impacts to the upland environment would be essentially the same for all action alternatives. A total of 12.6 acres (10.3 acres vegetated) would be disturbed by construction. New impervious surface created (with stormwater management) would be 3.6 acres; the remaining area would be revegetated with native forest and shrub species or otherwise returned to its original condition (paved or gravel). A 0.2-acre wetland would be lost; this loss would be mitigated. The impacts to the social environment would be similar among the five action alternatives. In addition to impacts from construction noise and air emissions (dust), other impacts that would be similar for all action alternatives include changes in visual conditions, substantial benefits to the local economy from increased employment during construction, increased energy use, and increased upland and marine traffic.

The No-Action Alternative would not result in a change to existing conditions.

MARINE ENVIRONMENT

The existing condition of the marine environment at the project site is characterized by excellent water quality for most of the year, except during late summer when dissolved oxygen (DO) levels are typically lower. Other water quality parameters typically are within the state water quality standards. Sediment quality is generally good and chemical contaminant concentrations meet Sediment Quality Standards (SQS). The marine vegetation at the project site is diverse and includes species such as red, brown, and green algae and eelgrass that provide high quality habitat. The attributes of the marine environment create a rich habitat for benthic organisms, shellfish, plankton, fish, marine mammals, and marine birds, and a wide variety of organisms live or forage in this environment. Protected species that are present include several salmonid fish and rockfish species listed under the Endangered Species Act (ESA), two common marine mammals (California sea lion and harbor seal) protected under the Marine Mammal Protection Act (MMPA), one ESA-listed marine mammal (Steller sea lion), and one ESA-listed bird (marbled murrelet). Other protected species, such as the Southern Resident killer whale, are rare in the project area, and unlikely to be affected by the proposed action.

For the purpose of this environmental impact statement (EIS), the marine environment at and near the project site has been divided into four habitat types (Table 3.0–1): estuaries, nearshore marine, marine deeper water, and manmade structures. These four habitat types are influenced by water depth, tides, currents, water quality, and wave energy resulting in distinct physical conditions and species assemblages (Dethier 1990; Johnson and O'Neil 2001). Each resource in the Marine Environment section (e.g., hydrography, water quality, sediment) refers to the marine habitats described in Table 3.0–1.

Of the three major environmental areas covered in this EIS (i.e., marine, upland, and social), the marine environment is the most sensitive to disruptions and change and would be most impacted by the project. Some impacts incurred by construction of the second Explosives Handling Wharf (EHW-2) would become permanent, such as loss of habitat from pile placement and shading of marine vegetation by the overwater structures. Other impacts would be temporary, such as high noise levels produced by pile driving, which would propagate both underwater and overwater. Pile driving would also displace sediment, which would cause temporary (on the order of minutes to hours) turbidity and localized changes in water chemistry. Thus, pile driving has the potential to impact fish, wildlife, and other biological organisms that live in or use the marine environment, as well as human activities such as fishing and recreation. Threatened and endangered species of salmon use the Bangor waterfront and would be affected by construction noise, loss of habitat, and the partial barrier-to-migration effect caused by the EHW-2. Marbled murrelets, another threatened species, as well as several species of marine mammals are present in the project area, and construction noise would adversely affect these species as well. All of the analysis of impacts from pile installation due to noise, seafloor disturbance, and water quality account for the temporary falsework and permanent piles.

Modifications to the marine environment would occur after completion of construction, as the presence of the new in-water structures would create different habitat conditions. Construction and operation of the EHW-2 would result in the loss of soft-bottom habitat that would be replaced by the hard surfaces of the piles. Shading and nighttime lighting impacts would be created, and water circulation and sediment character and deposition would be locally altered. Thus, marine vegetation and biological species types and abundances would change as these species adapt to the new habitat conditions. Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components as required. These activities

would not be appreciably different from existing conditions, and impacts to the marine environment would be negligible.

Table 3.0–1. Marine Habitats at the EHW-2 Project Site

HABITAT TYPE		DESCRIPTION	HABITAT VALUES
Estuaries		Defined as areas where salt water and fresh water mix. From the upstream extent of spray or influence of ocean-derived salts (salinity: <0.5 parts per thousand [ppt] grams) to 20 feet below MLLW, generally with salinity above 30 ppt at the deeper extent. Substrates include organics, silts, and sands.	Estuarine habitats are highly productive environments. Abundant organic material from freshwater outflows of lower river reaches provides nutrients to vegetation communities, including eelgrass, in intertidal sand and mud flats, salt water and brackish marshes, and open-water portions of associated estuaries.
Nearshore Marine [1] Extends from upper intertidal to subtidal non-photic zone. Bottom types are consolidated (rock) and unconsolidated (cobble, gravel, sand, and mud) substrate.	**Intertidal Zone**	***Upper Intertidal*** extends from the upper limit of spray or influence of ocean-derived salts (16.2 feet above MLLW) to the mean high water of spring tides (MHWS) (12.3 feet above MLLW). ***Lower Intertidal*** extends from MHWS (12.3 feet above MLLW) to the extreme low water of spring tides (ELWS) (3.9 feet below MLLW).	The upper intertidal zone provides habitat for salt-tolerant marine vegetation and animals that can tolerate being submerged for short periods of time. The lower intertidal zone provides habitat for marine vegetation and animals that can tolerate being submerged for longer periods of time alternating with short-term exposure to air.
	Subtidal Zone	***Subtidal Photic Zone*** extends from ELWS to 50 feet below MLLW, where sufficient light for primary productivity occurs. ***Subtidal Non-Photic Zone*** extends from 50 to 65 feet below MLLW, where light is insufficient for primary productivity to occur.	The subtidal zone provides entirely submerged benthic habitat for marine vegetation and animals.
Marine Deeper Water		Deeper than 66 feet below MLLW. Primarily sand substrate sometimes covered with shells.	Inland marine deeper waters have diverse underwater structures created by tidal currents and from regional geologic historical conditions (i.e., marine sills). These physical features provide dynamic habitats for a variety of marine species reliant on the plankton food web.
Manmade Structures		Includes marine vessels, piers, piles, buoys, wharves, and associated structures in marine waters.	Vertical surfaces of concrete, steel, wood, rubber, fiberglass, and other substances provide an environment for attachment of algae and marine invertebrates and can shade marine habitat.

Sources: Dethier 1990; Johnson and O'Neil 2001.

1. For evaluating habitat impacts and mitigation in a regulatory context, the 30 feet below mean lower low water (MLLW) line is used to define nearshore habitat.

The proposed three new buildings and pure water facility (and its associated water lines) would not include in-water construction, operation, or discharges to the marine environment. Therefore, the following marine resource areas would not be affected by these components of the proposed project: hydrography, marine sediments, underwater noise, marine vegetation, plankton, and benthic communities including shellfish.

Appendix F contains the U.S. Department of the Navy (Navy's) proposed Mitigation Action Plan. The Mitigation Action Plan includes compensatory habitat mitigation that would compensate for the impacts of the proposed action to marine habitats and species.

3.1 HYDROGRAPHY (CURRENTS AND TIDES)

Hydrography focuses on circulation (water movement) patterns as affected by the seafloor topography (bathymetry), tides, waves, and the characteristics (density) of the different water masses in the project vicinity. Hydrographic processes are important because they affect the dispersion and mixing of sediments resuspended from in-water construction activities as well as the rate of sediment accumulation or erosion from the seafloor.

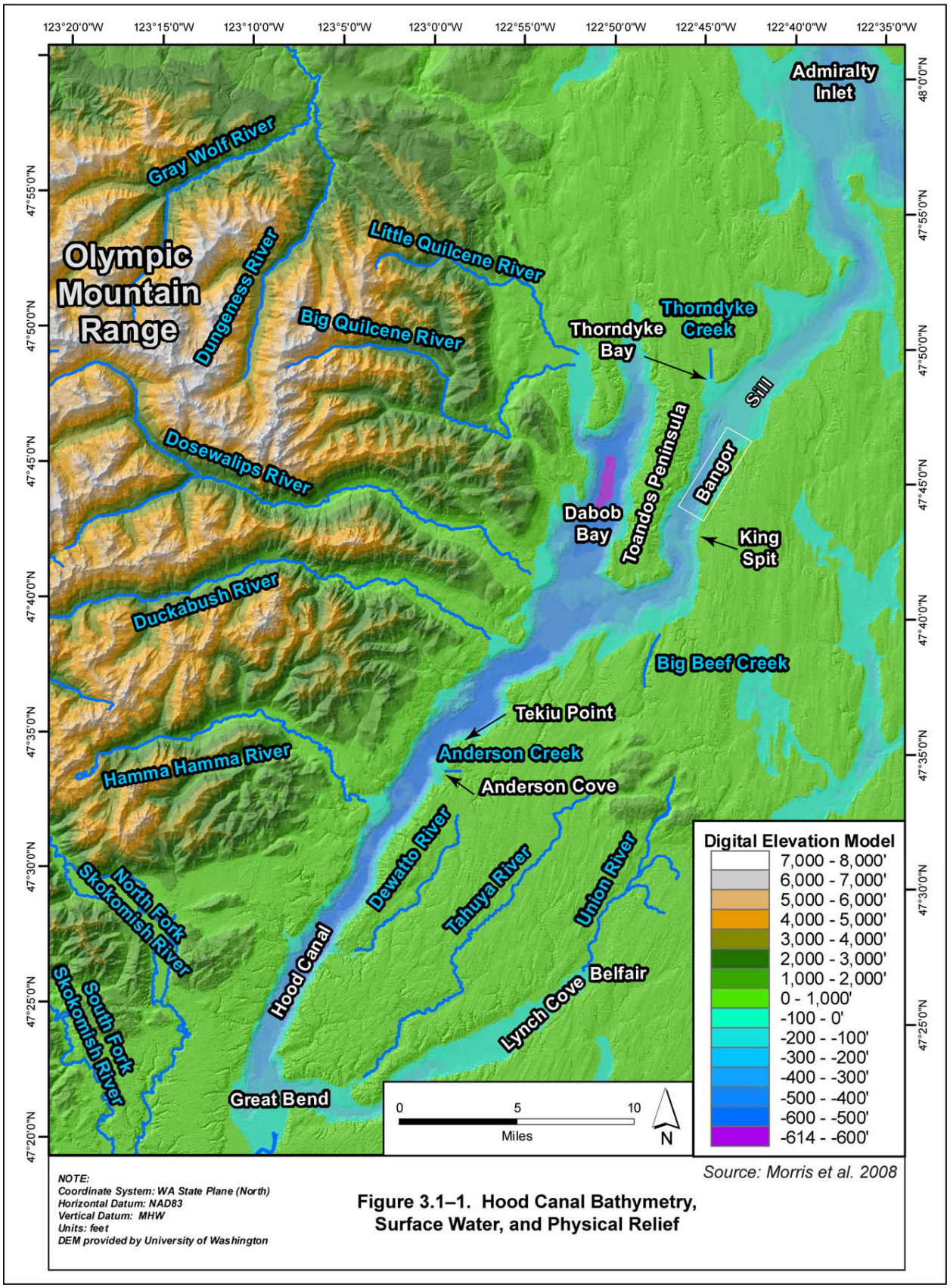
Section 10 of the Rivers and Harbors Act (33 United States Code [USC] 401 et seq.) requires authorization from the U.S. Army Corps of Engineers (USACE) for the development of any structure in or over any navigable water of the United States, as well as the excavation/dredging or deposition of material in these waters, or development of any obstruction or alteration in navigable water. Navigable waters of the United States are those subject to the ebb and flow of the tide shoreward to the mean high water mark and/or which have been used, are currently used, or may be used in the future for transporting interstate or foreign commerce. The term includes navigable coastal and inland waters, lakes, rivers, and streams and the territorial seas. Section 401 (water quality certification) of the Clean Water Act (CWA) is also applicable to this project. The Washington Department of Ecology (WDOE) is responsible for issuing water quality certification under Section 401. Under the Coastal Zone Management Act (CZMA), the Navy must ensure its activities affecting the coastal zone are consistent to the maximum extent practicable with the Washington State Coastal Zone Management Program (CZMP) (see Section 3.20).

Consultation and Permit Compliance Status. The Navy has applied for a Rivers and Harbors Act Section 10 permit from USACE and a Section 401 water quality certification from WDOE. In accordance with the CZMA, the Navy submitted a Phase I Coastal Consistency Determination (CCD) to WDOE (included in Appendix I of this final environmental impact statement [FEIS]). WDOE concurred with the Phase I CCD on August 26, 2011 (included in Appendix I of this FEIS). The Navy will prepare and submit a Phase II CCD in spring 2012.

3.1.1 Existing Environment

This section summarizes the hydrographic setting of Hood Canal and the nearshore areas around the EHW-2 project site. Hydrographic measurements focus on the physical properties of the water body and include bathymetry, tides, currents and circulation, as well as annual and seasonal variability, all of which influence other EIS resources (such as water quality, marine vegetation, fish, and benthic communities).

Hood Canal is a long, narrow, fjord-like basin of western Puget Sound. Oriented northeast to southwest, the canal is 52 miles long from Admiralty Inlet to a large bend, called the Great Bend, at Skokomish, Washington. East of the Great Bend, the canal extends an additional 15 miles to the headwaters at Belfair (Figure 3.1–1). Throughout its 67-mile length, the width of Hood Canal varies from approximately 1 to 2 miles and exhibits strong depth/elevation gradients and irregular seafloor topography in many areas. The length of the entire Hood Canal basin shoreline, inclusive of the many embayments and coves, is approximately 288 miles.



Source: Morris et al. 2008

NOTE:
Coordinate System: WA State Plane (North)
Horizontal Datum: NAD83
Vertical Datum: MHW
Units: feet
DEM provided by University of Washington

Figure 3.1–1. Hood Canal Bathymetry, Surface Water, and Physical Relief

Although no official boundaries exist along the waterway, the northeastern section of the canal extending from the mouth of the canal at Admiralty Inlet to the southern tip of Toandos Peninsula is referred to as northern Hood Canal, while the region from Toandos Peninsula south to Great Bend is considered mid-Hood Canal, and the reach from Great Bend to Lynch Cove is referred to as southern Hood Canal. The EHW-2 project site is located in northern Hood Canal.

In general, estimates indicate that Hood Canal holds in excess of 34 billion cubic yards of water at the mean lower low water (MLLW) mark. That volume increases with each flood tide due to the influx of water from the Pacific Ocean and Puget Sound, then decreases again on the subsequent ebb tide.

The normal tidal cycle in the region results in the occurrence of two flood tides and two ebb tides of different magnitudes during a typical 24-hour and 50-minute tide day, resulting in seawater exchange between Hood Canal and Puget Sound. The water currents associated with these tides are variable and directly dependent upon the tidal range and hydrodynamics in a particular area of interest.

The Bangor shoreline is generally in a more natural condition than are Hood Canal shorelines as a whole. Approximately 6 percent of the Bangor shoreline is modified with armoring (e.g., bulwarks, riprap) or other structures such as piers (Judd 2010), compared to approximately 27 percent for Hood Canal as a whole (Puget Sound Partnership 2008) and 25 percent for the west Kitsap County shoreline (Judd 2010).

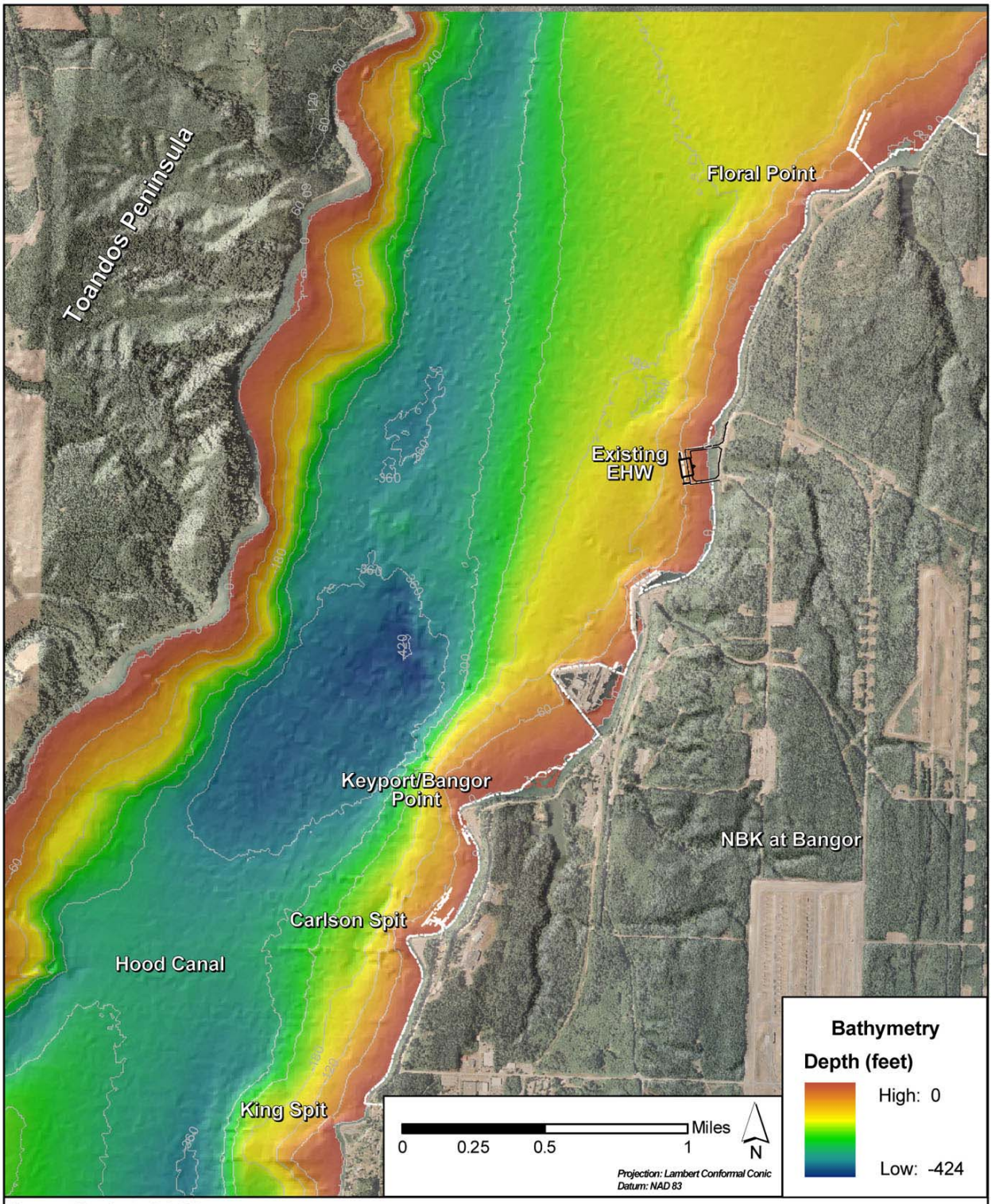
3.1.1.1 Bathymetric Setting

Hood Canal is a fjord-like body of water with relatively steep sides and irregular seafloor topography. In northern Hood Canal, water depths in the center of the waterway near Admiralty Inlet vary between 300 and 420 feet. As the canal extends southwestward toward the Olympic Mountain Range and Thorndyke Bay, the water depth decreases to approximately 160 feet over a moraine deposit. This deposit forms a sill across the canal in the vicinity of Thorndyke Bay, which limits seawater exchange with the rest of Puget Sound. The Bangor waterfront occupies approximately 5 miles of the shoreline within northern Hood Canal (1.7 percent of the entire Hood Canal coastline) and lies just south of the sill feature. Depths of the in-water project site are provided in Figure 3.1–2. Southwest of Thorndyke Bay, the seafloor rapidly falls away to depths in excess of 300 feet adjacent to Brown Point on the Toandos Peninsula (Figure 3.1–3). The width of the canal is approximately 1.5 miles at the site, 2.2 miles at the northern end of Naval Base Kitsap at Bangor (NBK at Bangor), and constricts to approximately 1.1 miles near the southern end near Hazel Point (Figure 3.1–3).

3.1.1.2 Tides

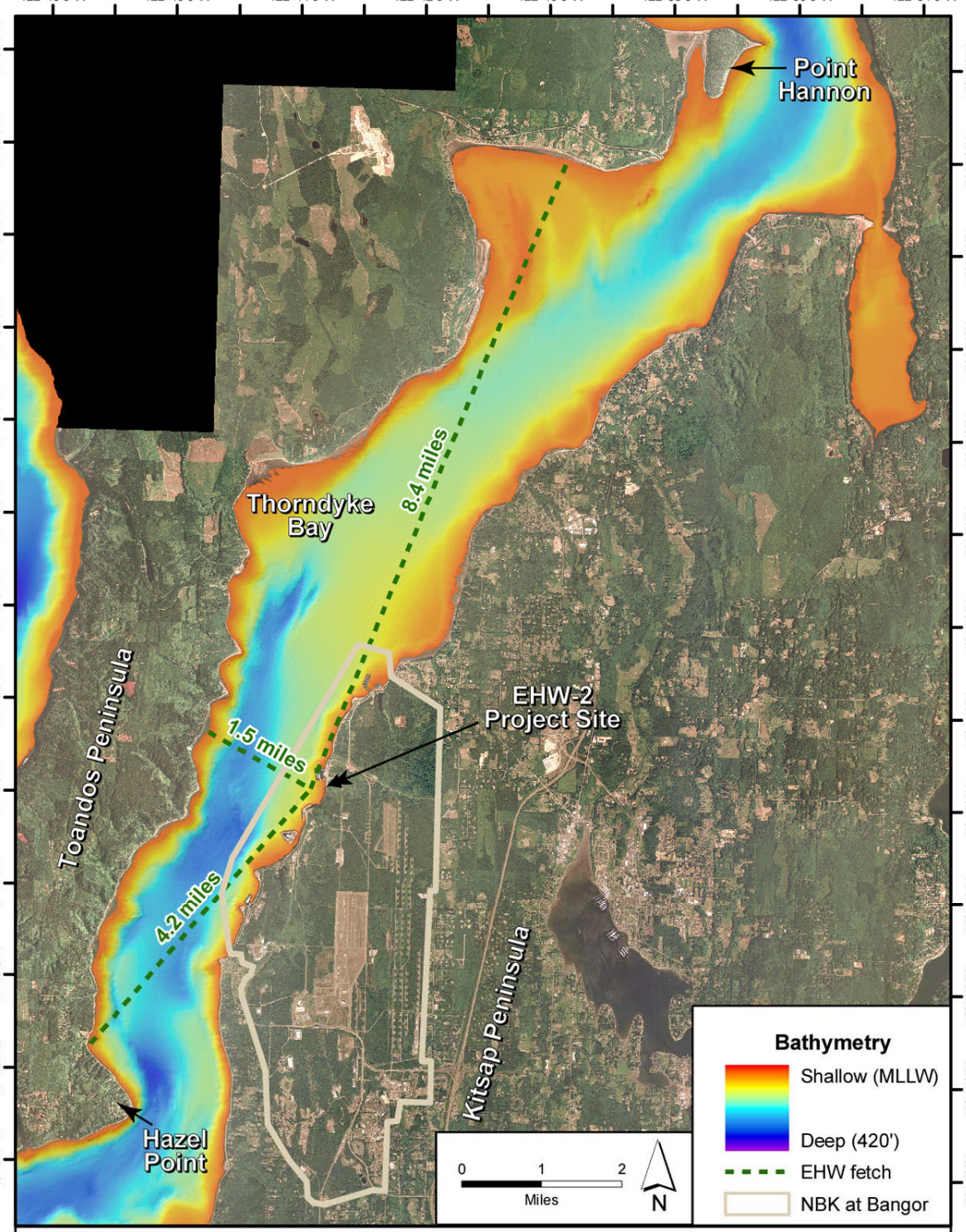
The tides in Hood Canal are mixed, diurnal-semidiurnal with a range determined by the gravitational forces of the moon and sun (URS 1994; Morris et al. 2008). The astronomic influences (tides) on water level within Puget Sound and Hood Canal result in one flood and one ebb tidal event with a small to moderate range (1 to 6 feet) and a second flood and second ebb with a larger range (8 to 16 feet) during a 24-hour and 50-minute tidal day. As a result, higher high, lower high, higher low, and lower low water levels are recorded within each tide day.

Since the tides within Hood Canal are mixed diurnal-semidiurnal, this body of water is subject to one major flushing event per tide day when approximately 3 percent of the total canal volume is exchanged over a 6-hour period. Due to the wide range of tidal heights that can occur in this body of water, the actual seawater exchange volume for Hood Canal ranges from 1 percent during a minor tide to 4 percent during a major tide.



Source: Morris et al. 2008

Figure 3.1–2. EHW Bathymetry



Source: Morris et al. 2008

NOTE:
Coordinate System: WA State Plane (North)
Horizontal Datum: NAD83
Vertical Datum: MHW
Units: feet
DEM provided by University of Washington

Figure 3.1–3. EHW Maximum Fetch Diagram

Despite considerable tidally driven seawater influx within the basin, some studies have estimated water residence time in the southern and middle portions of Hood Canal can be up to one year due to the natural limitation on seawater exchange (i.e., bathymetry) (Warner et al. 2001; Warner 2007). However, at the project site, the majority of the daily volume of seawater exchange flows directly across the Bangor waterfront area.

As a result, the degree of flushing that occurs at the EHW-2 project site is relatively high and the characteristics of this seawater are similar to the physical, chemical, and biological conditions of Puget Sound rather than southern Hood Canal.

3.1.1.3 Circulation and Currents

Tidal currents and resulting circulation patterns within Hood Canal are complex due to the configuration of the basin, as well as the mixed diurnal-semidiurnal tidal regime. Current measurements obtained from the reaches of northern Hood Canal in the summer of 2007 indicate that tidal phase and range have a significant impact on the velocity of currents associated with the flood and ebb tides (Morris et al. 2008).

Tidal range serves as an indication of the volume of water that flows into or out of the Hood Canal basin over a 6-hour period. As a result, the larger tidal ranges promote higher velocity currents and increased flushing of the basin, while small to moderate tidal ranges yield a diminished tidal current regime and limit the volume of seawater exchange between Hood Canal and Puget Sound.

The shallow sill feature near Thorndyke Bay (Figure 3.1–1) allows surface waters to readily enter and exit the canal as part of normal tidal flux. However, the topographic feature serves as an obstacle to deep-water circulation and reduces the outflow volume into Puget Sound during major ebb tide events. Seawater that enters the canal from Puget Sound during an incoming flood tide tends to be cooler, more saline, and well-oxygenated relative to the Hood Canal waters. As a result, the incoming Puget Sound water has a tendency to sink to the bottom of the canal as it flows over the sill and move south during each flood tide, while the lower density Hood Canal water tends to remain in the upper water column. Despite the large volume of water that moves into and out of Hood Canal with each tidal cycle, this density-driven process contributes to net inward flow at depths greater than 160 feet and a net outward flow at depths less than 160 feet. Historical values for average current velocities and transport measured along the axis of the Hood Canal trough were low, with a net subsurface (below 100 feet) southeastward (inward) flow of 0.07 foot/second, and a net northward (outward) surface (0 to 30 feet) flow of 0.11 foot/second (Evans Hamilton and D.R. Systems 1987). This circulation pattern tends to impact the overall flushing of mid and southern Hood Canal.

Current flow (speed and direction) at the EHW-2 project site is primarily a function of tidal action based on the phase and range of each tide within the mixed diurnal-semidiurnal regime, and current velocities in the shallower water areas (less than 50 feet) around the EHW-2 project site are variable and complex. The magnitude or instantaneous velocity of these fluctuating water column currents ranges from 0 to 0.88 foot/second within the 30- to 65-foot water depth interval (Morris et al. 2008). However, current flow in any one direction is short-lived and inconsistent in magnitude, with relatively few periods of time when sufficient energy (0.7 foot/second) exists to exceed the threshold for resuspending deposits of unconsolidated material on the seafloor (Boggs 1995). Statistical summaries show that time-averaged net flow is within the 0.07 to

0.10 foot/second range in the upper water column and less than 0.03 foot/second in proximity to the seafloor.

The nearshore current observations at the EHW-2 project site and other NBK at Bangor piers and wharves in the summer of 2006 suggest that tidal currents were inconsistent with water level (tide) measurements. Rather than the typical relationship where maximum current corresponds to mid-flood or mid-ebb in the water level record, maximum flow velocities at the EHW-2 project site aligned with water levels at the high and low tide. Furthermore, the direction of nearshore flow often ran counter to expectations in a normal system, with flood tide coinciding with northeastward currents and ebb tide resulting in southwesterly currents (Morris et al. 2008).

Currents at depths between 13 and 59 feet near the EHW-2 project site appeared to be variable in direction and magnitude of flow within the mid and upper water column throughout each tidal phase, while flow in the lower water column appeared to be more consistent (Morris et al. 2008). Although variability is present in both the magnitude and direction of water column currents, a general trend of north-northeast and south-southwest flow was observed. Maximum flow rates in excess of 0.7 foot/second were documented in the upper (13 feet), mid (36 feet), and lower (59 feet) water column, and typically corresponded to the time of high tide (maximum water level). Current velocities were also elevated at the time of low tide (minimum water level) but at speeds that ranged from 0.3 to 0.5 foot/second.

Supplemental current studies showed that, due to the shape of the basin and local bathymetry, seawater within Hood Canal has the tendency to move easterly into the Bangor waterfront area during both the flood and the ebb (Morris et al. 2008). As the water mass driven by each phase of the tide begins to interact with the sloping seafloor and headland features along the eastern shoreline of Hood Canal (i.e., Floral Point, the point at Keyport/Bangor [KB] Docks, Carlson Spit), the hydrostatic pressure increases, resulting in a reduction in linear flow velocity toward the shore (Figure 3.1–2). As the tidal flow into the area continues and resulting pressure builds against the beach face, the water mass over the shallow (less than 50 feet) areas tends to move in the direction of least resistance. Therefore, depending upon the phase of the tide and conditions at the time of the observation, the water mass over the shallower areas occupied by NBK at Bangor can move along shore in the opposite direction of the water mass over the deeper portions of northern Hood Canal.

Historical drift studies performed near the Bangor waterfront pier structures observed the formation of distinct eddies (URS 1994). The eddies were readily apparent on the water surface during both strong flood and ebb tides and were attributed to the complexity in the flow dynamics along the shoreline as previously described. Anticyclonic eddies were formed south of two major waterfront wharves during ebb tides, and cyclonic eddies were formed north of these wharves during flood tide (URS 1994). Eddies were also established adjacent to many of the headland features (i.e., King Spit, Carlson Spit, and Floral Point) along the shoreline (Figure 3.1–2). These eddy features likely contributed to the erratic fluctuations measured during recent current studies at the Bangor waterfront (Morris et al. 2008). Eddies serve as pumps that move water along the shoreline and around the pier structures on NBK at Bangor. As a result, they represent a useful mechanism for increasing suspended load transport and seawater mixing in shallow water (less than 50 feet) in proximity to the shoreline.

3.1.1.4 Annual and Seasonal Variability

Responsible for much of the productivity and climate along the west coast of the United States, coastal upwelling and the California Current are the primary mechanisms producing the cool water mass moving into Puget Sound with a relatively narrow range of temperatures throughout the year. Water temperatures in the Strait of Juan de Fuca and Puget Sound typically range from 44 to 46 degrees Fahrenheit (°F) throughout the winter months (mid-December through mid-March). Surface waters slowly warm throughout the spring and summer due to increased solar heating, reaching temperatures of 50°F in mid-May or early June to a maximum temperature of 54°F during the month of August. Beginning in September, water temperatures begin to decrease over time, falling 6 to 8°F over the next 3 months due to decreasing levels of solar radiation. Occasionally, anomalies in this pattern of heating and cooling are detected in the data record but are often short in duration (1 to 2 weeks). Since the energy input into the surface waters associated with solar radiation is relatively predictable by season, this variability of the temperature cycle may be driven by small variations in circulation patterns in the North Pacific Current and/or California Current.

El Niño is a state of the atmospheric circulation within the Southern Oscillation in the equatorial Pacific that leads to a large-scale warming of the Pacific Ocean, and is associated with a slackening, or even cessation, of the cold upwelling conditions that normally prevail in proximity to the Strait of Juan de Fuca. The onset of El Niño conditions usually results in a warming trend in the surface waters along the Washington and Oregon coasts in addition to drier winters within the Pacific Northwest (Western Regional Climate Center 1998). In contrast, La Niña, which is a state of atmospheric circulation within the Southern Oscillation that leads to large-scale cooling of the Pacific Ocean, enhances upwelling, resulting in an accumulation of cold water in the Pacific Northwest, as well as colder air temperatures and an increase in precipitation in the late fall and early winter. Since the winter of 1999 to 2000, atmospheric and oceanic conditions associated with the Southern Oscillation have not exhibited strong El Niño or La Niña characteristics (Western Regional Climate Center 2008). Following a weak La Niña period in 2000, the Southern Oscillation has tended to show signs of weak El Niño or neutral conditions to date.

Apart from larger impacts associated with large-scale changes in weather and ocean circulation in the Pacific Basin, seasonal variability in Hood Canal circulation can occur in the winter, when strong meteorological events (e.g., storms, high winds) are more prevalent. Regardless of direction, winds with velocities in excess of 25 knots (42 feet/second) occur relatively infrequently in the Puget Sound region (Morris et al. 2008). The typically light winds afforded by the surrounding highlands (Olympic and Cascade Mountain Ranges), coupled with the fetch-limited environment of Hood Canal, result in relatively calm wind conditions throughout most of the year. However, during the winter months, storm events associated with the passing of frontal systems are more common and are responsible for stronger winds in the region. Winds associated with winter storms are predominantly from the south. The topography adjacent to Hood Canal results in funneling of strong southwesterly winds during periods of southerly flow. Due to the southwest to northeast orientation of the northern and middle sections of Hood Canal, and increased fetch, southwesterly flows with wind speeds in excess of 20 knots (34 feet/second) have the capability to generate substantial wind waves and/or to alter normal tidal flow within the basin. Sustained wind events over the long axis of Hood Canal can disrupt the normal surface current patterns and vertically mix the water column, which tends to break down stratification and promote upwelling of colder, saline subsurface waters (Golder Associates 2010a).

Annual and seasonal variability of circulation and currents near the EHW-2 project site follows the same patterns as the remainder of Hood Canal. Winter storm events originating from the southwest, as well as fair weather systems producing higher winds out of the northeast have the capability to affect normal circulation patterns dominated by tidal flow due to the southwest to northeast orientation of Hood Canal. The measured fetch between the EHW-2 project site and the southwestern boundary of northern Hood Canal is approximately 6.6 miles, while the fetch between the EHW-2 project site and the northernmost bend (Point Hannon) is approximately 12.4 miles (Figure 3.1–3).

However, the EHW-2 project site is afforded some protection by the coastlines of both Kitsap and Toandos Peninsulas (Figure 3.1–3). Using a maximum fetch of 8.4 miles between the EHW-2 project site and north shore of Thorndyke Bay to the north-northeast, estimates indicate that a 20-knot sustained wind has the capability to generate average wave heights of 1.9 feet, and a 30-knot wind event could produce wave heights of 3.1 feet (Coastal Engineering Research Center 1984). The maximum fetch to the southwest is one-half that to the northeast (4.2 miles), and could yield average waves of 1.3 feet in height in a 20-knot wind, and 1.9 feet in a 30 knot wind. Maximum wave heights that would be expected in these weather conditions would actually be 67 percent higher than average estimates reported above. Thus, a weather event capable of generating waves with an average height of 3.1 feet could also yield waves with maximum heights of 5.1 feet (Coastal Engineering Research Center 1984).

3.1.1.5 Longshore Sediment Transport

Storm waves are the principal mechanism driving longshore coastal sediment transport and are responsible for shaping many of the coastal morphologic features such as spits and points along the Hood Canal shoreline (Golder Associates 2010b). Wave energy and the magnitude of sediment transport in Hood Canal are related to the direction and speed of the regional winds. The general wave environment in Hood Canal is characterized as low energy. Significant wave heights (the average wave height of the one-third largest waves) range from approximately 0.16 foot to 0.49 foot directions of storm waves in the project area are from the southwest and northeast, parallel to the axis of Hood Canal in the vicinity of NBK at Bangor. Waves from north storms tend to be locally larger off NBK at Bangor than waves generated by the more severe south storms, due to longer fetch to the north. While northerly waves are of greater magnitude, the probability of occurrence of the extreme winds from northerly directions is lower than from the south.

Because tidal currents rarely exceed 0.66 foot/second (Morris et al. 2008), waves are the primary source of energy that prevents the long-term deposition of fine-grained sediments and results in the well-sorted sandy seafloor and gravel beaches within the shallow (less than 33 feet) seabed and intertidal zones at the project site (see Section 3.3). The instantaneous velocity associated with passing waves is likely sufficient to lift unconsolidated sediments (sand, silt, and clay) into the water column. Once in suspension, the speed and direction of sediment transport is a function of tidal current flows. Unconsolidated material transported toward the center of Hood Canal would likely remain in suspension indefinitely as water column currents closer to the centerline of Upper Hood Canal provide sufficient energy to keep finer-grained sediments in suspension and prevent settlement and deposition. The entrained sediments that are transported closer to the shoreline and away from areas displaying coherent current flow are subject to re-deposition when energy levels associated with the local wave field diminish. Over time, this sediment would then be systematically resuspended and transported with subsequent storm-

related wave events until it reaches the centerline of Hood Canal or is deposited for the long term along the shoreline in a location offering sufficient protection from wave action.

Golder Associates (2010b) estimated that the net longshore transport rate calculated over the delta adjacent to Devil's Hole (south of the EHW-2 project site on NBK at Bangor) was only 150 cubic yards per year to the northeast. While this value is only an estimate of annual littoral drift, the direction of net transport agrees with regional transport directions presented by Kitsap County Department of Community Development (2007) and the WDOE Coastal Atlas (https://fortress.wa.gov/ecy/coastalatlas/viewer.htm), as well as geomorphologic indicators such as shoreline orientation and delta asymmetry.

Several waterfront facilities currently exist on NBK at Bangor. These structures were constructed at substantial distances from each other, leaving relatively long expanses of uninterrupted shoreline and open water between them. Depending on the direction and intensity of the local winds, each facility offers varying amounts of fetch for the generation of wind waves, as well as protection from the effects of those waves. In most cases, the pier facilities are constructed on a foundation of solid pilings configured in a manner that serves to disrupt well-organized wave fields approaching the shoreline from open water, which reduces the amount of energy reaching the shallow subtidal and intertidal zones adjacent to each pier facility and the capacity of the waves to re-suspend and transport unconsolidated seafloor sediments. Evidence from bathymetric surveys and aerial photographs confirms the presence of sediment deposits along portions of the shoreline, some of which are co-located with the pier facilities, suggesting that the pilings in the pier foundations promote a depositional environment and the accretion of unconsolidated material in the form of shallow subtidal shoals and broadening intertidal beaches in the immediate vicinity of the structures (Morris et al. 2009). However, in some cases, the co-occurrence of shoreline structures and shoals may be coincidental. For example, an aerial photograph of the existing Explosives Handling Wharf (EHW) taken shortly after the structure was constructed shows the presence of a shoal immediately inshore of the wharf, indicating that the shoal was present at the time the wharf was constructed (Prinslow et al. 1979; Plate 1). Other localized areas of shoaling, such as immediately north of the point at KB Docks, are clearly related to sediment discharge from the adjacent wetland (Devil's Hole).

The Bangor shoreline is generally in a more natural condition than are Hood Canal shorelines as a whole. Approximately 6 percent of the Bangor shoreline is modified with bulwarks, riprap, or other structures (Judd 2010), compared to approximately 27 percent for Hood Canal as a whole (Puget Sound Partnership 2008) and 25 percent for Kitsap County (Judd 2010).

Golder Associates (2010b) evaluated historical topographic sheets and orthophotos to assess the magnitude of shoreline change that has occurred in the project vicinity. These assessments show that relatively little shoreline change has occurred over the last two decades, and only moderate change since 1876, indicating that the shoreline in the region is fairly stable as a result of the relatively sheltered environment and relatively low net longshore transport rates.

3.1.2 Environmental Consequences

The evaluation of impacts to the natural hydrographic setting considers whether substantial changes would occur to water level, water column (including current patterns), or seafloor topography either directly or indirectly due to construction and operation of the EHW-2. A substantial change is defined as a degradation of the characteristics of Hood Canal in a manner that reduces or negates its overall value to the resources that naturally occur in the marine environment.

Construction activities that physically alter the bathymetric profile of the area, substantially increase or decrease current velocities, or modify the tidal regime in the immediate area would be considered a direct impact to the hydrographic setting. Direct impacts can be assessed by identifying the types and locations of construction activities and evaluating the severity of the disturbance or degradation of the waterway. Indirect impacts from the EHW-2 would result from project-induced changes to the water column or seafloor following construction, due to its long-term planned uses or its physical presence in the waterway. In addition to the wharf structure, the proposed project would construct a trestle abutment above the high tide line. The abutment would be exposed to wave run-up only during extreme high tides. This impact would be inconsequential because infrequent, short, and highly localized interactions would not interfere with alongshore currents or sediment transport processes. While the project would replace the natural shoreline with a concrete structure, the size of this structure is small in comparison to the overall length of undeveloped shoreline in the area, and the effect on the shoreline would be minimal. Construction and operation of project components in the upland portion of the project site, such as new buildings, utilities, and other infrastructure, would not alter or impact the hydrographic setting.

3.1.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

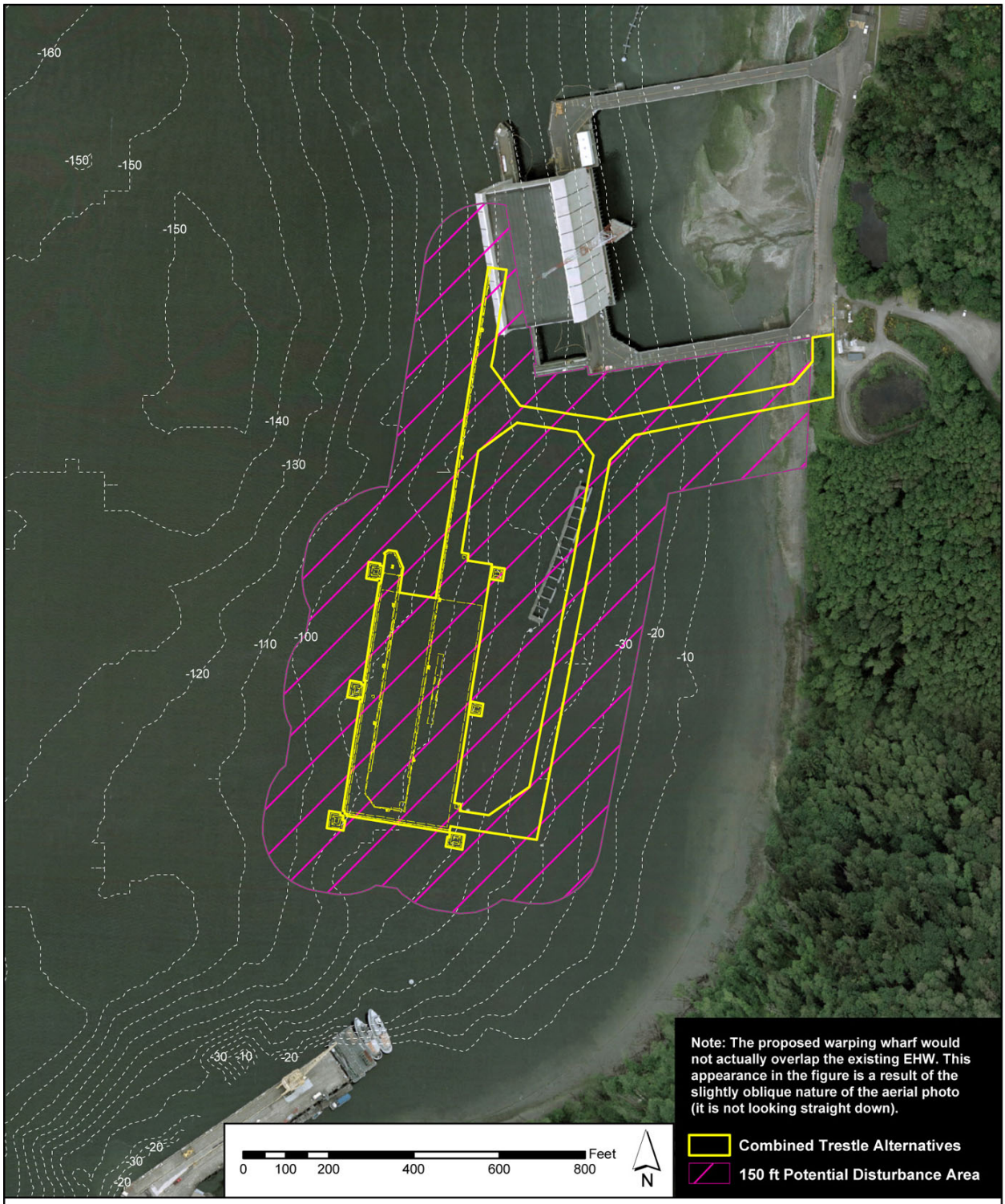
3.1.2.1.1 CONSTRUCTION

The overall impacts to the hydrographic setting associated with the construction of Alternative 1, the Combined Trestle, Large Pile Wharf Alternative, would be limited to the subtidal area at the EHW-2 project site and the intertidal area under the proposed combined trestle. Seafloor impacts from construction would be associated with disturbance of the surface sediments and resident benthic flora and fauna from pile driving (up to 1,250 piles), propeller wash and vessel movement, and other construction activities, such as temporary anchoring of barges and work vessels and spud deployment. Measures would be implemented to avoid underwater anchor drag and line drag (see Appendix F, Mitigation Action Plan). Using the design footprint (the area of the wharf and trestle) along with a 150-foot construction corridor, the estimated surface area of seafloor that could be impacted by construction is 25.7 acres (Figure 3.1–4).

3.1.2.1.1.1 BATHYMETRIC SETTING

Construction of Alternative 1 would have some temporary impacts to the bathymetry (seafloor topography) within the immediate construction site. Given the deep-water setting of the EHW-2 project site (65 to 100 feet below MLLW) (Figure 3.1–4), there is no anticipated need for dredging within the construction corridor. However, interaction of construction equipment, mooring ground tackle, barge grounding, vessel propeller wash, and anchor and spud placement would result in bottom scour and disturbance to the seafloor, such as mounding and displacement or movement of both coarse and fine-grained sediments.

Changes to bathymetry would be limited to highly localized areas and would range between 0.5 and 3 feet. The greatest localized change in bathymetry would likely occur from pile driving and anchor or spud placement during construction activities. The maximum height is estimated by the displacement of sediment by a typical vessel or barge anchor (width of up to 3 feet). The majority of localized sediment disturbance from construction activities is expected to be much less than the maximum.



Source: Morris et al. 2009

Figure 3.1−4. Seafloor Potentially Disturbed by Construction of the Combined Trestle Alternatives (1 and 2)

These impacts are anticipated to be temporary because natural processes that occur at the sediment-water interface (bedload transport, bioturbation [mixing of surface sediment by benthic infaunal organisms], etc.) following completion of the construction activity would return the seafloor topography to near its original profile over time (6 to 12 months) without intervention or mitigation.

A period of 6 to 12 months would allow for a full seasonal cycle of storm and wind events, tides, etc., and resumption of ambient sediment transport patterns to degrade temporary boundary roughness and reshape the seabed to the surrounding environment. Although some movement and redistribution of in-place sediments is anticipated, no substantial changes to bathymetry would occur.

3.1.2.1.1.2 TIDES

Construction of Alternative 1 would have no impact to tidal range or water levels in Hood Canal or the immediate area. Since the wharf and trestles would be constructed on a foundation of pilings, the flow of Hood Canal water as driven by tidal currents would not be impeded in the marine deeper water or nearshore marine areas of the EHW-2 project site. Water levels at the EHW-2 project site would not be impacted, and would be similar to other areas of northern Hood Canal.

3.1.2.1.1.3 CIRCULATION AND CURRENTS

The circulation patterns in the surface water (upper 10 to 15 feet of water) over the project area would be subject to short-term and temporary changes due to the presence of construction equipment and barges, which would partially obstruct flow. Small-scale changes in the direction and intensity of flow over periods of hours are anticipated. However, the overall circulation pattern and velocities in the nearshore and marine deeper water areas along the Bangor waterfront would be relatively unaffected. Currents and water circulation patterns are driven by tides and would return to normal patterns following removal of the construction equipment or barges. Thus, in-water construction activity would have small but temporary impacts to circulation and currents.

3.1.2.1.1.4 ANNUAL AND SEASONAL VARIABILITY

Storm events and inclement weather would occur during construction, particularly during the period between October and mid-February. Storms occurring after mid-February would not affect project construction activities because the in-water work window ends on February 15. Surface waves generated by elevated southwest winds (which are more prevalent during winter and spring storms) have the potential to complicate and/or disrupt in-water construction activities. Impacts to the seafloor can occur if storm waves move the construction barges and mooring system anchors are dragged. However, with implementation of current practices, such as avoiding anchor dragging, as discussed in the Mitigation Action Plan (Appendix F), impacts to the seafloor would be minimized.

3.1.2.1.1.5 LONGSHORE SEDIMENT TRANSPORT

Construction activities would not affect longshore sediment transport processes along the Bangor shoreline because the influence of construction equipment on wave and current energy that are responsible for resuspending and transporting sediments along the shoreline would be negligible.

3.1.2.1.2 OPERATION/LONG-TERM IMPACTS

Alternative 1 would have some periodic impacts to water circulation and currents, depending upon the type and frequency of operations conducted. Surface and mid-water column current velocities would be temporarily altered when deep draft submarines and other support vessels are moored at the wharf. Normal current patterns and velocities would resume when the vessels departed the EHW-2. Water levels and tidal exchange volumes in the basin would be unaffected by the continued presence and use of the EHW-2 because the wharf and trestles would be constructed on a foundation of pilings. Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components as required. These activities would not affect hydrographic conditions. The presence of the wharf and trestle abutment structures would not affect longshore sediment transport processes.

3.1.2.1.2.1 BATHYMETRIC SETTING

The natural process governing sediment erosion, deposition, and transport would result in the bathymetric profile of the seafloor near the EHW-2 project site returning to pre-construction conditions within 6 to 12 months following completion of construction and demobilization, as discussed above for construction of Alternative 1. However, small changes to the bathymetry inshore of the EHW-2 project site would occur over the long term due to the attenuation (reduction in energy) of surface waves approaching from the west. This reduction in wave energy would establish an environment shoreward of the EHW-2 project site more conducive to long-term deposition of sediments, promoting accumulation of fine-grained sediment in the form of a shoal area in the nearshore environment (Kelty and Bliven 2003). The general orientation of the shoal area would be expected to follow the general north-northeast and south-southwest flow patterns along the NBK shoreline (Section 3.1.1.3). Over time, coastal processes would gradually shift this material along the immediate coast, eventually forming a broader beach face and increasing the overall area of the intertidal zone. Once equilibrium is reached, there would be no long-term impedance of littoral drift along the shoreline, due to the considerable spacing between piles. This broader beach face may develop similar to the beach face behind Service Pier, another waterfront facility at the base, but would not be as large as that along the shore adjacent to the existing EHW (Figure 3.1–4). The Hunter's Marsh estuary is located to the east of the existing EHW, and may be a historical source of sediment that contributed to the broader beach face. A sediment source is not present inshore of the EHW-2 project site.

The support piles installed for the EHW-2 would alter current speeds beneath the wharf and trestles, which would cause erosion of fine-grained sediments near some piles impacted by turbulent flows, as well as settling and accumulation of fine-grained sediments at the base of other piles (Chiew and Melville 1987). Under this alternative, the wharf would be supported with larger piles (up to 48-inch diameter) than a conventional pile-supported wharf (24- to 36-inch diameter). Over the lifetime of the EHW-2, tidal currents would result in a gradual coarsening of surface sediments and thin scouring initially around the perimeter of each pile, and groups of piles (Sumer et al. 2001). Scouring would be greater around larger piles, but similar around the group of piles. However, shells and barnacles that accumulate on the trestle and wharf piles would also slough off over time and contribute to the sediment content below the piles. The loss of fine-grained sediment would be offset by the accumulation of shell and barnacle particles. These two processes would result in no net impact to seafloor bathymetry below the trestle support piles.

3.1.2.1.2.2 TIDES

The wharf and trestles would have no impact to the tidal range along the Bangor shoreline or the immediate project area because they would be constructed on a foundation of pilings. The flow of Hood Canal water as driven by tidal currents would be slightly impeded in the nearshore marine areas of the EHW-2 project site, although flow volumes would remain the same. Water depths would remain the same in the subtidal and intertidal areas adjacent to the EHW-2 project site. Over time, a broader beach face would develop east of the EHW-2 project site due to sediment deposition, which would increase the overall area of the intertidal zone. Water depths would decrease in the intertidal areas adjacent to the EHW-2 project site, but the tidal range along the shoreline would remain the same.

3.1.2.1.2.3 CIRCULATION AND CURRENTS

Since the wharf and trestles would be constructed on a foundation of pilings, the overall flow volume of water into the nearshore and deeper water areas adjacent to the EHW-2 project site would not be affected by the structures. Under this alternative, the wharf would be supported with larger piles (48-inch diameter) than a conventional pile-supported wharf (24- to 36-inch diameter). It is anticipated that the flow pattern immediately under the wharf would become more chaotic and fractured as the water mass driven by tidal currents moves between and around the piles, especially during periods of peak flow. The resulting impact would be a decrease in water column current velocities downcurrent of the wharf, but an overall increase in the turbulence and mixing in the water mass passing directly under the structure.

Turbulence in the water column would be a function of small-scale increases in the instantaneous velocity of water flow between the individual pile structures relative to the remainder of the water column. This occurs when the pressure exerted by a moving water body forces the tidal exchange volume to flow around obstructions or into channels between the piles (Potter and Wiggert 1991). The impact of turbulence in the water column is beneficial to water quality through the deflection of linear flow downward and laterally, promoting increased mixing between depth intervals. Along the seafloor, turbulent flow beneath the wharf could result in some erosion of fine-grained material resulting in a coarsening of surficial sediments and thin scouring around each pile (Chiew and Melville 1987; Sumer et al. 2001).

Surface and mid-water column current velocities would be temporarily altered when deep draft submarines and other support vessels are moored at the wharf. Although the water mass would flow around these relatively small obstructions during normal tidal exchange, it would do so at different rates and circulation patterns than would be observed without the presence of the naval assets alongside the EHW-2. Similar to flow around the wharf piles, a localized acceleration of flow would occur as the volume of seawater flows around the vessel hulls. Normal current patterns and velocities would resume when the vessels departed the EHW-2.

3.1.2.1.2.4 ANNUAL AND SEASONAL VARIABILITY

Operation of the EHW-2 would not alter seasonal patterns in hydrography, weather, or the wave climate of northern Hood Canal. However, the dense aggregation of piles under the wharf structure would disrupt surface waves generated by westerly winds before the waves enter the shallow water areas along the Bangor shoreline. The resulting attenuation of wave energy would reduce sediment resuspension and transport in the shallow water directly east of the EHW-2 project site. Therefore, accretion of fine sand and silt in this area would be anticipated in this normally sandy substrate over time.

3.1.2.1.2.5 LONGSHORE SEDIMENT TRANSPORT

The proposed action would add another pile-supported structure along the Bangor shoreline. However, based on evidence and data presented in Section 3.1.1, this new structure is not expected to result in significant changes to the overall Bangor shoreline. Pilings installed to the support the EHW-2 are expected to cause small, localized changes in water movement and may attenuate the energy of surface waves associated with storm events approaching the project site from the north and south. This reduction in wave energy in areas shoreward of the structure would reduce the frequency and magnitude of sediment resuspension events and promote conditions more conducive to long-term deposition of sediments and accumulation of fine-grained sediment in the form of a shoal area or comparatively broader intertidal area (Kelty and Bliven 2003).

Accumulation of sediments inshore of the EHW-2 structure would be expected to be similar to the accumulation inshore of the existing EHW (Figure 3.1–4) and would occur slowly and be insufficient to smother fauna or submerged vegetation. Further, effects of the wharf structure would be localized and would not contribute to changes in sediment transport in areas beyond the immediate project area. Thus, the project would not affect the sediment budget and rates of erosion/accretion outside of the project footprint. This conclusion is supported by the Golder Associates (2010) study, which concluded that the presence of other Navy structures along the Bangor shoreline has not caused appreciable changes in the morphology of the shoreline. Similarly, operation of the EHW-2 is not expected to significantly interrupt longshore sediment transport processes or result in changes to the Bangor or West Kitsap County shoreline.

The trestle abutment would be exposed to wave run-up only during extreme high tides. This impact would be inconsequential because infrequent, short, and highly localized interactions would not interfere with alongshore currents or sediment transport processes. While the project would replace the natural shoreline with a concrete structure, the size of this structure is small in comparison to the overall length of undeveloped shoreline in the area, and the effect on the shoreline would be minimal.

3.1.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.1.2.2.1 CONSTRUCTION

Alternative 2, the Combined Trestle, Conventional Pile Wharf Alternative, would have the same location as Alternative 1. The wharf would be constructed with up to 1,460 piles under Alternative 2, compared to 1,250 piles for wharf construction under Alternative 1. However, the design footprint (the area of the wharf and trestle) and 150-foot construction corridor is the same for both alternatives and the estimated surface area of seafloor that could be impacted by construction is 25.7 acres (Figure 3.1–4). Thus, the predicted impacts from this alternative on the bathymetric setting, tides, circulation and currents, and annual and seasonal variability would be similar to those for Alternative 1. Seafloor impacts from construction would be associated with disturbance of the surface sediments and resident benthic flora and fauna from pile driving, propeller wash and vessel movement, and other construction activities. Construction of Alternative 2 would not significantly affect longshore sediment transport processes or result in erosion of the shoreline within or near the project site.

3.1.2.2.2 OPERATION/LONG-TERM IMPACTS

As described for Alternative 1, the long-term operation of Alternative 2 would only have localized and temporary impacts to the existing hydrography depending upon the type and

frequency of operations that are conducted. Surface and mid-water column current velocities would be temporarily altered when deep draft submarines and other support vessels are moored at the wharf. Normal current patterns and velocities would resume when the vessels departed the EHW-2. The impacts to bathymetry and tides would be the same as for Alternative 1.

The impact to circulation and currents for Alternative 2 would be less than that described for Alternative 1. The wharf and trestles would be constructed on a foundation of conventional pilings and water flow around and between the piles would result in some thin scouring and erosion of fine-grained material (Sumer et al. 2001). However, water velocities around and between the conventional piles would be less than expected around the large piles that are proposed for wharf construction under Alternative 1. The higher number of conventional piles for Alternative 2 would further reduce water velocities under the wharf and trestles and would reduce the amount of fine-grained sediment erosion. The accumulation of sediment in the nearshore area, due to the reduction in wave energy caused by the presence of the EHW-2, would be the same as Alternative 1. Therefore, operations for Alternative 2 would not significantly affect longshore sediment transport processes or result in erosion of the shoreline within or near the project site. Maintenance of the EHW-2 under Alternative 2 would be the same as for Alternative 1, and the impacts to hydrography would be negligible.

3.1.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

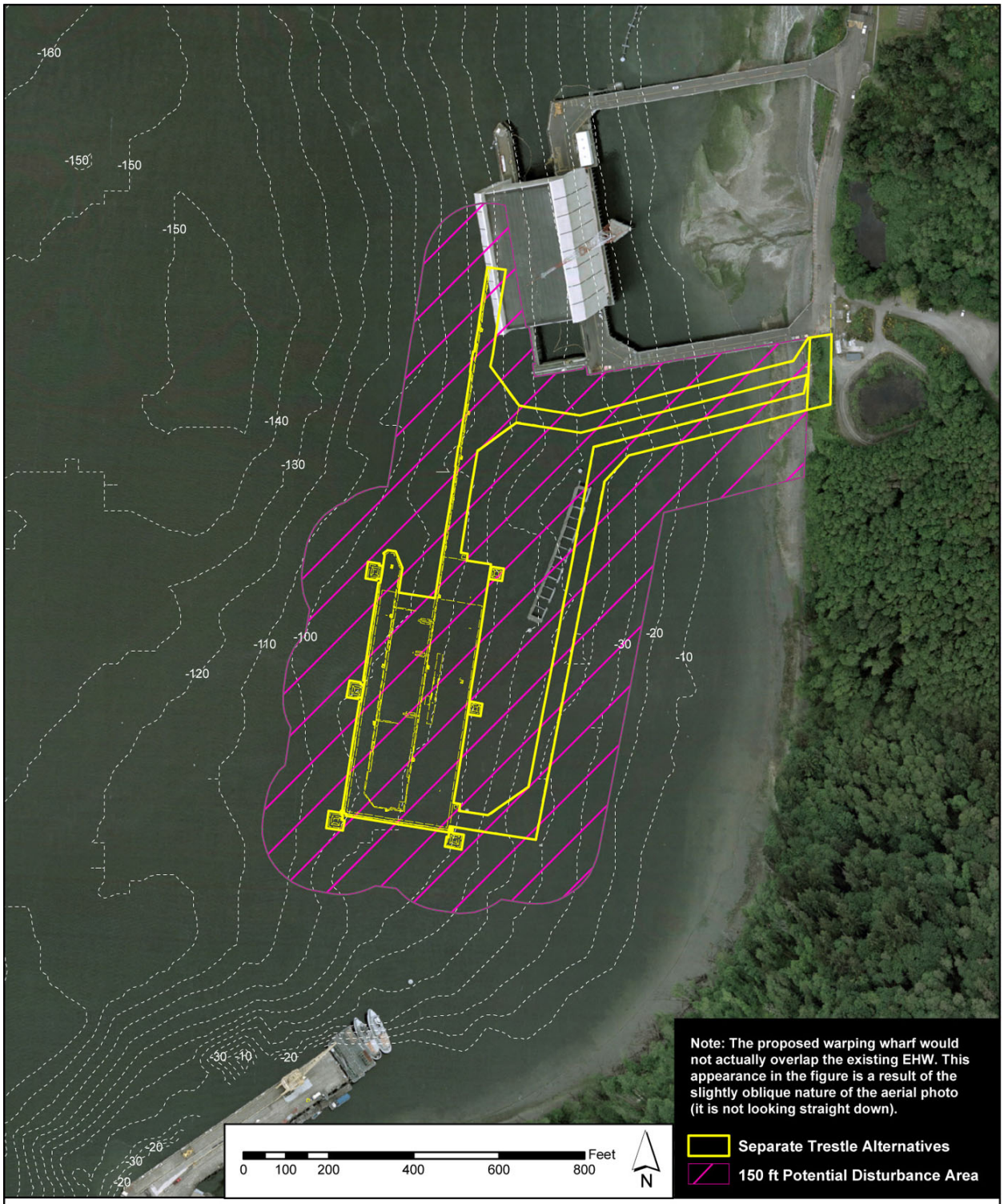
3.1.2.3.1 CONSTRUCTION

The entrance and exit trestles would be separate under Alternative 3 (Figure 3.1–5) and would require up to 1,290 piles. Overall impacts to the hydrographic setting associated with the construction of Alternative 3 would be similar to Alternative 1 and would be limited to the subtidal area at the EHW-2 project site and the intertidal area under the proposed trestles. Seafloor impacts from construction would be associated with disturbance of the surface sediments and resident benthic flora and fauna from pile driving, propeller wash and vessel movement, and other construction activities.

Based on the surface area of the design footprint (the area of the wharf and separate trestles) plus the 150-foot construction corridor, construction activities associated with this alternative would potentially impact the seafloor over an area of 25.8 acres (Figure 3.1–5), which is slightly greater than the area potentially impacted by Alternative 1 (25.7 acres). Construction of Alternative 3 would not significantly affect longshore sediment transport processes or result in erosion of the shoreline within or near the project site.

3.1.2.3.2 OPERATION/LONG-TERM IMPACTS

The impacts to existing hydrography from the long-term operation of Alternative 3 would be similar to Alternative 1. During operations, impacts to hydrography would be localized and temporary and depend on the type and frequency of operations that are conducted. Surface and mid-water column current velocities would be temporarily altered when deep draft submarines and other support vessels are moored at the wharf. Normal current patterns and velocities would resume when the vessels departed the EHW-2. The impacts to bathymetry and tides would be similar to Alternative 1.



Source: Morris et al. 2009

Figure 3.1−5. Seafloor Potentially Disturbed by Construction of the Separate Trestle Alternatives (3 and 4)

Alternative 3 would install more conventional piles for the trestles than Alternative 2. Water flow around these additional piles would increase the turbulence and mixing in the water mass passing directly under the trestles. Along the seafloor, turbulent flow around the additional trestle piles could result in more scouring and erosion of fine-grained material around the piles over a slightly greater area (25.9 acres) compared to Alternative 1 (Chiew and Melville 1987; Sumer et al. 2001). However, as described in Alternative 1, shells and barnacles that accumulate on the trestle and wharf piles would also slough off over time and contribute to the sediment content below the piles. These two processes would result in no net impact to seafloor bathymetry below the trestle support piles. In the nearshore area, however, the accumulation of sediments due to reduced wave energy would be somewhat greater than for Alternative 1. This is because the two trestles are expected to reduce wave energy to a greater extent than the combined (albeit slightly wider) trestle. Operations for Alternative 3 would not significantly affect longshore sediment transport processes or result in erosion of the shoreline within or near the project site. Maintenance of the EHW-2 under Alternative 3 would be the same as for Alternative 1, and the impacts to hydrography would be negligible.

3.1.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.1.2.4.1 CONSTRUCTION

The predicted impacts from Alternative 4 on the bathymetric setting, tides, circulation and currents, and annual and seasonal variability would be similar to those for Alternative 1. Seafloor impacts from construction would be associated with disturbance of the surface sediments and resident benthic flora and fauna from pile driving, propeller wash and vessel movement, and other construction activities. The estimated surface area of seafloor that could be impacted by construction of Alternative 4 is 25.8 acres (Figure 3.1–5), which is slightly larger than the area potentially impacted by Alternative 1 (25.7 acres). Similar to Alternative 1, construction of Alternative 4 would not significantly affect longshore sediment transport processes or result in erosion of the shoreline within or near the project site.

3.1.2.4.2 OPERATION/LONG-TERM IMPACTS

The long-term operation of Alternative 4 would result in temporary and localized impacts to hydrography that would be similar to those associated with Alternative 1. Surface and mid-water column current velocities would be temporarily altered when deep draft submarines and other support vessels are moored at the wharf. Normal current patterns and velocities would resume when the vessels departed the EHW-2. The impacts to bathymetry and tides would be similar to Alternative 1, including the accumulation of sediments in the nearshore area.

Under Alternative 4, the impact to circulation and currents under the wharf would be less than that described for Alternative 1. The wharf and trestles would be constructed on a foundation of conventional pilings and water flow around and between the piles would result in some thin scouring and erosion of fine-grained material (Sumer et al. 2001). However, water velocities around and between the conventional piles would be less than expected around the large piles that are proposed for wharf construction under Alternative 1. The impact to circulation and currents under the separate trestles would be less than Alternative 1. Operations for Alternative 4 would not significantly affect longshore sediment transport processes or result in erosion of the shoreline within or near the project site. Maintenance of the EHW-2 under Alternative 4 would be the same as for Alternative 1, and the impacts to hydrography would be negligible.

3.1.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.1.2.5.1 CONSTRUCTION

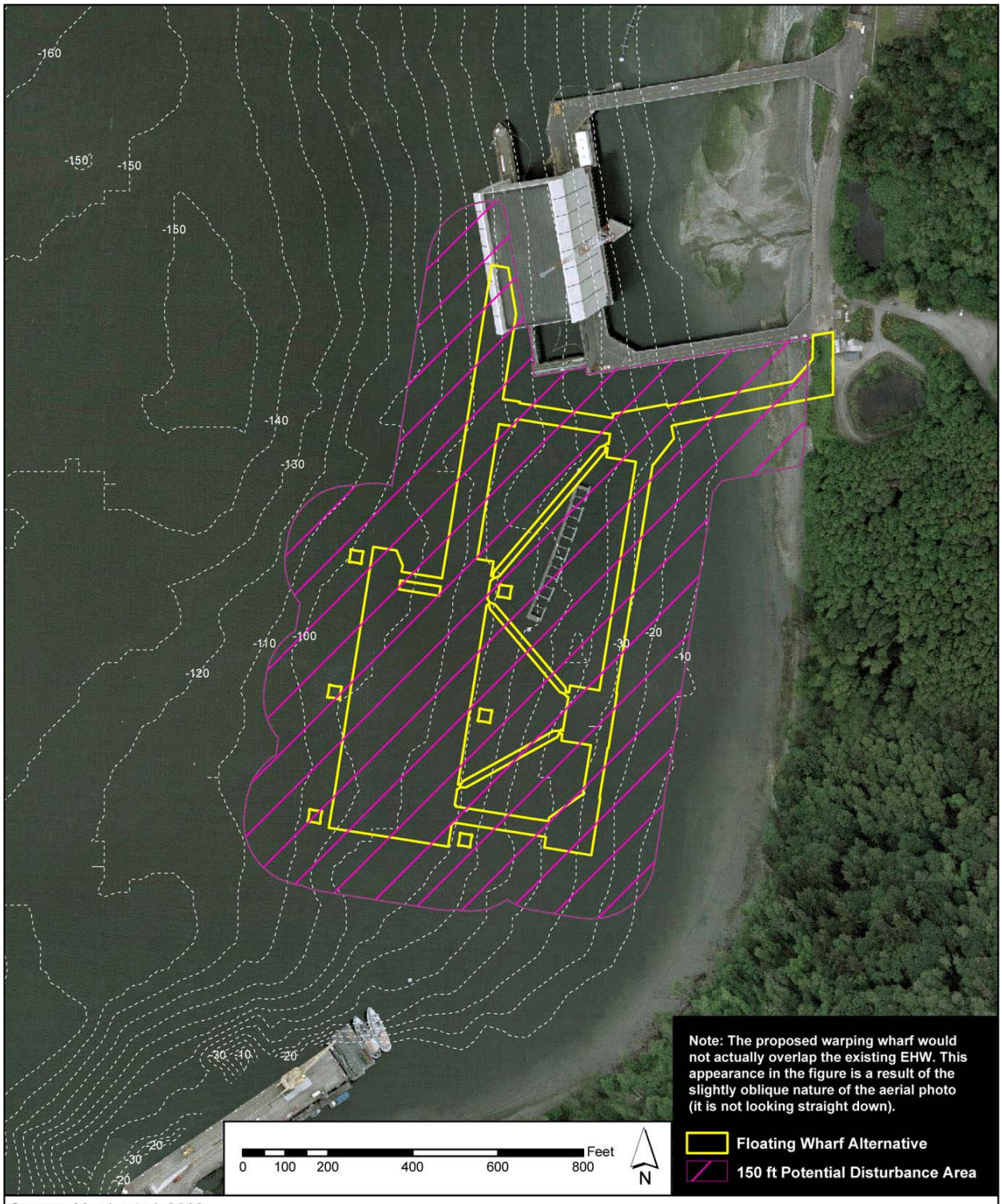
Using the design footprint along with a 150-foot construction corridor, Alternative 5 would cover the greatest estimated surface area of seafloor (29.4 acres) (Figure 3.1–6). However, Alternative 5 would need fewer piles than the other alternatives, requiring up to 440 piles compared to up to 1,250 piles for Alternative 1. The type of seafloor impacts related to construction would be similar to the other alternatives, consisting of surface sediment and benthic flora and fauna disturbance in areas of pile driving, propeller wash, vessel movement, and other construction activities. However, the total area of seafloor impacted by these activities is expected to be less than the other alternatives. Similar to Alternative 1, construction of Alternative 5 would not significantly affect longshore sediment transport processes or result in erosion of the shoreline within or near the project site.

3.1.2.5.2 OPERATION/LONG-TERM IMPACTS

Similar to the other alternatives, the long-term operation of Alternative 5 could result in localized changes to the existing wave and current patterns and hydrographic conditions. Alternative 5 would require fewer piles for wharf construction than the other alternatives, and localized water flow would be less impeded by installed piles under Alternative 5. However, the floating wharf would be supported by pontoon structures, with a draft of 20 feet, which would alter surface and mid-water column current velocities, as well as surface wave energy, to a greater extent than the pile-supported wharf structures associated with the other project alternatives. Similar to the other alternatives, surface and mid-water column current velocities also would be temporarily altered when deep draft submarines and other support vessels are moored at the wharf.

Under certain conditions, the reduced wave energy resulting from the presence of the wharf pontoons could promote a higher sediment deposition and accumulation rate in the area shoreward from the wharf. For example, the pontoons would intercept waves from westerly directions. However, as discussed in Section 3.1.1.4, the greatest wave energy is associated with winter and spring storms that generate waves moving in north-northeast and south-southwest directions. Under these conditions, the effect of the pontoon on the wave energy shoreward of the wharf would be reduced due to the orientation of the obstructions. Further, currents in the vicinity of the wharf structure would still be dominated by tidal motions and eddies, similar to existing conditions. Maintenance of the EHW-2 under Alternative 5 would be the same as for Alternative 1, and the impacts to hydrography would be negligible.

Thus, the pontoons may reduce some of the wave energy, while the amount of thin scouring and erosion of fine-grained sediments by water flow around installed piles would be less than the other proposed alternatives. Overall, impacts to circulation and currents for Alternative 5 would be comparable to those described for the other alternatives. Similar to conditions at the existing EHW, some sediment deposition and shoaling is expected to occur shoreward of the Alternative 5 wharf structure, but the extent of shoaling is not expected to be appreciably greater than that associated with Alternative 1. Operations for Alternative 5 would not significantly affect longshore sediment transport processes or result in erosion of the shoreline within or near the project site.



Source: Morris et al. 2009

Figure 3.1−6. Seafloor Potentially Disturbed by Construction of the Floating Wharf Alternative (5)

As described in Alternative 1, shells and barnacles that accumulate on the trestle piles and wharf pontoons would also slough off over time and contribute to the sediment content below the wharf. The rate and amount of accumulation of residual materials under Alternative 5 would be comparable to that of Alternative 1. Thus, the impacts to bathymetry and tides would be the same as for Alternative 1, including the accumulation of sediments in the nearshore area.

3.1.2.6 No-Action Alternative

The EHW-2 would not be constructed under the No-Action Alternative and overall operations would not change from current levels, so impacts to existing hydrography would not occur.

3.1.2.7 Mitigation Measures and Regulatory Compliance

Because there would only be localized impacts to hydrography, no mitigation measures are necessary. However, the Mitigation Action Plan (Appendix F) contains current practices to minimize impacts to the seafloor bathymetry, such as instructing vessel operators to avoid using excess engine thrust in waters less than 30 feet, avoid bottoming out (running aground) in shallow areas, and avoid underwater anchor and line drag.

Hood Canal is considered navigable water, and construction of the EHW-2 will require compliance with the regulatory guidelines associated with Section 10 of the Rivers and Harbors Act because it would be considered an alteration in these navigable waters. The Navy has applied for a Rivers and Harbors Act Section 10 permit from USACE and a Section 401 water quality certification from WDOE. In accordance with the CZMA, the Navy submitted a Phase I CCD to WDOE (included in Appendix I of this FEIS). WDOE concurred with the Phase I CCD on August 26, 2011 (included in Appendix I of this FEIS). The Navy will prepare and submit a Phase II CCD in spring 2012.

3.1.3 Summary of Impacts

Impacts to hydrography associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.1–1.

Table 3.1–1. Summary of Impacts to Hydrography

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO HYDROGRAPHY
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction*: Temporary and localized disturbances of bottom sediments (bathymetry) from anchor dragging, spud deployment, and propeller wash within the construction footprint (maximum 25.7 acres), and small-scale changes in wave and current patterns. *Operation/Long-term Impacts*: Small-scale changes in flow patterns under wharf (6.3 acres) could result in localized scouring or accumulation of sediments near pier pilings and increased deposition rate for sediments inshore of wharf. This would not affect longshore sediment transport processes in the project vicinity.

Table 3.1–1. Summary of Impacts to Hydrography (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO HYDROGRAPHY
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction*: Temporary and localized disturbances of bottom sediments (bathymetry) from anchor dragging, spud deployment, and propeller wash within the construction footprint (maximum 25.7 acres), and small-scale changes in wave and current patterns. *Operation/Long-term Impacts*: Small-scale changes in flow patterns under wharf (6.3 acres) could result in localized scouring or accumulation of sediments near pier pilings and increased deposition rate for sediments inshore of wharf. This would not affect longshore sediment transport processes in the project vicinity.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction*: Temporary and localized disturbances of bottom sediments (bathymetry) from anchor dragging, spud deployment, and propeller wash within the construction footprint (maximum 25.8 acres), and small-scale changes in wave and current patterns. *Operation/Long-term Impacts*: Small-scale changes in flow patterns under wharf (6.6 acres) could result in localized scouring or accumulation of sediments near pier pilings and increased deposition rate for sediments inshore of wharf. The nearshore sediment accumulation effect may be slightly greater than for Alternative 1 due to the two trestles. This would not affect longshore sediment transport processes in the project vicinity.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction*: Temporary and localized disturbances of bottom sediments (bathymetry) from anchor dragging, spud deployment, and propeller wash within the construction footprint (maximum 25.8 acres), and small-scale changes in wave and current patterns. *Operation/Long-term Impacts*: Small-scale changes in flow patterns under wharf (6.6 acres) could result in localized scouring or accumulation of sediments near pier pilings and increased deposition rate for sediments inshore of wharf. The nearshore sediment accumulation effect may be slightly greater than for Alternative 1 due to the two trestles. This would not affect longshore sediment transport processes in the project vicinity.
Alternative 5: Combined Trestle, Floating Wharf	*Construction*: Temporary and localized disturbances of bottom sediments (bathymetry) from anchor dragging, spud deployment, and propeller wash within the construction footprint (maximum 29.4 acres), and small-scale changes in wave and current patterns. *Operation/Long-term Impacts*: Small-scale changes in flow patterns under wharf (8.5 acres) and wave energy could result in increased deposition rate for sediments inshore of wharf. The local effect on circulation and sediment accumulation near the wharf would be less than for Alternative 1 due to fewer piles. Operations would not affect longshore sediment transport processes in the project vicinity.
No-Action Alternative	The No Action Alternative would not result in any changes to existing water level, water column, or seafloor topography.

Table 3.1–1. Summary of Impacts to Hydrography (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO HYDROGRAPHY
Mitigation • No mitigation measures are necessary beyond current practices.	
Consultation and Permit Status • The Navy has applied for a Rivers and Harbors Act Section 10 permit from USACE and a CWA Section 401 water quality certification from WDOE. • The Navy submitted a Phase I CCD to WDOE and WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD.	

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3.2 WATER QUALITY

Water quality focuses on the chemical and physical properties of a water body. Water quality parameters include temperature and salinity, which affect density layering and stratification, as well as chemical characteristics such as DO, nutrients, pH, turbidity/water clarity, and contaminant levels that affect the suitability of the water body as habitat for marine organisms and other beneficial uses.

The Federal Water Pollution Control Act Amendments of 1972, as amended in 1977 and 2002, and commonly known as the Clean Water Act (CWA) (33 USC §1251), established the basic structure for regulating discharges of pollutants into waters of the United States. The CWA contains the requirements to set water quality standards for all contaminants in surface waters. The U.S. Environmental Protection Agency (USEPA) is the designated regulatory authority to implement pollution control programs and other requirements of the CWA.

For Washington State, the responsibility for reviewing, establishing, and revising water quality standards has been delegated by the USEPA to WDOE. State water quality standards must be at least as stringent as the federal standards. As long as state standards meet this criterion, WDOE may modify the water quality standards to reflect site-specific conditions or adopt standards based on other scientifically defensible methods. WDOE also has responsibility for identifying impaired waters that do not meet applicable surface water quality standards. This list of impaired water bodies is referred to as the 303(d) list, referring to the section of the CWA that requires the development of a cleanup plan for those waters not meeting the standards. The current 303(d) list includes two segments impaired by low DO levels along the Bangor waterfront. Waters of Hood Canal immediately south of the proposed project site and approximately 0.5 mile north of the NBK at Bangor base boundary are on the current 303(d) list for low DO (WDOE 2009a) (see Section 3.2.1.2, Dissolved Oxygen). No total maximum daily load (TMDL) has been developed by WDOE for this area.

The state water quality standards are defined in the Washington State Water Pollution Control Act (Revised Code of Washington [RCW] 90.48) and implemented in the Washington Administrative Code (WAC) 173-201A. WAC 173-201A establishes four water body quality classifications as summarized in Table 3.2–1.

WDOE, per WAC 173-201A, has designated Hood Canal as an Extraordinary Quality (EQ) water body, meaning aquatic life uses include salmonid and other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; and crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning.

With respect to water quality, CWA Section 401 (water quality certification) and Section 402 (National Pollutant Discharge Elimination System [NPDES] permits) are applicable to this project. WDOE is responsible for administering Section 401, while the USEPA administers Section 402 at federal facilities such as NBK at Bangor. The certification process is coordinated with other federal processes, including the Rivers and Harbors Act Section 10 permit process. The Section 401 Certification relays the WDOE determination that the action is consistent with State Water Quality Standards and other water quality goals. WDOE sets water quality standards to maintain the overall desired water quality in Hood Canal (in this case extraordinary water quality). Section 402 establishes the NPDES permit program to regulate point source discharges of pollutants into waters of the United States. An NPDES permit sets specific discharge limits and conditions for point sources discharging pollutants into waters of the United States and establishes monitoring and reporting requirements.

Table 3.2–1. Marine Water Quality Criteria

WATER QUALITY CLASSIFICATION	WATER QUALITY CRITERIA			
Aquatic Life	**Temperature[1]**	**Dissolved Oxygen[2]**	**Turbidity[3]**	**pH**
Extraordinary Quality	13°C (55°F)	7.0 mg/L	+5 NTU or +10%[4]	7.0 – 8.5[6]
Excellent Quality	16°C (61°F)	6.0 mg/L	+5 NTU or +10%[4]	7.0 – 8.5[7]
Good Quality	19°C (66°F)	5.0 mg/L	+10 NTU or +20%[5]	7.0 – 8.5[7]
Fair Quality	22°C (72°F)	4.0 mg/L	+10 NTU or +20%[5]	6.5 – 9.0[7]
	COLIFORM BACTERIA			
Shellfish Harvesting	Geometric mean not to exceed 14 MPN/100 mL fecal coliforms[8]			
Recreation				
Primary Contact	Geometric mean not to exceed 14 MPN/100 mL fecal coliforms[8]			
Secondary Contact	Geometric mean not to exceed 70 MPN/100 mL enterococci[9]			

Source: WAC 173-201A as amended in November 2006.

1. One-day maximum (degrees Celsius [°C]). Temperature measurements should be taken to represent the dominant aquatic habitat of the monitoring site. Measurements should not be taken at the water's edge, the surface, or shallow stagnant backwater areas.
2. One-day minimum (milligrams per liter [mg/L]). When DO is lower than the criteria or within 0.2 mg/L, then human actions considered cumulatively may not cause the DO to decrease more than 0.2 mg/L. DO measurements should be taken to represent the dominant aquatic habitat of the monitoring site. Measurements should not be taken at the water's edge, the surface, or shallow stagnant backwater areas.
3. Measured in Nephelometric Turbidity Units (NTU); point of compliance for non-flowing marine waters — turbidity not to exceed criteria at a radius of 150 feet from activity causing the exceedance.
4. 5 NTU over background when the background is 50 NTU or less; or 10 percent increase in turbidity when background turbidity is more than 50 NTU.
5. 10 NTU over background when the background is 50 NTU or less; or 20 percent increase in turbidity when the background turbidity is more than 50 NTU.
6. Human-caused variation within range must be less than 0.2 units.
7. Human-caused variation within range must be less than 0.5 units.
8. No more than 10 percent of all samples used to calculate geometric mean may exceed 43 most probable number (MPN)/100 milliliters (mL); when averaging data, it is preferable to average by season and include five or more data collection events per period.
9. No more than 10 percent of all samples used to calculate geometric mean may exceed 208 MPN/100 mL; when averaging data, it is preferable to average by season and include five or more data collection events per period.

In Washington, the USEPA has issued the NPDES General Permit for Storm Water Associated with Construction Activities (Construction General Permit) to be used at federal facilities. The Construction General Permit provides permit coverage for federal construction site operators engaged in clearing, grading, and excavating activities that disturb one acre or more. Ecology's *Stormwater Management Manual for Western Washington* (WDOE 2005a) provides technical guidance on measures to control the quantity and quality of stormwater runoff from development projects for compliance with CWA permit conditions.

NBK at Bangor currently holds a USEPA-issued NPDES permit for stormwater discharges associated with industrial activity. The permit, titled Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity (MSGP), requires stormwater monitoring, inspections, training/awareness, documentation, reporting, and implementation of control measures (including best management practices [BMPs]), to reduce and/or eliminate stormwater pollutant discharges. NBK at Bangor staff regularly review changes in facility infrastructure and operations as related to MSGP coverage. If a new facility conducts an

industrial activity, it would be incorporated under existing MSGP coverage. In addition, the Navy submitted a Phase I CCD (included in Appendix I of this FEIS) to comply with the requirements of the CZMA (see Section 3.20) and WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD.

Section 438 of the Energy Independence and Security Act of 2007 (Public Law 110-140) requires federal development projects with a footprint exceeding 5,000 square feet to "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to temperature, rate, volume, and duration of flow." According to the USEPA guidance on implementing Section 438 of the Act (USEPA 2009), the intent of Section 438 is to "require federal agencies to develop and redevelop applicable facilities in a manner that maintains or restores stormwater runoff to the maximum extent technically feasible" and to "replicate the pre-development hydrology to protect and preserve both the water resources onsite and those downstream."

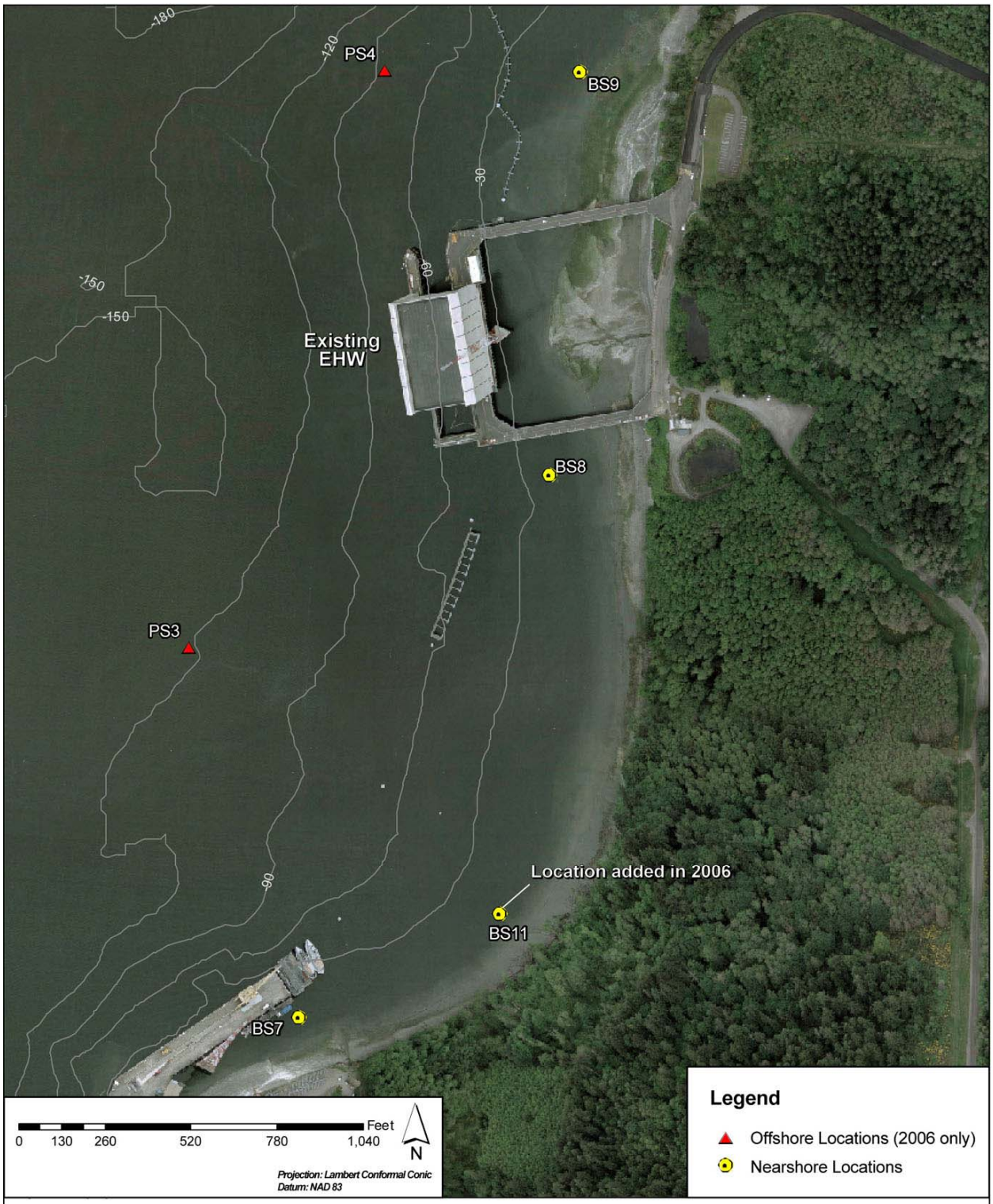
Consultation and Permit Compliance Status. The Navy has submitted a Joint Aquatic Resources Permit Application (JARPA) to USACE and WDOE, requesting a permit under CWA Section 404 and a Section 401 water quality certification. The Navy will submit an application to USEPA for coverage under the Construction General Permit in compliance with CWA Section 402. In accordance with the CZMA, the Navy has submitted a Phase I CCD to WDOE and WDOE concurred with the Phase I CCD on August 26, 2011 (included in Appendix I of this FEIS). The Navy will prepare and submit a Phase II CCD after applying for permits under the CWA and Rivers and Harbors Act.

3.2.1 Existing Environment

This section summarizes the existing marine water quality conditions of Hood Canal and the nearshore areas around the EHW-2 project site. The quality of surface waters in the upland portions of the project area, including stormwater runoff, is discussed in Section 3.12. The following discussion provides ranges in values for several of the water quality parameters (temperature, salinity, DO, and turbidity) that were measured at a series of shallow, nearshore, and deeper, offshore sampling locations along the Bangor waterfront in 2005 and 2006 (Phillips et al. 2009) and in 2007 and 2008 (Hafner and Dolan 2009). The sampling stations, shown in Figure 3.2–1, include locations near the EHW-2 project site. Existing conditions for these parameters are also based on information collected as part of regional monitoring programs, such as the WDOE Marine Water Quality Monitoring Program (WDOE 2005b). Water quality for NBK at Bangor is good by most measures and meets applicable standards. Although DO is low in much of Hood Canal, this problem is less pronounced in northern Hood Canal, the location of NBK at Bangor, than elsewhere in the canal. Based on measurements performed during 2005 through 2008 (Phillips et al. 2009; Hafner and Dolan 2009), DO concentrations in nearshore waters at the project site almost always meet water quality standards (Section 3.2.1.2).

3.2.1.1 Stratification, Salinity, and Temperature

The waters of Hood Canal surrounding the EHW-2 project site reflect a stratified water column with less saline surface water overlying cooler saline water with depth. The salinity of the upper water layer is sensitive to the amount of freshwater input and may become more diluted during heavy precipitation (URS 1994). Variances due to seasonal changes (such as freshwater input, wind-induced mixing, and solar heating) are common (URS 1994).



Source: Phillips et al. 2009

Figure 3.2–1. Water Quality Monitoring Stations for 2005 and 2006

Freshwater input into Hood Canal comes from creeks, rivers, groundwater (including artesian wells), and stormwater outfalls. Artesian wells also contribute to freshwater inputs, with estimated flows of 2,000 to 2,500 gallons per minute (WDOE 1981). Overland flow from much of the western portion of NBK at Bangor is routed to Hood Canal through a series of stormwater outfalls. Saltwater and freshwater mixing zones exist at the mouths of each of these streams and outfalls (URS 1994).

During the 2005 through 2008 water quality surveys, average surface water salinity values along the Bangor waterfront ranged from 24 to 34 practical salinity units (PSU) (Table 3.2–2). Based on vertical profile measurements, the transition between the lower salinity surface waters and higher salinity subsurface waters occurs at a depth of about 33 feet (Phillips et al. 2009). The lowest surface water salinity (18.4 PSU) was measured in February 2007 when freshwater (low salinity) input may have been high due to winter storms and runoff (Hafner and Dolan 2009). The range in salinity values along the Bangor waterfront measured during the 2005 through 2008 water quality surveys is typical for marine waters in Puget Sound (Newton et al. 1998, 2002).

The temperature of marine surface waters designated as EQ should not exceed 13 degrees Celsius (°C). When a water body's temperature is warmer than 13°C and that condition is due to natural conditions, then human actions considered cumulatively may not cause the temperature of the water body to increase more than 0.3°C (WAC 173-201A). Minimum, maximum, and mean surface water temperatures along the Bangor waterfront in 2005 through 2008 are summarized in Table 3.2–2. Average water temperatures for NBK at Bangor ranged from 8.1 to 17.4 °C, and temperatures exceeded 13°C during late spring through summer (May through September). Nearshore areas are susceptible to greater temperature variations due to seasonal differences in solar radiation input. WDOE through the Section 303(d) program (Water Quality Assessment for Washington) has not classified the water quality in the area of NBK at Bangor as impaired for temperature (WDOE 2009a).

Table 3.2–2. Minimum, Maximum, and Mean Values of Water Quality Parameters at Nearshore Locations on NBK at Bangor during the 2005–2008 Water Quality Surveys

Dates	Year	DO (mg/L)			Salinity (PSU)			Temperature (°C)			Turbidity (NTU)		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
1/22–1/28	2005	7.2	11.3	9.1	25.9	27.3	26.6	7.7	8.2	8.1	0.2	12.4	1.1
2/5–2/11	2005	7.1	10.6	8.8	26.5	29.8	28.3	7.4	8.4	8.0	0.3	26.4	1.3
2/26–3/4	2005	8.8	11.3	9.4	28.5	30.1	29.3	6.9	8.3	8.1	0.2	12.7	1.1
3/5–3/11	2005	8.9	10.3	9.3	26.4	28.7	28.1	7.4	8.4	8.3	0.0	12.0	1.0
3/12–3/18	2005	8.8	10.6	9.4	29.5	30.8	30.1	7.0	8.4	8.2	-0.1	41.8	2.6
3/19–3/25	2005	9.2	12.1	10.8	26.3	29.4	27.4	8.3	9.9	9.0	-0.3	42.9	1.3
3/26–4/1	2005	9.9	10.3	9.3	26.9	28.2	27.5	8.6	9.5	8.9	-0.1	15.7	1.2
4/2–4/8	2005	9.0	11.0	9.8	25.2	28.3	27.4	8.8	9.8	9.3	-0.2	8.0	0.7
4/9–4/15	2005	9.9	13.0	11.6	30.5	31.7	30.9	9.2	10.0	9.8	-0.1	3.8	0.5
4/16–4/22	2005	9.0	12.7	11.5	28.7	29.9	29.2	10.0	10.3	10.1	0.1	3.5	0.4

Table 3.2–2. Minimum, Maximum, and Mean Values of Water Quality Parameters at Nearshore Locations on NBK at Bangor during the 2005–2008 Water Quality Surveys (continued)

Dates	Year	DO (mg/L)			Salinity (PSU)			Temperature (°C)			Turbidity (NTU)		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
4/23–4/29	2005	9.5	10.8	9.5	34.9	33.7	34.5	9.6	10.9	10.1	-0.2	7.8	0.9
4/30–5/6	2005	10.2	10.8	9.8	25.8	27.6	26.7	9.6	11.4	10.6	0.1	12.5	1.3
5/7–5/13	2005	9.9	11.3	9.6	29.9	31.3	30.4	10.0	11.7	11.2	-0.7	29.4	1.5
5/14–5/20	2005	9.3	10.1	9.1	30.1	31.4	30.6	10.6	12.8	11.9	-2.6	6.5	-1.0
5/21–5/27	2005	7.6	10.0	8.8	29.3	31.7	30.2	11.1	13.9	12.4	†	†	†
5/28–6/3	2005	7.9	10.5	9.3	29.1	32.0	30.5	11.2	13.9	12.6	†	†	†
6/11–6/17	2005	8.1	10.5	10.0	29.6	31.1	30.0	11.9	13.9	13.3	†	†	†
6/29–7/1	2005	8.5	11.4	10.1	27.4	30.3	28.9	15.3	17.8	16.7	-2.4	6	-0.2
7/14–7/16	2005	8.3	11.2	9.2	27.3	32.5	31.7	13.2	16.9	14.5	-0.5	8.9	1
7/21–7/22	2005	6.9	11	8.3	26.8	28.1	27.6	11.9	16.4	13.7	-0.4	18	1
7/27–7/29	2005	7.2	9.4	8.2	34	35.1	34.5	13.3	15.8	14.5	0	11.8	0.7
8/3-8/4	2005	5.9	12.4	9	27.9	29.4	28.9	11.9	17.8	14.9	0	14.5	1.4
8/10-8/12	2005	7.8	9.2	8.6	29.9	31.6	30.6	15.1	19.1	17.4	0	15.7	1
8/15-8/16	2005	6.5	9.7	8.3	30.5	31.2	30.8	12.6	15.5	14.2	0.6	15.9	1.8
8/22-8/23	2005	5.3	8.7	6.9	30.3	31.3	30.9	12.4	15.5	13.8	0.1	4.8	0.5
8/29-8/30	2005	8.2	10.3	9.3	30.1	31.5	30.9	16.3	18.6	17.3	0.2	6	0.6
9/9-9/10	2005	7.9	9.2	8.7	28.1	29.5	28.9	13.5	15.6	14.8	0	12.6	0.7
9/12	2005	7	9.6	8.8	27.8	28.9	28.3	13.5	15.9	15.2	0.1	8.4	0.7
1/26-1/27	2006	7.2	11.3	9.1	25.9	27.3	26.6	7.7	8.2	8.1	0.2	12.4	1.1
2/7-2/8	2006	7.1	10.6	8.8	26.5	29.8	28.3	7.4	8.4	8	0.3	26.4	1.3
3/1-3/2	2006	8.8	11.3	9.4	28.5	30.1	29.3	6.9	8.3	8.1	0.2	12.7	1.1
3/7-3/8	2006	8.9	10.3	9.3	26.4	28.7	28.1	7.4	8.4	8.3	0	12	1
3/13-3/14	2006	8.8	10.6	9.4	29.5	30.8	30.1	7	8.4	8.2	-0.1	41.8	2.6
3/23-3/24	2006	9.2	12.1	10.8	26.3	29.4	27.4	8.3	9.9	9	-0.3	42.9	1.3
3/27-3/28	2006	9.9	10.3	9.3	26.9	28.2	27.5	8.6	9.5	8.9	-0.1	15.7	1.2
4/4-4/5	2006	9	11	9.8	25.2	28.3	27.4	8.8	9.8	9.3	-0.2	8	0.7

Table 3.2–2. Minimum, Maximum, and Mean Values of Water Quality Parameters at Nearshore Locations on NBK at Bangor during the 2005–2008 Water Quality Surveys (continued)

Dates	Year	DO (mg/L)			Salinity (PSU)			Temperature (°C)			Turbidity (NTU)		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
4/11-4/12	2006	9.9	13	11.6	30.5	31.7	30.9	9.2	10	9.8	-0.1	3.8	0.5
4/20	2006	9	12.7	11.5	28.7	29.9	29.2	10	10.3	10.1	0.1	3.5	0.4
4/24-4/25	2006	9.5	10.8	9.5	33.7	34.9	34.5	9.6	10.9	10.1	-0.2	7.8	0.9
5/2-5/3	2006	10.2	10.8	9.8	25.8	27.6	26.7	9.6	11.4	10.6	0.1	12.5	1.3
5/11-5/12	2006	9.9	11.3	9.6	29.9	31.3	30.4	10	11.7	11.2	-0.7	29.4	1.5
5/15-5/16	2006	9.3	10.1	9.1	30.1	31.4	30.6	10.6	12.8	11.9	-2.6	6.5	-1
5/25-5/26	2006	7.6	10	8.8	29.3	31.7	30.2	11.1	13.9	12.4	†	†	†
5/30-5/31	2006	7.9	10.5	9.3	29.1	32	30.5	11.2	13.9	12.6	†	†	†
5/16	2006	8.1	10.5	10	29.6	31.1	30	11.9	13.9	13.3	†	†	†
1/25-1/26	2007	8.9	10.1	9.4	27.9	29.5	28.8	7.8	8.2	8.1	-0.2	0.6	0.0
2/8-2/9	2007	10.4	14.0	12.3	18.4	29.4	23.7	8.0	8.7	8.2	-1.0	8.3	0.0
3/1-3/2	2007	9.4	11.4	10.3	27.5	28.6	28.3	7.6	8.2	8.0	9.5	11.0	9.9
3/8-3/9	2007	3.9	8.0	6.5	23.9	25.7	24.9	8.3	9.0	8.7	-0.1	10.1	0.9
4/24-4/25	2007	9.1	10.6	10.0	25.4	27.0	26.5	10.8	11.5	11.2	-1.1	4.7	0.0
4/30-5/1	2007	8.8	12.3	10.0	27.5	28.8	28.3	9.3	12.1	10.3	-0.2	16.7	1.2
5/14-5/15	2007	8.3	12.3	10.2	28.3	29.4	28.9	9.9	12.1	10.8	-0.3	3.1	0.4
5/24-5/25	2007	8.8	11.7	10.2	30.4	31.9	31.1	11.4	14.1	12.6	-1.0	29.9	1.4
6/7-6/8	2007	9.2	12.0	11.3	30.2	31.1	30.8	12.6	13.5	13.1	0.0	11.7	1.3
2/2-2/3	2008	†	†	†	28.8	30.0	29.4	6.6	7.6	7.4	†	†	†
2/8-2/9	2008	†	†	†	29.3	29.7	29.6	7.4	7.7	7.6	†	†	†
3/12-3/13	2008	†	†	†	29.5	30.3	30.0	7.8	8.3	8.2	†	†	†
3/24-3/25	2008	†	†	†	30.0	30.4	30.3	7.8	8.5	8.1	†	†	†
4/1-4/2	2008	†	†	†	29.8	31.5	30.3	6.3	8.8	8.1	†	†	†
4/15-4/16	2008	†	†	†	31.8	32.4	32.2	8.5	9.1	8.8	0.1	0.8	0.4
4/29-4/30	2008	†	†	†	30.9	32.3	31.8	8.7	10.8	9.4	0.0	13.0	0.9
5/8-5/9	2008	†	†	†	31.2	32.8	32.2	8.4	10.3	9.3	0.1	9.4	1.3
5/21-5/22	2008	†	†	†	28.4	32.4	31.1	9.7	13.6	11.3	0.1	7.3	1.5
6/9-6/10	2008	†	†	†	26.7	28.0	27.3	10.4	12.8	11.6	-1.4	9.0	-0.2

Source: Phillips et al. (2009); Hafner and Dolan (2009).

† No data collected due to sensor malfunction.

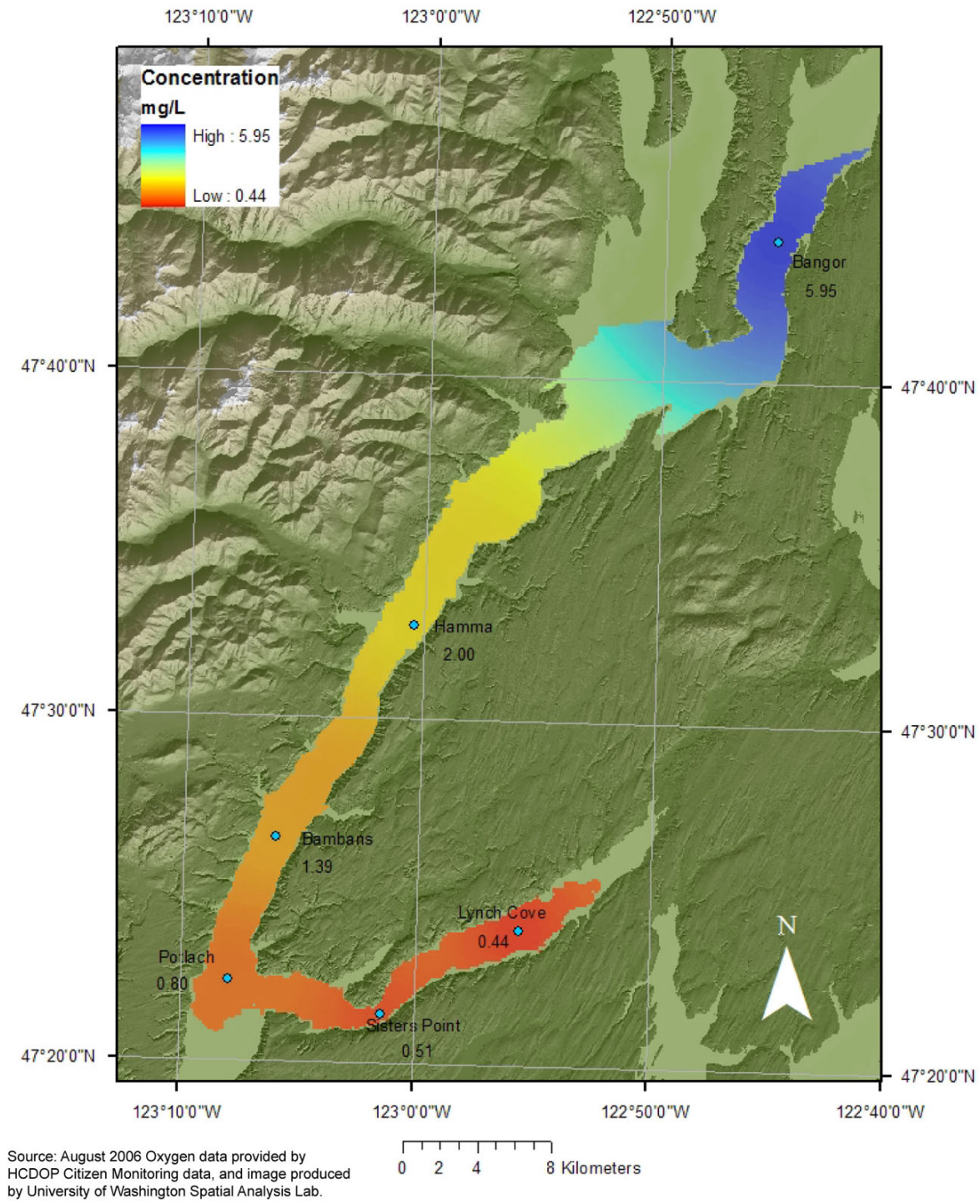
3.2.1.2 Dissolved Oxygen

Per the state's water quality classification, concentrations of DO in EQ marine surface waters, such as Hood Canal, should exceed 7.0 milligrams per liter (mg/L), allowing for only 0.2 mg/L reductions in the natural condition by human-caused activities (WAC 173-201A). State guidelines [WAC 173-201A 200(1)(d)(i)] specify that "when a water body's DO is lower than the criteria in Table 200(1)(d) (or within 0.2 mg/L of the criteria) and that condition is due to natural conditions, the human action considered cumulatively may not cause the DO of that water body to decrease more than 0.2 mg/L." Data from WDOE's Marine Water Quality Monitoring Program for 1998 to 2000 and the Hood Canal Dissolved Oxygen Program (HCDOP) for 2002 to 2004 show that Hood Canal is particularly susceptible to low DO levels (Newton et al. 2002; HCDOP 2005).

Scientists have proposed the following possible causes for the lower DO concentrations in Hood Canal: (1) changes in production or input of organic matter, due to naturally better growth conditions, such as increased sunlight (or other climate factors), increased nutrient availability, or human loading of nutrients or organic material; (2) changes in ocean properties, such as seawater density that affects flushing of the canal's waters, oxygen concentration, or nutrients in the incoming ocean water; (3) changes in river input or timing from natural causes (e.g., drought) or from human actions (e.g., diversion) that affect both flushing and mixing in the canal; and (4) changes in weather conditions, such as wind direction and speed, which affect the flushing and/or oxygen concentration distribution. There is supporting evidence for all of these hypotheses (HCDOP 2009a).

The EHW-2 project site is located along the northern stretch of Hood Canal, which is less affected by these seasonal episodes of low DO (Figure 3.2–2). From 2003 through 2008, DO concentrations in Hood Canal offshore from the southern boundary of NBK at Bangor ranged from approximately 3.8 to 11.8 mg/L at depths of 33 feet (HCDOP 2009b). For this same time period, DO concentrations in surface waters ranged from approximately 5 to 13.8 mg/L. The concentrations fluctuate seasonally, with higher DO concentration in the spring and early summer and lower DO concentrations in late summer and fall. The lowest concentration during this period occurred during October 2006. Dissolved oxygen concentrations in Hood Canal between Dabob Bay and the Great Bend (south of the NBK at Bangor area) during this same time period ranged from approximately 2.6 to 5.2 mg/L at depths greater than 66 feet (Warner 2007). The long term measurements since the 1990s indicate an overall trend of decreasing DO concentrations in the southern end of Hood Canal (Warner 2007).

The 2008 303(d) list, the most recent list approved by the USEPA, includes five segments within northern Hood Canal impaired by low DO levels (WDOE 2009a). Two of these (IDs 40984 and 10271) are located along the Bangor waterfront (Figure 3.2–3). The low DO for both of those segments is believed to be due to or influenced by human actions, such as leaking septic systems and runoff of fertilizers from other watersheds (WDOE 2009a).



Source: August 2006 Oxygen data provided by HCDOP Citizen Monitoring data, and image produced by University of Washington Spatial Analysis Lab.

Figure 3.2–2. Dissolved Oxygen Concentration in Hood Canal

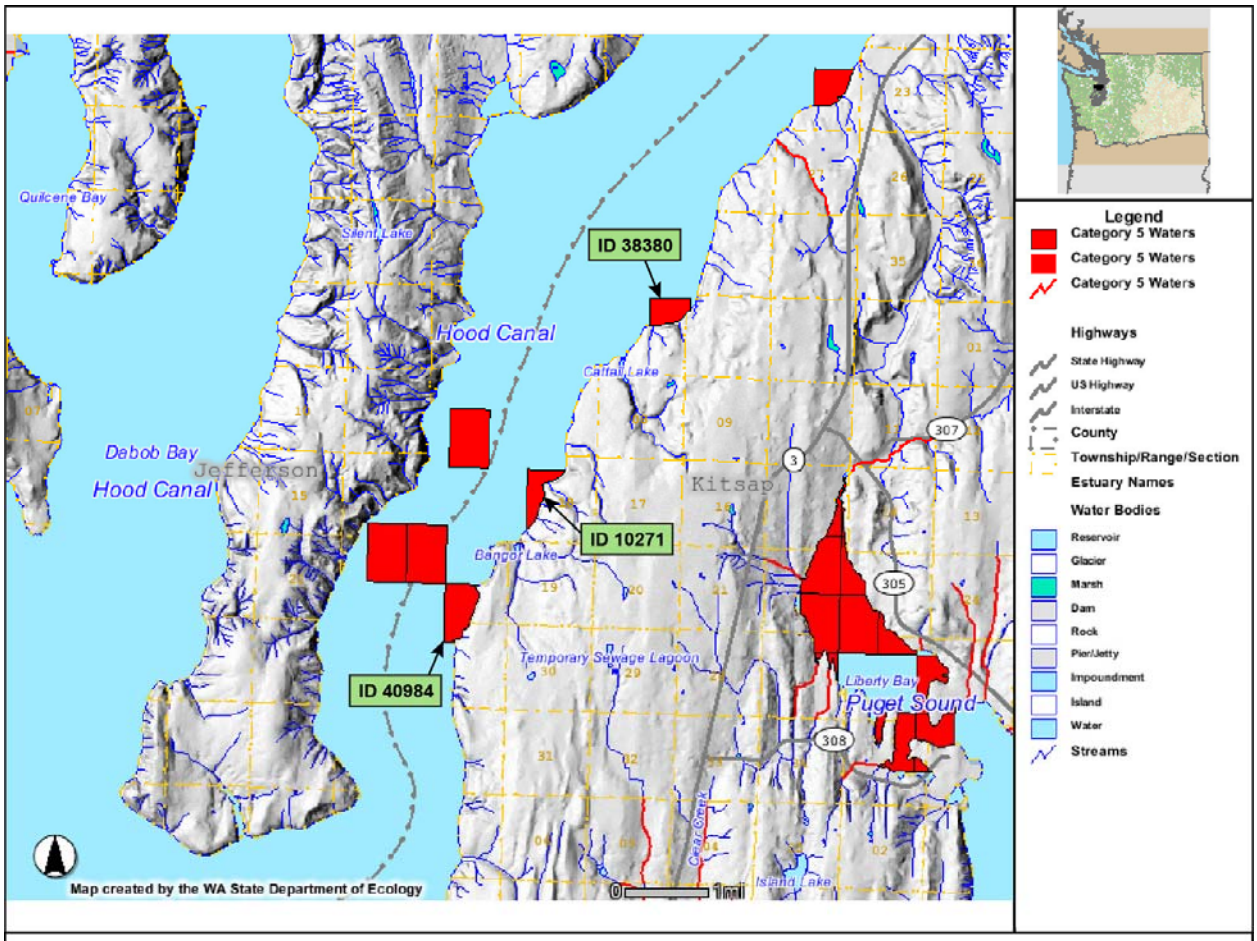


Figure 3.2–3. Washington State 303(d) List Map for the NBK at Bangor Area

Although some waters along the Bangor waterfront are on the 303(d) list, mean DO measurements during 2005 through 2008 indicate that nearshore stations at the Bangor waterfront consistently met EQ standards for DO (Table 3.2–2). During the water quality surveys, mean DO concentrations were above 7 mg/L during all but two surveys (August 22–23, 2005 and March 8–9, 2007), although it should be noted that water quality surveys during 2006 through 2008 did not extend into late summer and fall when the lowest seasonal DO concentrations are expected to occur. At the offshore water quality sampling locations, water quality ratings based on DO concentrations ranged from fair to EQ standards during 2005–2006 (Phillips et al. 2009), whereas all DO concentrations measured at deep-water locations in 2007 were above 7 mg/L and met EQ standards (Hafner and Dolan 2009). The DO concentrations measured during the water quality surveys along the Bangor shoreline are on the upper range of DO conditions measured historically throughout Hood Canal during the late summer and fall periods (Warner 2007).

3.2.1.3 Turbidity

Turbidity is a measure of the amount of light scatter related to total suspended solids (TSS) in the water column and is measured in nephelometric turbidity units (NTUs). Sources of turbidity in Hood Canal waters may include plankton, organic detritus from streams and other storm or wastewater sources, fine suspended sediments (silts and clays), and resuspended bottom sediments and organic particulates. Suspended particles in the water have the ability to absorb heat in the sunlight, which then raises water temperature and reduces light available for photosynthesis.

Washington State-designated EQ marine surface waters should have an average turbidity reading of less than 5 NTUs (WAC 173-201A). Turbidity measurements were conducted along the Bangor waterfront, including the vicinity of the EHW-2 project site, during the 2005 through 2008 water quality surveys (Phillips et al. 2009; Hafner and Dolan 2009) Minimum, maximum, and mean turbidity levels in nearshore waters are shown in Table 3.2–2. The mean monthly turbidity measurements for nearshore waters ranged from 0.0 to 9.9 NTU and, for all but one survey (March 1–2, 2007), were within the Washington State standards for extraordinary water quality.

3.2.1.4 Nutrients

Nutrients (particularly nitrogen-based compounds), sunlight, and a stratified water column play important roles in algae productivity in Hood Canal. High algae productivity (e.g., algal blooms) is believed to be a contributing factor to low DO conditions in Hood Canal, due to algae die off and decomposition (HCDOP 2005). Nitrogen enters the canal from the ocean, rivers, and atmosphere. However, as more nitrogen enters Hood Canal through uncontrolled sources (e.g., runoff, fertilizer use, leaking septic systems), algae growth is stimulated, which can then reduce oxygen levels when the algae dies and decomposes in the late summer and early fall (HCDOP 2005).

WDOE's Marine Water Monitoring Program monitors nutrients in Hood Canal marine waters in the vicinity of the Bangor waterfront (WDOE 2005b). Concentrations of nitrate and phosphate during the 2005 monitoring year ranged from 0.02 to 2 mg/L and from 0.04 to 0.4 mg/L, respectively. Specific water quality standards for nutrients are not established, but the ranges observed in Hood Canal near the project site are typical for marine waters in Puget Sound (Newton et al. 1998, 2002).

3.2.1.5 Fecal Coliform Bacteria

Fecal coliform covers two bacteria groups (coliforms and fecal streptococci) that are commonly found in animal and human feces and are used as indicators of possible sewage contamination in marine waters (USEPA 1997). Although the fecal indicator bacteria typically are not harmful to humans, they indicate the possible presence of pathogenic bacteria, viruses, and protozoa that also live in animal and human digestive systems. Therefore, their presence in marine waters at elevated levels may indicate the presence of pathogenic microorganisms that pose a health risk.

The Washington Department of Health (WDOH) Office of Food Safety and Shellfish Programs conducts annual fecal coliform bacteria monitoring in Hood Canal including stations near the Bangor waterfront. The standard for approved shellfish growing waters is a fecal coliform geometric mean not greater than 14 most probable number (MPN)/100 milliliters (mL) and an estimate of the 90th percentile not greater than 43 MPN/100 mL (Table 3.2–1). When this standard is met, the water is considered safe for shellfish harvesting and for water contact use by humans (also referred to as primary human contact). The most recent data from August 2002 through November 2007 covering six monitoring stations in Hood Canal near the Bangor waterfront (WDOH 2008) showed an average geometric mean of 3.1 MPN/100 mL and an estimated 90th percentile of 11.8 MPN/100 mL. These values are within the shellfish harvesting and recreation standard for fecal coliform.

WDOH summarizes the annual fecal coliform bacteria monitoring results in Hood Canal and the rest of Puget Sound in the form of an index rating system ranging from bad to good, where lower numbers indicate lower fecal coliform. In 2005, the fecal pollution index for Hood Canal was 1.09, which corresponds to a WDOH "good" rating (low bacterial levels) for most of the survey sites (WDOH 2006). The fecal pollution index for the area near the EHW-2 project site was 1.0, which was also a good rating.

While WDOH uses a rolling average of about 30 samples to calculate the 90th percentile for classification of shellfish growing areas, the WDOE water quality criteria uses no more than one year of data to determine compliance with WAC 173-201A if enough data points are available to reasonably represent seasonal variation. However, WDOE's assessment policy allows for bridging data over several years to determine a geometric mean when doing so does not mask periods of non-compliance with the standards. The closest sampling stations to the EHW-2 project site (85 and 86) meet the WDOE standard (WDOH 2008).

3.2.1.6 pH

The term *pH* is a measure of alkalinity or acidity and affects many chemical and biological processes in water. For example, low pH can affect the mobility (solubility) of toxic elements and their availability for uptake by aquatic plants and animals, which can produce conditions toxic to aquatic life, particularly to juvenile organisms. Washington State-designated EQ marine surface waters should have a pH reading between 7.0 and 8.5 (WAC 173-201A). WDOE's Marine Water Monitoring Program monitors pH in Hood Canal marine waters in the vicinity of the Bangor waterfront. The measured pH levels from the 2005 monitoring year ranged from 3.6 to 8.4, and all but 5 of the 45 data values were within EQ standards (WDOE 2005b).

3.2.2 Environmental Consequences

The evaluation of impacts to marine water quality considers whether project-related construction and operation activities create conditions that violate state water quality standards or interfere with beneficial uses of the water body. Applicable standards that are the basis for determinations of environmental consequences are discussed in the introduction to Section 3.2.

In general, construction and operation of project components in the upland portion of the project site, new buildings, utilities, the pure water facility, and other infrastructure, would not directly alter or impact marine water quality. Potential indirect impacts to marine water quality from contaminant loading associated with construction and operations of project elements in the upland portion of the site would be minimized through implementation of stormwater measures.

During construction of the EHW-2 roads, three new buildings, pure water facility, and associated utilities, stormwater discharges would be in accordance with an NPDES Construction General Permit. A Stormwater Pollution Prevention Plan (SWPPP) would be developed, following guidance in WDOE's *Stormwater Management Manual for Western Washington* (WDOE 2005a). The SWPPP would specify what BMPs would be implemented during construction to limit contaminant discharges to Hood Canal. New stormwater conveyance features would be constructed within existing disturbed areas.

During operation of the EHW-2 roads, three new buildings, pure water facility, and associated utilities, stormwater discharges would be in accordance with Bangor's NPDES MSGP for industrial stormwater discharges (USEPA 2008; Navy 2009a). Stormwater discharges from the area immediately adjacent to the proposed EHW-2 would be routed to a 20- by 8-foot stormwater vault installed just south of the backflow preventer and eventually discharged to Hood Canal. Stormwater from the new pure water facility would be routed to and treated through the existing stormwater collection system prior to discharge into Hood Canal. Because the discharges would be regulated by the permit limits, adverse impacts to marine water quality at the EHW-2 project site from stormwater discharges would not be expected. Wastewater from the relocated pure water facility would not be discharged into the marine environment.

The Navy would require the construction contractor to prepare and implement a Debris Management Plan with procedures for retrieving and cleaning up any accidental spills. The contractor would also prepare and implement a spill response plan (e.g., a Spill Prevention, Control, and Countermeasure [SPCC] Plan) to clean up fuel or fluid spills. All areas of in-water and above-water work would be surrounded by floating debris barriers and a floating oil absorbent boom. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups.

3.2.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.2.2.1.1 CONSTRUCTION

Under Alternative 1, up to 1,250 in-water piles would be installed over 200 to 400 days. In-water construction of Alternative 1 facilities and supporting components would not require dredging or placement of fill. Direct discharges of waste to the marine environment would not occur, other than stormwater runoff during construction. Construction-related impacts to water quality would be limited to short-term and localized changes associated with resuspension of bottom sediments from pile installation and barge and tug operations, such as anchoring and

propeller wash, as well as accidental losses or spills of construction debris into Hood Canal. These changes would be spatially limited to the construction corridor, including areas potentially impacted by anchor drag (see discussion of impacts to hydrography in Section 3.1.2.1), and areas immediately adjacent to the corridor (i.e., up to approximately 150 feet from the offshore edge of the construction corridor) that could be impacted by plumes of resuspended bottom sediments. Construction-related impacts would not violate applicable state or federal water quality standards.

3.2.2.1.1.1 STRATIFICATION, SALINITY, AND TEMPERATURE

Construction of Alternative 1 would not impact water temperature or salinity because construction activities would not discharge wastewaters other than stormwater runoff, in accordance with the SWPPP. In the absence of project-related discharges, construction of the EHW-2 would not alter stratification, salinity, or temperature in Hood Canal.

3.2.2.1.1.2 DISSOLVED OXYGEN

Construction of Alternative 1 would not discharge any wastes containing materials with an oxygen demand into Hood Canal. However, pile installation would resuspend bottom sediments, which may contain chemically reduced organic materials. Subsequent oxidation of sulfides, reduced iron, and organic matter associated with the suspended sediments would consume some DO in the water column. The amount of oxygen consumed would depend on the magnitude of the oxygen demand associated with suspended sediments (Jabusch et al. 2008). As discussed in Section 3.3.1.1, the organic carbon content of sediments at the EHW-2 project site is low (0.18 to 0.86 percent), and total sulfides concentrations are below 100 milligrams per kilogram (mg/kg). Therefore, the impacts of sediment resuspension from pile installation to DO concentrations would be minimal. Additionally, a bubble curtain or other noise attenuating device would be used as mitigation for in-water noise during some construction activities (see discussion of impacts to underwater noise in Section 3.4.2). The exact type of bubble curtain that would be used has not yet been determined. However, use of a traditional bubble curtain would increase DO concentrations in marine waters at the EHW-2 project site by (1) increasing the rate of vertical mixing of site waters and (2) promoting dissolution of air bubbles, thereby increasing oxygen saturation levels. The impact to DO from use of a bubble curtain would be relatively greater than that associated with sediment resuspension, and a net increase in DO levels would be expected. Use of a Type II confined bubble curtain would not increase DO concentrations in marine waters. Stormwater discharges would be controlled by a construction stormwater discharge permit and SWPPP. Consequently, discharges would not alter DO concentrations at the EHW-2 project site. Construction activities would not result in decreases in DO concentrations, cause changes that would violate water quality standards, or exacerbate low DO concentrations that occur seasonally in Hood Canal waters.

3.2.2.1.1.3 TURBIDITY

Installation of piles for the EHW-2 would resuspend bottom sediments within the immediate construction area, resulting in short-term and localized increases in suspended sediment concentrations that, in turn, would cause increases in turbidity levels. The suspended sediment/turbidity plumes would be generated periodically, in relation to the level of in-water construction activities, during the work window of July 16 to February 15, spanning 2 to 3 work seasons (see Section 2.2.2, Alternative 1). The installation of large piles proposed under this alternative would resuspend a higher proportion of bottom sediments than conventional piles. However, the time required for installation of the large piles would be shorter than for conventional piles, and sediments would be resuspended for a shorter duration.

The amount of bottom sediments that would be resuspended into the water column during pile placement, and the duration and spatial extent of the resulting suspended sediment/turbidity plume, would reflect the composition of the sediments. Surface sediments at the EHW-2 project site are coarse-grained, ranging from 82 to 100 percent sand and gravel in shallow areas (less than 40 feet MLLW), 94 to 100 percent sand and gravel in mid depth areas (40 to 60 feet MLLW), and 65 to 100 percent sand and gravel in deeper areas (greater than 60 feet MLLW) (Hammermeister and Hafner 2009). In general, these coarse-grained sediments that occur in most areas of the EHW-2 project site are more resistant to resuspension and have a faster settling speed than fine-grained sediments. Higher settling rates would result in a shorter water column residence time and a smaller horizontal displacement by local currents (Herbich and Brahme 1991; LaSalle et al. 1991; Herbich 2000).

The majority of piles would be installed in deeper water (greater than 60 feet MLLW) for construction of Alternative 1. Assuming that bottom sediments are disturbed during construction, and resuspended by two-thirds of the water column (a conservative assumption of 40 feet), the maximum water column residence of sand sized particles would be approximately 2 minutes. A sand particle settles through the water column at a velocity of approximately 0.3 foot/second. The water column residence time would be proportionately shorter in shallower waters. With a current velocity of 1 foot/second (see Section 3.1, Hydrography), the maximum dispersion distance would be approximately 130 feet (i.e., it would take 130 seconds for a sand particle to settle 40 feet through the water column, at which time the particle is being transported horizontally at a rate of 1 foot/second, resulting in horizontal displacement of 130 feet). Silt and clay particles associated with the offshore sediments that are resuspended during construction activities could have relatively longer water column residence times because they have slower settling speeds. Based on the size of sediment particles typical of the project site, the settling period for individual particles could be up to several hours depending on the water depth and initial distance above the bottom. Suspended silt- and clay-sized particles would form weak (low particle density) plumes, which would be subject to rapid dilution by currents and eventual flushing during subsequent tidal exchanges (Morris et al. 2008). Therefore, relatively greater dispersion of these fine-grained suspended sediments would occur.

For other project-related construction activities, such as spud use and barge anchoring, fine-grained particles resuspended from the bottom would be confined to the near-bottom depth layers by natural density stratification of the water column. The subsurface suspended sediment plume would disperse rapidly as a result of particle settling and current mixing. In most cases, suspended sediment/turbidity plumes would not be visible at the surface, with the possible exception of the shallow portions (water depths less than 20 feet) of the construction area (Hitchcock et al. 1999). Propeller wash impacts would be limited to shallower waters and would not be expected at the greater depths where the main wharf and warping wharf would be constructed. Stormwater discharges would be in accordance with a stormwater discharge permit and SWPPP, which would minimize the potential for discharges to affect turbidity levels at the EHW-2 project site.

As mentioned above in the discussion of DO, a bubble curtain could be used as mitigation for in-water noise during some construction activities, although the type of bubble curtain that could be used has not yet been determined. Type I (unconfined) bubble curtains involve use of pressurized air being injected from small holes in aluminum or PVC pipe from an air compressor located on the pile driving barge. Since the bottom ring is located on the soil/substrate/overburden, it is likely that bubbling action would increase turbidity in the vicinity.

Type II (confined) bubble curtains keep the bubbles "inside" a jacket (usually rigid or fabric), and thus the majority of suspended sediments as a result of the bubble curtain would be likewise confined. When the pile is driven, the curtain is removed; there would still be some residual plume, although less than the unconfined bubble curtain. Nevertheless, construction activities would not result in persistent increases in turbidity levels or cause changes that would violate water quality standards because processes that generate suspended sediments, which result in turbid conditions, would be short-term and localized, and suspended sediments would disperse and/or settle rapidly (within a period of minutes to hours) after construction activities cease.

3.2.2.1.1.4 NUTRIENTS

Construction activities would not result in the discharge of wastes containing nutrients. Because sediments at the EHW-2 project site do not contain high concentrations of nutrients, such as ammonia (Hammermeister and Hafner 2009), sediment resuspension during construction would not release nutrients to site waters in amounts that would violate water quality standards. Construction activities would not result in increases in nutrient levels or cause changes that would violate water quality standards.

3.2.2.1.1.5 FECAL COLIFORM BACTERIA

Construction activities would not impact bacteria (fecal indicator bacteria) levels because this alternative would not discharge untreated wastes or other materials containing bacteria. As mentioned in Section 3.2.1.5, levels of coliform bacteria in the Hood Canal waters near the EHW-2 project site generally are low and within the shellfish harvesting and recreation standard for fecal coliform. Consequently, bacterial levels in coarse-grained marine sediments at the EHW-2 project site also are expected to be low, and resuspension of sediments during construction activities would not release bacteria to site waters in amounts that would violate water quality standards. Stormwater discharges would be controlled in accordance with a stormwater discharge permit and SWPPP. Construction activities would not result in increases in bacteria levels or cause changes that would violate water quality standards.

3.2.2.1.1.6 pH

Construction activities would not impact the pH levels of local waters because this alternative would not discharge wastes at the EHW-2 project site. During construction, there is a potential for concrete to spill into Hood Canal, which could cause small, localized changes in pH levels. Measures to prevent concrete spillage, and clean up of any spilled material before or after it contacts site waters, would be addressed in the Debris Management Plan. Also, seawater has a high buffering capacity that minimizes the potential for substantial changes in pH in well-mixed marine settings (Jabusch et al. 2008). Stormwater discharges would be controlled in accordance with a stormwater discharge permit and SWPPP. Construction activities would not result in changes in pH that would violate water quality standards.

3.2.2.1.1.7 OTHER CONTAMINANTS

Another possible source of construction-related impacts to water quality would be accidental spills of debris, fuel, or other contaminants from barges or construction platforms into Hood Canal. Some types of construction debris such as wood scraps spilled into the water would be recovered and would have no impact, while other materials such as hydraulic fluids or fuel (marine diesel) may impact turbidity, pH, DO, or other water quality parameters in a localized area. Typically, spills are prevented by a number of measures, including containing and cleaning up materials leaked on the deck of work vessels, prohibiting washdown of materials into the

water, and prohibiting refueling in non-authorized areas. Generally, these types of spills are not anticipated to have a large impact to water quality because the spills would likely be small and the impact would be highly localized. The existing facility response and prevention plans for the Bangor waterfront (the *Commander Navy Region Northwest Oil and Hazardous Substance Integrated Contingency Plan* and the *NBK Bangor Spill Prevention, Control, and Countermeasure Plan* [COMNAVREGNWINST 5090.1, Integrated Contingency Plan, Annex G]) provide guidance that would be used in a spill response, such as a response procedures, notification, and communication plan; roles and responsibilities; and response equipment inventories. In the event of an accidental spill, response measures would be implemented immediately to minimize potential impacts to the surrounding environment.

The Navy would require the construction contractor to prepare and implement a Debris Management Plan with procedures for retrieving and cleaning up any debris spilled into Hood Canal. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups. Overall, construction activities associated with Alternative 1 would not cause any water quality standards to be violated.

3.2.2.1.2 OPERATION/LONG-TERM IMPACTS

Operation of Alternative 1 would not discharge wastes to Hood Canal. Stormwater runoff from the EHW-2 operations area rooftop would not require treatment and could discharge directly into Hood Canal since the rooftop would consist largely of inert materials and would not represent a source of substantial pollutant loadings to Hood Canal. Some of the materials used for the wharf structure would be galvanized metal, which can leach zinc that contributes to zinc loading in stormwater runoff (WDOE 2008a). However, this is not expected to affect water quality at the project site because most surfaces would consist of inert materials; thus, the magnitude of the zinc input from galvanized metals used in the EHW-2 structure would be minimal, and the project would implement stormwater BMPs and be operated in accordance with the NPDES permit.

Drainage water from the warping wharf, trestles, and upland areas would be collected, run through oil/water separators, released to a wetpond or other stormwater management facility designed to meet the basic treatment requirements of the WDOE Stormwater Management Manual for Western Washington, and then discharged to Hood Canal in accordance with an NPDES permit. Thus, operations would not intentionally release materials that would have a potential to impact marine water quality and WDOE stormwater standards would be maintained. Containment practices would be consistent with the existing NBK at Bangor waterfront structures, including the use of in-water containment booms and facility response plans, and would minimize the risk of spills during operations. However, changes to water quality from operations could occur as a result of accidental spills, such as a fuel or oil spill. The number and size of potential spills and releases of contaminants in general would not increase from the existing conditions, because the level of operations and number of ships involved would not increase from the existing conditions. Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components (no pile replacement) as required. Measures would be employed to avoid discharge of contaminants to the marine environment. These activities would not affect water quality.

3.2.2.1.2.1 STRATIFICATION, SALINITY, AND TEMPERATURE

Operations would not result in any discharges, other than treated stormwater, into local waters. Therefore, operations would not result in impacts to stratification, salinity, or temperature conditions or cause changes that would violate water quality standards.

3.2.2.1.2.2 DISSOLVED OXYGEN

Operations would not result in discharges with the potential for altering DO concentrations in waters near the EHW-2 project site. Therefore, operations would not result in impacts to DO conditions or cause changes that would violate water quality standards.

3.2.2.1.2.3 TURBIDITY

Vessel berthing activities associated with routine operations would occur at the berthing areas in water depths of 80 to 90 feet MLLW. Episodic sediment resuspension would not likely occur because propeller wash-induced turbulence at the surface would not reach the seafloor at those water depths. However, if sediment resuspension events did occur, the frequency and magnitude of these events would remain consistent with conditions at the existing EHW since there would not be an appreciable change in naval operations associated with the EHW-2.

3.2.2.1.2.4 NUTRIENTS

Operations would not affect nutrient concentrations in marine waters at the EHW-2 project site because wastewater discharges from vessels would be prohibited, similar to existing conditions. Instead, sewage and grey water wastes would be retained in holding tanks on vessels operating in the project area and eventually transferred via transmission lines on the wharf to the existing NBK at Bangor wastewater infrastructure. Therefore, operations would not result in impacts to nutrient levels or cause changes that would violate water quality standards.

3.2.2.1.2.5 FECAL COLIFORM BACTERIA

Operations would not affect fecal coliform bacteria levels in marine waters at the EHW-2 project site because wastewater discharges from vessels would be prohibited, similar to existing conditions. Instead, sewage and grey water wastes would be retained in holding tanks on vessels operating in the project area and eventually transferred via transmission lines on the wharf to the existing NBK at Bangor wastewater infrastructure. Therefore, operations would not result in impacts to bacteria levels or cause changes that would violate water quality standards.

3.2.2.1.2.6 pH

Operations would not result in discharges with the potential for impacting the pH of marine waters. Therefore, operations would not result in impacts to pH levels or cause changes that would violate water quality standards.

3.2.2.1.2.7 OTHER CONTAMINANTS

Operations would not increase the risk of accidental spills of fuel, explosives, cleaning solvents, and other contaminants that, if spilled, would impact water quality in Hood Canal. This is because no increases are currently anticipated in the number or types of ships served by the existing and EHW-2. The existing NBK at Bangor spill prevention and response plans would help ensure the avoidance of fuel spills. In the event of an accidental spill, emergency cleanup measures would be implemented immediately in accordance with state and federal regulations. The cleanup would minimize impacts to the surrounding environment. In addition, operation of the EHW-2 would not increase the mass loading of contaminants such as copper or zinc from

anti-fouling hull paints and cathodic protection (such as sacrificial anodes used to protect metals from corrosion) into the marine waters surrounding the EHW-2 because there would be no increase in the number of vessels using the existing and EHW-2. Therefore, operation of Alternative 1 would not violate water quality standards.

Placement of sacrificial aluminum anodes (for cathodic protection) on individual piles would represent a source for input of aluminum to Hood Canal waters. Aluminum anodes typically contain approximately 95 percent aluminum, 5 percent zinc, up to 0.001 percent mercury, and small amounts of silicon and iridium (USEPA 1999). As the anode is consumed (oxidized), aluminum and other trace constituents are released to surrounding waters. Based on modeling performed by USEPA (1999), the estimated flux of aluminum from an anode is 2.2×10^{-6} pounds of aluminum per pound of anode per hour. USEPA (1999) concluded that the resulting concentrations in seawater would be well below the federal and the most stringent state water quality criteria. Consequently, metal leaching from aluminum anodes placed on the wharf piles is not expected to impact water quality in the project area.

3.2.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.2.2.2.1 CONSTRUCTION

Impacts to marine water quality from in-water construction of Alternative 2 would be short-term, localized, and similar to those associated with Alternative 1. Construction activities would not impact water salinity, temperature, DO, nutrients, and pH. Construction would not increase fecal coliform bacteria levels and other contaminants in water. These parameters would remain in compliance with applicable water quality standards.

Alternative 2 would require a proportionately longer duration for in-water construction (275 to 550 days of pile driving) due to the higher number of piles compared to Alternative 1 (200 to 400 days of pile driving). Up to 1,460 piles are proposed for installation under Alternative 2, compared to 1,250 piles under Alternative 1. The additional piles would result in resuspension of bottom sediments (turbidity) within the immediate construction area for a longer duration compared to Alternative 1. Thus, the potential for water quality impacts during pile driving under Alternative 2 would be greater than for Alternative 1 because pile driving and in-water construction would occur over a longer duration under Alternative 2.

3.2.2.2.2 OPERATION/LONG-TERM IMPACTS

Impacts to water quality from operation of Alternative 2 would be the same as for Alternative 1. This alternative would not result in any direct discharges into Hood Canal or in activities that would have direct or indirect impacts to water quality. Maintenance of the EHW-2 under Alternative 2 would have the same water quality impacts as Alternative 1.

3.2.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.2.2.3.1 CONSTRUCTION

Impacts to marine water quality from in-water construction of Alternative 3 would be short-term, localized, and similar to those associated with Alternative 1. Construction activities would not impact water salinity, temperature, DO, nutrients, and pH. Construction would not increase fecal coliform bacteria levels and other contaminants in water. These parameters would remain in compliance with applicable water quality standards.

The entrance and exit trestles would be built separately. For the trestles and wharf combined, Alternative 3 would require up to 1,290 piles compared to 1,250 for Alternative 1. The pile driving days required under Alternative 3 (210 to 420 days of pile driving) would be similar to Alternative 1 (200 to 400 days of pile driving). The additional piles would be installed in water depths of -30 feet MLLW or less where 90 percent or more of sediments are composed of sand-sized particles (Hammermeister and Hafner 2009). The turbidity would be short-term and localized and suspended sediments would settle rapidly (within minutes to hours) after construction activities cease. Construction activities would not result in persistent increases in turbidity levels or cause changes that would violate water quality standards.

3.2.2.3.2 OPERATION/LONG-TERM IMPACTS

Impacts to water quality from operations of Alternative 3 would be the same as for Alternative 1. This alternative would not result in any direct discharges into Hood Canal or in activities that would have direct or indirect impacts to water quality. Maintenance of the EHW-2 under Alternative 3 would have the same water quality impacts as Alternative 1.

3.2.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.2.2.4.1 CONSTRUCTION

Impacts to marine water quality from in-water construction of Alternative 4 would be short-term, localized, and similar to those associated with Alternative 1. Construction activities would not impact water salinity, temperature, DO, nutrients, and pH. Construction would not increase fecal coliform bacteria levels and other contaminants in water. These parameters would remain in compliance with applicable water quality standards.

Alternative 4 would require the greatest number of piles (up to 1,500) and longest duration of pile driving (290 to 570 days) of all alternatives to support construction of separate trestles and the wharf. By comparison, Alternative 1 would require 200 to 400 days of pile driving. Thus, resuspension of bottom sediments (turbidity) within the wharf construction area would occur for a longer duration. The potential for water quality impacts would be greater under Alternative 4 than for Alternative 1 because the duration of pile driving and in-water construction would be comparatively longer.

3.2.2.4.2 OPERATION/LONG-TERM IMPACTS

Impacts to water quality from operations of Alternative 4 would be the same as for Alternative 1. This alternative would not result in any direct discharges into Hood Canal or in activities that would have direct or indirect impacts to water quality. Maintenance of the EHW-2 under Alternative 4 would have the same water quality impacts as Alternative 1.

3.2.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.2.2.5.1 CONSTRUCTION

Alternative 5 would require fewer piles for the wharf than the other alternatives. Up to 440 piles would be installed for the wharf to support the lightning towers and mooring dolphins. By comparison, Alternative 1 requires up to 1,250 piles for wharf construction. Therefore, the potential for construction-related impacts to water quality for Alternative 5 would be limited to short-term and localized changes and would be much less and of shorter duration than for

Alternative 1. Alternative 5 would require 130 to 175 days for pile driving compared to 200 to 400 pile driving days for Alternative 1. Construction activities for Alternative 5 would not impact water salinity, temperature, DO, nutrients, and pH. Construction would not increase fecal coliform bacteria levels and other contaminants in water. These parameters would remain in compliance with applicable water quality standards.

The combined access trestle would be used for this alternative and sediment resuspension (turbidity levels) during trestle construction would be similar to those described for Alternative 1. Sediment resuspension in the wharf construction area would be of much shorter duration than Alternative 1. Construction activities would not result in persistent increases in turbidity levels or cause changes that would violate water quality standards.

3.2.2.5.2 OPERATION/LONG-TERM IMPACTS

Impacts to water quality from operations of Alternative 5 would be the same as for as for Alternative 1. This alternative would not result in any direct discharges into Hood Canal or in activities that would have direct or indirect impacts to water quality. Maintenance of the EHW-2 under Alternative 5 would have the same water quality impacts as Alternative 1.

3.2.2.6 No-Action Alternative

The EHW-2 would not be built under the No-Action Alternative and overall operations would not change from current levels, so water quality would not be impacted.

3.2.2.7 Mitigation Measures and Regulatory Compliance

Because impacts to water quality from construction and operation of the EHW-2 would not violate water quality standards, no mitigation measures are necessary beyond the current practices and BMPs described in the preceding sections:

- The construction contractor will be required to prepare and implement a spill response plan (e.g., an SPCC Plan).
- Areas of in-water and above-water work will be surrounded by floating barriers (combined debris barrier and oil absorbent booms).
- The Navy will require the construction contractor to prepare and implement a Debris Management Plan with procedures for retrieving and cleaning up any accidental spills.
- During operation of the EHW-2 facilities, stormwater will be discharged to Hood Canal in accordance with the conditions of the stormwater discharge permit.

Stormwater discharges during project construction will be in accordance with the EPA general construction stormwater discharge permit. Operation of the EHW-2 will be in compliance with state water quality standards, including the industrial stormwater permit. The Navy has submitted a JARPA to USACE and WDOE requesting a permit under CWA Section 404 and a Section 401 water quality certification. The Navy will submit an application to USEPA for coverage under the Construction General Permit in compliance with CWA Section 402. Construction and operation of the EHW-2 will be in compliance with the Energy Independence and Security Act of 2007 with respect to maintenance of existing marine water quality. In accordance with the CZMA, the Navy submitted a Phase I CCD to WDOE and WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will submit a Phase II CCD in spring 2012.

3.2.3 Summary of Impacts

Impacts to water quality associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.2–3.

Table 3.2–3. Summary of Impacts to Water Quality

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO WATER QUALITY
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction*: Project construction activities could result in temporary and localized changes in water quality associated with resuspension of bottom sediments (increased suspended sediment concentrations and turbidity levels), stormwater discharges (contaminant loading), and spills (contaminant releases), but conditions are not expected to exceed water quality standards. In-water pile driving would last between 200 and 400 days, and construction would occur over 42 to 48 months including 2 to 3 in-water work seasons. *Operation/Long-term Impacts*: Project operations could result in temporary and localized changes to water quality associated with stormwater discharges or leaks/spills of fuels or other materials. However, these are not expected to result in conditions that would exceed permit limits or water quality standards.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction*: Project construction activities could result in temporary and localized changes in water quality associated with resuspension of bottom sediments (increased suspended sediment concentrations and turbidity levels), stormwater discharges (contaminant loading), and spills (contaminant releases), but conditions are not expected to exceed water quality standards. Impacts from Alternative 2 would be greater than for Alternative 1 due to the longer duration of in-water pile driving (275 to 550 vs. 200 to 400 days) and longer construction duration (54 to 64 vs. 42 to 48 months). *Operation/Long-term Impacts*: Project operations could result in temporary and localized changes to water quality associated with stormwater discharges or leaks/spills of fuels or other materials. However, these are not expected to result in conditions that would exceed permit limits or water quality standards.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction*: Project construction activities could result in temporary and localized changes in water quality associated with resuspension of bottom sediments (increased suspended sediment concentrations and turbidity levels), stormwater discharges (contaminant loading), and spills (contaminant releases), but conditions are not expected to exceed water quality standards. Impacts from Alternative 3 would be similar to those for Alternative 1 due to the similar duration of in-water pile driving (210 to 420 vs. 200 to 400 days) and similar construction duration (42 to 49 vs. 42 to 48 months). *Operation/Long-term Impacts*: Project operations could result in temporary and localized changes to water quality associated with stormwater discharges or leaks/spills of fuels or other materials. However, these are not expected to result in conditions that would exceed permit limits or water quality standards.

Table 3.2–3. Summary of Impacts to Water Quality (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO WATER QUALITY
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction*: Project construction activities could result in temporary and localized changes in water quality associated with resuspension of bottom sediments (increased suspended sediment concentrations and turbidity levels), stormwater discharges (contaminant loading), and spills (contaminant releases), but conditions are not expected to exceed water quality standards. Impacts from Alternative 4 would be greater than for Alternative 1 due to the longer duration of in-water pile driving (290 to 570 vs. 200 to 400 days) and longer construction duration (54 to 64 vs. 42 to 48 months). *Operation/Long-term Impacts*: Project operations could result in temporary and localized changes to water quality associated with stormwater discharges or leaks/spills of fuels or other materials. However, these are not expected to result in conditions that would exceed permit limits or water quality standards.
Alternative 5: Combined Trestle, Floating Wharf	*Construction*: Project construction activities could result in temporary and localized changes in water quality associated with resuspension of bottom sediments (increased suspended sediment concentrations and turbidity levels), stormwater discharges (contaminant loading), and spills (contaminant releases), but conditions are not expected to exceed water quality standards. Impacts from Alternative 5 would be less than those for Alternative 1 due to the shorter duration of in-water pile driving (135 to 175 days vs. 200 to 400 days for Alternative 1) and slightly shorter construction duration (42 to 44 vs. 42 to 48 months). *Operation/Long-term Impacts*: Project operations could result in temporary and localized changes to water quality associated with stormwater discharges or leaks/spills of fuels or other materials. However, these are not expected to result in conditions that would exceed permit limits or water quality standards.
No-Action Alternative	No impact.
Mitigation • No mitigation measures are necessary beyond the proposed current practices and BMPs.	
Consultation and Permit Status • The Navy has submitted a JARPA to USACE and WDOE requesting a permit under CWA Section 404 and a Section 401 water quality certification. • The Navy will submit an application to USEPA for coverage under the Construction General Permit in compliance with CWA Section 402. • The Navy has submitted a Phase I CCD to WDOE and WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD.	

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3.3 SEDIMENT

Sediment quality focuses on the physical and chemical properties of bottom sediments. Physical parameters include grain size, which is a quantitative description of the proportions of gravel, sand, silt, and clay-sized particles and the dominant size classes for the sediment matrix. Sediment quality also considers concentrations of total organic carbon, as well as the concentrations of trace constituents, including metals, petroleum-derived hydrocarbons, and chlorinated organic compounds, that may reflect a combination of natural and human-derived sources. The combination of sediment texture (grain size), organic content, and contaminant levels affect the suitability of the sediments as habitat for marine organisms and other beneficial uses.

The Washington State Sediment Management Standards (SMS) (WAC 173-204) provide the framework for the long-term management of marine sediment quality in Washington State. The purpose of the SMS is to reduce and ultimately eliminate adverse biological impacts and threats to human health from sediment contamination. The SMS establishes standards for the quality of sediments as the basis for management and reduction of pollutant discharges by providing a management and decision-making process for contaminated sediments.

The marine SQS established by the SMS include numeric criteria using bulk contaminant concentrations and biological impacts criteria based on sediment bioassays that define the lower limit of sediment quality expected to cause no adverse impacts on biological resources in Puget Sound. The SMS Cleanup Screening Levels (CSL) consist of numeric chemical concentration and biological impacts criteria that represent cleanup thresholds. Bulk sediment concentrations between the SQS and CSL values require further investigation to determine whether actual adverse impacts exist at the site due to contaminated sediments.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also commonly known as Superfund, was enacted to address hazardous waste sites. The law has subsequently been amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and is implemented by the National Oil and Hazardous Substances Contingency Plan (NCP). CERCLA is administered by the USEPA and provides for site identification and listing on the National Priorities List (NPL). Sites on NBK at Bangor have been listed on the NPL because of contamination associated with a number of hazardous waste sites at the base. Under Executive Order (EO) 12580, the Navy is the lead agency for investigation and cleanup of contaminated sites on NBK at Bangor. Investigations were conducted from 1988 to 1994 in Site 26, Hood Canal Sediments, which was part of Operable Unit (OU) 7. In January 1990, the Navy, USEPA, and WDOE entered into a Federal Facilities Agreement for the study and cleanup of possible contamination on NBK at Bangor. Subsequently, WDOE was designated as the lead regulatory agency for contaminated sites on NBK at Bangor. The Navy was monitoring sediment quality at Site 26. As of 2005, all required actions for Site 26 have been completed. WDOE concurred that there was no increasing trend of contaminants of concern and additional sampling was not needed (Madakor 2005).

As discussed in Section 3.20, Coastal and Shoreline Management, the CZMA requires that federal actions that have reasonably foreseeable effects on coastal users or resources must be consistent to the maximum extent practicable with the enforceable policies of approved state coastal management programs. Activities and development impacting coastal resources that involve the federal government are evaluated through a process called federal consistency, in which the proponent agency is required to prepare a CCD for concurrence from the affected state.

Consultation and Permit Compliance Status. In accordance with the CZMA, the Navy submitted a Phase I CCD to WDOE (included in Appendix I of this FEIS). WDOE concurred with the Phase I CCD on August 26, 2011 (included in Appendix I of this FEIS). The Navy will prepare and submit a Phase II CCD in spring 2012.

3.3.1 Existing Environment

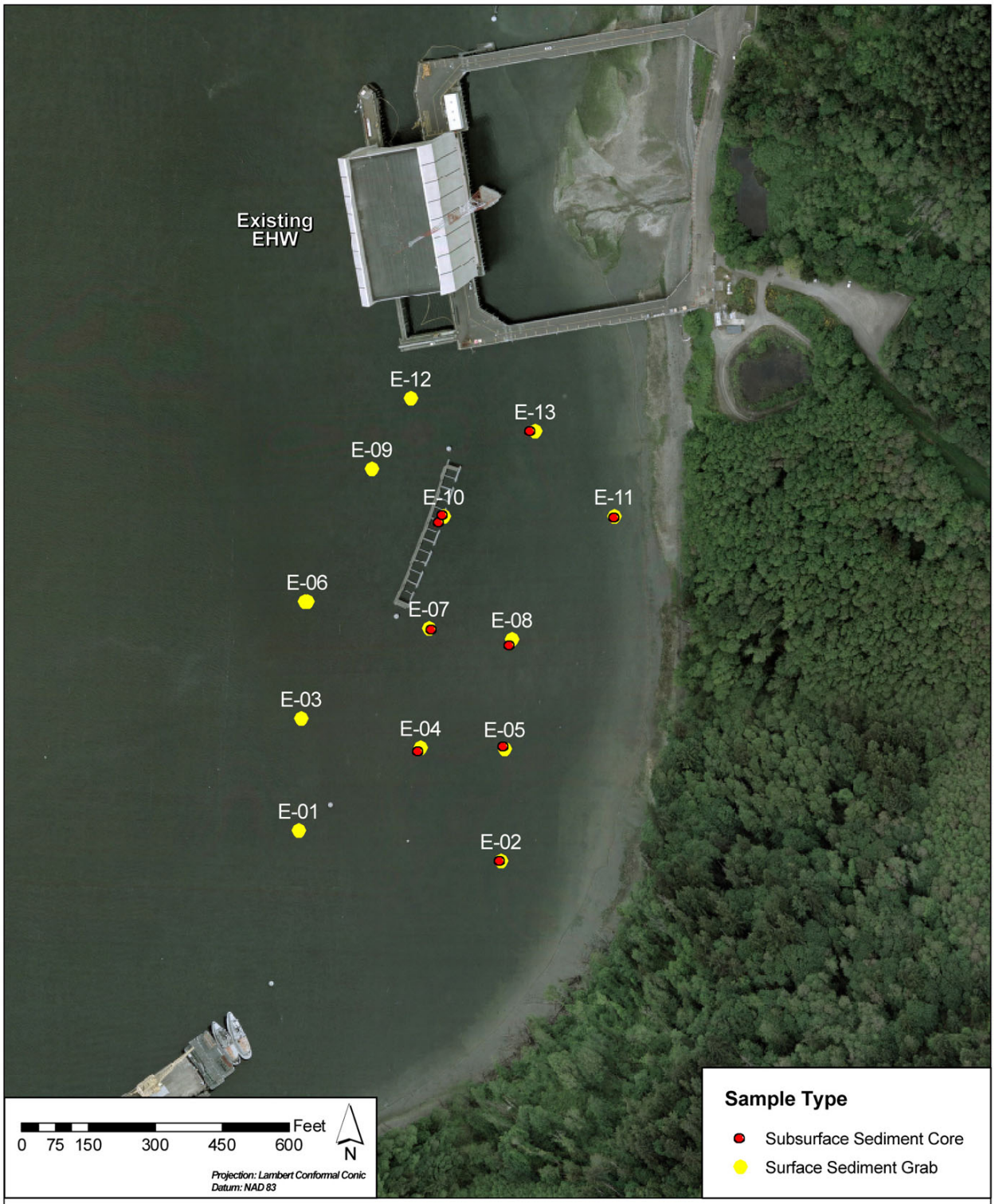
Sediment supply, distribution, deposition and erosion rates, grain size, organic content, and chemistry are all critical factors that determine the presence or absence of marine plants and animals at specific locations. Existing sediment information is based on results from sampling at the EHW-2 project site during 2007 (Hammermeister and Hafner 2009); sampling locations are shown in Figure 3.3–1. Sediment quality at the project site is generally good; levels of contaminants meet applicable state standards.

The primary sources of sediment along the east shore of Hood Canal are natural erosion (by wind and waves) of bluffs; no river systems or large watersheds occur along the east shore. Other contributions come from the numerous small drainages along the waterfront. The primary mechanism for sediment transport from eroding bluffs to the waterfront is littoral drift or shore drift. Drift results primarily from the oblique approach of wind-generated waves and can therefore change in response to short-term (daily, weekly, or seasonal) shifts in wind direction. Over the long term, however, many shorelines exhibit a single direction of net shore drift, determined through geomorphologic analysis of beach sediment patterns and of coastal landforms (WDOE 2009b). The Bangor waterfront has net northerly shore drift (WDOE 1991).

Other constructed features (e.g., wharves, piers, dolphins, floats, ramps, and groins) alter sediment transport and deposition by decreasing water velocity, resulting in sedimentation along one side of an obstruction. Offshore structures that alter wave energy (such as breakwaters, floats, and moored vessels) reduce erosion along the shore and allow drift sediment to accumulate. The change in sediment distribution at piers and groins creates patches of coarse-grained sediment adjacent to patches of fine-grained sediment and a sediment-depleted beach on the opposite side of the obstruction. As natural wave and current action gradually move fine sediment from intertidal elevations to subtidal elevations, the upper intertidal substrate gradually coarsens and its slope steepens without new sources of sediment to replace the finer material (Downing 1983).

3.3.1.1 Physical and Chemical Properties of Sediments

Marine sediments are composed of gravelly sands with some cobbles in the intertidal zone, transitioning to silty sands in the subtidal zone (Hammermeister and Hafner 2009). Subsurface coring studies conducted in 1994 found the presence of glacial till approximately 6 feet below mud line in the intertidal zone, increasing to over 10 feet in the subtidal zone (URS 1994). The composition of sediment samples from the EHW-2 project site ranged from 65 to 100 percent for sand, less than 1 to 7 percent for gravel, 2 to 32 percent for silt, and 2 to 11 percent for clay (Table 3.3–1).



Source: Hammermeister and Hafner 2009

Figure 3.3–1. Sediment Sampling Locations

Table 3.3–1. Physical and Chemical Characteristics of Surface Sediments at the EHW-2 Project Site

PARAMETER	SEDIMENT QUALITY STANDARDS (SQS)	CLEANUP SCREENING LEVELS (CSL)	EHW-2 SITE[1] (MINIMUM – MAXIMUM VALUES)
Conventionals			
Total Organic Carbon (TOC) (%)	—	—	0.2 – 0.9
Total Volatile Solids (%)	—	—	1.4 – 3.4
Total Solids (%)	—	—	57.8 – 75.7
Ammonia (mg-N/kg)	—	—	1.3 – 6.2
Total Sulfides (mg/kg)	—	—	ND – 82.6
Grain Size			
Percent Gravel (>2.0mm)	—	—	<0.1 – 6.9
Percent Sand (<2.0mm – 0.06mm)	—	—	64.6 – 100
Percent Silt (0.06mm – 0.004mm)	—	—	2.0 – 32.1
Percent Fines (<0.06mm)	—	—	4.6 – 41.2
Percent Clay (<0.004mm)	—	—	2.3 – 11.3
Metals (mg/kg)			
Antimony	—	—	<0.1
Arsenic	57	93	1.1 – 3.5
Cadmium	5.1	6.7	<0.1 – 0.3
Chromium	260	270	13.4 – 26.6
Copper	390	390	5.8 – 21.6
Lead	450	530	2.2 – 6.5
Mercury	0.41	0.59	ND – <0.1
Nickel	—	—	13.2 – 28.2
Selenium	—	—	ND – 0.4
Silver	6.1	6.1	<0.1
Zinc	410	960	21.8 – 47.2
Butyltins (µg/kg)			
Di-n-butyltin	—	—	ND – 13.0
Tri-n-butyltin	—	—	ND – 7.5
Tetra-n-butyltin	—	—	ND
n-butyltin	—	—	ND – 0.9
Low Molecular Weight Polycyclic Aromatic Hydrocarbons (LPAH) (mg/kg TOC)			
Naphthalene	99	170	ND
Acenaphthylene	66	66	ND
Acenaphthene	16	57	ND – 1.5
Fluorene	23	79	ND – 1.4
Phenanthrene	100	480	1.0 – 10.0
Anthracene	220	1200	ND – 1.4
2-Methylnaphthalene	38	64	ND
Total LPAH[2]	370	780	0.7 – 14.3

Table 3.3–1. Physical and Chemical Characteristics of Surface Sediments at the EHW-2 Project Site (continued)

PARAMETER	SEDIMENT QUALITY STANDARDS (SQS)	CLEANUP SCREENING LEVELS (CSL)	EHW-2 SITE[1] (MINIMUM – MAXIMUM VALUES)
High Molecular Weight Polycyclic Aromatic Hydrocarbons (HPAH) (mg/kg TOC)			
Fluoranthene	160	1200	1.1 – 10.0
Pyrene	1000	1400	1.0 – 9.6
Benz(a)anthracene	110	270	ND – 3.7
Chrysene	110	460	ND – 8.2
Benzofluoranthenes[3]	230	450	ND – 6.7
Benzo(a)pyrene	99	210	ND – 3.1
Indeno(1,2,3-cd)pyrene	34	88	ND – 2.3
Dibenz(a,h)anthracene	12	33	ND
Benzo(g,h,i)perylene	31	78	ND – 2.3
Total HPAH[4]	960	5300	2.2 – 48.8
Chlorinated Aromatics (mg/kg TOC)			
1,3-Dichlorobenzene	—	—	ND
1,2-Dichlorobenzene	2.3	2.3	ND
1,4-Dichlorobenzene	3.1	9	ND
1,2,4-Trichlorobenzene	0.81	1.8	ND
Hexachlorobenzene	0.38	2.3	ND
Phthalate Esters (mg/kg TOC)			
Dimethylphthalate	53	53	ND
Diethylphthalate	61	110	ND – 5.7
Di-n-Butylphthalate	220	1700	3.5 – 26.1
Butylbenzylphthalate	4.9	64	ND – 2.1
bis(2-Ethylhexyl)phthalate	47	78	ND – 8.3
Di-n-Octylphthalate	58	4500	ND
Phenols (µg/kg dw)			
Phenol	420	1200	14.0 – 53.0
2-Methylphenol	63	63	ND
4-Methylphenol	670	670	ND – 23.0
2,4-Dimethylphenol	29	29	ND
Pentachlorophenol	360	690	ND
Misc. Extractables (mg/kg TOC)			
Benzyl Alcohol	57	73	ND
Benzoic Acid	650	650	ND
Dibenzofuran	15	58	ND – 10.4
Hexachloroethane	—	—	ND
Hexachlorobutadiene	3.9	6.2	ND
N-Nitrosodiphenylamine	28	130	ND

Table 3.3–1. Physical and Chemical Characteristics of Surface Sediments at the EHW-2 Project Site (continued)

PARAMETER	SEDIMENT QUALITY STANDARDS (SQS)	CLEANUP SCREENING LEVELS (CSL)	EHW-2 SITE[1] (MINIMUM – MAXIMUM VALUES)
Pesticides and PCBs (mg/kg TOC)			
Total DDT[5]	—	—	ND
Aldrin	—	—	ND
alpha-Chlordane	—	—	ND
Dieldrin	—	—	ND
Heptachlor	—	—	ND
gamma-BHC (Lindane)	—	—	ND
Total PCBs[6]	12	65	ND

Source: SQS and CSL from WAC 173-204-320(b), EHW sample data are from Hammermeister and Hafner (2009).

— = No sediment quality standard or screening levels exist; mm = millimeter; dw = dry weight; ND = not detected; PCB = polychlorinated biphenyl; mg/kg = milligrams per kilogram; µg/kg = micrograms per kilogram.

1. Samples taken at depths from 0–10 cm. Values represent the ranges for samples from 13 locations near the EHW-2 project site.
2. Sum of LPAH results for naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. LPAH does not include 2-methylnaphthalene.
3. Sum of benzo(b)fluoranthene and benzo(k)fluoranthene.
4. Sum of HPAH results for fluoranthene, pyrene, benz(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
5. Sum of 4,4'-DDD, 4-4'-DDE, and 4-4'-DDT.
6. Sum of Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260.

Sediment parameters (such as total organic carbon [TOC], metals, and organic contaminants) were used to characterize sediment quality. TOC, which provides a measure of how much organic matter occurs in the sediments, was less than 1 percent at the EHW-2 project site (Table 3.3–1). A range of 0.5 to 3 percent is typical for Puget Sound marine sediments, particularly those in the main basin and in the central portions of urban bays (Puget Sound Water Quality Action Team and Puget Sound Estuary Program 1997). Total sulfide concentrations range from not detected (ND) (i.e., below the detection limit of 0.4 milligrams per kilogram [mg/kg]) to 82.6 mg/kg. Ammonia concentrations range from 1.3 to 6.2 mg/kg. There are no SQS for TOC, sulfides, or ammonia concentrations.

3.3.1.2 Metals

Table 3.3–1 shows the concentrations of metals in sediments at the EHW-2 project site based on sampling conducted by Hammermeister and Hafner (2009). These concentrations are comparable to background levels for Puget Sound and below sediment quality guidelines (e.g., SQS values and CSL values). For example, cadmium concentrations ranged from less than 0.1 to 0.3 mg/kg, which were below the standards of 5.1 and 6.7 mg/kg for SQS and CSL, respectively.

3.3.1.3 Organic Contaminants

The primary source of organotin (butyltin) compounds in marine sediments is residues from anti-fouling paints applied to vessel hulls (Danish EPA 1999). Use of organotins in anti-fouling paints for ships less than 25 meters in length and non-aluminum hulls was banned in 1988 by the Organotin Anti-Fouling Paint Control Act. Sediments at the EHW-2 project site contain

tri-n-butyltin concentrations up to 7.5 micrograms per kilogram (µg/kg) or 870 µg/kg TOC (organic carbon normalized value) (Table 3.3–1). While there is no existing sediment quality standard for organotins, Meador et al. (2002) proposed a threshold value of 6,000 µg/kg TOC for tributyltin in sediments as protective of juvenile salmonids. Concentrations in sediments near the EHW-2 project site are below this threshold.

Concentrations of individual polycyclic aromatic hydrocarbon (PAH) compounds in sediments near the EHW-2 project site varied from ND to 10 mg/kg TOC (Table 3.3–1). Concentrations of individual PAH compounds, as well as the summed concentrations (i.e., total low molecular weight PAHs and total high molecular weight PAHs) were below the corresponding SQS and CSL values.

Concentrations of other classes of organic contaminants, such as chlorinated aromatics, phthalate esters, phenols, and other miscellaneous extractable compounds, typically were at or below the analytical detection limits and consistently below the SQS and CSL values.

3.3.2 Environmental Consequences

The evaluation of impacts to marine sediments considers whether project-related construction and operation activities create conditions, such as sediment contaminant concentrations or physical changes, that violate state standards or interfere with beneficial uses of the water body. Applicable standards that are the basis for determinations of environmental consequences are discussed in the introduction to Section 3.3.

Construction would result in disturbance of bottom sediments through pile installation and anchoring of barges and vessels, which would affect physical characteristics of the sediments such as grain size. Impacts to sediment contaminant levels are unlikely. The presence of the EHW-2 structure would cause accretion of sediments in shallow nearshore areas protected by the EHW-2, with associated increases in the proportions of fine-grained sediments in these localized areas. Installation of the trestle abutment and associated armor rock would not affect marine sediments because the structure would be installed from land and it would not extend beyond the shoreline (i.e., into the waters of Hood Canal). In general, construction and operation of project components in the upland portion of the project site, new buildings, utilities, the pure water facility, and other infrastructure, would not directly alter or impact marine sediment quality. Potential indirect impacts to marine sediments from contaminant loading associated with construction and operations of project elements in the upland portion of the site would be minimized through implementation of stormwater management measures (BMPs for managing stormwater runoff and erosion of site soils are discussed in Section 3.11, Geology and Soils).

3.3.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.3.2.1.1 CONSTRUCTION

No in-water dredging or placement of fill would occur under Alternative 1. There would be no direct discharges of wastes, other than stormwater runoff, to the marine environment during construction. Stormwater discharges would meet the requirements of a construction stormwater discharge permit. Therefore, construction-related impacts to sediment quality would be limited to localized changes associated with disturbances of bottom sediments from installation of up to 1,250 piles over 200 to 400 days, and from accidental losses or spills of construction debris into Hood Canal. Setting spuds and anchors for the barges, and propeller wash from tugs used to

construct the facilities, represent other, construction-related sources for disturbances of bottom sediments. Measures would be implemented to avoid underwater anchor drag and line drag (see Appendix F, Mitigation Action Plan).

Another possible source for construction-related impacts to sediments would be from accidental debris spills from barges or construction platforms into Hood Canal. Debris spills could impact bottom sediments and create nuisance conditions by adding materials that could represent obstructions. The construction contractor would be required to retrieve and clean up any accidental spills as a current practice in accordance with the Debris Management Plan that would be developed and implemented per the Mitigation Action Plan (Appendix F). Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups.

Construction-related changes to sediment quality would be spatially limited to the construction corridor, including areas potentially impacted by anchor drag (see discussion of impacts to hydrography in Section 3.1.2.1).

3.3.2.1.1.1 Physical Properties of Sediments

Some degree of localized changes in sediment composition would occur as a result of in-water construction activities. In particular, sediments that are resuspended by pile installation and anchoring activities would be dispersed by currents and eventually redeposited on the bottom (Barnard 1978; Hitchcock et al. 1999). Depending on the distance suspended sediments are transported before settling on the bottom, this process could result in minor changes to sediment texture (grain size characteristics), particularly if coarse-grained sediments are transported from shallow to deeper portions of the EHW-2 project site or fine-grained sediments are transported from deeper to shallower areas. The distance over which suspended sediments are dispersed would depend on a number of factors, such as the sediment characteristics, current speeds, and distance above the bottom.

In general, coarse-grained sediments (e.g., sands and gravels) that occur in the majority of areas of the EHW-2 project site would be more resistant to resuspension, have a higher settling speed and lower water column residence time, and a smaller horizontal displacement by local currents. Surface sediments at the EHW-2 project site range from 82 to 100 percent sand and gravel in shallow areas (less than 40 feet MLLW), 94 to 100 percent sand and gravel in mid depth areas (40 to 60 feet MLLW), and 65 to 100 percent sand and gravel in deeper areas (greater than 60 feet MLLW) (Hammermeister and Hafner 2009). The majority of piles under Alternative 1 would be installed in deeper water. Assuming that bottom sediments are disturbed during construction, and resuspended by two-thirds of the water column (a conservative assumption of 40 feet), the maximum dispersion distance would be approximately 130 feet, assuming a horizontal current velocity of 1 foot/second (see Section 3.1, Hydrography) and particle settling velocity of 0.3 foot/second (settling speed for a sand particle). It would take 130 seconds for a sand particle to settle 40 feet through the water column, at which time the particle is being transported horizontally at a rate of 1 foot/second, resulting in horizontal displacement of 130 feet which would fall within the disturbance area of 25.7 acres for Alternative 1.

Silt and clay particles would be dispersed over relatively larger distances (greater than 150 feet) because they have slower settling speeds; however, because these resuspended fines represent a small proportion of sediments, they would probably not result in appreciable changes

in the physical composition of bottom sediments as they settle. In water depths greater than about 60 feet, where the proportions of fine-grained sediments are higher than in the shallower, nearshore environment of the EHW-2 project site, relatively greater dispersion of these sediments would be expected. Rapid dilution and dispersion would minimize the potential for fine-grained sediments to settle and accumulate within sensitive habitat areas near the project site, such as nearshore eelgrass beds.

During construction, there is a potential for concrete to spill into Hood Canal, which could cause small, localized changes in pH levels and physical properties of sediments such as grain size. Measures to prevent concrete spillage, and clean up of any spilled material before or after it contacts site waters, would be addressed in the Debris Management Plan.

3.3.2.1.1.2 METALS

Construction activities would not result in the discharge of wastes containing metals or otherwise alter the concentrations of trace metals in bottom sediments. However, because the magnitude of metal concentrations in sediment can vary as a function of grain size (higher concentrations typically are associated with fine-grained sediments) (Schiff and Weisberg 1999), small changes to grain size associated with construction-related disturbances to bottom sediments could result in minor changes in metal concentrations. However, these changes would not cause chemical constituents to violate SQS because current sediment concentrations are below the SQS and the project-related changes are expected to be minimal.

3.3.2.1.1.3 ORGANIC CONTAMINANTS

Construction activities would not result in the discharge of contaminants or otherwise alter the concentrations of organic contaminants in bottom sediments. Similar to metal concentrations (discussed above), construction would not impact sediment quality with the exception of minor changes in the concentrations of organic compounds that would result from changes in grain size. These changes would not cause chemical constituents to violate SQS because current sediment concentrations are below the SQS and the project-related changes are expected to be minimal.

Accidental fuel spills or releases of other materials (e.g., hydraulic fluids) to Hood Canal could add contaminants (petroleum hydrocarbons) that could also impact sediment quality. However, as explained for impacts to water quality in Section 3.2.2.1, the spill cleanup response would minimize impacts to the surrounding environment.

3.3.2.1.2 OPERATION/LONG-TERM IMPACTS

Operation of Alternative 1 would not discharge any wastes, other than treated stormwater, or increase contaminant loadings from vessels or the frequency or size of possible spills into Hood Canal that would affect marine sediment quality. Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components (no pile replacement) as required. Measures would be employed to avoid discharges of contaminants to the marine environment. These activities would not affect sediment quality.

3.3.2.1.2.1 PHYSICAL PROPERTIES OF SEDIMENTS

The support piles installed for the EHW-2 would alter current speeds beneath the wharf and trestles, which would cause both erosion of fine-grained sediments near some piles impacted by turbulent flows and settling and accumulation of fine-grained sediments at the base of other piles (see discussion of impacts to hydrography in Section 3.1.2.1). Shells and decaying organic

matter from animals would slough from the wharf and trestle piles and accumulate on the bottom, contributing to localized changes in sediment grain size immediately adjacent to the piles (Hanson et al. 2003). Because fine-grained sediments have a greater affinity for some metal and organic contaminants from both local and regional sources, the spatial distribution of contaminants in bottom sediments may change relative to existing distributions. Specifically, the fine-grained sediments trapped by the wharf or trestle piles could have higher contaminant concentrations compared to the coarse-grained sediments that presently occur at the site. However, these changes would only be expected immediately adjacent to the pile and would not extend beyond the footprint of the EHW-2.

The reduction in wave energy caused by the presence of the EHW-2 would result in accumulation of sediments, and a change to finer grained sediments, along the shoreline inshore of the new structure (see discussion of impacts to hydrography in Section 3.1.2.1).

3.3.2.1.2.2 METALS

Operation of Alternative 1 would not result in the discharge of contaminants that would alter the concentrations of trace metal in bottom sediments. The use of aluminum sacrificial anodes on individual piles would result in release of aluminum and other trace constituents to the surrounding water. However, as discussed in Section 3.2.2.1.2.7, the resulting concentrations in seawater would be well below the federal and the most stringent state water quality criteria and would therefore also not affect the sediments. Therefore, no chemical constituents would violate SQS.

3.3.2.1.2.3 ORGANIC CONTAMINANTS

Operation of Alternative 1 would not result in the discharge of organic contaminants or otherwise alter the concentrations of organic contaminants in bottom sediments. Therefore, no chemical constituents would violate SQS.

Operation of Alternative 1 would not increase the risk of accidental spills of fuel, explosives, cleaning solvents, and other contaminants that, if spilled, would impact sediment quality in Hood Canal. No changes are currently anticipated in the number or types of vessels at the Bangor waterfront as a result of construction of the EHW-2. As discussed in Section 3.2.2.1, in the event of an accidental spill, emergency cleanup measures would be implemented immediately, and the spill response would minimize impacts to the surrounding environment. In addition, operations would not increase the mass loading of contaminants such as copper or zinc from anti-fouling hull paints and sacrificial anodes to marine sediments at the EHW-2 project site because there would be no increase in the number of vessels using the Bangor waterfront as a result of construction of the EHW-2.

3.3.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.3.2.2.1 CONSTRUCTION

Impacts to marine sediment quality from in-water construction of Alternative 2 would be short-term, localized, and similar to or slightly greater than those associated with Alternative 1 due to the longer duration of pile driving and in-water construction. Construction activities would not result in the discharge of metals or organic contaminants that would alter the concentrations in bottom sediments. Sediment resuspension from pile installation would occur over a longer duration (275 to 550 days) than Alternative 1 (200 to 400 days) and result in a greater degree of localized changes in sediment composition within the potential disturbance area of 25.7 acres.

However, as described in Alternative 1, surface sediments in the EHW-2 project site are composed mostly of sand, and these coarse grained resuspended sediments would be expected to settle within the potential disturbance area even over a longer duration.

While the fine-grained (silt and clay) particles would be dispersed over relatively large distances following resuspension, the fraction of surface sediments is small. Thus, the physical composition of bottom sediments is not likely to change appreciably when the fine particles settle to the bottom. In water depths greater than about 60 feet, relatively greater dispersion of these fine-grained sediments would be expected.

3.3.2.2.2 OPERATION/LONG-TERM IMPACTS

Impacts to marine sediment quality from long-term operations for Alternative 2 would be the same as Alternative 1. Operation of Alternative 2 would not discharge any wastes, other than treated stormwater, or increase contaminant loadings from vessels or the frequency or size of possible spills into Hood Canal that would affect marine sediment quality. The accumulation of sediments, and change to finer grained sediments, inshore of the EHW-2 would be the same as for Alternative 1. Maintenance of the EHW-2 under Alternative 2 would have the same sediment quality impacts as Alternative 1.

3.3.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.3.2.3.1 CONSTRUCTION

Impacts to marine sediment quality from in-water construction of Alternative 3 would be short-term, localized, and similar to those associated with Alternative 1 due to the similar durations for pile driving and in-water construction. Construction activities would not result in the discharge of metals or organic contaminants that would alter the concentrations in bottom sediments. Sediments in 25.8 acres would be subject to potential disturbance, compared to 25.7 acres under Alternative 1.

Sediment resuspension from pile installations would occur over 210–420 days compared to 200–400 days under Alternative 1. Up to 1,290 piles would be required under Alternative 3, compared to 1,250 piles for Alternative 1. Compared to Alternative 1, more piles (up to 160 vs. up to 90) would be installed in shallower water (-30 feet MLLW) where coarse-grained sediments (90 to 100 percent sand) are present (Hammermeister and Hafner 2009). Resuspended sediments in the trestle construction area would be expected to settle well within the potential disturbance area.

3.3.2.3.2 OPERATION/LONG-TERM IMPACTS

Impacts to marine sediment quality from long-term operations for Alternative 3 would be the same as Alternative 1. Due to the separate trestles, the accumulation of sediments, and change to finer grained sediments, inshore of the EHW-2 would be somewhat greater than for Alternative 1. Maintenance of the EHW-2 under Alternative 3 would have the same sediment quality impacts as Alternative 1.

3.3.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.3.2.4.1 CONSTRUCTION

Impacts to marine sediment quality from in-water construction of Alternative 4 would be short-term, localized, and similar to or slightly greater than those associated with Alternative 1 due to the longer duration of pile driving and in-water construction. Construction activities would not result in the discharge of metals or organic contaminants that would alter the concentrations in bottom sediments. Sediments in 25.8 acres would be subject to potential disturbance, representing a slightly greater area compared to Alternative 1.

Sediment resuspension from pile installations would occur over a longer duration (290 to 570 days) than Alternative 1 (200 to 400 days) Alternative 4 would result in a slightly greater degree of localized changes in sediment composition compared to Alternative 1 because the potential disturbance area would be 0.1 acre larger. However, as described in Alternative 1, surface sediments in the EHW-2 project site are composed mostly of sand and these coarse grained resuspended sediments would be expected to settle within the potential disturbance area even over a longer duration.

As described in Alternative 1, the fine-grained (silt and clay) fraction of surface sediments is small, and these particles would be dispersed over relatively larger distances following resuspension. Thus, the physical composition of bottom sediments is not likely to change appreciably when the fine particles settle to the bottom. In water depths greater than about 60 feet, relatively greater dispersion of these fine-grained sediments would be expected.

3.3.2.4.2 OPERATION/LONG-TERM IMPACTS

Impacts to marine sediment quality from long-term operations for Alternative 4 would be the same as for Alternative 1. The accumulation of sediment, and change to finer grained sediment, inshore of the EHW-2 would be somewhat greater than Alternative 1. Maintenance of the EHW-2 under Alternative 4 would have the same sediment quality impacts as Alternative 1.

3.3.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.3.2.5.1 CONSTRUCTION

Impacts to marine sediment quality from in-water construction of Alternative 5 would be short-term and localized, and the types of impacts would be similar to those associated with Alternative 1. Construction activities would not result in the discharge of metals or organic contaminants that would alter the concentrations in bottom sediments. Alternative 5 would have the largest potential surface area of seafloor disturbance (29.4 acres), but also the fewest piles to install (up to 440 piles). Thus, the potential disturbance to surface sediments from construction activities would be comparable to or less than that associated with the other alternatives due to the shorter duration of pile driving and in-water construction.

Sediment resuspension from pile installations would occur over a shorter duration (135 to 175 days) than Alternative 1 (200 to 400 days), but localized changes in sediment composition would occur within the potential disturbance area of 29.4 acres, which is approximately 14 percent larger than the disturbance area associated with Alternative 1.

3.3.2.5.2 OPERATION/LONG-TERM IMPACTS

Impacts to marine sediment quality from long-term operations for Alternative 5 would be the same as Alternative 1. The accumulation of sediment, and change to finer grained sediment, inshore of the EHW-2 would be the same as for Alternative 1. Maintenance of the EHW-2 under Alternative 5 would have the same sediment quality impacts as Alternative 1.

3.3.2.6 No-Action Alternative

The EHW-2 would not be constructed under the No-Action Alternative and overall operations would not change from current levels, so impacts to sediment quality would not occur.

3.3.2.7 Mitigation Measures and Regulatory Compliance

Because impacts to sediment quality from construction and operation of the EHW-2 would be localized and no sediment standards would be violated, no mitigation measures are necessary beyond the current practices and BMPs discussed in the Mitigation Action Plan (Appendix F) and summarized under Hydrography (Section 3.1.2.1) and Water Quality (Section 3.2.2.1).

Construction and operation of the EHW-2 would be in compliance with the Washington State SMS because there would be no violations of the standards at the EHW-2 project site, and there would be no release of toxic substances to the sediment.

In accordance with the CZMA, the Navy submitted a Phase I CCD to WDOE and WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD in spring 2012.

3.3.3 Summary of Impacts

Impacts to sediment quality associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.3–2.

Table 3.3–2. Summary of Impacts to Sediment Quality

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO SEDIMENT QUALITY
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction*: Project construction activities would result in disturbance of bottom sediments through pile installation and anchoring of barges and vessels, which would affect physical characteristics of the sediments such as grain size. Impacts to sediment contaminant levels are unlikely, and conditions are not expected to exceed SQS. In-water pile driving would last between 200 and 400 days, and construction would occur over 42 to 48 months including 2 to 3 in-water work seasons. *Operation/Long-term Impacts*: The presence of the EHW-2 structure would cause accretion of sediments in shallow nearshore areas protected by the EHW-2, with associated increases in the proportions of fine-grained sediments in these localized areas. Project operations also could result in temporary and localized changes associated with stormwater discharges or leaks/spills of fuels or other materials. However, these are not expected to result in conditions that would exceed SQS.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction*: Project construction activities would result in disturbance of bottom sediments through pile installation and anchoring of barges and vessels, which would affect physical characteristics of the sediments such as grain size. Impacts to sediment contaminant levels are unlikely, and conditions are not expected to exceed SQS. Alternative 2 would have a greater impact than Alternative 1 due to the longer duration of in-water pile driving (275 to 550 days vs. 200 to 400 days) and longer construction duration (54 to 64 vs. 42 to 48 months). *Operation/Long-term Impacts*: The presence of the EHW-2 structure would cause accretion of sediments in shallow nearshore areas protected by the EHW-2, with associated increases in the proportions of fine-grained sediments in these localized areas. Project operations also could result in temporary and localized changes associated with stormwater discharges or leaks/spills of fuels or other materials. However, these are not expected to result in conditions that would exceed SQS. The nearshore sediment accumulation effect would be the same as Alternative 1.

Table 3.3–2. Summary of Impacts to Sediment Quality (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO SEDIMENT QUALITY
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction*: Project construction activities would result in disturbance of bottom sediments through pile installation and anchoring of barges and vessels, which would affect physical characteristics of the sediments such as grain size. Impacts to sediment contaminant levels are unlikely, and conditions are not expected to exceed SQS. Alternative 3 would have similar impacts to Alternative 1 due to similar durations for in-water pile driving (210 to 420 vs. 200 to 400 days) and similar construction durations (42 to 49 vs. 42 to 48 months). *Operation/Long-term Impacts*: The presence of the EHW-2 structure would cause accretion of sediments in shallow nearshore areas protected by the EHW-2, with associated increases in the proportions of fine-grained sediments in these localized areas. Project operations also could result in temporary and localized changes associated with stormwater discharges or leaks/spills of fuels or other materials. However, these are not expected to result in conditions that would exceed SQS. The nearshore sediment accumulation effect may be slightly greater than for Alternative 1, due to the two trestles.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction*: Project construction activities would result in disturbance of bottom sediments through pile installation and anchoring of barges and vessels, which would affect physical characteristics of the sediments such as grain size. Impacts to sediment contaminant levels are unlikely, and conditions are not expected to exceed SQS. Alternative 4 would have a greater impact than Alternative 1 due to the longer duration of in-water pile driving (290 to 570 vs. 200 to 400 days) and the longer construction duration (54 to 64 vs. 42 to 48 months). *Operation/Long-term Impacts*: The presence of the EHW-2 structure would cause accretion of sediments in shallow nearshore areas protected by the EHW-2, with associated increases in the proportions of fine-grained sediments in these localized areas. Project operations also could result in temporary and localized changes associated with stormwater discharges or leaks/spills of fuels or other materials. However, these are not expected to result in conditions that would exceed SQS. The nearshore sediment accumulation effect may be slightly greater than for Alternative 1, due to the two trestles.

Table 3.3–2. Summary of Impacts to Sediment Quality (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO SEDIMENT QUALITY
Alternative 5: Combined Trestle, Floating Wharf	*Construction*: Project construction activities would result in disturbance of bottom sediments through pile installation and anchoring of barges and vessels, which would affect physical characteristics of the sediments such as grain size. Impacts to sediment contaminant levels are unlikely, and conditions are not expected to exceed SQS. Alternative 5 would have a smaller impact than Alternative 1 due to the shorter duration of in-water pile driving (135–175 days vs. 200–400 days for Alternative 1) and slightly shorter construction duration (42 to 44 vs. 42 to 48 months). *Operation/Long-term Impacts*: The presence of the EHW-2 structure would cause accretion of sediments in shallow nearshore areas protected by the EHW-2, with associated increases in the proportions of fine-grained sediments in these localized areas. Project operations also could result in temporary and localized changes associated with stormwater discharges or leaks/spills of fuels or other materials. However, these are not expected to result in conditions that would exceed SQS. The nearshore sediment accumulation effect for Alternative 5 would be the same as Alternative 1.
No-Action Alternative	No impact.
Mitigation • No mitigation measures are necessary beyond the current practices and proposed BMPs.	
Consultation and Permit Status • The Navy submitted a Phase I CCD to WDOE and WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD.	

3.4 UNDERWATER NOISE

Noise is defined as unwanted sound. Sound is characterized by frequency or pitch, intensity or loudness, and duration. Underwater noise at the Bangor waterfront is generated by vessels, operational equipment, and natural sources such as weather conditions and biological sources.

There are no mandatory public regulations regarding safe human underwater exposure limits for noise; however, internal Naval Submarine Medical Research Laboratory (2002) guidance for human divers states that underwater sound levels above 154 decibels (dB) referenced to 1 micropascal (dB re 1µPa) would result in human physiological impacts (changes in breathing frequency and heart rate) and sound pressure levels (SPL) above 200 dB would result in physiological damage. The U.S. Navy Diving Manual prohibits exposure of un-hooded Navy divers to SPLs in excess of 200 dB, and further prohibits exposure of Navy divers to levels above 215 dB for any reason (Navy 2008a). The Kitsap County Shoreline Management Master Program (SMP) (applicable under the CZMA) states that new industrial development should give adequate consideration to mitigating negative environmental impacts of noise pollution (Section 22.28).

Several underwater noise thresholds have been established by federal agencies (U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) to prevent harm or harassment to marine organisms and wildlife. These agency-mandated thresholds derive their authority from two federal acts: the MMPA and the ESA. These acts prohibit the take (harm or harassment) of threatened or endangered species or marine mammals without approval (see Sections 3.8, Marine Fish; and 3.9, Marine Mammals). Underwater noise levels above established thresholds have the potential to result in the take of a protected species.

Consultation and Permit Compliance Status. Noise impacts have been addressed through consultation under the ESA, Magnuson-Stevens Fishery Conservation and Management Act (MSA), MMPA, and CZMA. The Navy completed consultation with NMFS and USFWS under the ESA in September 2011 and November 2011, respectively.

3.4.1 Existing Environment

Underwater ambient noise at the EHW-2 project site is widely variable over time due to a number of natural and human-related sources. Predominant sources of natural noise include weather-related noise (such as wind and precipitation) and biological noise. There is also human-generated noise from ship or boat traffic and other mechanical sources (Urick 1983). Actual average background underwater noise at the EHW-2 project site is 114 dB re 1µPa between 100 hertz (Hz) and 20 kilohertz (kHz) (Slater 2009). This can be attributed to wind-driven wave action and manmade noise sources from small boat traffic and industrial noise. Noise is described in units of Hz, or cycles-per-second, and in kHz, 1,000 cycles-per-second. High-pitched sounds are characterized by many cycles per second (Hz); low-pitched sounds are characterized by few Hz. Noise is also characterized as to volume or level, as measured by pressure. Due to the wide range of values for acoustic pressure, noise levels are defined using a logarithmic dB scale referenced to a standard pressure. A doubling of pressure results in a 6 dB increase in noise level. Unless otherwise noted, all underwater sound levels are expressed in dB re 1µPa.

3.4.1.1 Underwater Sound Levels

The propagation of noise is different in water and air. Unimpeded underwater noise spreads spherically from the source, and these sound waves spread out equally in all directions. Bottom topography and underwater structures can block or refract sound waves, which is evident in the nearshore environment in the immediate vicinity of the EHW-2 project site, and would limit the attenuation rate from the spherical spreading condition in a free-field environment. Sound attenuation underwater near the project site would likely follow a practical spreading loss model of 4.5 dB loss in the sound level per doubling of distance from the source (e.g., 15Log_{10} [range/reference range]), in which this attenuation occurs at this same rate for all frequencies. Figure 3.4–1 graphically shows this attenuation relationship as a function of the distance ratio between two locations. Each point within the chart represents a doubling in distance from the previous point.

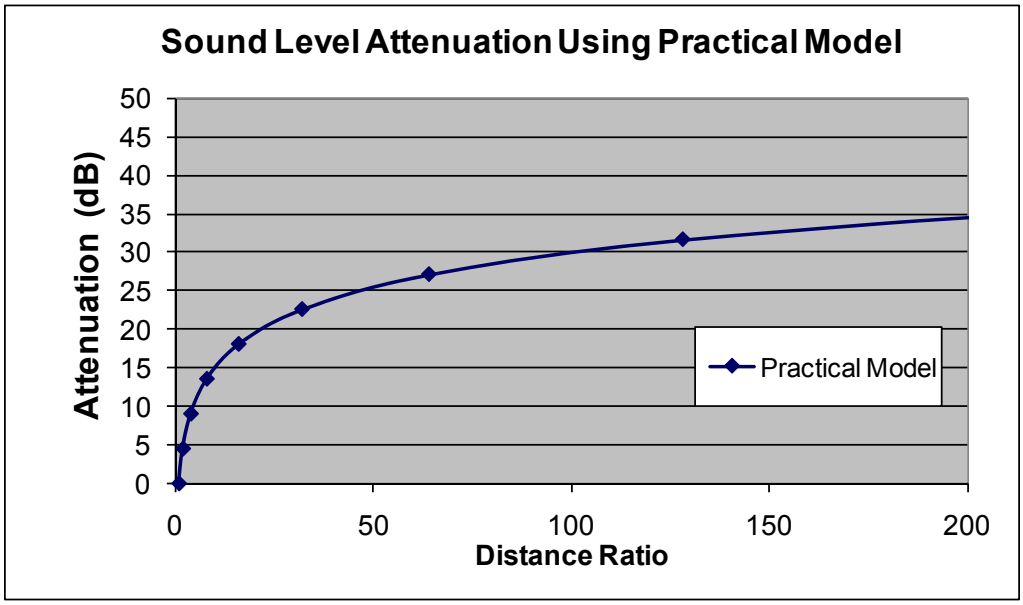


Figure 3.4–1. Underwater Sound Level Attenuation as Function of Distance Ratio Using Practical Spreading Model

A number of sources of underwater sound exist in the vicinity of the EHW-2 project site. Sources of naturally caused underwater noise include wind, waves, precipitation, and biological sources (such as shrimp, fish, and cetaceans). Noise derived from biological organisms can be absent or dominant over narrow and broad frequency ranges. Precipitation can contribute up to 35 dB to the existing sound level, and increases in wind speed of 5 to 10 knots can cause a 5 dB increase in ambient ocean noise across most frequencies (Urick 1983). The highest noise levels occur in nearshore areas where the sound of surf can increase underwater noise levels by 20 dB or more within 200 yards from the surf zone in the 200 Hz to 2 kHz regime (Wilson et al. 1985). In addition, wakes from boat traffic cause breaking waves in the surf zone.

Small powerboats generate peak narrow band SPLs of 150 to 165 dB at 3 feet in the 350 to 1,200 Hz region, with mean SPLs of 148 dB at 3 feet (Barlett and Wilson 2002). Fishing vessels can generate peak spectral densities of 140 dB at 3 feet in the 250 to 1,000 Hz regime (Hildebrand 2004). Underwater sound from human activities includes ship traffic noise, use of sonar and echo sounders in commercial fishing to locate fish schools, industrial ship noise, and recreational boat use. Ship and small boat noise comes from propellers and other on-board rotating equipment.

Other sources of underwater noise at industrial waterfronts could come from cranes, generators, and other types of mechanized equipment on wharves or the adjacent shoreline.

In the vicinity of the EHW-2 project site, average broadband ambient noise levels were measured at 114 dB re 1µPa between 100 Hz and 20 kHz (Slater 2009, see Appendix L). Peak spectral noise from industrial activity was noted below the 300 Hz frequency, with maximum levels of 110 dB re 1µPa noted in the 125 Hz band. In the 300 Hz to 5 kHz range, average levels ranged between 83 and 99 dB re 1µPa. Wind-driven wave noise dominated the background noise environment at approximately 5 kHz and above, and ambient noise levels flattened above 10 kHz. The primary source of noise was due to industrial activity along the waterfront (such as at EHW, Marginal Wharf, and Delta Pier), small boat traffic, and wind-driven wave noise. No substantial precipitation was noted during the study period, although this noise would be undoubtedly present during seasonal periods.

Carlson et al. (2005) measured the underwater baseline noise at Hood Canal Bridge and found that broadband (24 kHz bandwidth) underwater noise levels ranged from 115 to 135 dB re 1µPa. The Washington State Department of Transportation (WSDOT) summarized underwater broadband (all frequencies) noise at ferry terminals with no construction activity as ranging from 135 dB (root-mean-square [RMS] levels) at Mukilteo ferry terminal, 131 to 136 dB (peak levels) at Friday Harbor, and 151 dB (peak levels) at the Bainbridge Island terminal (WSDOT 2010a). In a study conducted in Haro Strait, San Juan Islands, data showed that the ambient half-hourly SPL in Haro Strait ranged from 95 dB to 130 dB (Veirs and Veirs 2005), which demonstrates the range over which localized human-generated noise can vary by specific locations and time periods. Average underwater broadband noise levels measured at the EHW-2 project site between 100 Hz and 20 kHz, inclusive of existing human activities but in the absence of construction activities, fell within the minimum and maximum range of measurements taken at similar environments within Puget Sound.

3.4.2 Environmental Consequences

The evaluation of impacts due to underwater noise considers noise generated by both impact and vibratory pile driving, as well as noise from vessel and boat traffic and construction equipment. Standard, accepted noise transmission models are used to estimate dissipation of noise over distance from the noise source. These noise levels over distance are expressed in several standard noise metrics. The biological effects of the projected noise levels are discussed in subsequent sections of Chapter 3.

3.4.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

Underwater noise would be generated by pile driving, vessel and boat traffic, and construction equipment. The greatest sound levels would be produced by impact driving large (48 inches in diameter or smaller) hollow steel piles, which could generate peak sound levels of approximately 200 dB_{PEAK} re 1µPa and average RMS levels of approximately 185 dB_{RMS} re 1µPa at a distance of 33 feet while using a bubble curtain or other noise attenuating device that would reduce noise levels by 10 dB. RMS calculations used for acoustic analyses are computed as 20 times $\log_{10}$ of the square-root of the sum of squared pressures over the noise event in question, referred to the standard reference pressure of 1µPa. Vibratory pile driving, which would be used predominantly, would produce lower noise levels, approximately 180 dB_{RMS} re 1µPa at 33 feet. Underwater noise levels from pile driving would exceed the threshold limits for effects on marine mammals, fish, and diving birds such as marbled murrelets. Once constructed, there would be no increase in

underwater noise from the operation of the EHW 2. Recreational and commercial scuba divers diving between Hazel Point and Termination Point on the Toandos Peninsula could experience underwater noise levels that could cause a behavioral response including increased breathing and elevated heart rate (154 dB re 1μPa) (Naval Submarine Medical Research Laboratory 2002) within 40,000 feet of the construction site during pile driving activity but would not receive levels sufficient to cause injury (SPL of 200 dB re 1μPa).

3.4.2.1.1 CONSTRUCTION

Construction of Alternative 1 would result in increased underwater noise levels in Hood Canal, due primarily to installation of piles. Some noise would be generated with construction support vessels, small boat traffic, and barge-mounted equipment such as cranes and generators, but this noise would typically not exceed existing underwater noise levels resulting from existing routine waterfront operations in the vicinity of the construction site, encompassing Delta Pier, Marginal Wharf, and the existing EHW facility. Several non-pile driving construction activities would also occur at the project area as part of the proposed action. Among them are the installation of cast-in-place concrete pile caps, concrete wharf deck, operations support building, cranes, power utility booms, lightning protection towers, and camels. While no empirical data exist for these construction activities that would occur on the tops of the piles or attached to the wharf's deck, they are expected to be significantly lower than those estimated for pile installation using an impact/vibratory pile driver. It is possible that sound could be transmitted from these activities along the piles' length and enter the water. Therefore, underwater acoustic impacts from these construction operations are expected to be minimal.

The greatest underwater noise would be created while driving piles using an impact hammer. An impact hammer would be used to "proof" every fourth to fifth driven pile to ensure it provides adequate load bearing capacity. The majority of the pile driving, however, would use vibratory methods. In some cases where difficult geological conditions are encountered, it may be necessary to use an impact hammer to drive certain piles for part or all of their required depth. The most likely scenario is that there would be no more than 1,000 impact hammer strikes per day (1,000 daily strike scenario), with a maximum scenario of 6,400 strikes per day (6,400 daily strike scenario). The number of in-water pile driving days would be between 200 and 400.

Up to three vibratory driving rigs could be used concurrently, but only one impact hammer rig would operate at a time or in conjunction with multiple vibratory rigs. Details of the proposed pile driving activity are described more fully in Section 2.2.1.

Construction would typically occur 6 days per week. Impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). These restrictions were identified in the Biological Opinion from USFWS (2011) (Appendix I).

Several measures would be used to minimize the noise generated by pile driving. A soft-start approach (noise attenuator), in which hammer energy levels are increased from low to high would be used for both pile driving methods to allow time for fish, birds, and mammals to move away from the pile driving site before the highest noise levels are produced. Soft starts for vibratory drivers require initial starts of 15 seconds at reduced energy followed by a 30-second

waiting period.[1] This measure shall be repeated two additional times. Soft starts for impact hammers shall be one dry fire followed by a 30-second waiting period. This procedure shall be repeated two additional times. A bubble curtain or other noise attenuating device would be used to minimize underwater noise levels when the impact hammer is used.

All of the piles would be constructed of hollow steel. From the perspective of underwater noise generation, in general driving larger piles requires more energy, and thus pile driving larger piles is expected to produce higher underwater noise levels than smaller piles. The available data, however, indicate that the difference between 30-inch and 48-inch piles in terms of noise levels generated during pile driving is minimal (WSDOT 2010a). Therefore, estimating source levels for impact pile driving for the EHW-2 considered information for 30-inch to 66-inch piles, and a conservative approach was used to select source levels to use in the analysis. Available information from studies of impact hammer pile driving was reviewed, and those most relevant to the EHW-2 pile driving project in terms of pile type and size, pile driver type, and water depth were identified (Table 3.4–1).

Based on this review, the best conservative estimate of source level for impact hammer driving for the EHW-2 project is approximately 195 dB$_{RMS}$ re 1μPa at 33 feet, in the absence of noise attenuation measures. The corresponding peak source level is approximately 210 dB re 1μPa, and the sound exposure level (SEL) is 185 dB$_{SEL}$ re 1μPa^2-sec at 33 feet (WSDOT 2010a).

Note that Table 3.4–1 includes recent impact pile driving of 42-inch steel pipe piles for the Carderock pier project on NBK at Bangor. This project was similar to the proposed EHW-2 in terms of pile size and type, and location (substrate). The fact that the source level for the Carderock pier project was estimated at 195 dB$_{RMS}$ supports using this source level for the EHW-2 pile driving.

Available data for vibratory pile driving projects were reviewed (Table 3.4–2). Considering the paucity of data for vibratory driving, the most conservative source level was used for the EHW-2 analysis: 180 dB$_{RMS}$ re 1μPa.

Use of a bubble curtain or other noise attenuating device to mitigate noise levels would be employed to minimize the noise levels during impact pile driving operations. Unconfined bubble curtain attenuators (Type I) emit a series of bubbles around a pile to introduce a high-impedance boundary through which pile driving noise is attenuated. Noise reduction results using an unconfined bubble curtain from several projects performed (Illingworth and Rodkin 2001; WSDOT 2010c) indicate a wide variance results, with very little measurable attenuation in some cases and high attenuation in other cases. Reductions of 85 percent (approximately 17 dB, computed as $20 \cdot \log_{10}$ the ratio of peak pressure reduced by 85 percent with the use of a bubble curtain) or more have been reported with the proper use of a Type II (confined) bubble curtain (Longmuir and Lively 2001), although reductions of 5 to 15 dB are more typical (Laughlin 2005a). A confined bubble curtain places a shroud around the pile to hold air bubbles near the pile, ensuring they are not washed away by currents or tidal action. For impact analysis, an average

[1] The sequence of the soft-start procedures includes a minor deviation from those typically requested by NMFS, which utilize a longer waiting period (one minute vs. 30 seconds). The Navy requested to change the waiting period because observational data during the Test Pile Program and EHW-1 repairs indicated a one-minute wait period may be too long. Longer breaks between the sounds may be interpreted by the animals as a transient sound and may not serve the intended purpose to provide an indication that louder sounds are about to begin. The Navy consulted with NMFS regarding using a shorter waiting period (i.e., 30 seconds) and the Service found the Navy's reasoning to be valid and accepted the requested modification.

SPL reduction of 10 dB was assumed. Estimated SPLs for impact pile driver noise without a noise attenuator are presented for reference only.

Due to the sharp, impulsive nature of impact pile driving, the frequency range over which detectable noise can be heard is broad; measurements have reported detectable noise up to 25.6 kHz (David 2006). However, the bulk of acoustic energy generated underwater due to pile driving ranges between 50 and 1,000 Hz (WSDOT 2010a). This range was confirmed by recent pile driving acoustic reports in Puget Sound, which show the majority of observed energy to be below 1,000 Hz (Carlson et al. 2005; Laughlin 2005b).

A practical sound propagation modeling technique was used to estimate the range from the pile driving activity to various expected SPLs in the water. This model follows a geometric propagation loss based on the distance from the driven pile, resulting in a 4.5 dB reduction in level for each doubling of distance from the source. In this model, the SPL at some distance away from the source (e.g., driven pile) is governed by a measured source level (SL), minus the transmission loss (TL) of the energy as it dissipates with distance.

Table 3.4–1. Sound Pressure Levels from Pile Driving Studies Using Impact Hammers

Project	Location	Pile Type	Hammer Type	Water Depth	Distance	Measured Sound Levels (rms)
Eagle Harbor Maintenance Facility[1]	Bainbridge Island, WA	Steel Pipe/ 30-inch	Diesel Hammer	10 m/33 feet	10 m/33 feet	192 dB re 1 µPa
Friday Harbor Ferry Terminal[2]	Friday Harbor, WA	Steel Pipe/ 30-inch	Diesel Hammer	10 m/33 feet	10 m/33 feet	196 dB re 1 µPa
Unknown[3]	CA	Steel Pipe/ 36-inch	Impact Hammer	~10 m/33 feet	10 m/33 feet	193 dB re 1 µPa
Mukilteo Test Piles	WA	Steel Pipe/ 36-inch	Impact	7.3 m/24 feet	10 m/33 feet	195 dB re 1 µPa
Anacortes Ferry	WA	Steel Pipe/ 36-inch	Impact	12.8 m/42 feet	10 m/33 feet	199 dB re 1 µPa
Carderock Pier, NBK at Bangor[4]	WA	Steel Pipe/ 42-inch	Impact	15-21 m/ 48–70 feet	10 m/33 feet	195 dB re 1 µPa
Russian River	Russian River, CA	Steel Pipe/ 48-inch	Diesel Impact	2 m/6.6 feet	10 m/33 feet 20 m/65 feet 45 m/148 feet 65 m/213 feet	195 dB re 1 µPa 190 dB re 1 µPa 185 dB re 1 µPa 175 dB re 1 µPa
Unknown	CA	Steel CISS/ 60-inch	Impact	~10 m/33 feet	10 m/33 feet	195 dB re 1 µPa
Richmond-San Rafael Bridge	San Francisco Bay, CA	Steel Pipe/ 66-inch	Diesel Impact	4 m/13 feet	4 m/13 feet 10 m/33 feet 20 m/65 feet 30 m/98 feet 40 m/131 feet 60 m/197 feet 80 m/262 feet	202 dB re 1 µPa 195 dB re 1 µPa 189 dB re 1 µPa 185 dB re 1 µPa 180 dB re 1 µPa 169 dB re 1 µPa 170 dB re 1 µPa

1. JASCO Research Ltd. (2005).
2. Laughlin (2005b).
3. Adapted from Compendium of Pile Driving Data report to the California Department of Transportation - Illingworth & Rodkin, Inc. (2007).
4. Navy (2009b). Source level at 10 meters (m) (33 feet) estimated based on measurements at distances of 48 to 387 m (157 to 1,269 feet).

Table 3.4–2. Sound Pressure Levels from Pile Driving Studies Using Vibratory Hammers

PROJECT	LOCATION	PILE TYPE	HAMMER TYPE	WATER DEPTH	DISTANCE	MEASURED SOUND LEVELS (RMS)
Vashon Terminal[1]	WA	Steel Pipe/ 30-inch	Vibratory	~6 m/20 feet	11 m/36 feet	165 dB re 1 μPa
Keystone Terminal[2]	WA	Steel Pipe/ 30-inch	Vibratory	~5 m/16 feet	10 m/33 feet	164 dB re 1 μPa
Keystone Terminal[2]	WA	Steel Pipe/ 30-inch	Vibratory	~8 m/26 feet	10 m/33 feet	165 dB re 1 μPa
Unknown[3]	CA	Steel Pipe/ 36-inch	Vibratory Driver*	~5 m/16 feet	10 m/33 feet	170 dB re 1 μPa
Unknown[3]	CA	Steel Pipe/ 36-inch	Vibratory Driver*	~5 m/16 feet	10 m/33 feet	175 dB re 1 μPa
Unknown	CA	Steel Pipe/ 72-inch	Vibratory Driver	~ 5 m/16 feet	10 m/33 feet	170 dB re 1 μPa
Unknown	CA	Steel Pipe/ 72-inch	Vibratory Driver	~ 5 m/16 feet	10 m/33 feet	180 dB re 1 μPa

1. Source: Laughlin 2010a; RMS noise levels reported in terms of the 30-second average continuous sound level and computed from the Fourier transform of pressure waveforms in 30-second time intervals. Average of measured values at 11 meters.
2. Source: Laughlin 2010b; RMS noise levels reported in terms of the 30-second average continuous sound level and computed from the Fourier transform of pressure waveforms in 30-second time intervals.
3. Adapted from *Compendium of Pile Driving Data* report to the California Department of Transportation - Illingworth & Rodkin, Inc. (2007); *RMS impulse level used duration of (35 msec).

The TL equation is given by:

$$Transmission\ Loss, TL = 15\log_{10}\left(\frac{R_1}{R_2}\right)$$

where TL is the transmission loss in dB, R_1 is the distance of the modeled SPL from the driven pile, and R_2 is the distance from the driven pile of the initial measurement. This model follows recommended best practices by WSDOT (2010a).

Underwater noise is frequently characterized by three specific descriptors: (1) instantaneous peak sound pressure level (dBPEAK), which describes the instantaneous maximum overpressure or underpressure observed during an event; (2) RMS (dBRMS) sound pressure level, which is computed as the square root of the sum of the pressure squared normalized over the event duration, and is thus representative of an "average" sound pressure level during an event; and (3) SEL, or (dBSEL), which indicates the amount, e.g., "dose" of acoustic energy normalized to a one-second time interval, and is computed as the cumulative sum of sound pressure squared normalized to a one-second duration. When characterizing impulsive noise, such as with impact pile driving, all three descriptors are used to assess different biological effects to a number of marine species: the peak level indicates the maximum over- or underpressure seen in an impulse event, the RMS level represents the average level during the event, and the SEL level represents the energy observed during an impulse or over several impulses, normalized to a one-second time period. For quasi steady-state noise, such as operation of a boat or during vibratory pile driving, RMS levels are typically compared, although peak and SEL levels can also be computed, whereas SEL is numerically equal to RMS level in this case. Specific noise thresholds are described within each biological section, and use peak, RMS, and SEL representations to describe specific impacts to marine species.

3.4.2.1.1.1 CONSTRUCTION – IMPACT PILE DRIVING

PEAK LEVELS

Peak attenuation levels for 48-inch hollow steel piles driven with a bubble curtain are provided in Table 3.4–3 and shown in Figure 3.4–2. Peak levels without a noise attenuator are also shown in the table for reference; all biological impact analyses assume the 10 dB reduction. Peak levels of 206 dBPEAK would be exceeded within a radius of 13 feet from each driven pile, and levels exceeding 180 dBPEAK would be exceeded within a radius of 707 feet when a properly operating confined bubble curtain or other noise attenuating device is used.

ROOT-MEAN-SQUARE LEVELS

RMS attenuation levels for impact driven 48-inch hollow steel piles using a confined bubble curtain or noise attenuator are provided in Table 3.4–4 and shown in Figure 3.4–3. Using the practical propagation model, SPLs above 190 dBRMS re 1µPa would be exceeded within a circle centered at the location of the driven pile out to a distance of 15 feet (5 meters) while driving 48-inch hollow steel piles. Values for 180 dBRMS and 160 dBRMS are also provided in the table. RMS levels without a noise attenuator are provided for reference; all biological impact analyses assume the 10 dB reduction.

Average underwater baseline noise levels acquired near the NBK at Bangor Marginal Wharf facility, which is near the location of the EHW-2, were measured at a level of 114 dBRMS re 1µPa (Slater 2009). Sound during impact pile driving would be detected above the average background noise levels at any location in Hood Canal with a direct acoustic path (i.e., "line of sight" from the driven pile to the receiver location). To the west of the EHW-2, Toandos Peninsula bounds the extent of sound travel within the construction area; thus, geography would not allow direct sound path propagation south of Brown Point, nor north of Termination Peninsula at the western terminus of the Hood Canal Bridge adjacent to Squamish Harbor (see Figure 3.9–1 in Section 3.9.2). Locations beyond these points would receive substantially lower noise levels since there is no direct sound path, and thus no impacts would be observed.

SOUND EXPOSURE LEVELS (SEL)

Impact SEL attenuation levels for 48-inch hollow steel piles driven with an impact hammer and with a confined bubble curtain or other noise attenuating device are provided in Table 3.4–5 and shown in Figure 3.4–4. Two pile driving scenarios were modeled, as described in Chapter 2. Analysis included both the 1,000 and 6,400 daily strike scenarios. (Table 3.4–5 also shows attenuation over distance without active noise attenuation such as a bubble curtain, but the subsequent biological impact analyses assume active attenuation would occur.)

For this analysis, stationary, non-moving fish conditions were assumed, that is, fish that would not move away from the site during pile driving operations. Model results followed the technique used by NMFS (WSDOT 2009). A single strike SEL value of 175 dBSEL re 1µPa^2-sec at 10 meters (assumes 10 dB of attenuation from a bubble curtain) was used in the practical spreading model, and corresponds to the amount of acoustic energy in a single strike. Calculation of the SEL cumulative acoustic energy for all strikes completed during a pile driving day was determined using the following formula:

$$\textit{Cumulative SEL} = \textit{Single Strike SEL} + 10 \cdot Log_{10}\,(\textit{Number of strikes})$$

Table 3.4–3. Attenuation Levels vs. Distance Underwater for Pile Driving Peak Impact Noise

Distance (feet) From Driven Pile	With Noise Attenuator Practical Spreading Loss Model [1,2] (dBpeak re1µPa)	Without Noise Attenuator Practical Spreading Loss Model [1] (dBpeak re1µPa)
7	210	220
13	206	216
24	202	212
33	200	210
66	195	205
100	193	203
200	188	198
300	186	196
400	184	194
500	182	192
600	181	191
707	180	190
1,000	178	188
1,600	175	185
3,200	170	180
6,400	166	176
16,000	160	170
38,251	154	164

Sound Pressure Levels in dBpeak re 1µPa
Source level 210 dBpeak at 33 feet assumed for 48-inch-diameter hollow steel pile
10 dB reduction for confined bubble curtain or other noise attenuating device

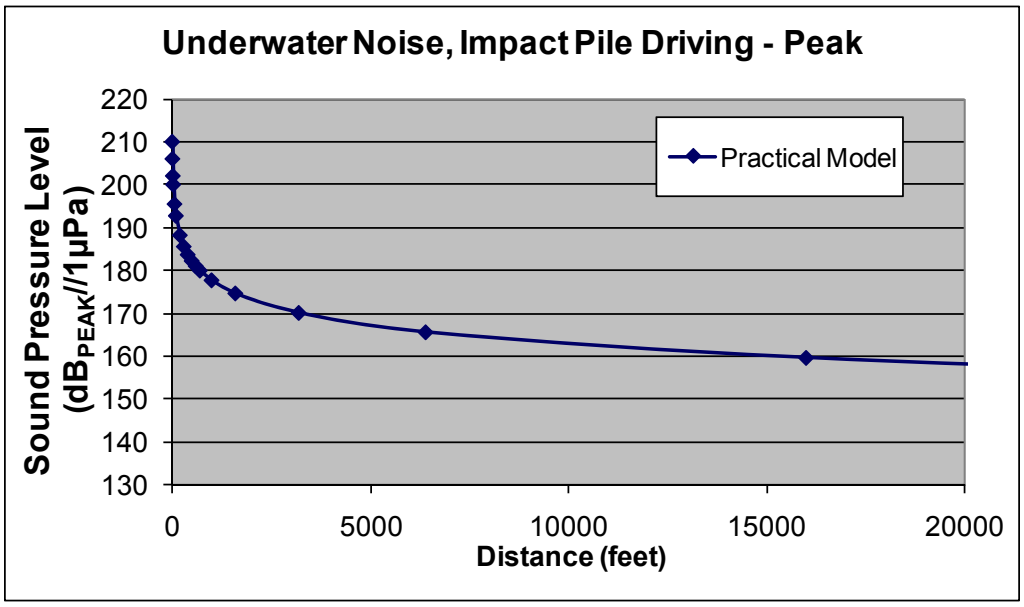


Figure 3.4–2. Underwater Noise Assessment for Impact Pile Driving With Noise Attenuator

Table 3.4–4. Attenuation Levels vs. Distance for Pile Driving RMS Impact Noise

Distance (feet) From Driven Pile	With Noise Attenuator Practical Spreading Loss Model [1,2] (dBRMS re1µPa)	Without Noise Attenuator Practical Spreading Loss Model [1] (dBRMS re1µPa)
7	195	205
15	190	200
33	185	195
38	184	194
71	180	190
178	174	184
300	171	181
400	169	179
500	167	177
600	166	176
800	164	174
1,000	163	173
1,523	160	170
4,000	154	164
5,200	152	162
6,000	151	161
7,068	150	151

Sound Pressure Levels in dBRMS re 1µPa.
Source level 195 dBRMS at 33 feet assumed for 48-inch diameter hollow steel pile.
10 dB reduction for confined bubble curtain or other noise attenuator.

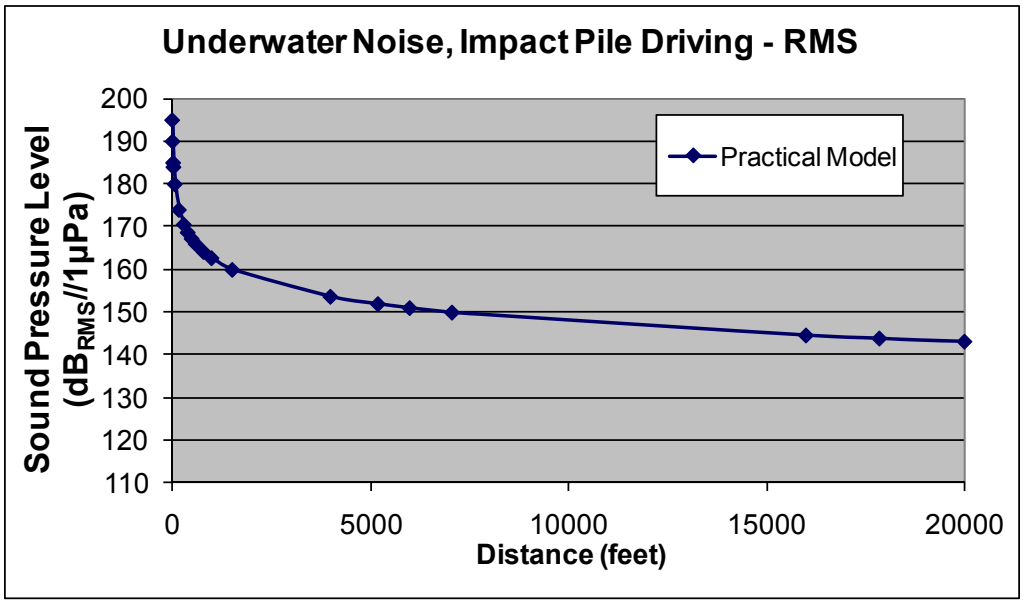


Figure 3.4–3. Underwater Noise Assessment for Impact Pile Driving With Noise Attenuator

Table 3.4–5. Attenuation Levels vs. Distance for Pile Driving SEL Impact Noise, 1,000 and 6,400 strikes per day

Distance (feet) From Driven Pile	Practical Spreading Loss Model [1,2,3] 1,000 Strikes (dBSEL re1μPa^2-sec)		Practical Spreading Loss Model [1,2,4] 6,400 Strikes (dBSEL re1μPa^2-sec)	
	With Attenuator	Without Attenuator	With Attenuator	Without Attenuator
7.1	215	225	223	233
15	210	220	218	228
33	205	215	213	223
53	202	212	210	220
66	200	210	209	219
112	197	207	205	215
181	194	204	202	212
244	192	202	200	210
520	187	197	195	205
961	183	193	191	201
842	184	194	192	202
1,792	179[4]	189	187[4]	197
2,428	177[4]	187	185[4]	195
3,312	175[4]	185	183[4]	193
4,486	173[4]	183	181[4]	191
8,368	169[4]	179[5]	177[4]	187[5]
15,463	165[4]	175[5]	173[4]	183[5]

1. SELs in dBSEL re 1μPa^2-sec.
2. Single strike source level 185 dBSEL at 33 feet assumed for 48-inch diameter hollow steel pile.
3. 10 dB reduction for confined bubble curtain or noise attenuator.
4. Effective quiet range for SEL impact with noise attenuator is 1,522 feet (see text).
5. Effective quiet range for SEL impact without noise attenuator is 7,068 feet (see text).

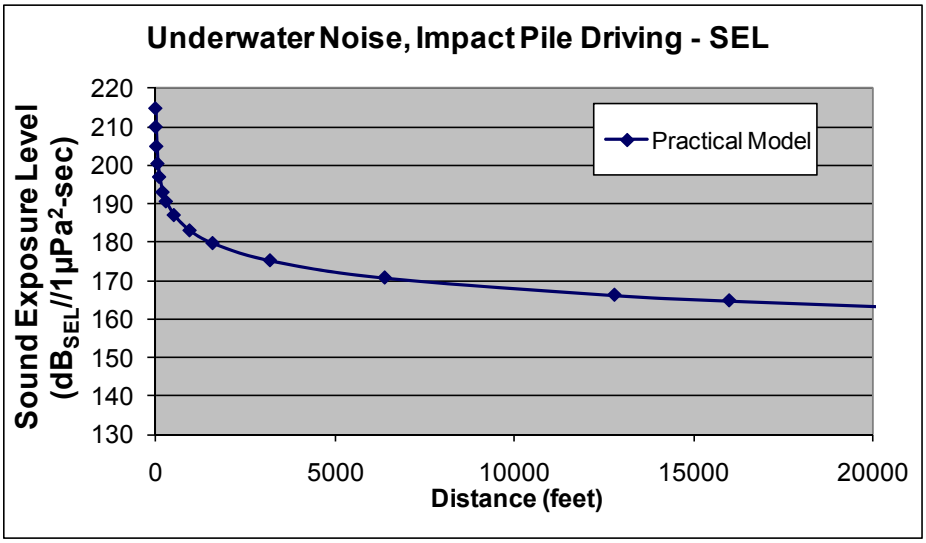


Figure 3.4–4. Underwater Noise Assessment for Impact Pile Driving With Noise Attenuator, Likely Scenario, 1,000 Strikes

From this, estimated distances at which the 202 dBSEL[2], 187 dBSEL, and 183 dBSEL values would be exceeded were determined using the cumulative SEL for both 1,000 strike and 6,400 strike scenarios. Using the practical spreading model, a level of 202 dBSEL re 1μPa^2-sec would be exceeded within a circle centered at the location of the driven pile out to a distance of approximately 53 feet while driving 48-inch hollow steel piles (1,000 daily strike scenario) using a bubble curtain attenuator, and up to 181 feet for the 6,400 daily strike scenario. Levels of 187 dBSEL re 1μPa^2-sec would be exceeded within a circle centered at the location of the driven pile out to a distance of approximately 520 feet in the 1,000 daily strike scenario, and 1,792 feet in the 6,400 daily strike scenario. Levels of 183 dBSEL re 1μPa^2-sec would be exceeded within a circle centered at the location of the driven pile out to a distance of approximately 961 feet in the 1,000 daily strike scenario, and 3,312 feet in the 6,400 daily strike scenario. It should be noted that the NMFS SEL model methodology includes a factor that limits the maximum affected distance for the onset of physical injury. For a given source level, this is the distance at which the acoustic energy from a single strike attenuates to 150 dBSEL re 1μPa^2-sec, beyond which no physical injury is expected to occur (WSDOT 2009). This modeling factor, known as the "effective quiet" distance, has the effect of placing a limit on the total affected area, regardless of the total number of hammer strikes. However, within this zone, the severity of injury can increase as the number of hammer strikes increases. The NFMS SEL model accounts for this factor by truncating any distances beyond the effective quiet range once the effective quiet criteron of 150 dBSEL re 1μPa^2-sec has been satisfied. This condition was realized when the 6,400 strike scenario was modeled, in which the maximum zone of injury was fixed at 464 meters. While additional strikes may not increase the size of the injury zone, the accumulated acoustic energy within that area would continue to build as a result of additional strikes. For these assumed conditions, both 187 and 183 dBSEL re 1 μPa^2-sec threshold values would be limited to 1,522 feet for 6,400 pile strikes.

3.4.2.1.1.2 CONSTRUCTION – PILE DRIVING, MULTIPLE-RIG OPERATION

Underwater noise levels during multiple-rig pile driving would produce noise levels higher than those observed with a single rig operating due to the additive effects of multiple noise sources. Noise from multiple simultaneous sources produces an increase in the overall noise field. A doubling in sound power results in an increase of 3 dB, which is the result of two sources incoherently adding acoustic pressures in the combined noise environment. The resultant sound pressure level (SPL) from *n*-number of multiple sources is computed with the following relationship using principles of dB addition:

$$CombinedSPL = 10 \cdot \log_{10}\left(10^{\frac{SPL1}{10}} + 10^{\frac{SPL2}{10}} + \ldots + 10^{\frac{SPLn}{10}}\right)$$

For each multiple-source analysis, a two-dimensional grid of closely spaced points was created, and noise levels were computed from individual sources at each grid point, then incoherently summed together to estimate the combined noise field. This analyses provides a robust means to estimate the additive effects of noise levels with multiple pile drivers simultaneously operating. Peak and RMS values were computed for each multiple rig scenario analyzed. Impact SEL calculations for multiple-rig scenarios were not repeated, since only one impact pile driver would be operated at any time. Continuous vibratory energy contributions were not included in SEL calculations for comparison to SEL thresholds for impact driving.

[2] The noise injury criterion due to impact pile driving in a 24-hour period for marbled murrelet was recently established at 202 dBSEL re 1μPa^2-sec (SAIC 2011).

This is because the SEL metric is intended to characterize total energy in transient noise events and is not intended for long-term continuous noise types; the existing SEL thresholds are intended for transient noise events. Peak levels were determined by summing peak levels from impact pile driving with peak levels from vibratory driving. Peak vibratory levels were assumed to be 3 dB higher than continuous RMS levels following the assumption that the typical vibratory waveform is sinusoidal (WSDOT 2010a); thus, peak pressures would be higher than RMS values by √2 (approximately 1.41 times higher pressure), which matches typical values of 183 dBPEAK reported in the literature (Illingworth and Rodkin 2007). Infrequent transient peaks of higher SPLs during vibratory driving could be possible if a pile contacts a hard object such as a rock in the substrate during vibratory driving, but this case was not modeled due to the transient, occasional nature of this occurrence.

RMS calculations were made for both equivalent continuous sound and impulsive sound. An equivalent continuous SPL was computed for the impact driver by spreading the impulsive RMS energy over the same time duration as a vibratory driver. Since the impulsive noise only exists for a short duration, a time-weighting factor was calculated to determine the effective continuous sound level to apply to the impulsive source level. With an assumed impact rate of one pile strike per second, and an impulsive duration of 100 msec (one tenth of a second), the time-weighting factor was computed as $10Log_{10}$[100msec/1sec], or -10 dB. With an assumed impulsive source level of 195 dBRMS (Section 3.4.2.1.1), this factor reduced the effective continuous source level to 185 dBRMS, with another 10 dB reduction assumed for the use of a bubble curtain or other noise attenuator. This result was summed with continuous RMS noise levels from the vibratory drivers to establish the combined equivalent continuous noise level. For the impulsive RMS metric of concurrently operating pile drivers, vibratory RMS levels were added directly to the impulsive RMS sound levels of the impact driver. The maximum impulsive noise was computed as the additive sum of continuous vibratory energy and the impulsive RMS energy over the duration of the impact strike. Since this is only computed over the duration of each pile strike, the impulsive RMS SPL for multiple rigs operating are always be higher than continuous equivalent RMS SPLs.

Two multiple-rig scenarios were analyzed: (1) three vibratory rigs operating concurrently, and (2) three vibratory rigs and one impact rig operating concurrently. Up to three vibratory rigs could be operating simultaneously, with each rig producing noise levels of up to 180 dBRMS re 1µPa at 33 feet (Illingworth and Rodkin 2007). An impact pile driver would produce peak levels of 200 dBPEAK and 185 dBRMS re 1µPa at 33 feet with a noise attenuator assumed to reduce radiated levels by 10 dB. Highest levels would be produced immediately adjacent to each pile being driven, and would taper off as the receiver moved away from the work area.

3.4.2.1.1.3 CONSTRUCTION – THREE VIBRATORY PILE DRIVING RIGS

A majority of the pile driving would be done using vibratory methods. A vibratory pile driver operates by continuously shaking the pile at a fixed frequency, basically vibrating it into the ground. The vibrating action of the pile loosens or "liquefies" the bottom substrate in the vicinity of the pile, and, as a result, the pile moves downward due to the weight of the pile and the vibratory driver (WSDOT 2010a). Due to the nature of the project, up to three vibratory pile-driving rigs could be used simultaneously, which would create more underwater noise than a single vibratory driver.

With three vibrating pile rigs operating, SPLs of 150 dBRMS would occur at a distance of 6,832 feet from the work area, and levels of 120 dBRMS would occur at distances of up to

679,000 feet (129 miles). Practically, the maximum affected range above 120 dBRMS would be approximately 45,276 feet (8.6 miles) from the driven pile, which is bounded by the furthest line-of-sight distance from the EHW-2 location to the northern shore of Squamish Harbor. Further propagation is limited by land masses.

Within 33 feet of each pile being driven, the noise from other piles being driven hundreds of feet away would not noticeably contribute to the noise in the vicinity of the initial pile. Thus, within 33 feet from a pile, maximum noise levels for a multiple-rig operating scenario would be approximately the same as that for a single rig operating. However, further away from each pile, the noise contributions from adjacent pile drivers would become more significant, resulting in a more complex attenuation environment and higher observed noise levels than with a single rig operating. The noise field in the vicinity of the pile driving area (nominally within 1,000 feet of the work area) would not attenuate in a simple circular pattern due to the interaction and addition of the multiple rigs contributing to the overall noise field. At substantial distances, the field would behave in a more circular manner, however, as the relative distance from the rigs becomes large compared to the distance between the rigs. Table 3.4–6 summarizes estimated distances to specific functional hearing group thresholds from the EHW-2 project site during three-rig vibratory driving.

Table 3.4–6. Estimated Distances to Underwater Noise Thresholds, Three Vibratory Drivers, Continuous RMS Noise

Functional Hearing Group	Underwater Threshold	Distance to Threshold (Feet)
Marbled murrelets		
Behavior	150 dBRMS	6,832
Cetaceans (whales, dolphins, porpoises)		
Injury	180 dBRMS	33
Behavior	120 dBRMS	45,276[1]
Pinnipeds (seals, sea lions, walrus)		
Injury	190 dBRMS	7
Behavior	120 dBRMS	45,276[1]
Fish all sizes		
Behavior	150 dBRMS	6,832

1. Limited by propagation due to land mass.

3.4.2.1.1.4 Construction – One Impact and Three Vibratory Pile Driving Rigs

With one impact rig and three vibrating pile rigs operating, SPLs exceeding 150 dBRMS would occur at distances within 11,024 feet from the EHW-2 location (Table 3.4–7). Peak levels exceeding 202 dBSEL would occur within 181 feet of the pile driving activity.[3] Use of a noise attenuator, such as a bubble curtain, was assumed to provide a 10 dB reduction in peak and impulsive RMS noise. Levels of 120 dBRMS would practically occur at distances of up to 45,276 feet (8.6 miles) from the driven pile, which is bounded by the furthest line-of-sight distance from

[3] The noise injury criterion due to impact pile driving in a 24-hour period for marbled murrelet was recently established at 202 dBSEL re 1μPa^2-sec (SAIC 2011).

the EHW-2 location to the northern shore of Squamish Harbor. Further propagation is limited by land mass.

Table 3.4–7. Estimated Distances to Underwater Noise Thresholds, One Impact and Three Vibratory Pile Drivers, Peak, RMS, and SEL

Functional Hearing Group	Underwater Threshold	With Noise Attenuator Distance to Threshold (Feet)	Without Noise Attenuator Distance to Threshold (Feet)
Marbled murrelets			
Injury	202 dBSEL [1]	181	842
Behavior	150 dBRMS	7,295 (continuous) 11,024 (impulsive)	11,024 (continuous) 35,072 (impulsive)
Cetaceans (whales, dolphins, porpoises)			
Injury	180 dBRMS	33 (continuous) 72 (impulsive)	71 (continuous) 344 (impulsive)
Behavior	160 dBRMS (impulsive)	2,375	7,530
Behavior	120 dBRMS (continuous)	45,276 [2]	45,276 [2]
Pinnipeds (seals, sea lions, walrus)			
Injury	190 dBRMS	7 (continuous) 16 (impulsive)	16 (continuous) 71 (impulsive)
Behavior	160 dBRMS (impulsive)	2,375	7,530
Behavior	120 dBRMS (continuous)	45,276 [2]	45,276 [2]
Fish ≥ 2 grams			
Injury	187 dBSEL	1,792 [3]	8,368 [4]
Fish < 2 grams			
Injury	183 dBSEL	3,312 [3]	15,463 [4]
Fish all sizes			
Injury	206 dBPEAK	13	61
Behavior	150 dBRMS	7,295 (continuous) 11,047 (impulsive)	11,047 (continuous) 35,072 (impulsive)

1. The noise injury criterion due to impact pile driving in a 24-hour period for marbled murrelet was recently established at 202 dBsel re 1μPa2-sec (SAIC 2011).
2. Limited by propagation due to land mass.
3. 6,400 impact pile strikes, if not limited by effective quiet distance of 1,522 feet.
4. 6,400 impact pile strikes, if not limited by effective quiet distance of 7,067 feet.

3.4.2.1.2 OPERATION/LONG-TERM IMPACTS

Once the EHW-2 is constructed, there would be no increase in overall underwater noise along the Bangor waterfront from the operation of the EHW-2 because there would be no expected increase in vessel traffic or other operational activities. However, operational noise would be introduced at the site of the EHW-2, which is adjacent to the existing EHW. Routine maintenance of the EHW-2 would include inspection and repair of piles, which would infrequently increase underwater noise levels due to occasional repair activity.

3.4.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.4.2.2.1 CONSTRUCTION

The levels of underwater noise and environmental effects generated by Alternative 2 (chiefly from pile driving) would be the same as Alternative 1. The only difference would be the duration of pile-generated underwater noise. Alternative 2 is likely to require more in-water work seasons (3 to 4) than Alternative 1 (2 to 3 work seasons). Under this alternative, there would be 275 to 550 days of pile driving noise in the underwater marine environment when compared to Alternative 1 (200 to 400 pile driving days). Construction timing and restrictions would be the same as those described for Alternative 1.

3.4.2.2.2 OPERATION/LONG-TERM IMPACTS

Operational effects for Alternative 2 would be the same as Alternative 1.

3.4.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.4.2.3.1 CONSTRUCTION

The levels of underwater noise and environmental effects generated by Alternative 3 would be the same as Alternative 1. The only difference would be the duration of pile-generated underwater noise. Under this alternative, there would be slightly more days (210 to 420) of pile driving noise in the underwater marine environment compared to Alternative 1. Construction timing and restrictions would be the same as those described for Alternative 1.

3.4.2.3.2 OPERATION/LONG-TERM IMPACTS

Operational effects for Alternative 3 would be the same as Alternative 1.

3.4.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.4.2.4.1 CONSTRUCTION

The levels of underwater noise and environmental effects generated by Alternative 4 (chiefly from pile driving) would be similar to Alternative 1. The only difference would be the duration of pile-generated underwater noise. Alternative 4 is likely to require more in-water work seasons (3 to 4) than Alternative 1 (2 to 3). Under this alternative, there would be more days (290 to 570) of pile driving noise in the underwater marine environment compared to Alternative 1. Construction timing and restrictions would be the same as those described for Alternative 1.

3.4.2.4.2 OPERATION/LONG-TERM IMPACTS

Operational effects for Alternative 4 would be the same as Alternative 1.

3.4.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.4.2.5.1 CONSTRUCTION

The duration of pile driving underwater noise for Alternative 5 would be less than Alternative 1. However, specific noise levels would be the same as Alternative 1. Under this alternative, there would be fewer days (135 to 175) of pile driving noise in the underwater marine environment when compared to Alternative 1, and pile driving would occur during

2 in-water work seasons compared to 2 or 3 for Alternative 1. Construction timing and limitations would be the same as those described for Alternative 1.

3.4.2.5.2 OPERATION/LONG-TERM IMPACTS

Operational effects for Alternative 5 would be the same as Alternative 1.

3.4.2.6 No-Action Alternative

The main effect of construction on underwater noise under the action alternatives is the underwater noise generated by pile driving. Under the No-Action Alternative there would be no pile driving or construction-related boat traffic. Operations including existing boat traffic and mission operations would not change from existing conditions. No additional sources of underwater noise would occur under the No-Action Alternative; thus, there would be no effect on the intensity, frequencies, or duration of underwater noise.

3.4.2.7 Mitigation Measures and Regulatory Compliance

Use of a bubble curtain or other noise attenuating device would provide some attenuation (10 dB) of underwater noise during impact pile driving as described above. Pile driving only during the allowable work window would minimize impacts to salmonids, including threatened and endangered species (see Section 3.8.2). A soft start of pile driving energy would be used for both impact and vibratory driving to induce marine mammals and birds to leave the immediate pile driving area. Installation of the pilings would only occur within the in-water work window for ESA-protected species (July 16 through February 15). Monitoring for the presence of marine mammals and birds would minimize impacts to these species (see Sections 3.9.2 and 3.10.2, respectively). Mandatory shutdown of pile driving activities could occur if marine mammals or marbled murrelets approach or enter modeled zones of influence that could correlate with injurious SPLs to each species.

Construction would typically occur 6 days per week. Impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). These restrictions were identified in the Biological Opinion from USFWS (2011) (Appendix I). Divers, including tribal divers, would receive notice of pile driving activities through the Notice to Mariners, as well as notification to the public about upcoming construction activities and noise at the beginning of each construction season.

Unweighted ambient conditions, both airborne and underwater, would be measured and recorded during the first 30 days of the construction period (in the absence of construction activities) to determine background noise levels. Recordings would be made with a minimum 20 kHz sampling rate to provide noise data up to 10 kHz. For the first 30 days of pile driving, the Navy would conduct underwater acoustic monitoring for impact driving of steel piles to confirm that noise levels are comparable to those measured during the test pile program for the project. All measurements would be made with the noise attenuation measures discussed above in place. The Navy would also conduct underwater acoustic monitoring for vibratory pile driving. Maximum SPLs would also be documented. Noise impacts have been addressed through consultation under the ESA, MSA, MMPA, and CZMA. The Navy completed

consultation with NMFS and USFWS under the ESA in September 2011 and November 2011, respectively.

3.4.3 Summary of Impacts

Impacts due to underwater noise associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.4–8.

Table 3.4–8. Summary of Impacts Due to Underwater Noise

ALTERNATIVE	ENVIRONMENTAL IMPACTS DUE TO UNDERWATER NOISE
Impact Underwater noise levels from pile driving could exceed the threshold limits for behavioral disturbance or injury to biota near the pile driving activity. There would be no overall increase in underwater noise at the Bangor waterfront from operation of the EHW-2. Noise exposure due to impact pile driving could cause behavioral changes to divers or underwater swimmers (elevated breathing and heart rate) within 40,000 feet of the pile driving activity.	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Substantial increase in underwater noise due primarily to in-water pile driving (200–400 days). 42 to 48 months of overall construction. *Operation/Long-term Impacts:* No overall increase over existing noise levels, although operational noise would be introduced at the site of the EHW-2.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Substantial increase in underwater noise due primarily to pile driving. Greater impact than Alternative 1 due to longer duration of in-water pile driving (275–550 vs. 200–400 days) and longer construction duration (54 to 64 vs. 42 to 48 months). *Operation/Long-term Impacts:* No overall increase over existing noise levels, although operational noise would be introduced at the site of the EHW-2.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Substantial increase in underwater noise due primarily to pile driving. Similar impact to Alternative 1 due to similar duration of in-water pile driving (210–420 vs. 200–400 days) and longer construction duration (42 to 49 vs. 42 to 48 months). *Operation/Long-term Impacts:* No overall increase over existing noise levels, although operational noise would be introduced at the site of the EHW-2.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Substantial increase in underwater noise due primarily to pile driving. Greater impact than Alternative 1 due to longer duration of in-water pile driving (290–570 vs. 200–400 days) and longer construction duration (54 to 64 vs. 42 to 48 months). *Operation/Long-term Impacts:* No overall increase over existing noise levels, although operational noise would be introduced at the site of the EHW-2.

Table 3.4–8. Summary of Impacts Due to Underwater Noise (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS DUE TO UNDERWATER NOISE
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Substantial increase in underwater noise due primarily to pile driving. Less impact than Alternative 1 due to shorter duration of in-water pile driving (135–175 vs. 200–400 days) and slightly shorter construction duration (42 to 44 vs. 42 to 48 months). *Operation/Long-term Impacts:* No overall increase over existing noise levels, although operational noise would be introduced at the site of the EHW-2.
No-Action Alternative	No impact.
Mitigation • A bubble curtain or other noise attenuating device would be used during impact pile driving to reduce maximum levels. • A soft start approach to pile driving would be used for both impact and vibratory driving to induce marine mammals and birds to leave the immediate pile driving area. • Divers, including tribal divers, would receive notice of pile driving activities through the Notice to Mariners, as well as notification to the public about upcoming construction activities and noise at the beginning of each construction season.	
Consultation and Permit Status • Noise impacts have been addressed through consultation under the ESA, MSA, MMPA, and CZMA. The Navy completed consultation with NMFS and USFWS under the ESA in September 2011 and November 2011, respectively.	

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3.5 MARINE VEGETATION

Marine vegetation includes macrophytes and macroalgae. Macrophytes are aquatic rooted, flowering plants. Macrophyte genera that occur in the Pacific Northwest include *Salicornia* (sea asparagus), *Zostera* (eelgrasses), and *Phyllospadix* (surfgrasses). Algae are a diverse group of simple plants that are mainly aquatic. These organisms are capable of photosynthesis and range in size from single-celled organisms (i.e., phytoplankton, discussed in Section 3.6) to large plants often referred to as seaweeds. Macroalgae lack true roots, stems, and leaves. Macroalgae are divided into three taxonomic groups based upon their dominant photosynthetic pigmentation: brown, green, and red (Lamb and Hanby 2005).

Eelgrass is protected under several federal laws. The MSA (16 USC § 1801-1881 et seq.) established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) including eelgrass for those species regulated under a federal Fisheries Management Plan (FMP). The MSA requires federal agencies to consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (MSA §305(b)(2)). EFH protects waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity for federally managed (commercially harvested) fisheries. Federal agencies are required to consult with NMFS about activities that may affect EFH for habitat protected under the MSA. In addition to EFH designations, Habitat Areas of Particular Concern (HAPCs) are also designated by the regional Fishery Management Councils (FMCs). Designated HAPCs are discrete subsets of EFH that provide extremely important ecological functions or are especially vulnerable to degradation (50 Code of Federal Regulations [CFR] 600.805-600.815). The seagrasses HAPC for Pacific coast groundfish includes eelgrass beds in estuaries (NAVFAC 2011a).

Under the provisions of CWA Section 404 implemented by USACE and USEPA, eelgrass beds are also considered Special Aquatic Sites that receive special protection. Section 404 pertains to discharges of dredged or fill material in waters of the United States, which include areas suitable for supporting eelgrass. The jurisdictional limit for Section 404 in tidal waters is the high tide line. Construction of the abutment on the western end of the paved roadway (Section 2.2.1) would require excavation below mean higher high water (MHHW), thus requiring a CWA Section 404 permit from USACE. In accordance with USEPA Section 404(b)(1) guidelines, permits for discharges of dredged or fill material in eelgrass beds may not be issued if practicable alternatives would avoid such impacts.

Section 404 activities permitted by USACE require that a Section 401 water quality certification be issued or waived by WDOE. Thus, a Section 401 water quality certification would be required for the abutment work permitted by USACE. The Navy would apply for Section 404 and Section 401 certification by submitting a Washington State JARPA for review by USACE and WDOE. The Washington Department of Fish and Wildlife (WDFW) regulates non-federal in-water construction actions through the State Hydraulic Code (RCW 77.55) and specifically protects eelgrass and kelp (*Saccharina* sp. [formerly *Laminaria*]) resources through WAC 220-110-300, which requires "no-net-loss of productive capacity of fish and shellfish habitat." Eelgrass and kelp are also considered saltwater habitats of special concern (WAC 220-110-250(3)).

WDFW may comment and provide recommendations on federal construction projects through the JARPA and National Environmental Policy Act (NEPA) processes. WDOE may incorporate these comments and recommendations into a Section 401 certification.

Section 10 of the Rivers and Harbors Act (33 USC 401 et seq.) requires authorization from USACE for the development of any structure in or over any navigable water of the United States, as well as the excavation/dredging or deposition of material in these waters. The Navy would request a Section 10 permit for construction of the overwater portion of the EHW-2 as well as excavation for the abutment. The permit process for Section 10 of the Rivers and Harbors Act of 1899 would result in an evaluation of project impacts to eelgrass beds. While not subject to specifications of the CWA 404(b)(1) guidelines, USACE would consider impacts to eelgrass (as part of the public interest review) in their evaluation of permit applications for structures or work in navigable waters pursuant to Section 10. This would apply to non-fill activities such as pile-supported structures, moorings, floats, dredging, and other structures or work conducted beyond mean high water in tidal waters.

Under Kitsap County's SMP, Section 22.28.030, General Policies (which is applicable under the CZMA), development activities are directed to avoid eelgrass, kelp, and estuarine ecosystems because of their high ecological value. As a federal agency, the Navy prepares a CCD in compliance with the CZMA explaining how their action would be "consistent to the maximum extent practicable" with the state's coastal zone management program, which in Washington invokes the applicable local shorelines management program (i.e., Kitsap County's program) (Section 3.20, Coastal and Shoreline Management). WDOE would review the CCD and make a federal consistency determination in the form of concurrence, conditional concurrence, or objection.

Consultation and Permit Compliance Status. The Navy consulted with NMFS under the ESA and MSA. The Navy submitted a JARPA to USACE and WDOE, requesting a permit under CWA Section 404 and Rivers and Harbors Act Section 10, and a CWA Section 401 water quality certification. In accordance with the CZMA, the Navy submitted a Phase I CCD to WDOE (included in Appendix I of this FEIS). WDOE concurred with the Phase I CCD on August 26, 2011 (included in Appendix I of this FEIS). The Navy will prepare and submit a Phase II CCD in spring 2012.

3.5.1 Existing Environment

Aquatic marine vegetation at the EHW-2 project site is composed of intertidal and subtidal species, as well as floating and attached species. Distribution maps of key species are presented in Section 3.5.1.1. Eelgrass is high quality habitat and is most abundant in low-energy areas, occurring in the lower intertidal and shallow subtidal photic zone where organic matter and nutrients are abundant (Johnson and O'Neil 2001). Dense to patchy bands of eelgrass are located in the vicinity of the EHW-2 project site (Morris et al. 2009). Green algae grow mainly in the lower intertidal and subtidal zones and include common species, such as sea lettuce (*Ulva* spp.). Red algae are located in the cobble and gravel upper intertidal zone but also occur subtidally. Brown algae, which include understory kelps (*Saccharina* sp. [*Laminaria* in the Pacific Northwest have recently been reclassified as *Saccharina* sp. except for *L. yezoensis*, which does not occur in Washington waters]) and the non-native Sargasso weed (or wireweed, *Sargassum muticum*), are found in nearshore environments of the Bangor waterfront from lower intertidal to subtidal zones (Morris et al. 2009, see Appendix L).

3.5.1.1 Marine Vegetation Types

Marine vegetation within the Bangor waterfront area includes eelgrass, kelp, *Sargassum*, and green, red, and brown algae (Table 3.5–1). Marine vegetation in the vicinity of the EHW-2

project site includes primarily eelgrass, kelp (a type of brown algae that includes *Saccharina* sp.), and green and red algae. Most forms of macroalgae were documented in the shallow subtidal zone between 0 and 10 feet below MLLW, often growing in the direct presence of eelgrass (Morris et al. 2009, see Appendix L).

Table 3.5–1. Abundance of Marine Vegetation Classified as Percent of Linear Shoreline

VEGETATION TYPE	PERCENT LINEAR SHORELINE[1]	ACREAGE[2,3]
Eelgrass (*Zostera* sp.)	81.9	37.7
Brown Algae		
(*Fucus*-Barnacle Assemblage)[2]	60.4	Not determined
Kelp (*Saccharina* sp.)	75.8	58.4
Sargassum muticum	15.9	11.8
Green Algae (e.g., *Ulva* spp.)	97.4	202.1
Red Algae (e.g., *Gracilaria* spp.)	76.8	73.8

Sources: Washington Department of Natural Resources (WDNR) 2006; Morris et al. 2009.

1. Percent represented by proportionate amount in sampled area.
2. Macroalgae coverage data collected by Science Applications International Corporation (SAIC) in 2007 were concentrated in the lower intertidal and shallow (less than 70 feet) zones along the Bangor shoreline. *Fucus* occurrence in the upper intertidal of the Bangor shoreline is based on the Washington State Shorezone Inventory (WDNR 2006). These data are not included in algal distribution figures.
3. Eelgrass and macroalgae overlap in their occurrence along the Bangor waterfront; therefore, the total shoreline length or acreage of marine vegetation cannot be calculated by simply summing the values for each vegetation type.

3.5.1.1.1 EELGRASS

One of the most important vegetation types in the marine ecosystem is eelgrass. Eelgrass beds produce large amounts of carbon that fuel nearshore food webs and provide critical three-dimensional structure in otherwise two-dimensional environments, offering habitat to many marine species. Eelgrass beds build up in the spring and summer and decay in the fall and winter (Puget Sound Water Quality Action Team 2001). Shellfish, such as crabs and bivalves, use eelgrass beds for habitat and nursery areas. Eelgrass is an important habitat for juvenile salmonids, which use eelgrass beds as migratory corridors, for protection from predators, and for foraging (review in Mumford 2007).

Kitsap County has one of the state's highest percentages of estuary and nearshore marine habitats occupied by eelgrass. Well-established eelgrass beds were documented in 2007 in all survey areas along the Bangor shoreline in shallow water depths ranging from 0 to 20 feet below MLLW (Morris et al. 2009). A dense band of eelgrass covering approximately 0.5 acre occurs in the inshore area of the existing EHW from MLLW to 5 feet below MLLW (Figure 3.5–1) (Morris et al. 2009). South of the existing EHW, a 2,400-foot long, 3.3-acre continuous eelgrass bed occurs below MLLW to a depth of 10 feet below MLLW (Morris et al. 2009). This eelgrass bed was re-delineated in early October 2010 (Hart Crowser 2011). Its location and size was consistent with the 2007 survey, with eelgrass occupying depths between 2 and 24 feet below MLLW (the areas shown in Figure 3.5–1). The total area increased to 4.1 acres, and the bed appeared healthy and dense, with a small break at the southern end due to a shallow sand bar (Hart Crowser 2011).

3.5.1.1.2 MACROALGAE

3.5.1.1.2.1 GREEN MACROALGAE

Sea lettuce (*Ulva* spp.) is the most common green algae at the EHW-2 project site. It grows from the lower-intertidal subzone to depths of more than 50 feet below MLLW in protected areas along the waterfront. However, the *Ulva* community is concentrated at depths less than about 30 feet below MLLW and occurs only sparsely (less than 10 percent coverage) at greater depths (Figure 3.5–2) (Pentec 2003; Morris et al. 2009). Boulders in the nearshore marine habitats at the EHW-2 project site are typically encrusted with sea lettuce (Pentec 2003). Sea lettuce has a high nutrient value (Kirby 2001) which, when it dies and decomposes, provides an important source of marine nitrogen, as detritus, that supports eelgrass growth. In the October 2010 survey, macroalgae were more prevalent in the shallow subtidal/intertidal than at deeper depths (Hart Crowser 2011). This was likely due to substrate differences where shell fragments (likely enhanced by seastar predation) contributed to the larger sediment fraction at shallower depths. This larger sediment fraction offers more opportunity for macroalgal colonization. Overall, macroalgae, although present, did not represent a dominant habitat type within the survey area, unlike eelgrass.

3.5.1.1.2.2 RED MACROALGAE

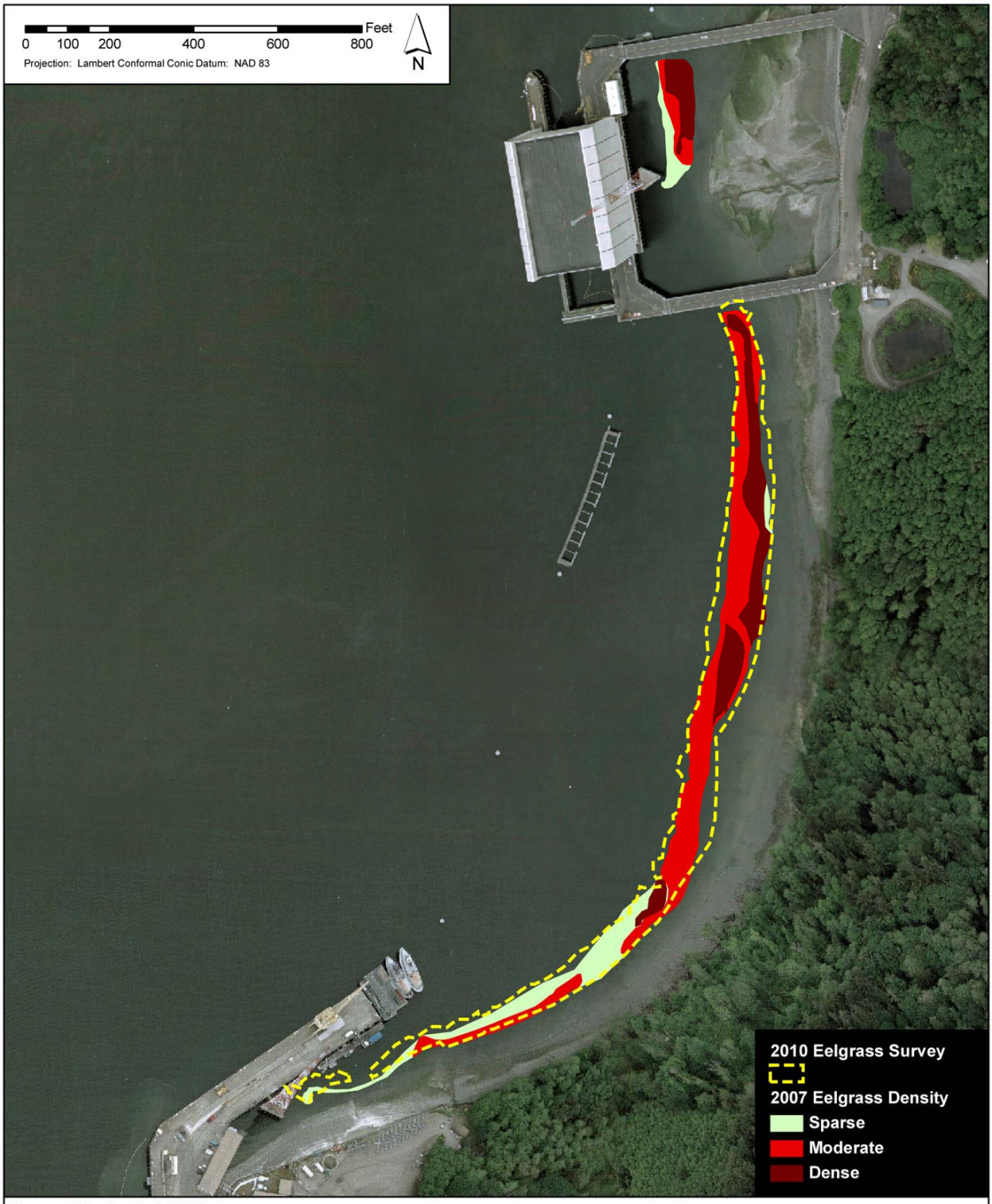
Red algae of the genera *Endocladia*, *Mastocarpus*, *Ceramium, Porphyra*, and *Gracilaria* are present at the EHW-2 project site in the intertidal zones (Pentec 2003) (Figure 3.5–2). During the 2007 survey, red algae (primarily *Gracilaria*) were more abundant at water depths between 10 feet and 25 feet below MLLW but also occurred sparsely (less than 10 percent coverage) out to depths of 60 feet below MLLW (Morris et al. 2009). Red algae such as those found along the Bangor shoreline are ecologically important as primary producers and for providing structural habitat for other marine organisms.

3.5.1.1.2.3 BROWN MACROALGAE

Brown algae are found in a variety of forms, including encrusting, filamentous, and leafy varieties on rocks and boulders. A key brown alga, the understory kelp *Saccharina* sp., is discussed below under Kelp. Several leafy brown algae species (e.g., *Egregia*) are present in the vicinity of the EHW-2 project site. During the 2007 survey, brown algae were most abundant at water depths between 10 feet and 25 feet below MLLW (Morris et al. 2009). Rock weed (*Fucus spp.*) is common in the project area attached to rocks and cobble in the intertidal barnacle zone (Pentec 2003) (Table 3.5–1).

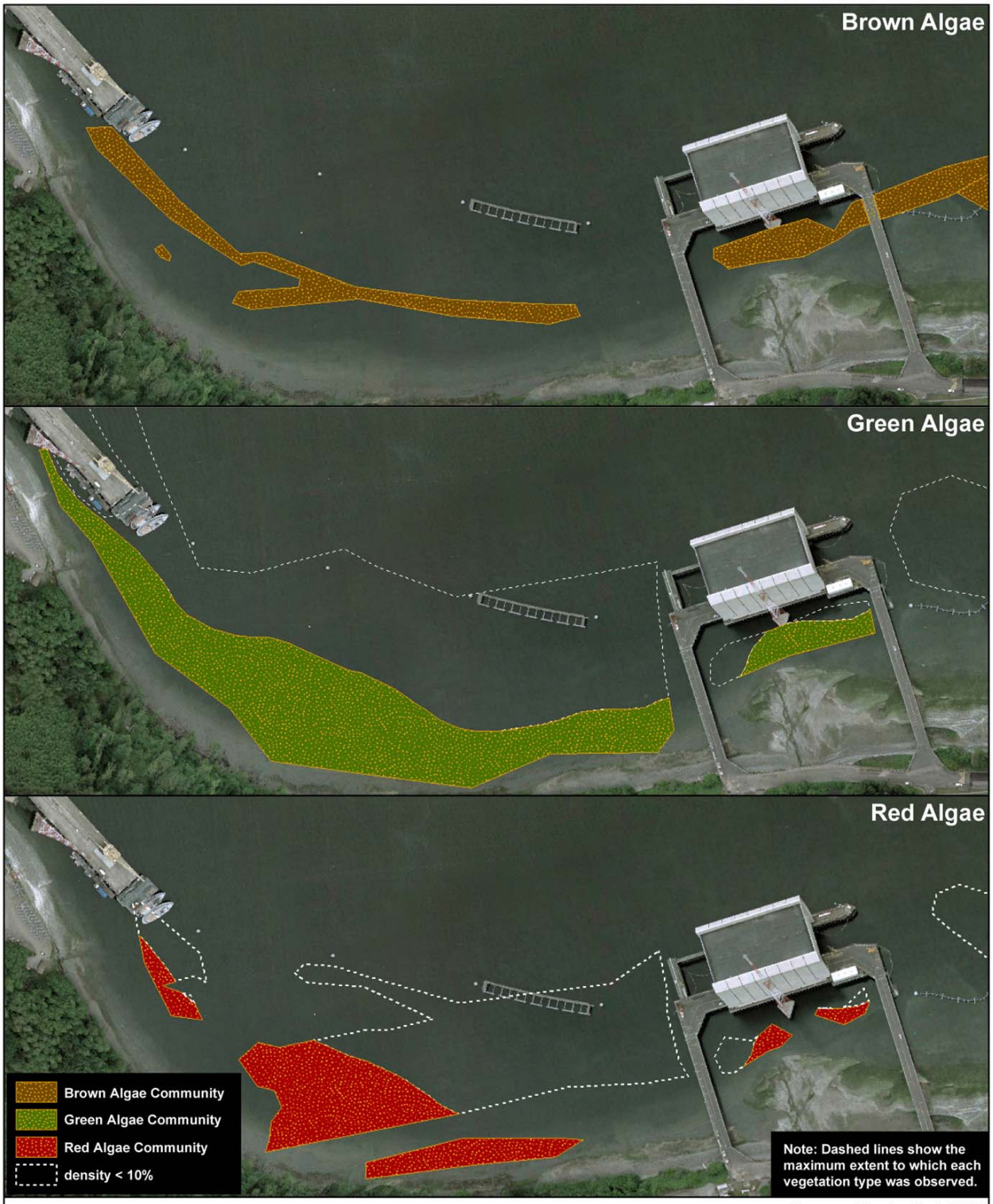
KELP

Understory kelp (*Saccharina* sp.) provide an important source of nutrients to the seafloor (from fragmentation and decomposition) and multi-species vertical habitat in deeper marine waters (Mumford 2007). Two narrow bands of understory kelp occur in the vicinity of the EHW-2 project site approximately 330 feet to the south of the existing EHW and shoreward of the existing EHW wharf between the entrance and exit trestles (Figure 3.5–2). The southern band is approximately 1,600 feet long and covers 2.3 acres. The northern band behind the existing EHW extends to the north covering 4,300 feet and covering over 13.8 acres. The kelp beds along the Bangor shoreline occur to depths of about 25 feet below MLLW.



Source: Morris et al. 2009

Figure 3.5–1. Eelgrass Distribution Near the Existing EHW



Source: Morris et al. 2009

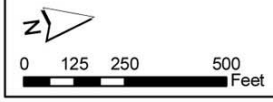


Figure 3.5–2. Macroalgae Distribution Near the Existing EHW

In the October 2010 survey, drift (detached) kelp fronds were noted at the deeper edges of the survey area (Hart Crowser 2011). Most kelp in the lower-intertidal subzone and the nearshore marine habitats of NBK at Bangor are *Saccharina* sp., but traces of the genera *Desmarestia* and *Pilayella* also have been documented (Pentec 2003; Morris et al. 2009). No attached, canopy-forming kelp beds (e.g., bull kelp) occur at the EHW-2 project site (Morris et al. 2009).

SARGASSUM MUTICUM

Sargassum muticum is a brown macroalga native to the Sea of Japan but now occurs in most areas of the Pacific Coast of North America. It was first documented in Washington State waters in the 1950s and was likely introduced when Pacific oysters were planted in the early 1900s. The complex branching of *Sargassum* plants provides habitat for amphipods and other invertebrates and their predators; however, where *Sargassum* overlaps with native marine vegetation (such as eelgrass, kelp, and other macroalgae), it outcompetes those species by shading (Whatcom County Marine Resources Committee 2005). Further, *Sargassum* "may negatively affect water movement, light penetration, sediment accumulation, and [DO concentrations] at night" (Williams et al. 2001). Two large beds of *Sargassum* occur along the Bangor waterfront between Delta Pier and Carlson Spit. Other pockets of *Sargassum* on the base are small and isolated. No *Sargassum* occurs at the EHW-2 project site.

3.5.2 Environmental Consequences

The evaluation of impacts to marine vegetation considers whether there would be loss or degradation of marine vegetation including eelgrass or kelp, which are protected under federal or state law, or if there would be introduction of an exotic species, such as *Sargassum muticum*, that would impact the growth of protected or native species.

3.5.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

The total area of marine habitat potentially disturbed during construction of Alternative 1 would be 3.7 acres in the nearshore (shallower than 30 feet below MLLW) and 22 acres in deep water (deeper than 30 feet below MLLW). Of those 25.7 acres, approximately 1 acre supports vegetation communities. Construction activities for Alternative 1 would result in impacts to approximately 0.43 acre of eelgrass beds[4] (approximately 10 percent of the bed), 0.13 acre of kelp beds (approximately 6 percent of the bed), 0.92 acre of green macroalgae beds, and 0.17 acre of red macroalgae beds (Table 3.5–2). Areas with less than 10 percent coverage of a particular vegetation type were not considered beds or communities of that type. The various types of macroalgae are expected to return to the area following construction, with some reduction of algal habitat in fully shaded areas. Construction of the EHW-2 would not facilitate the introduction or increase the existing prevalence of exotic species, such as *Sargassum muticum*, along the Bangor shoreline. Long-term presence and operation of the EHW-2 would reduce some productivity in the immediate area due to shading. Shading would result in the loss or reduction of eelgrass directly under the trestles, but the additional surface area of the piles would provide additional habitat for other marine vegetation species such as *Ulva*. The Mitigation Action Plan (Appendix F) describes the marine habitat mitigation action that the Navy would undertake as part of the proposed action. This habitat mitigation action, including

[4] Impacts to eelgrass for this assessment are based on the 2010 eelgrass survey data (Hart Crowser 2011); macroalgae impacts are based on the 2007 survey data (Morris et al. 2009), which mapped macroalgae in the project area in addition to eelgrass.

mitigation for eelgrass, would compensate for the impacts of the proposed action to marine habitat and species.

Table 3.5–2. Marine Habitat Impacted by Alternative 1

Habitat Type	Potential Construction Disturbance Area (acres)[1]	Area Displaced by Piles (Acres)	Operational Shading Area (acres)	
			Full Shade[2]	Partial Shade[3]
Nearshore[4]	3.7	0.008	0.41	0.18
Deep Water[5]	22	0.20	5.9	1.5
Vegetation Type[6]				
Eelgrass	0.43	Not Determined[7]	0.067	0.027
Brown Macroalgae (Kelp)	0.13	Not Determined[7]	0	0
Green Macroalgae	0.92	Not Determined[7]	0.13	0.05
Red Macroalgae	0.17	Not Determined[7]	0	0

1. The potential construction disturbance area includes the structure footprint and the area within 150 feet of the proposed EHW structure. Areas actually disturbed by construction are likely to be substantially less.
2. The area in full shade was assumed to be that directly in the footprint of the proposed EHW structure.
3. The area in partial shade was assumed to be that within 10 feet of the footprint of the proposed EHW structure.
4. Nearshore = the area shallower than -30 feet MLLW.
5. Deep water = the area deeper than -30 feet MLLW.
6. Eelgrass and macroalgae overlap in their occurrence along the Bangor waterfront. Therefore, the total acreage of marine vegetation potentially impacted cannot be calculated by summing the values for each vegetation type.
7. Areas of vegetation displaced by piles were not determined because the exact locations of piles are not yet known.

3.5.2.1.1 CONSTRUCTION

Barges, tugboats, and other vessels (e.g., skiffs) would be stationed at the EHW-2 project site during construction. Tugboats would bring in and position barges and then leave the site. While the vessels would be directed to avoid grounding and damaging marine vegetation on the seafloor, the vegetation would be directly impacted by seafloor disturbance from anchor and spud placement, pile driving, and vessel shading. Measures would be implemented to avoid underwater line drag and anchor drag (see Appendix F, Mitigation Action Plan). The impact area would consist of the EHW-2 footprint where piles would be driven and new wharf construction would occur, as well as a 150-foot area surrounding the site where barges would be stationed and tug boats would maneuver the barges during pile driving. A possible source for construction-related impacts to marine vegetation would be from accidental debris spills from barges or construction platforms into Hood Canal. Debris spills could smother bottom vegetation. The Navy would require the construction contractor to prepare and implement a Debris Management Plan with procedures for retrieving and cleaning up any accidental spills. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups.

As shown in Table 3.5–2, construction activities for Alternative 1 would result in impacts to 0.43 acre of eelgrass, 0.13 acre of kelp, 0.92 acre of green macroalgae, and 0.17 acre of red macroalgae. Because vegetated communities comprise a mixture of vegetation types, the acreages are not additive, and the total marine vegetation area potentially impacted by in-water construction activities would be 1 acre. While construction activities would be limited to the EHW and 150-foot surrounding area, not all of the seafloor within the 150-foot corridor would be disturbed. Therefore, construction impacts identified in this section are conservative; the actual impact would be substantially less.

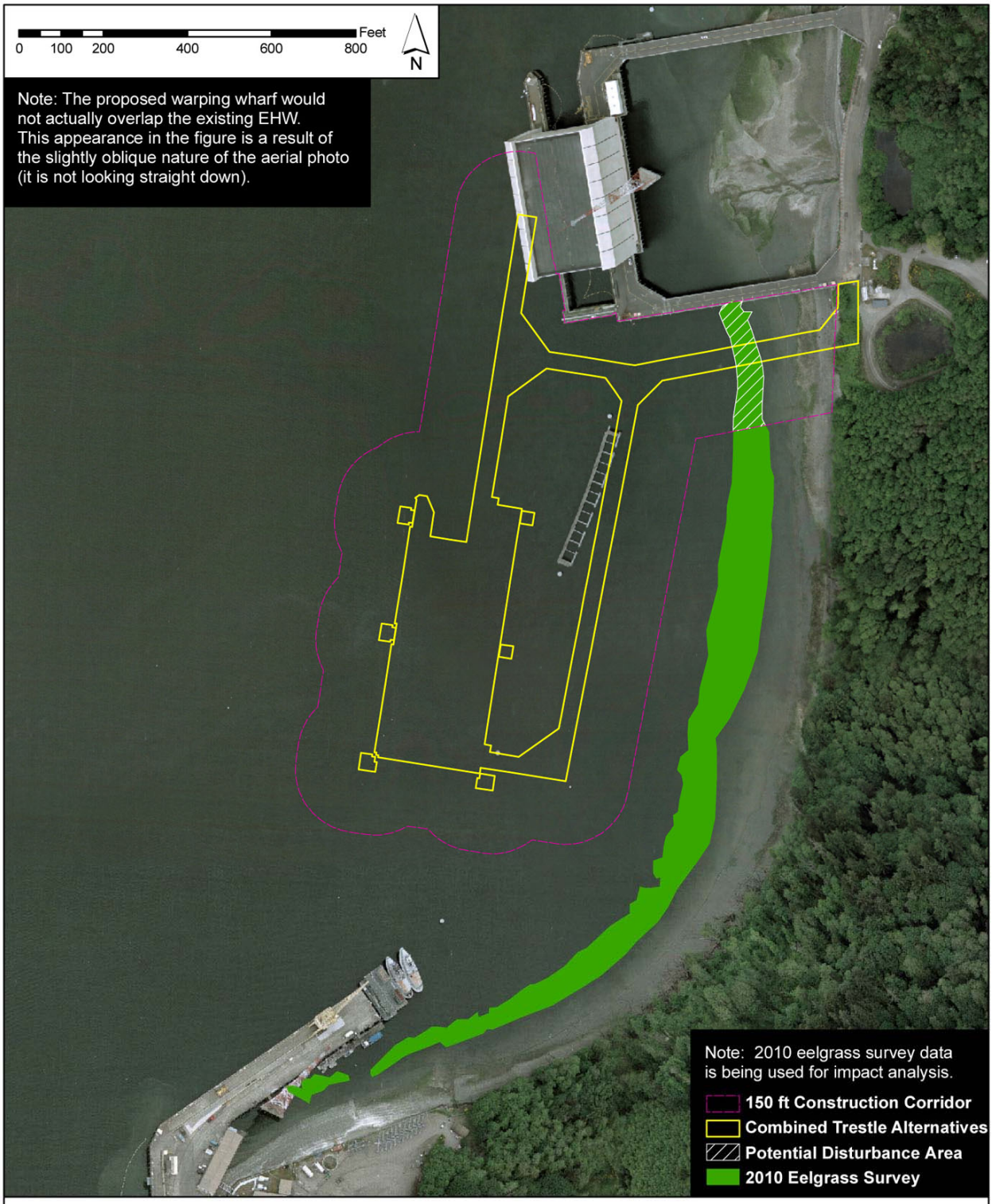
3.5.2.1.1.1 EELGRASS

The combined trestle would cross an eelgrass bed located immediately south of the existing EHW. A maximum of 0.43 acre of that 4.1-acre bed would be impacted during construction (Table 3.5–2, Figure 3.5–3). This area includes eelgrass directly under the proposed trestle, as well as within 150 feet of the proposed structures. No eelgrass occurs beneath the main wharf, warping wharf, or covered berth portions of the EHW-2 structure.

Eelgrass is a rooted aquatic plant that depends on biogeochemical processes in sediment to maintain growth (Hart Crowser 1997; Thom et al. 1998; review in Mumford 2007). Sediments also protect the roots from drying out and being eaten by herbivores. Repeated disturbance around individual plants, such as would occur from pile driving, can result in death or shifting of the bed location (Hart Crowser 1997). Over time, events causing erosion would remove sediments from the root system and expose below-ground plant parts to degradative processes. In addition, vessel propeller wash can scour and redistribute sediments and reduce the amount of light energy reaching the plants at the sea floor (Thom et al. 1998). Barges and boats involved in pile driving would be expected to impact existing eelgrass beds (e.g., by anchor and spud placement) within 150 feet of the EHW-2 project site where the vessels would be stationed and most boat movement activities would occur.

Oil spills could potentially occur during construction, which could result in the loss of eelgrass. As described under Water Quality (Section 3.2.2.1.1.7), the existing facility response and prevention plans for the Bangor waterfront provide guidance that would be used in the event of a spill, including a response procedures, notification, and communication plan; roles and responsibilities; and response equipment availability. The contractor would also prepare and implement a spill response plan (e.g., an SPCC Plan) to clean up fuel or fluid spills. In the event of an accidental spill, response measures would be implemented immediately to reduce the potential for exposure to the environment.

Eelgrass within 150 feet of construction that is not directly impacted would potentially experience reduced growth due to increased turbidity and sediment particle settlement on individual plant blades, as well as between the plants. In the shallow areas where eelgrass occurs, sediment resuspension would be associated with pile driving and barge operations. Due to the sandy composition of the surficial sediments and the nature of the water column currents in the area, the majority of the sediment particles would fall out of suspension within 130 feet of disturbance (see discussion of impacts to water quality in Section 3.2.2.1). In addition, eelgrass would experience lower irradiance during construction due to vessel shading. The eelgrass area subject to shading during the construction period is assumed to be equal to that located within the 150-foot construction area (0.43 acre); however, this is a highly conservative estimate because the vessels would not be stationary for the entire construction period and would be positioned to avoid eelgrass beds to the extent possible.



Source: Morris et al. 2009

Figure 3.5–3. Disturbance Area for Eelgrass Near the Combined Trestle Alternatives (1 and 2)

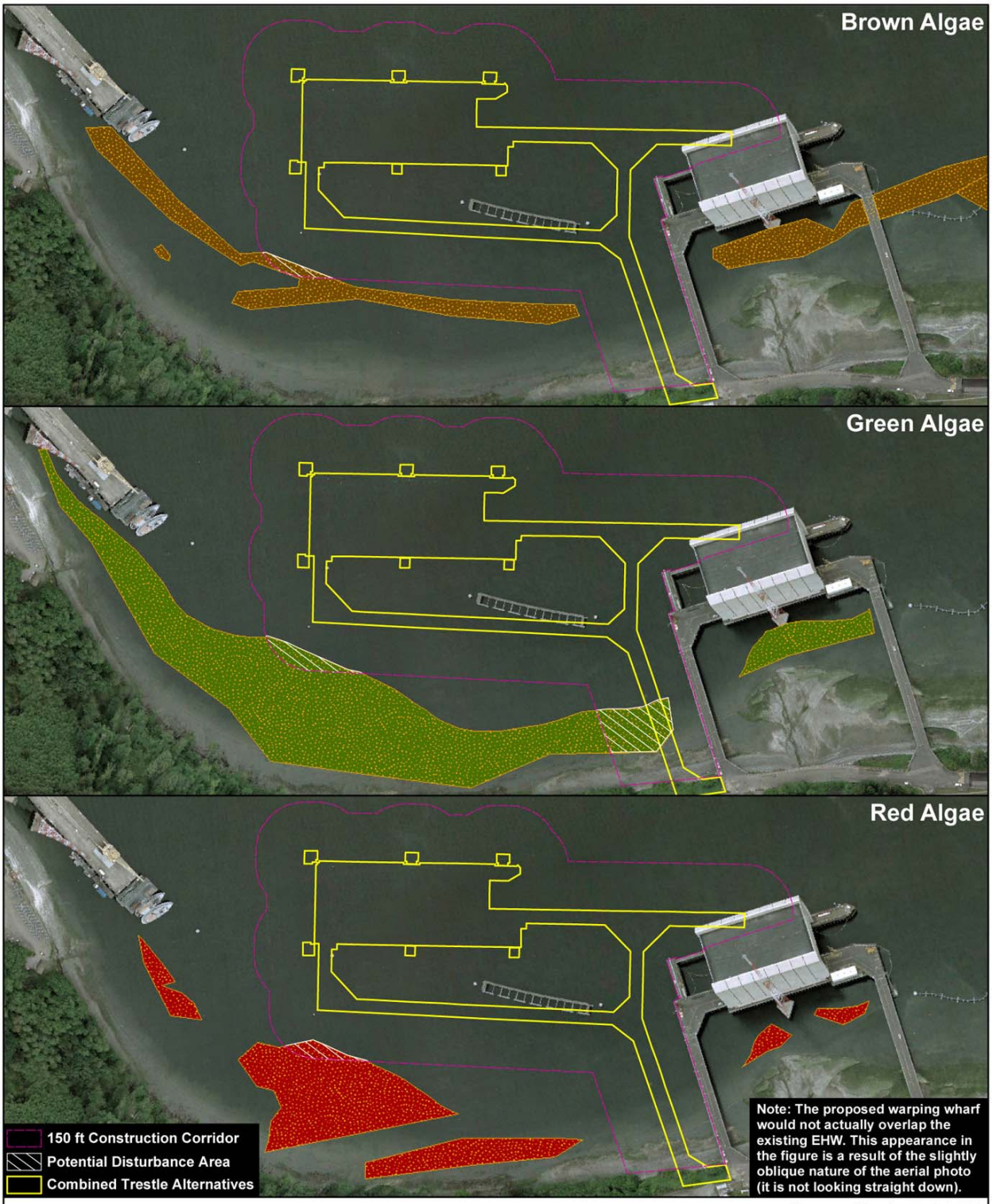
Eelgrass is sensitive to low light levels (reviews in Nightingale and Simenstad 2001a and Mumford 2007), and marine plant communities in Washington, including eelgrass, can be limited by light availability (Thom and Albright 1990). The eelgrass bed in this area would be expected to lose individual plants and become less dense. However, eelgrass plants have more rapid growth rates during the spring and summer months (Puget Sound Water Quality Action Team 2001). Therefore, eelgrass in the construction zone would have time to grow prior to the onset of construction in mid-July and contribute to more rapid recovery. Only the area directly under the trestle and within 10 feet (trestle shaded area) would not be expected to recover from construction impacts due to operational shading once the trestle is completed (described under Section 3.5.2.1.2, Operation/Long-term Impacts).

To mitigate impacts, construction would be conducted to the extent feasible from barges in deep water, during high tides, and/or from land. Vessel traffic would be excluded from shallow areas outside of the 150-foot construction zone. Spuds would be used to prevent barges from grounding in shallow areas including eelgrass beds. Measures would be put in place to avoid seafloor disturbance from underwater line drag and anchor drag. Barges and boats would be positioned to prevent shading any vegetated area for extended periods. The Mitigation Action Plan (Appendix F) describes the marine habitat mitigation action that the Navy would undertake as part of the proposed action. This habitat mitigation action, including mitigation for eelgrass, would compensate for impacts of the proposed action to marine habitat and species.

3.5.2.1.1.2 MACROALGAE

Macroalgae, which occur at a greater range of depths than eelgrass at the EHW-2 project site (Morris et al. 2009), require less intense light than eelgrass for growth (Frankenstein 2000; Nightingale and Simenstad 2001a), and would be expected to recruit back to the seafloor following construction. As described in above in Section 3.5.1, green macroalgae, such as sea lettuce, have rapid growth rates during summer and early fall months when light intensity is highest in the Pacific Northwest (Nelson et al. 2003). Therefore, macroalgae in the construction zone would have time to grow prior to the onset of construction in mid-July and contribute to rapid recovery. In addition, green algae species potentially impacted are predominantly *Ulva* species, which are known to cause nuisance blooms in Puget Sound in late fall (Frankenstein 2000).

A maximum of 0.92 acre of seafloor supporting green macroalgae and 0.17 acre of red macroalgae beds would be impacted during construction (Table 3.5–2, Figure 3.5–4). The impact area would primarily occur within 150 feet of the EHW-2 project site where most direct (e.g., vessel shading), and indirect (e.g., turbidity, sedimentation) impacts would occur. Propeller wash impacts to marine vegetation would be limited to shallower waters and would not be expected at greater depths where the main wharf and warping wharf would be constructed. No impacts to macroalgae would be expected beyond the 150-foot area. Oil spills could also potentially occur during construction, which could result in the loss of macroalgae. In the event of an accidental spill, response measures as noted above would be implemented immediately to reduce potential exposure to the environment.



Source: Morris et al. 2009

Figure 3.5−4. Disturbance Area for Macroalgae Near the Combined Trestle Alternatives (1 and 2)

No kelp grows directly in the footprint of Alternative 1 structure, but a narrow kelp bed (*Saccharina* sp.) occurs roughly parallel to the exit trestle structure at a distance of 25 to 150 feet (Figure 3.5–4). A total of 0.13 acre of kelp occurs within the 150-foot construction disturbance area (Table 3.5–2). Within 150 feet of construction, kelp could experience reduced growth due to turbidity, settled sediments on top of the kelp blades, and vessel shading. Oil spills could potentially occur during construction, which could result in the loss of kelp. In the event of an accidental spill, response measures as noted above would be implemented immediately to reduce potential exposure to the surrounding environment.

As described above in Section 3.5.1.1.2, *Sargassum* occurs primarily in the southern portion of the Bangor waterfront, although a small area (0.07 acre) occurs south of the EHW-2 project site. No *Sargassum* occurs within the 150-foot disturbance area of the EHW-2 project site. *Sargassum muticum* is an invasive non-native species that has been shown to out-compete native marine vegetation, such as eelgrass and kelp, for habitat and ambient light via rapid growth (Britton-Simmons 2004; Whatcom County Marine Resources Committee 2005). *Sargassum* can be introduced to new areas by distribution on the hulls of barges, tugboats, and other boats, and on propellers or anchors (review in Josefsson and Jansson 2007). The piles and decking materials for this alternative would be new and therefore would not be sources of attached exotic organisms. In addition, the vessels used during construction would comply with U.S. Coast Guard regulations designed to minimize the spread of exotic species. As a result, construction of the EHW-2 would not introduce exotic species from foreign water bodies or increase the prevalence of existing exotic species in Hood Canal.

3.5.2.1.2 OPERATION/LONG-TERM IMPACTS

The total area of marine habitat impacted by operation of Alternative 1 would be 0.4 acre in the nearshore (shallower than 30 feet below MLLW) and 5.9 acres in deep water (deeper than 30 feet below MLLW). Operational activities would primarily impact the growth of marine vegetation through shading that would occur from the EHW-2. Water depths at the main wharf and warping wharf (greater than 80 feet below MLLW) would be too deep for propeller wash from submarines and tug boats to disturb marine vegetation or for the submarines to contribute to operational shading. The total area of marine vegetation impacted by shading would be 0.13 acre. Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components as required. These activities would not directly affect marine vegetation. Measures such as those documented under Section 3.2.2, Water Quality, would be employed to avoid discharges of contaminants to the marine environment during EHW-2 operations.

3.5.2.1.2.1 EELGRASS

Some eelgrass habitat would be impacted during operation of the EHW, principally because shading from the overwater structure of the trestle would reduce primary production. Approximately 0.09 acre of the 4.1-acre eelgrass habitat would receive some degree of shading. Approximately 0.06 acre of the 0.09 acre would be completely shaded directly beneath the trestle and 0.03 acre within 10 feet to either side of the trestle would be partially shaded. Marine vegetation, including eelgrass and macroalgae, grows within 10 feet of the existing EHW trestle, which has similar dimensions and height to the proposed EHW-2 trestle. Due to security reasons, surveying under the current EHW trestle was not possible, and it is unknown to what extent eelgrass occurs under the trestle. Therefore, a conservative estimate for the area of partial shading was defined as marine vegetation within 10 feet of the proposed EHW structure.

The area of eelgrass traversed by the trestle was minimized by orienting the trestle perpendicular to the shoreline (compare with the Diagonal Trestle Alternative in Figure 2–7, and discussion of Alternative Trestle Layouts in Section 2.2.10.1.1). The area of eelgrass shaded by the trestle would also be minimized by the height of the trestle over the water (15.2 feet above MLLW). An increased structure height over the water diminishes the intensity of shading by providing a greater distance for light to diffuse and refract around its surface as the sun arcs across the sky (review in Nightingale and Simenstad 2001a). The shading effect would be greatest at higher tides when the trestle height over water would range from 1 to 5 feet. This daytime shadow effect would occur during less than 13 percent of all daylight hours throughout the year. During the rest of the time, the trestle clearance would be 5 feet or more over the water.

Seafloor areas in full shade throughout the day, which would be something less than the overwater footprint of the structure due to the sun arc, would not support eelgrass growth, and existing eelgrass in these areas would become sparse or die off. These shaded areas would create gaps (called fragmentation) or patchy areas in the eelgrass bed. The gaps would be exploited by macroalgae species requiring less light (see macroalgae discussion below). Healy and Hovel (2004) found no general trend for the effects of seagrass bed fragmentation on faunal densities. Other seagrass field studies have shown that patchy seagrass areas would continue to provide habitat to benthic organisms or that grain size or location of the seagrass in the intertidal zone had more influence on faunal community than patch size (Frost et al. 1999; Bell et al. 2001; Hirst and Attrill 2008; Mills and Berkenbusch 2009). The effects of eelgrass bed fragmentation on marine fish are discussed in Section 3.8.2.

As described in Section 3.1.2.1, the presence of the EHW-2 piles would produce small changes to the bathymetry inshore of the EHW-2 project site that would occur over the long term due to the attenuation (reduction in energy) of surface waves approaching from the west. This reduction in wave energy would establish an environment shoreward of the EHW-2 project site more conducive to long-term deposition of sediments, promoting accumulation of fine-grained sediment in the form of a shoal area in the nearshore environment. This long term change in bathymetry may result in a gradual shift in the location of the eelgrass bed at this location over time.

3.5.2.1.2.2 MACROALGAE

The EHW-2 trestles and wharf would fully shade approximately 0.13 acre of green macroalgae; macroalgae diminish at depths greater than about 30 feet below MLLW and are only sparsely present at depths where the wharf would be constructed. The wharf would partially shade 0.05 acre of green macroalgae. Shading of existing eelgrass habitat could give adjacent macroalgae a competitive advantage because macroalgae require less intense light for growth (Frankenstein 2000). As with eelgrass, the area permanently shaded by the overwater structures would be decreased by the height of these structures over the water. Orientation of the wharf and longest trestles along a generally north-south alignment would also reduce shading (review in Nightingale and Simenstad 2001a). Macroalgae in fully shaded areas would become sparse or die off (Nightingale and Simenstad 2001a). Because macroalgae have considerably lower light requirements than eelgrass (Frankenstein 2000; Nightingale and Simenstad 2001a), macroalgae in partially shaded areas would not be expected to die off and the partially shaded areas are not considered to be negatively impacted for this marine vegetation type.

The piles would create new substrate to support colonization of algae common to marine fouling communities, such as sea lettuces and acid weeds (Figure 3.5–5) (Goyette and Brooks 2001). Colonization would vary among piles and water depth associated with light availability

and overwater shading (e.g., Navy 1988). Macroalgae would colonize the piles within months (Kozloff 1983) and should be well established within a year (Goyette and Brooks 2001). Colonization of algae on new hard structures would help to minimize, but would not fully offset, changes in primary production associated with overwater shading in areas with macroalgae.

Figure 3.5–5. Green Macroalgae Attached to a Waterfront Pier on NBK at Bangor

Operations would not be expected to inhibit kelp growth because none have been documented in the footprint of the structure for Alternative 1. Vessel activity from docking submarines at the EHW-2 would occur several hundred feet to the west of the nearest kelp bed and would not impact these species.

There would be no increase in vessel traffic over existing conditions from operation of the EHW-2. As a result, this alternative would not increase the potential for transfer of ballast water, a known exotic species vector, from water bodies outside of Puget Sound into Hood Canal. *Sargassum muticum* or other invasive marine vegetation may be able to colonize habitats where large-scale or repeated disturbances allow them a competitive advantage over native species (Britton-Simmons and Abbott 2008). However, operation of the EHW-2 would not create chronic disturbances that would facilitate colonization by non-indigenous species. Therefore, operation of the EHW-2 would not increase the presence of *Sargassum* along the Bangor waterfront or in Hood Canal.

3.5.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.5.2.2.1 CONSTRUCTION

As described in Chapter 2, Alternative 2 differs from Alternative 1 in that it would use a larger number of smaller piles for construction of the wharf. The trestle alignments and dimensions

would be the same. Impacts to marine vegetation from construction of this alternative would be of similar magnitude as those described for Alternative 1 (Figures 3.5–3 and 3.5–4; Table 3.5–3).

Table 3.5–3. Marine Habitat Impacted by Alternative 2

Habitat Type	Potential Construction Disturbance Area (acres)[1]	Area Displaced by Piles (Acres)	Operational Shading Area (acres)	
			Full Shade[2]	Partial Shade[3]
Nearshore[4]	3.7	0.008	0.41	0.18
Deep Water[5]	22	0.20	5.9	1.5
Vegetation Type[6]				
Eelgrass	0.43	Not Determined[7]	0.06	0.025
Brown Macroalgae (Kelp)	0.13	Not Determined[7]	0	0
Green Macroalgae	0.92	Not Determined[7]	0.13	0.05
Red Macroalgae	0.17	Not Determined[7]	0	0

1. The potential construction disturbance area includes the structure footprint and the area within 150 feet of the proposed EHW structure.
2. The area in full shade was assumed to be that directly in the footprint of the proposed EHW structure.
3. The area in partial shade was assumed to be that within 10 feet of the footprint of the proposed EHW structure.
4. Nearshore = the area shallower than -30 feet MLLW.
5. Deep water = the area deeper than -30 feet MLLW.
6. Eelgrass and macroalgae overlap in their occurrence along the Bangor waterfront. Therefore, the total acreage of marine vegetation potentially impacted cannot be calculated by summing the values for each vegetation type.
7. Areas of vegetation displaced by piles were not determined because the exact locations of piles are not yet known.

However, as described for water quality (Section 3.2), the additional piles would result in resuspension of bottom sediments (turbidity) within the immediate construction area for a longer duration. However, the installation of the conventional piles would resuspend less sediment per day compared to the large piles proposed for installation under Alternative 1. Thus, the potential for water quality impacts per day during pile driving under Alternative 2 would be less than Alternative 1, but pile driving would occur over a longer duration under Alternative 2. Therefore, turbidity impacts to marine vegetation would be slightly greater under Alternative 2.

3.5.2.2.2 OPERATION/LONG-TERM IMPACTS

Operational impacts to marine vegetation from the EHW-2 would primarily be due to shading effects. Because the shading footprints of the overwater structures in Alternatives 1 and 2 would be the same, operational impacts to marine vegetation would be the same as those described for Alternative 1. Maintenance impacts also would be the same as described for Alternative 1.

3.5.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

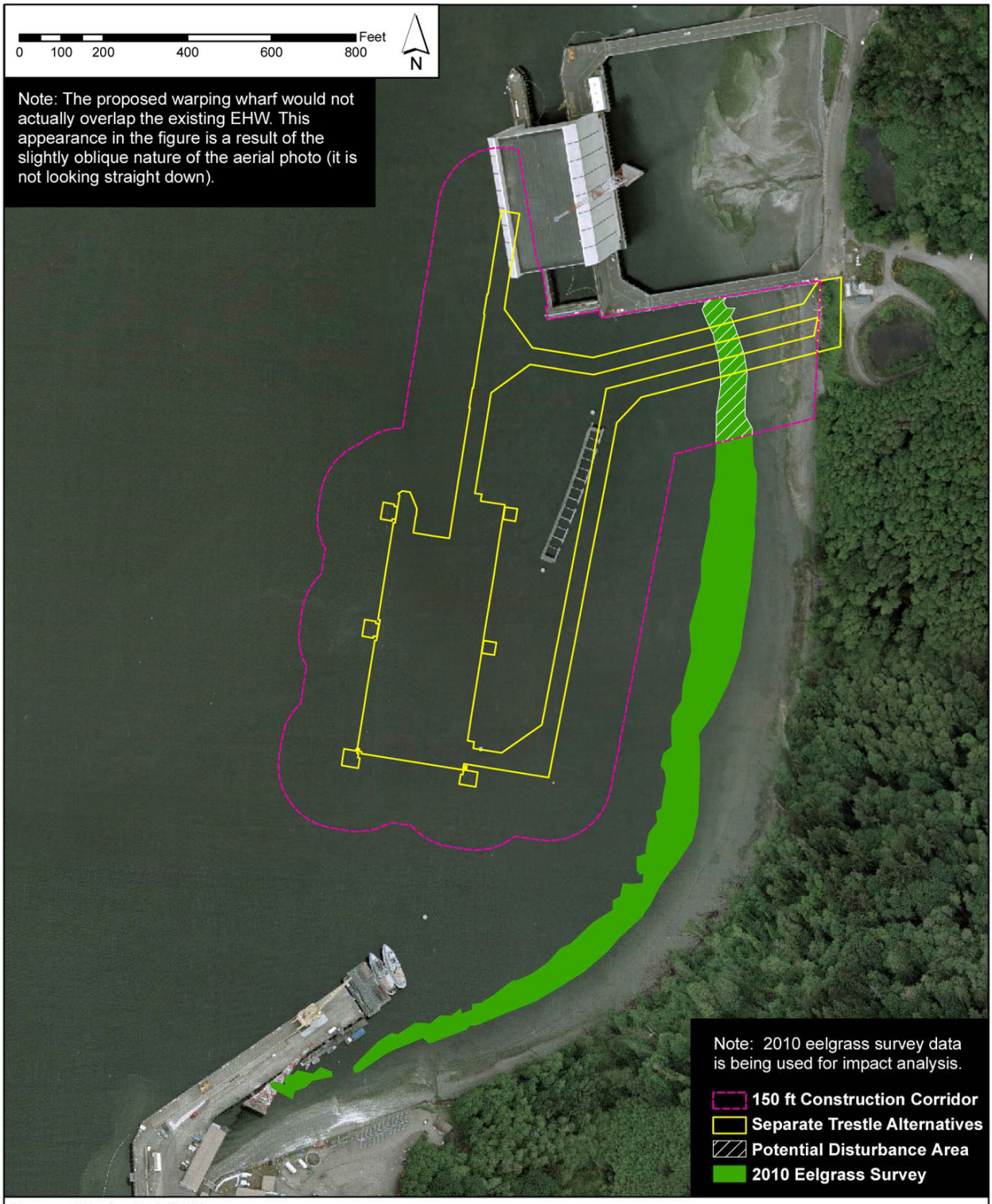
3.5.2.3.1 CONSTRUCTION

The total area of marine habitat potentially disturbed during construction of Alternative 3 would be 3.8 acres in the nearshore (shallower than 30 feet below MLLW) and 22 acres in deep water (deeper than 30 feet below MLLW). The types of direct impacts associated with placement of the piles and assembly of the wharf and trestles would be similar to those described for Alternative 1. However, the area of eelgrass disturbed during construction of Alternative 3 (0.49 acre) would be approximately 15 percent greater than for Alternative 1 (0.43 acre) (Table 3.5–2) because the entry and exit trestles would cross the eelgrass bed in two different locations (Figure 3.5–6). The areas of kelp and green macroalgae disturbed would be 6.9 percent and 11 percent greater than under Alternative 1 (Table 3.5–4, Figure 3.5–7). Because vegetated communities comprise a mixture of vegetation types, the acreages are not additive and the total area of marine vegetation potentially impacted by in-water construction activities of Alternative 3 would be 1.1 acres.

Table 3.5–4. Marine Habitat Impacted by Alternative 3

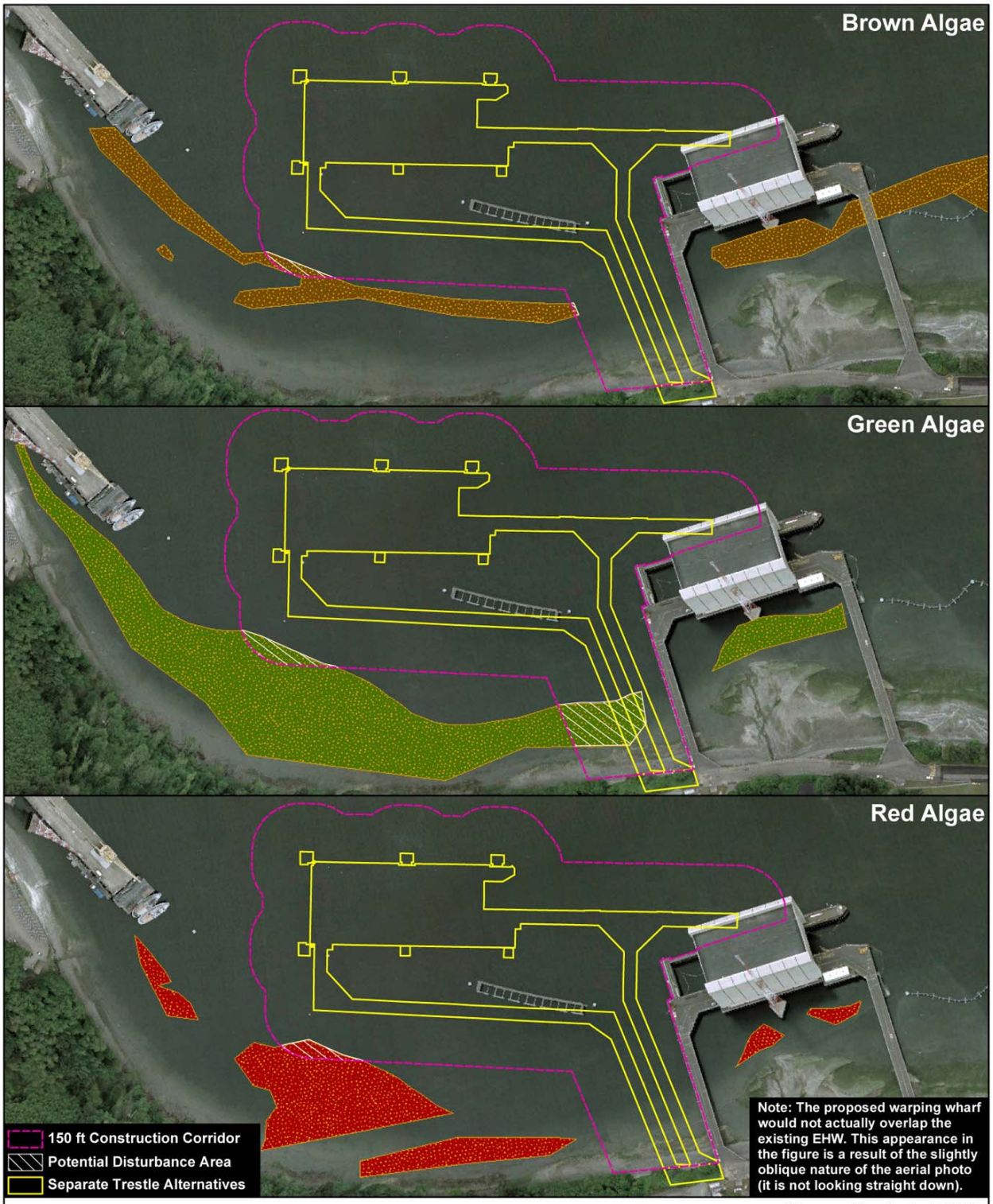
Habitat Type	Potential Construction Disturbance Area (acres)[1]	Area Displaced by Piles (Acres)	Operational Shading Area (acres)	
			Full Shade[2]	Partial Shade[3]
Nearshore[4]	3.8	0.015	0.75	0.45
Deep Water[5]	22	0.20	5.9	1.6
Vegetation Type[6]				
Eelgrass	0.49	Not Determined[7]	0.11	0.05
Brown Macroalgae (Kelp)	0.14	Not Determined[7]	0	0
Green Macroalgae	1.0	Not Determined[7]	0.17	0.08
Red Macroalgae	0.17	Not Determined[7]	0	0

1. The potential construction disturbance area includes the structure footprint and the area within 150 feet of the proposed EHW structure.
2. The area in full shade was assumed to be that directly in the footprint of the proposed EHW structure.
3. The area in partial shade was assumed to be that within 10 feet of the footprint of the proposed EHW structure.
4. Nearshore = the area shallower than -30 feet MLLW.
5. Deep water = the area deeper than -30 feet MLLW.
6. Eelgrass and macroalgae overlap in their occurrence along the Bangor waterfront. Therefore, the total acreage of marine vegetation potentially impacted cannot be calculated by summing the values for each vegetation type.
7. Areas of vegetation displaced by piles were not determined because the exact locations of piles are not yet known.



Source: Morris et al. 2009

Figure 3.5−6. Disturbance Area for Eelgrass Near the Separate Trestle Alternatives (3 and 4)



Source: Morris et al. 2009

Figure 3.5−7. Disturbance Area for Macroalgae Near the Separate Trestle Alternatives (3 and 4)

3.5.2.3.2 OPERATION/LONG-TERM IMPACTS

The total area of marine habitat impacted by operation of Alternative 3 would be 0.8 acre in the nearshore (shallower than 30 feet below MLLW) and 5.9 acres in deep water (deeper than 30 feet below MLLW). The area of nearshore fully shaded would be approximately 83 percent greater than for Alternative 1. Impacts to marine vegetation due to changes in shading during operation of Alternative 3 would be similar to those for Alternative 1, except that the total area shaded for all vegetation types would be more due to the larger size of the overwater structure in the nearshore (Table 3.5–2, Table 3.5–4). The permanent area of shading over the existing eelgrass bed (including fully plus partially shaded areas) would be approximately 73 percent greater (0.16 acre vs. 0.09 acre), with Alternative 3 shading 0.07 acre more eelgrass than Alternative 1. The area of permanent shading over green macroalgae would be approximately 24 percent greater (0.17 acre vs. 0.13 acre). Because vegetated communities comprise a mixture of vegetation types, the acreages are not additive, and the total area of marine vegetation impacted by shading would be 0.19 acre. There would also be more surface area on the piles for macroalgae to colonize because there would be more piles for this alternative compared to Alternative 1. Maintenance impacts would be the same as described for Alternative 1.

3.5.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.5.2.4.1 CONSTRUCTION

As described in Chapter 2, Alternative 4 differs from Alternative 1 in that it would use a larger number of smaller piles for construction of the wharf and there would be two trestles rather than one. Impacts to marine vegetation from construction of this alternative would be slightly greater than those described for Alternative 1 due to the wider construction zone in the nearshore (Figures 3.5–6 and 3.5–7, Table 3.5–5). The area of eelgrass disturbed during construction of Alternative 4 (0.49 acre) would be approximately 15 percent greater than for Alternative 1 (0.43 acre) (Table 3.5–2) because the entry and exit trestles would cross the eelgrass bed in two different locations (Figure 3.5–6). The areas of kelp and green macroalgae disturbed would be 6.9 percent and 11 percent greater than under Alternative 1 (Table 3.5–5, Figure 3.5–7). Because vegetated communities comprise a mixture of vegetation types, the acreages are not additive and the total area of marine vegetation potentially impacted by in-water construction activities of Alternative 4 would be 1.1 acres.

3.5.2.4.2 OPERATION/LONG-TERM IMPACTS

The main difference in marine vegetation impacts for this alternative compared to Alternative 1 would be increased long term impacts to eelgrass and green macroalgae due to shading. Under Alternative 4, 0.16 acre of eelgrass would be affected by total full and partial shading versus 0.09 acre for Alternative 1. For green macroalgae, the area of permanent shading would be approximately 24 percent greater (0.17 acre vs. 0.13 acre). Because vegetated communities comprise a mixture of vegetation types, the acreages are not additive and the total area of marine vegetation impacted by shading would be 0.19 acre. Maintenance impacts would be the same as described for Alternative 1.

Table 3.5–5. Marine Habitat Impacted by Alternative 4

Habitat Type	Potential Construction Disturbance Area (acres)[1]	Area Displaced by Piles (Acres)	Operational Shading Area (acres)	
			Full Shade[2]	Partial Shade[3]
Nearshore[4]	3.8	0.015	0.75	0.45
Deep Water[5]	22	0.20	5.9	1.6
Vegetation Type[6]				
Eelgrass	0.49	Not Determined[7]	0.11	0.05
Brown Macroalgae (Kelp)	0.14	Not Determined[7]	0	0
Green Macroalgae	1.0	Not Determined[7]	0.17	0.08
Red Macroalgae	0.17	Not Determined[7]	0	0

1. The potential construction disturbance area includes the area within 150 feet of the proposed EHW structure.
2. The area in full shade was assumed to be that directly in the footprint of the proposed EHW structure.
3. The area in partial shade was assumed to be that within 10 feet of the footprint of the proposed EHW structure.
4. Nearshore = the area shallower than -30 feet MLLW.
5. Deep water = the area deeper than -30 feet MLLW.
6. Eelgrass and macroalgae overlap in their occurrence along the Bangor waterfront. Therefore, the total acreage of marine vegetation potentially impacted cannot be calculated by summing the values for each vegetation type.
7. Areas of vegetation displaced by piles were not determined because the exact locations of piles are not yet known.

3.5.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.5.2.5.1 CONSTRUCTION

As described in Chapter 2, one of the main differences between Alternative 1 and Alternative 5 would be the greater overwater coverage of the main wharf and warping wharf of Alternative 5 (Figures 3.5–3 and 3.5–8). The total area of marine habitat potentially disturbed during construction of Alternative 5 would be 6.5 acres in the nearshore (shallower than 30 feet below MLLW) and 23 acres in deep water (deeper than 30 feet below MLLW). Because the long trestle is located closer to the shoreline in Alternative 5, the area of eelgrass in the 150-foot potential disturbance area is approximately 0.24 acre larger than for Alternative 1. Therefore, the potential for construction impacts to eelgrass from Alternative 5 would be greater than those described for Alternative 1 (Table 3.5–6).

Construction impacts to macroalgae would be similar to those described for Alternative 1 except that there would be significantly fewer piles under Alternative 5 (up to 440 vs. up to 1,250 piles) and, therefore, less sediment disturbance and turbidity due to pile driving. However, the size of the construction corridor would be 3.8 acres greater under Alternative 5 due to the larger size of the overwater structures (Figure 3.5–9). Therefore, although there would be fewer piles in this alternative, the construction impact area would be 162 percent and 788 percent greater for green and red macroalgae, respectively, and 969 percent greater for kelp

(Table 3.5–6). Because vegetated communities comprise a mixture of vegetation types, the acreages are not additive and the total area of marine vegetation potentially impacted by in-water construction activities of Alternative 5 would be 3.3 acres.

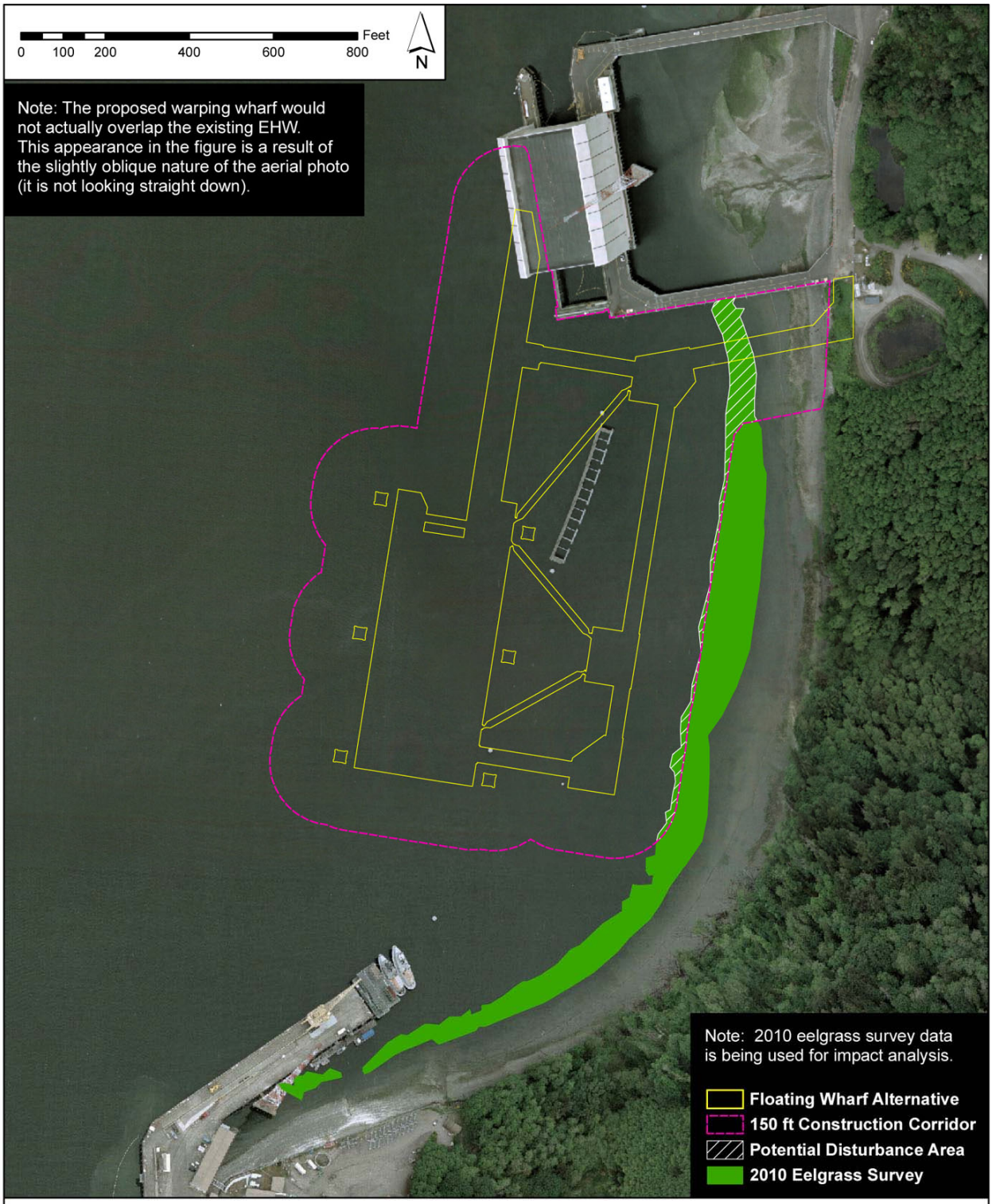
Table 3.5–6. Marine Habitat Impacted by Alternative 5

Habitat Type	Potential Construction Disturbance Area (acres)[1]	Area Displaced by Piles (Acres)	Operational Shading Area (acres)	
			Full Shade[2]	Partial Shade[3]
Nearshore[4]	6.5	0.025	0.78	0.42
Deep Water[5]	23	0.05	7.7	1.9
Vegetation Type[6]				
Eelgrass	0.67	Not Determined[7]	0.06	0.025
Brown Macroalgae (Kelp)	1.4	Not Determined[7]	0.02	0.03
Green Macroalgae	2.4	Not Determined[7]	0.20	0.08
Red Macroalgae	1.6	Not Determined[7]	0.06	0.05

1. The potential construction disturbance area includes the area within 150 feet of the proposed EHW structure.
2. The area in full shade was assumed to be that directly in the footprint of the proposed EHW structure.
3. The area in partial shade was assumed to be that within 10 feet of the footprint of the proposed EHW structure.
4. Nearshore = the area shallower than -30 feet MLLW.
5. Deep water = the area deeper than -30 feet MLLW.
6. Eelgrass and macroalgae overlap in their occurrence along the Bangor waterfront. Therefore, the total acreage of marine vegetation potentially impacted cannot be calculated by summing the values for each vegetation type.
7. Areas of vegetation displaced by piles were not determined because the exact locations of piles are not yet known.

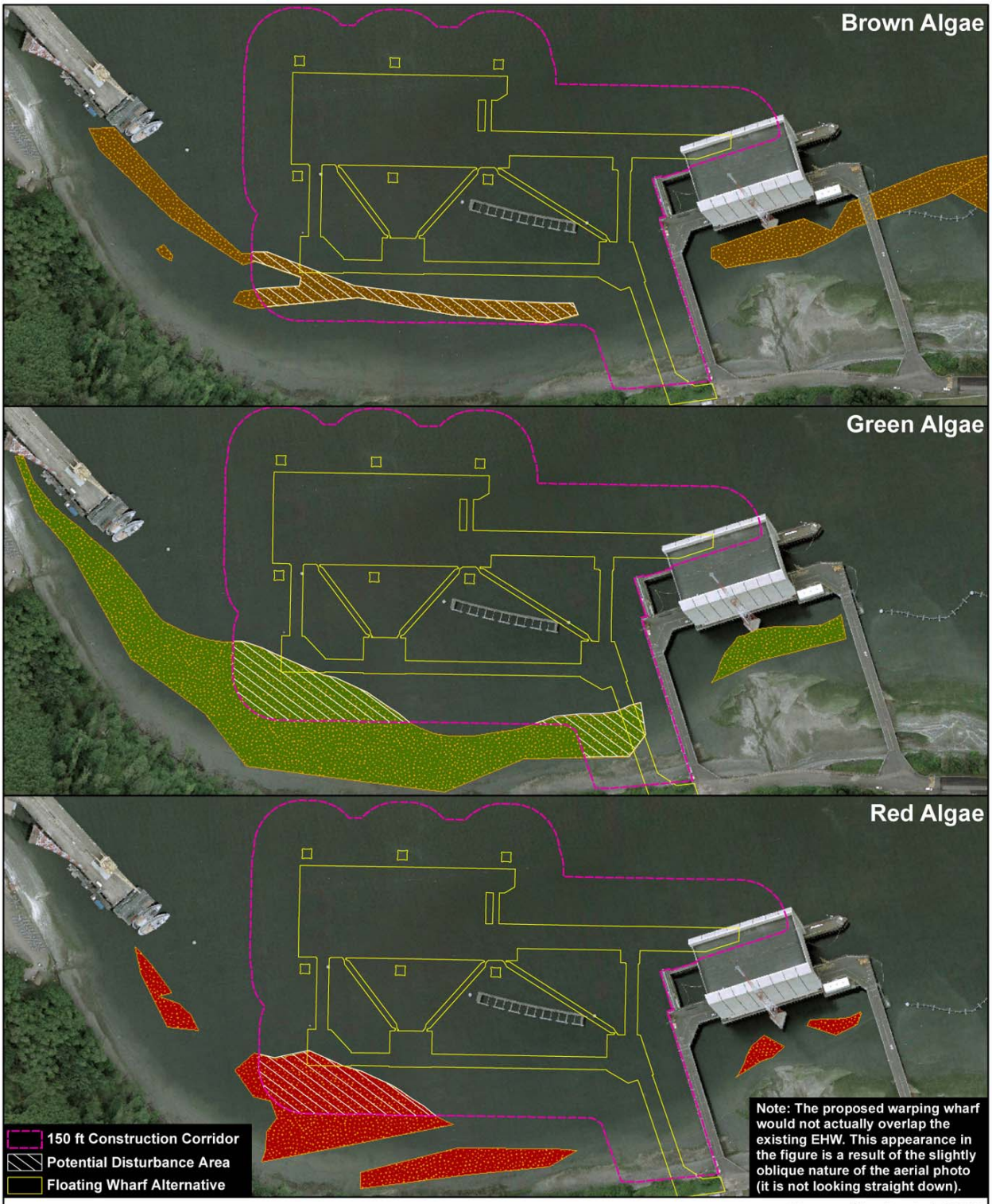
3.5.2.5.2 OPERATION/LONG-TERM IMPACTS

The total area of marine habitat impacted by operation of Alternative 5 would be 0.8 acre in the nearshore (shallower than 30 feet below MLLW) and 7.7 acres in deep water (deeper than 30 feet below MLLW). The area of nearshore fully shaded would be approximately 90 percent greater for this alternative than for Alternative 1. Operational impacts to eelgrass from Alternative 5 would be similar to those for Alternative 1 because the shading footprint of the trestle crossing the eelgrass bed would be similar under Alternative 5. However, because the long access trestle is located closer to the shoreline in Alternative 5 and the overall structure would be much larger (8.5 vs. 6.3 acres), the area of macroalgae shaded would be much greater than for Alternative 1 (0.2 vs. 0.13 acre for green macroalgae and 0.06 vs. 0 acre for red macroalgae). Because vegetated communities comprise a mixture of vegetation types, the acreages are not additive and the total area of marine vegetation impacted by shading would be 0.2 acre. Macroalgae would be expected to colonize the underwater sides of the floating concrete pontoons and pile surfaces where there is sufficient light to support their growth. Maintenance impacts would be the same as described for Alternative 1.



Source: Morris et al. 2009

Figure 3.5−8. Disturbance Area for Eelgrass Near the Floating Wharf Alternative (5)



Source: Morris et al. 2009

Figure 3.5−9. Disturbance Area for Macroalgae Near the Floating Wharf Alternative (5)

3.5.2.6 No-Action Alternative

There would be no additional direct loss of marine vegetation (including red, green, and brown algae, and eelgrass) under the No-Action Alternative. This is particularly important for eelgrass due to the relationship of survival for juvenile salmonids (Section 3.8.1.1.1.2, Salmonid Marine Habitat Requirements). For the No-Action Alternative there would be no construction or change in operation and, therefore, no impacts to marine vegetation.

3.5.2.7 Mitigation Measures and Regulatory Compliance

Current practices and mitigation measures that would minimize impacts of the proposed action to marine vegetation are provided below.

3.5.2.7.1 GENERAL MITIGATION MEASURES

- Impacts from marine vegetation disturbance by vessel activity would be minimized or avoided by conducting construction of the EHW-2 from barges in deep-water areas and/or during high tides, and/or from land. Vessel traffic would be excluded from the shallow areas outside of the 150-foot construction zone, which would be demarcated with clearly visible markers. Vessel operators would be provided maps of the project site with eelgrass beds clearly marked. Measures would be in place to avoid seafloor disturbance from underwater line drag and anchor drag (see description of current practices in Appendix F, Mitigation Action Plan).
- Construction barges would avoid grounding in eelgrass beds during construction activities. This would be conducted through the use of spuds that would elevate barges during low tides.
- Use of shallow draft, lower horsepower tugboats in the nearshore area and for extended operations in areas shallower than 40 feet below MLLW, where feasible, would reduce impacts to eelgrass during construction.
- Barges used for in-water construction would be repositioned at the construction site as often as necessary to avoid shading existing eelgrass for extended periods of time (more than one day). Previously shaded eelgrass must remain unshaded for at least one day before a barge can be positioned again above that habitat.

3.5.2.7.2 MITIGATION ACTION PLAN

The Mitigation Action Plan (Appendix F) describes the marine habitat mitigation action that the Navy would undertake as part of the proposed action. This habitat mitigation action, including mitigation for eelgrass, would compensate for the impacts of the proposed action to marine habitat and species.

3.5.2.7.3 REGULATORY COMPLIANCE

The Navy completed consultation with NMFS under the ESA and MSA on September 27, 2011. Eelgrass mitigation would be designed and finalized as part of permitting under USACE (Rivers and Harbors Act Section 10) and WDOE (CWA Section 401 water quality certification). The proposed action involves fill in waters of the U.S. (see Section 3.14.2.1) and would require a CWA Section 404 permit, although that fill would not directly affect marine vegetation. The fill would consist of armor rock with a cover of backfilled beach material, which would be placed

high on the beach, above where marine vegetation occurs. The compensatory aquatic mitigation (described in Appendix F, Mitigation Action Plan) would compensate for the loss of eelgrass from the proposed action. The Navy consulted with NMFS under the MSA and submitted a JARPA to USACE and WDOE, requesting permits under CWA Sections 401 and 404, and Rivers and Harbors Act Section 10. In accordance with the CZMA, the Navy submitted a Phase I CCD to WDOE. WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD in spring 2012.

3.5.3 Summary of Impacts

Impacts to marine vegetation associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.5–7.

Table 3.5–7. Summary of Impacts to Marine Vegetation

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE VEGETATION
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Would temporarily disturb marine vegetation in a localized area. Potential disturbance of 3.7 acres of shallow-water habitat, 0.43 acre of eelgrass, 0.13 acre of kelp, 0.92 acre of green macroalgae, and 0.17 acre of red macroalgae. Construction would be conducted over 2 to 3 in-water work seasons. *Operation/Long-term Impacts:* Shading would limit primary production in 0.09 acre of eelgrass and 0.13 acre of green macroalgae.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Would temporarily disturb marine vegetation in a localized area. Potential disturbance of 3.7 acres of shallow-water habitat, 0.43 acre of eelgrass, 0.13 acre of kelp, 0.92 acre of green macroalgae, and 0.17 acre of red macroalgae. Construction would be conducted over 3 to 4 in-water work seasons. *Operation/Long-term Impacts:* Shading would limit primary production in 0.09 acre of eelgrass and 0.13 acre of green macroalgae.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Slightly larger area of potential construction disturbance in shallow water (3.8 acres), 0.49 acre of eelgrass, 0.14 acre of kelp, 1.0 acre of green macroalgae, and 0.17 acre of red macroalgae. Construction would be conducted over 2 to 3 in-water work seasons. *Operation/Long-term Impacts:* Slightly greater impact to marine vegetation: shading would limit primary production in 0.16 acre of eelgrass and 0.17 acre of green macroalgae.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Slightly larger area of potential construction disturbance in shallow water (3.8 acres), 0.49 acre of eelgrass, 0.14 acre of kelp, 1.0 acre of green macroalgae, and 0.17 acre of red macroalgae. Construction would be conducted over 3 to 4 in-water work seasons. *Operation/Long-term Impacts:* Slightly greater impact to marine vegetation: shading would limit primary production in 0.16 acre of eelgrass and 0.17 acre of green macroalgae.

Table 3.5–7. Summary of Impacts to Marine Vegetation (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE VEGETATION
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Larger potential construction disturbance area for shallow habitat (6.5 acres) including eelgrass (0.67 acre) and macroalgae (1.4 acres of kelp, 2.4 acres of green macroalgae, 1.6 acres of red macroalgae) than Alternative 1; larger construction corridor with potential to disturb more marginal macroalgae habitat in deep water. Construction would be conducted over 2 in-water work seasons. *Operation/Long-term Impacts:* Shading would limit primary production in 0.09 acre of eelgrass; greater impact to macroalgae: shading of 0.02 acre of kelp, 0.2 acre of green macroalgae, and 0.06 acre of red macroalgae.
No-Action Alternative	No impacts.
Mitigation: Under all alternatives, the Mitigation Action Plan (see Appendix F) would compensate for the impacts of the EHW-2.	
Consultation and Permit Status • The Navy consulted with NMFS under the ESA and MSA. • The Navy has submitted a JARPA to USACE and WDOE, requesting a permit under CWA Section 404 and Rivers and Harbors Act Section 10, and a CWA Section 401 water quality certification. • The Navy submitted a Phase I CCD to WDOE and WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD.	

Note: Due to the sensitivity of eelgrass to low light levels, the area of eelgrass considered to be impacted by the proposed EHW structure consists of the eelgrass directly under the structure (fully shaded) plus partially shaded area. Macroalgae in partially shaded areas would not be expected to die off; therefore, the partially shaded areas are not considered to be negatively impacted for this marine vegetation type and only the directly shaded areas are indicated for macroalgae.

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3.6 PLANKTON

Plankton are single-celled algae and multi-cellular animals that reside in the water column and form the foundation of the marine food web. Most plankton are dispersed by wind, tides, and currents, although some have limited mobility. Plankton are often divided into two groups: photosynthetic species that transform light energy from the sun into chemical energy (phytoplankton) and heterotrophic species that derive nutrition by consuming other organisms (zooplankton). Zooplankton are an important part of the food chain for other marine organisms, such as threatened and endangered salmon species.

There are no federal or state regulations pertaining directly to plankton or requirements for regulatory consultation. Regulations indirectly affecting plankton include water quality criteria for parameters related to excessive nutrient loading, which can cause algal blooms (larger accumulations of phytoplankton) that can adversely affect water quality (described in Section 3.2, Water Quality).

3.6.1 Existing Environment

Plankton resources at the EHW-2 project site include common phytoplankton (planktonic algae) and zooplankton (planktonic animals) species. Phytoplankton and zooplankton are critical components of the Hood Canal food web, but their abundance and distribution are not well known or characterized (Puget Sound Action Team [PSAT] 2007a). The community in Hood Canal includes phytoplankton (e.g., diatoms and dinoflagellates) and zooplankton such as crustacean larvae (calanoid copepods, hyperiid amphipods, and euphausiids [krill]) and some life stages of shrimp, cumaceans, and fish larvae and eggs (called ichthyoplankton) (Schreiner 1977; Simenstad and Kinney 1978; Salo et al. 1980; Llansó 1998; WDOE 1998). Crustacean larvae are the most common type of zooplankton in Hood Canal.

3.6.1.1 Phytoplankton

In Hood Canal, phytoplankton are composed mainly of diatoms (unicellular algae with silica shells) and dinoflagellates (microscopic organisms with self-propulsion) (Strickland 1983). Diatoms account for most of the phytoplankton biomass in Hood Canal (PSAT 2007a).

Phytoplankton abundance in the Puget Sound region follows a seasonal pattern. In the summer, increased abundance is influenced by weak tidal mixing, reduced circulation, and increased heat from the sun, which contributes to strong stratification in the upper water column. In the fall, local wind events or strong tidal exchange can mix the stratified water and upwell nutrients from lower in the water column, causing a phytoplankton bloom. Phytoplankton abundance then decreases as winter approaches due to decreased sunlight and increased mixing and outflow from heavy rains (Newton and Mote 2005). Between 2001 and 2005, blooms were recorded in the waters adjacent to NBK at Bangor from February through June (PSAT 2007a).

Phytoplankton populations may become problematic during bloom periods because, once they die off, DO levels can decrease dramatically as bacteria consume the organic materials. Only a few dozen species are associated with toxic or harmful blooms (Boesch et al. 1997; Horner 1998; PSAT 2007a); however, many thousands of species of microscopic and macroscopic algae exist. Examples of toxic species that occur in Hood Canal include diatoms in the genus *Pseudo-nitzschia*, which produce domoic acid that causes amnesic shellfish poisoning in humans (domoic acid acts as a neurotoxin, causing permanent short-term memory loss, brain

damage, and death in severe cases), and dinoflagellates in the genus *Alexandrium* that can produce a toxin (saxitoxin, a neurotoxin) that causes paralytic shellfish poisoning. Poisoning of humans and wildlife can occur when filter-feeding shellfish concentrate these toxins to dangerous levels. Shellfish beaches on NBK at Bangor have been closed to harvesting in the past when testing indicated the presence of saxitoxin (Kalina 2008, personal communication). In addition, several diatom species of the genus *Chaetoceros* have barbed spines that can damage fish gills and can cause fish kills during bloom conditions.

3.6.1.2 Zooplankton

The most abundant types of zooplankton in Hood Canal are crustaceans (including various types of copepods, amphipods, ostracods, isopods, shrimp, and cumaceans) and crustacean larvae (Simenstad and Kinney 1978; Strickland 1983). Some zooplankton spend their entire life as planktonic organisms (resident plankton) while some spend only a portion of their life cycle as plankton (meroplankton) such as in egg or larval stages of development. Zooplankton do not occur in blooms, but their populations increase with phytoplankton abundance (PSAT 2007a).

Zooplankton depend on the availability of phytoplankton as a food source, which fluctuates seasonally, annually, and geographically. An increase in the abundance of zooplankton occurs locally near fish and invertebrate spawning sites, with the emergence of large clouds of meroplankton (planktonic larvae) during the winter and spring months. Other species contribute to the meroplankton population during other times of the year, such as bivalves and sand dollars that spawn in the summer (Strickland 1983; WDFW 2000; Snow et al. 2005). Zooplankton in the meroplankton stage may remain in this state for up to 7 weeks.

3.6.2 Environmental Consequences

The evaluation of impacts to plankton considers whether an increase of phytoplankton blooms or a decrease in plankton abundance would impact the aquatic organisms dependent on this food supply.

3.6.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

During construction and operation of Alternative 1, there would be minimal changes in plankton distribution and abundance and no increased possibility of phytoplankton blooms. Therefore, no mitigation measures are necessary.

3.6.2.1.1 CONSTRUCTION

No direct impacts to plankton would occur during construction because plankton are not sessile and subject to impacts associated with placement of the piles for the EHW-2. However, as described for construction impacts to water quality in Section 3.2.2.1.1, pile driving and propeller wash from construction vessels would result in suspension of bottom sediments and formation of a turbidity plume in near-bottom waters. Propeller wash impacts would be limited to shallower waters and would not be expected at greater depths where the main wharf and warping wharf would be constructed. BMPs, including installation of a temporary runoff capture and discharge system and installation of temporary siltation barriers below the excavation/construction zone to control stormwater runoff into Hood Canal, would limit turbidity from suspended sediments during construction work. Turbid conditions would be short-term and localized, and suspended sediments would disperse and/or settle rapidly (within a period of

minutes to hours) after construction activities cease (see discussion of impacts to water quality in Section 3.2.2.1). Changes in turbidity, such as those resulting from dredging or other bottom disturbances, can temporarily alter phytoplankton communities (Hanson et al. 2003). However, because the bulk of the resuspended material would remain in near-bottom waters, the photic zone would not be limited and phytoplankton productivity would not be reduced. In addition, in-water construction work would occur between mid-July and mid-February, outside of the most productive period for phytoplankton in Puget Sound (May) (Strickland 1983). Phytoplankton mature to reproductive life stages within a few days and can remain viable for days to weeks, resulting in new communities every few days.

Potential impacts of increased water column turbidity on zooplankton include entrapment and sinking of plankton due to particle ingestion or adhesion, and decreased survival, growth rates, and body weight resulting from clogged and damaged feeding appendages (Pequegnat et al. 1978; O'Connor 1991; USACE 1993). However, the majority of zooplankton are filter-feeders and are well adapted to suspended materials in the water. Studies in freshwater and marine systems have found that some zooplankton actively migrate to areas of turbidity (review in O'Connor 1991). Some non-selective filter-feeding zooplankton, including calanoid copepods commonly found in Puget Sound, may decrease their feeding rates in response to high TSS (O'Connor 1991). Further, because Alternative 1 would not increase nutrients in Hood Canal, construction of the EHW-2 would not cause increases in toxin-associated species such as *Pseudo-nitzschia*, which could harm other aquatic organisms.

Oil spills could potentially occur during construction, which could result in impacts to plankton. As described under Water Quality (Section 3.2.2.1.1.7), the existing facility response and prevention plans for the Bangor waterfront provide guidance that would be used in a spill response, such as a response procedures, notification, and communication plan; identification of roles and responsibilities; and response equipment availability. The contractor would also prepare and implement a spill response plan (e.g., an SPCC Plan) to clean up fuel or fluid spills. In the event of an accidental spill, response measures would be implemented immediately to minimize potential impacts to the environment.

Sediments at the EHW-2 project site have low organic carbon levels (Section 3.3, Sediment), which correspond to low levels of organic nutrients. Therefore, releases of nutrients to the water column due to sediment resuspension during construction would not be of sufficient magnitude to cause an increase in phytoplankton blooms, including blooms of toxic organisms such as *Alexandrium*, along the Bangor waterfront.

3.6.2.1.2 OPERATION/LONG-TERM IMPACTS

Piles supporting the wharf and trestles would create colonization sites for common marine fouling communities, including filter-feeders that prey on plankton. Hard surfaces are known to support a variety of planktonic organisms including protozoa, foraminiferans (Kozloff 1983), and benthic diatoms (Stark et al. 2000). Planktonic harpacticoid copepods, ostracods, amphipods, and isopods are often abundant around docks and piers that provide a habitat and food source of algae, diatoms, and hydroids (Kozloff 1983).

Alternative 1 would increase overwater shading at the project site by 6.3 acres. In aquatic systems with static water, such as lakes, overwater shading can substantially reduce the productivity of plankton (review in Kahler et al. 2000). However, given surface currents of approximately 0.1 foot per second (Section 3.1.1.3, Circulation and Currents) in the project vicinity, potential residence times for plankton under the EHW-2 would be a few hours or less,

depending on local variations in flow direction. Therefore, although the EHW-2 wharf, covered berth, and trestles would create new overwater shading, no appreciable reduction in primary production of phytoplankton communities would occur due to the localized nature of the shading; the design of the structures, which increase light penetration (see discussion of mitigation measures for marine vegetation in Section 3.5.2.1.3); and the short residence time of plankton under structures.

Security flood lights on the wharf and trestles would cast light on the surrounding water. An indirect impact of artificial nighttime lighting on plankton would be increased feeding opportunities by predators, including salmonids (Nightingale and Simenstad 2001a). Studies of freshwater plankton in a lake setting found potential inhibition of grazing of zooplankton that migrate toward the water surface at night to feed (Moore et al. 2006). However, as described above, surface currents in the area quickly move planktonic organisms through the area. Therefore, artificial lighting of the EHW-2 would not significantly impact plankton resources.

Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components as required. Measures would be employed to avoid discharge of contaminants to the marine environment (Section 3.2.2, Water Quality). These activities would not affect plankton.

3.6.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.6.2.2.1 CONSTRUCTION

As described in Chapter 2, Alternative 2 differs from Alternative 1 in that it uses a larger number of smaller piles for construction of the wharf. Because plankton are not sessile, they would not be subject to impacts from pile placement. Potential impacts to plankton from construction of Alternative 2 would be the same as those for Alternative 1 with the exception of construction duration for the wharf, which would likely require more in-water work seasons (3 to 4) than Alternative 1 (2 to 3).

3.6.2.2.2 OPERATION/LONG-TERM IMPACTS

Operational impacts to plankton from the EHW-2 would be primarily due to the effects of shading and artificial lighting. Because the shading footprints and lighting would be the same for Alternatives 1 and 2, potential impacts to plankton from operation of Alternative 2 would be the same as those for Alternative 1. Impacts from maintenance would be the same as described for Alternative 1.

3.6.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.6.2.3.1 CONSTRUCTION

Impacts to plankton from construction of Alternative 3 would be similar to those described for Alternative 1 because the structures are similar in scale and construction. The main difference would be in the size of the construction corridor, which would be slightly larger under Alternative 3. However, any increases in turbidity (see discussion of water quality impacts in Section 3.2.2.1) would be localized and limited to bottom waters, and would not result in adverse impacts to the plankton community along the Bangor waterfront.

3.6.2.3.2 OPERATION/LONG-TERM IMPACTS

Impacts to plankton due to shading and nighttime lighting during operation of this alternative would be similar to those described for Alternative 1, except that the areas shaded during the day and artificially lit at night would be slightly greater due to the larger size of the structure (6.6 vs. 6.3 acres total overwater area). Impacts from maintenance would be the same as described for Alternative 1.

3.6.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.6.2.4.1 CONSTRUCTION

Potential impacts to plankton from construction of Alternative 4 would be the same as those for Alternative 1 with the exception of construction duration for the wharf, which would likely require more in-water work seasons (3 to 4) than Alternative 1 (2 to 3).

3.6.2.4.2 OPERATION/LONG-TERM IMPACTS

Operational impacts to plankton from the EHW-2 would be primarily due to the effects of shading and artificial lighting. Because the shading footprints and lighting would be similar for Alternatives 1 and 4 (6.3 acres vs. 6.6 acres), potential impacts to plankton from operation of Alternative 4 would be the same as those described for Alternative 1 with the exception that the construction duration of the wharf would be approximately one year longer. Impacts from maintenance would be the same as described for Alternative 1.

3.6.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.6.2.5.1 CONSTRUCTION

As described for Alternative 1, construction impacts to plankton would primarily be due to increases in turbidity caused by prop wash from construction vessels and pile driving. Impacts to plankton from construction of Alternative 5 would be similar to those described for Alternative 1. The size of the construction corridor would be approximately 14 percent larger under Alternative 5, although the duration of in-water pile driving would be considerably shorter due to the smaller number of piles. Any increases in turbidity (see discussion of water quality impacts in Section 3.2.2.1) would be localized and limited to bottom waters, and would not result in adverse impacts to the plankton community along the Bangor waterfront.

3.6.2.5.2 OPERATION/LONG-TERM IMPACTS

Operational impacts to plankton from the EHW-2 would be primarily due to the effects of shading and artificial lighting. Alternative 5 would have greater total overwater coverage and create more shading. Total nighttime overwater lighting would be greater under Alternative 5 due to the increased size of the wharf compared to Alternative 1. As described for Alternative 1, surface currents in the area quickly move planktonic organisms through the area and shading and artificial lighting of the EHW-2 would not significantly impact plankton resources. The concrete pontoons and pile surfaces would be available for colonization by planktonic organisms. Impacts from maintenance would be the same as described for Alternative 1.

3.6.2.6 No-Action Alternative

Under the No-Action Alternative, the EHW-2 would not be built and overall operations would not change from current levels. Therefore, there would be no impacts to plankton.

3.6.2.7 Mitigation Measures and Regulatory Compliance

Because the proposed action would not adversely impact plankton, no mitigation measures are necessary. There are no federal or state regulations pertaining directly to plankton, nor requirements for regulatory consultation.

3.6.3 Summary of Impacts

Impacts to plankton associated with the construction and operations phase of each of the project alternatives, along with mitigation measures, are summarized in Table 3.6–1.

Table 3.6–1. Summary of Impacts to Plankton

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO PLANKTON
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Indirect and localized effects from increased turbidity and settling of resuspended sediments from in-water pile driving (200–400 days) and vessel activity. Construction would be conducted over 2 to 3 in-water work seasons. *Operation/Long-term Impacts:* No appreciable reduction in primary production of phytoplankton; increased feeding opportunities for plankton predators due to wharf and trestle lighting.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Greater potential for impacts than Alternative 1 due to greater number of in-water pile driving days (275–550 vs. 200–400) and an additional in-water work season (3 to 4 vs. 2 to 3). *Operation/Long-term Impacts:* No appreciable reduction in primary production of phytoplankton; increased feeding opportunities for plankton predators due to wharf and trestle lighting.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Slightly greater potential for impacts than Alternative 1 due to greater number of in-water pile driving days (210–420 vs. 200–400). Construction would be conducted over 2 to 3 in-water work seasons. *Operation/Long-term Impacts:* No appreciable reduction in primary production of phytoplankton; increased feeding opportunities for plankton predators due to wharf and trestle lighting; slightly more overwater shading (6.6 vs. 6.3 acres) and nighttime lighting than Alternatives 1 and 2.

Table 3.6–1. Summary of Impacts to Plankton (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO PLANKTON
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Greater potential for impacts than Alternative 1 due to greater number of in-water pile driving days (290–570 vs. 200–400) and an additional in-water work season (3 to 4 vs. 2 to 3). *Operation/Long-term Impacts:* No appreciable reduction in primary production of phytoplankton; increased feeding opportunities for plankton predators due to wharf and trestle lighting; slightly more overwater shading (6.6 vs. 6.3 acres) and nighttime lighting than Alternatives 1 and 2.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Less potential for impacts than other alternatives due to fewer in-water pile driving days (135–175 vs. 200–400). Construction would be conducted over 2 in-water work seasons. *Operation/Long-term Impacts:* No appreciable reduction in primary production of phytoplankton; increased feeding opportunities for plankton predators due to wharf and trestle lighting; includes additional 2.2 acres of overwater shading (total of 8.5 acres) and additional nighttime lighting on surrounding waters.
No-Action Alternative	No impact.
Mitigation • Because construction and operation of the EHW-2 would not adversely impact plankton resources, no mitigation measures are necessary.	
Consultation and Permit Status: There are no consultation requirements for this resource.	

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3.7 BENTHIC COMMUNITIES INCLUDING SHELLFISH

Benthic communities are the group of organisms inhabiting the region on the bottom of a body of water such as a lake or ocean. Shellfish are a subset of the benthic community that includes aquatic animals used as food and that have a shell or shell-like exoskeleton, such as molluscs (e.g., oysters and clams) and crustaceans (e.g., crabs and shrimp).

No federally listed benthic species within the vicinity of the project site are subject to regulation under the ESA. However, benthic invertebrates that constitute food for salmon listed under the ESA are indirectly protected. Activities that alter or eliminate benthic invertebrates or their habitats are evaluated for their significance to federally listed species during ESA consultations with NMFS. The MSA, through the EFH provision, protects substrate necessary for federally managed fisheries. In this context, "substrate" includes the associated benthic communities that make these areas suitable fish habitats. USACE also considers protection of shellfish under Section 404 of the CWA (e.g., Nationwide Permit regional conditions prohibit construction in special aquatic sites, which include oyster beds).

At the state level, WDFW is tasked with providing protection to benthic organisms, including shellfish as required under the Washington State Hydraulic Code (RCW 77.55). The code is implemented through WAC 220-110, which states that there should be "no net-loss of productive capacity of the habitat of food fish and shellfish resources of the state." However, NBK at Bangor is exempt from these requirements because it is a federal installation.

WDOH monitors beaches in Hood Canal, including those along the Bangor waterfront, for shellfish contamination to protect consumers from illness caused by eating shellfish contaminated by fecal pathogens, biotoxins, or other pollutants. However, the beach area at the EHW-2 project site (Figure 3.7–1) is closed to any shellfish harvest due to security restrictions (only the shellfish bed at the Devil's Hole outfall, approximately 5,000 feet south of the proposed EHW-2 site, is harvested by tribes [Kalina 2007, personal communication]).

Consultation and Permit Compliance Status. The Navy included impacts to the benthic community as part of its consultation with NMFS under the ESA and MSA. A biological assessment and EFH assessment have been prepared and submitted to NMFS. NMFS issued a Biological Opinion and EFH conservation recommendations on September 29, 2011. The EFH conservation recommendations (all related to pile driving) are more pertinent to marine fish than benthic community species, and are addressed in Section 3.8.3. The Navy has submitted a JARPA to USACE and WDOE, requesting a permit under CWA Section 404.

3.7.1 Existing Environment

Benthic organisms are abundant and diverse at the EHW-2 project site and are more abundant in the subtidal zone than in the intertidal zone (WDOE 2007). There is no dominant species among molluscs, crustaceans, and polychaetes, but as a larger group, molluscs are dominant in the subtidal zone. Echinoderms comprise only a small percentage (about 2 percent) of the benthic community.

Oyster beds occur along approximately 72 percent of the Bangor waterfront and occasionally co-occur with beds of mussels (Delwiche et al. 2008). Four beaches on NBK at Bangor were open to shellfish harvest by residents until recently when increased security measures closed the beaches to further shellfish gathering. American Indian tribes continue to harvest oysters and clams on NBK on a fifth beach at Bangor but not in the vicinity of the EHW-2 project site.

Tribal harvest occurs at the shellfish bed off the Devil's Hole outlet, approximately 1 mile southwest of the project site (see Section 3.19, American Indian Traditional Resources) and 1,000 feet south of the relocated pure water facility.

3.7.1.1 Benthic Abundance and Diversity

Benthic organisms, including shellfish, live on or in the substrate throughout intertidal and subtidal depths. Abundance and diversity increase from intertidal to subtidal depths (WDOE 2007). Local patterns of benthic community structure are influenced by physical and chemical characteristics; therefore, benthic organisms are useful indicators of habitat differences and quality.

Hood Canal has been divided into nine biotic subregions based on soft-bottom benthic community structure, dominant taxa, percent fines (i.e., the percent of silt or clay material), percent TOC, and depth (WDOE 2007). NBK at Bangor and the EHW-2 project site are within the north Hood Canal biotic subregion, which is characterized by coarser sediment, lower TOC, and higher DO values than the other biotic subregions of Hood Canal. These conditions support a relatively more abundant and diverse benthic community, including stress-sensitive species, such as the seed-shrimp, a small ostracod crustacean (WDOE 2007). Table 3.7–1 provides a list of some of the benthic invertebrates and shellfish occurring along the Bangor shoreline.

The soft-bottom benthic community at the EHW-2 project site is dominated by polychaetes, crustaceans, and molluscs across the tide zone, although in the intertidal zone other minor taxa (e.g., nemerteans, nematodes, and oligochaetes) also may be numerically abundant (Weston 2006; WDOE 2007). A recent survey of four different areas along the Bangor waterfront found consistently greater benthic community development in the subtidal zone compared to the intertidal zone and variable community development within and among survey areas (Weston 2006). A mean total of 2 to 12 species with a mean total abundance of 3 to 67 individuals per 0.1 square meter was observed in the intertidal zone. Subtidal values varied from a mean total of 36 to 77 species and a mean total abundance of 301 to 736 individuals per 0.1 square meter.

The lowest intertidal abundance of benthic organisms observed among the four locations sampled in 2005 was at the EHW-2 project site. The intertidal benthic community is characterized by the ghost shrimp *Neotrypaea* and the polychaete *Polydora* sp.; as well as a low but even distributions of the native littleneck (or steamer) clam; the amphipod *Ampithoe* sp.; the decapod *Crangon nigricauda* (blacktail bay shrimp); the polychaetes *Dipolydora* sp., *Glycinde picta*, *Mediomastus* sp., and *Platynereis bicanaliculata*; oligochaetes; and nematodes. The benthic community in the subtidal study area of the EHW-2 project site was dominated by the gastropod *Alvania compacta*, ostracods, and the bivalve *Nutricola* sp. and is primarily distinguished by the silky axinopsid clam.

Several factors likely contribute to local variability in benthic communities, including proportions of relatively coarser to finer sediment fractions associated with mixed sand and gravel substrates. Organic content of sediments is low along the waterfront, but may range higher in depositional areas near wharves (see Section 3.3, Sediment) and would be expected to be greater in areas with submerged aquatic vegetation. In addition, proximity to freshwater tributaries influences the composition of the benthic community along the waterfront (Weston 2006).

Table 3.7–1. Benthic Invertebrates at the Bangor Waterfront

PHYLUM	MAJOR TAXA	GENUS OR SPECIES	TYPICAL LOCATION	COMMON NAME OR DESCRIPTION
Mollusca	**Gastropods**	*Alvania compacta*	Sand, silt, clay or mixed substrate, vegetated shallow subtidal	Snail
		Lirularia acuticostata	Mixed substrate, intertidal-subtidal	Sharp-keeled lirularia
	Bivalves	*Macoma* sp.	Mixed substrate, intertidal-subtidal	Macoma clam
		Nutricola spp.	Sandy subtidal	Clam
		Saxidomus gigantea	Sandy subtidal	Butter clam
		Panopea generosa	Sandy intertidal-subtidal	Geoduck clam
		Venerupis philippinarum	Gravel, sand, mud above half-tide	Manila clam
		Rochefortia tumida	Sandy intertidal-subtidal	Robust mysella
		Axinopsida serricata	Sandy or mixed substrate with organic enrichment subtidal	Silky axinopsid
		Leukoma staminea	Sandy intertidal-subtidal	Native littleneck clam
		Tellina carpenteri	Sandy or mixed sand/silt intertidal-subtidal	Clam
		Mytilus spp. [prob. *M. trossulus*]	Intertidal-subtidal, hard substrates	Blue mussel
		Pododesmus macroschisma	Hard substrates	Jingle shell
		Crassidoma gigantea	Rocky substrates subtidal, rarely intertidal under boulders	Giant rock scallop
		Crassostrea gigas	Rocky substrates	Pacific oyster
Crustaceans	**Ostracods**	*Euphilomedes carcharodonta*	All soft substrates	Seed-shrimp
	Tanaids	*Leptochelia dubia*	Mixed substrate, vegetated habitat, manmade structures	Tanaid
	Barnacles	*Balanus* sp. could also include *Semibalanus* spp.	Rocky, manmade structures	Barnacle
	Amphipods	*Protomedeia* sp.	All soft substrates	Gammarid
		Aoroides spp.	Detritus, sand, vegetated habitats	Corophiid
		Rhepoxynius boreovariatus	Sandy subtidal	Gammarid
		Corophium and *Monocorophium* spp.	Sandy subtidal, manmade structures	Corophiid
	Crabs	*Hemigrapsus oregonensis*	Quiet water, rocky habitats, gravel	Yellow shore crab
		Pagurus granosimanus	Mixed substrate, eelgrass, subtidal	Hermit crab
		Pugettia spp.	Sand/silt/clay subtidal, eelgrass	Kelp crab
		Cancer gracilis	Intertidal and subtidal, eelgrass	Graceful crab
		Cancer magister	Intertidal and subtidal, eelgrass	Dungeness crab
		Cancer oregonensis	Rocky and manmade structures, intertidal-subtidal	Oregon Cancer crab
		Cancer productus	Sandy, protected rocky areas, eelgrass, intertidal-subtidal	Red rock crab
	Shrimp	*Crangon* sp.	Shallow waters, sandy substrates	True shrimp
		Pandalus sp.	Mixed sand substrate intertidal and shallow subtidal	Spot shrimp
		Neotrypaea sp.	Mixed sand substrate intertidal and shallow subtidal	Ghost shrimp

Table 3.7–1. Benthic Invertebrates at the Bangor Waterfront (continued)

PHYLUM	MAJOR TAXA	GENUS OR SPECIES	TYPICAL LOCATION	COMMON NAME OR DESCRIPTION
Annelida	***Polychaetes***	*Platynereis bicanaliculata*	Mixed substrates, manmade structures, eelgrass	Nereidae
		Pectinaria californiensis	Sandy, low intertidal and subtidal	Cone worm
		Owenia collaris	Sandy, intertidal-subtidal	Oweniidae
Echino-dermata	***Echinoderms***	*Pisaster brevispinus*	Subtidal eelgrass	Pink sea star
		Pisaster ochraceus	Lower intertidal, hard structures	Purple star
		Amphiodia urtica/periercta	Subtidal silty mud	Burrowing brittle star
		Pycnopodia helianthoides	Lower intertidal to subtidal soft substrates	Sunflower star
		Dendraster excentricus	Flat, sandy subtidal	Sand dollar
Chordata	***Tunicates***	*Corella willmeriana*	Subtidal to deep water	Transparent tunicate
		Distaplia occidentalis	Intertidal to subtidal	Mushroom compound tunicate

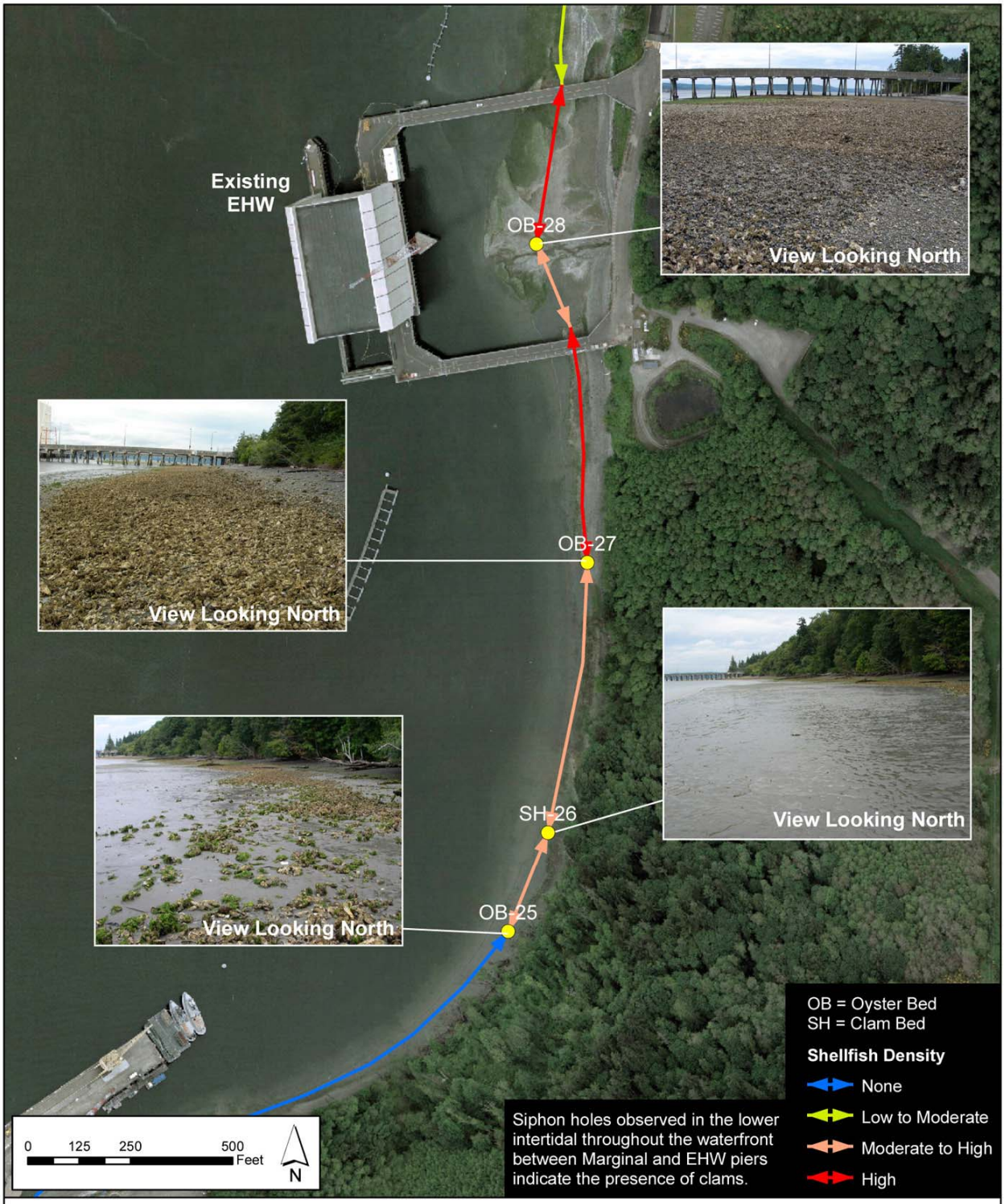
Sources: Abbott and Reish 1980; Barnard et al. 1980; Lee and Miller 1980; Kozloff 1983; URS 1994; WDOE 1998; Pentec 2003; Weston 2006.

3.7.1.2 Molluscs

Molluscs are invertebrates that have soft, unsegmented bodies and are usually protected by a shell. Those occurring within the EHW-2 project site include two major classes: gastropods (slugs and snails) and bivalves (having two-part shells, such as clams, oysters, and mussels). In contrast to mussels and oysters, which attach to hard substrate, clams live fully buried in the substrate and gastropods live on the substrate surface. Oysters and many species of clams are filter feeders on plankton. Some clams also may feed on organic matter at the sediment surface. Gastropods may feed on vegetation and organic matter at the sediment surface, and/or prey on other invertebrates.

The gastropod snail *Alvania compacta* was a numerical dominant of shallow subtidal waters at the EHW-2 project site (Weston 2006); it is commonly found in mixed sediments including fine gravels (Kozloff 1983). Other snails (e.g., sharp-keeled lirularia) are associated with eelgrass beds, and limpets occur intertidally on hard substrates (e.g., docks, cobble, and rocks).

Bivalves are ecologically important because, as filter feeders, they uptake and recycle organic matter, help control phytoplankton levels, and improve water clarity, thereby allowing greater light penetration for the growth of seagrass and other marine vegetation. Molluscs are an important food source for some fish species (WDOE 2007). Figure 3.7–1 presents the distribution of oysters and clams from a 2008 survey of the waterfront at the EHW-2 project site (Delwiche et al. 2008). Oyster beds were located in the mid- to upper intertidal zones while clam siphons were observed in the lower intertidal zone. The high density oyster bed located south of the existing EHW trestle can be seen in the photograph at survey station OB-27. A large mudflat with moderate to high density of clam siphons can be seen in the photograph taken at survey station SH-26.



Source: Delwiche et al. 2008

Figure 3.7–1. Shellfish Resources Near the EHW-2 Project Site

A variety of bivalves occur within the EHW-2 project site, ranging from intertidal to subtidal depths (Table 3.7–1). Common intertidal species include Macoma clams, Manila clams, littleneck clams, and robust mysella. The most abundant species in subtidal waters include silky axinopsid, various dwarf venus clams, fine-lined lucine, and robust mysella (Weston 2006). Robust mysella live in semi-permanent burrows and can be an indicator of a more stable habitat (Ockelmann and Muus 1978).

Common species on hard substrates (manmade structures, rocks) include multiple blue mussel species, jingle shell, rock scallop, and Pacific oyster (Navy 1988; WDFW 2007a). An approximately 70-foot wide by 1,500-foot (2.4-acre) long oyster bed is located off the southwestern corner of the existing EHW (Figure 3.7–1) (Morris et al. 2009). Bivalve siphons, likely indicating geoducks, were detected throughout the EHW-2 project site during a 2007 survey in a wide range of depths. These organisms tended to be more concentrated in the silty sand substrate present below -25 feet MLLW (Morris et al. 2009). A 1971 WDFW survey for the commercial tract (#21150) on which the EHW-2 would be located reported geoduck densities of 0.09 per square foot (Sizemore et al. 2003). Surveys conducted at NBK at Bangor in support of the 1974 TRIDENT FEIS found geoduck densities of 0.15 per square foot near the outlet from Hunter's Marsh (Navy 1974). No other geoduck survey data are available for the Bangor waterfront. More recent WDFW geoduck studies conducted in Hood Canal from 2004 to 2007 found densities ranging from 0.0029 per square foot at Quatsap (approximately 11 miles southwest of the EHW-2 project site) to 0.676 per square foot at Lofall/Vinland (2 to 6 miles north of the EHW-2 project site) (Sizemore et al. 2007).

3.7.1.3 Crustaceans

Crustaceans are aquatic arthropods with an exoskeleton or shell, a pair of appendages on each segment, and two pairs of antennae. Examples are shrimps, crabs, barnacles, and amphipods. Crustaceans are associated with all soft-bottom and hard substrate habitats (rocky outcrops, manmade structures) and also occur in the water column. A primary ecological value of crustaceans, particularly small epibenthic species, is as an important food source they provide for fish, birds, marine mammals, and other animals. For example, gammarid amphipods (small, shrimp-like crustaceans) were recorded as the primary food source for chum salmon near the EHW-2 project site (Simenstad and Kinney 1978). Dungeness crabs and spot prawns are WDFW regulated species and subject to commercial and sport harvest in Hood Canal.

Small epibenthic crustaceans (such as amphipods, copepods, cumaceans, isopods, ostracods, and tanaids) are associated with soft-bottom habitat. The most abundant species in the 2005 benthic sediment sampling along the Bangor waterfront was the seed-shrimp, an ostracod (Weston 2006). Benthic ostracods are minute crustaceans that are protected by a bivalve-like shell and typically feed on detritus in the subtidal nearshore marine habitats. Seed-shrimp comprised almost 30 percent of the individual organisms in the sandy deltaic subtidal zones along the waterfront (Weston 2006). This species is numerically dominant in other areas of the north Hood Canal biotic subregion in previous studies (WDOE 1998). Other common species in soft-bottom habitats include amphipods and tanaids (Weston 2006). Most amphipods are detritus-feeders or scavengers, and tanaids are associated with vegetated habitats and/or organic detritus (Barnard et al. 1980; Lee and Miller 1980).

Barnacles, amphipods, copepods, cumaceans, and isopods are common members of marine fouling communities. Amphipods often account for the greatest variety of crustaceans on manmade structures. Several of these fouling species are non-native in Puget Sound

(e.g., *Ampithoe valida*, *Corophium acherusicum*, and *Parapleustes derzhavini*) (Cohen et al. 1998).

Larger crabs and shrimps, which are mobile and evasive during sampling, are not well quantified near the EHW-2 project site. Several species have been commonly observed (Weston 2006). Dungeness crabs range from intertidal to subtidal depths in sandy habitats and may use eelgrass beds as nursery areas (LFR 2004). Hermit crabs, *Cancer* crabs, kelp crabs, and shore crabs occur in rocky and/or vegetated habitats (Table 3.7–1).

3.7.1.4 Annelids

Annelids are segmented worms that can be found in soils (e.g., earthworms) and freshwater and marine environments (e.g., leeches and polychaetes). Polychaetes are a major component of the benthic community and occupy intertidal and subtidal soft- and hard-bottom habitats (Weston 2006). Sessile polychaetes are often tube-building while other species may be active burrowers (Kozloff 1983). Polychaetes are typically more abundant in the nearshore subtidal zone than in the intertidal zone (Weston 2006; WDOE 2007). Several species of polychaetes live among fouling organisms on manmade structures. Suspension-deposit spionids, herbivorous nereids, predatory syllids, and scale worms were found during rapid assessment of several marinas in Puget Sound (Cohen et al. 1998).

3.7.1.5 Echinoderms

Echinoderms are a group of marine invertebrates that usually have a symmetry of five and skin typically covered in spines. Examples include sea stars (starfish), sea urchins, and sea cucumbers. Echinoderms contributed up to 6 percent to the abundance of benthic organisms occurring in soft-substrate benthic sediment sampling conducted in 2005 along the waterfront, but at most represented only 2 percent of the abundance of benthic organisms at the EHW-2 project site (Weston 2006). These species included brittle stars and green sea urchins (Navy 1988; Weston 2006). However, sea stars have also been observed at many locations along the waterfront (Navy 1988; Delwiche et al. 2008). Purple stars are found primarily in the lower-intertidal zone on piles where they feed on mussels. (A purple star can be seen clinging to the bottom of the pier structure in Figure 3.5–5). Pink sea stars are often found in subtidal eelgrass beds (Pentec 2003).

The red sea urchin has not been documented near the EHW-2 project site but typically lives in rocky areas, which have not been extensively surveyed at the waterfront. Red urchin habitat ranges from protected shallow subtidal zones to inland marine deeper water and nearshore marine habitats.

3.7.1.6 Other Minor Phyla

Other minor phyla at the EHW-2 project site include Nemertea (ribbon worms), Nematoda (round worms), Platyhelminthes (flat worms, mostly oyster leaches), Chordata (e.g., transparent tunicate and mushroom compound tunicate), Cnidaria (jellyfish, polyps, the frilled anemone *Metridium senile*), and Sipuncula (unsegmented worms) (Navy 1988, 1992; Weston 2006). Tunicates, also known as urochordates, are members of the subphylum Tunicata, a group of underwater saclike filter feeders with incurrent and excurrent siphons. An increased number of frilled anemones were noted at the EHW-2 project site relative to other areas of NBK at Bangor during the 2007 marine vegetation survey (Morris et al. 2009).

3.7.2 Environmental Consequences

The evaluation of impacts to benthic communities and shellfish considered whether the conditions resulting from project construction and operation would cause significant loss of benthic habitat or decreases in habitat value for benthic invertebrates or decreases in benthic invertebrate populations over the life of the project.

3.7.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

Construction would result in several impacts to the benthic community, including loss of soft-bottom habitat from pile placement, disturbance to the soft-bottom habitat from propeller wash, increased turbidity and suspended solids, and increased noise and vibration during pile placement. Operational impacts would include overwater shading and permanent replacement of soft-bottom habitat with hard-bottom habitat due to the installation of piles. These changes would adversely impact some species and benefit others, resulting in some localized changes in the number and composition of benthic species.

3.7.2.1.1 CONSTRUCTION

Barges, tugboats, and other vessels would be stationed within a 150-foot corridor surrounding the EHW-2 project site during construction. While the vessels would be directed to avoid grounding and damaging the seafloor, the benthic and shellfish communities would be directly impacted by substrate disturbance by anchor and spud placement, and pile driving. Measures would be put in place to avoid seafloor disturbance from underwater line drag and anchor drag in the construction area (see Appendix F, Mitigation Action Plan). The communities would also be impacted by turbidity and sediment redeposition resulting from these activities and vessel propeller wash, as well as by vessel shading. The impact area would consist of the EHW-2 footprint where piles would be driven and new pier construction would occur, as well as a 150-foot area surrounding the sites where barges would be stationed, tug boats would maneuver the barges during pile driving, and other boat-based construction activity would occur.

It is assumed that the benthic and shellfish communities would be disturbed and at least partially lost in the direct construction area, plus the 150-foot corridor around this area. Total disturbance area for the benthic community would be approximately 25.7 acres (Table 3.7–2). Areas beyond the 150-foot corridor would be protected by limiting construction equipment and activities to the construction corridor. Excavation for the abutment would be conducted above the oyster bed and would not impact oysters or other shellfish below in the intertidal zone. The abutment itself would be located above MHHW, above the benthic community habitat.

During construction activities, there would also be a potential for oil and gas spills that could impact the benthic and shellfish community. As described under Water Quality (Section 3.2.2.1.1.7), the existing facility response and prevention plans for the Bangor waterfront provide guidance that would be used in a spill response, such as a response procedures, notification, and communication plan; identification of roles and responsibilities; and response equipment availability. The contractor would also prepare and implement a spill response plan (e.g., an SPCC Plan) to clean up fuel or fluid spills. In the event of an accidental spill, response measures would be implemented immediately to reduce the potential for exposure to the environment.

Table 3.7–2. Area of Benthic and Shellfish Resources Impacted by the Combined Trestle Alternatives (1 and 2)

PARAMETER	POTENTIAL CONSTRUCTION IMPACT AREA (ACRES)	OPERATIONAL SHADING AREA (ACRES)
Benthic Community Area[1]	25.7	6.3
Oyster Bed Area[2]	0.48	0.06
Soft-bottom benthic habitat area in pile footprint (Alternative 1/Alternative 2)	0.21	N/A

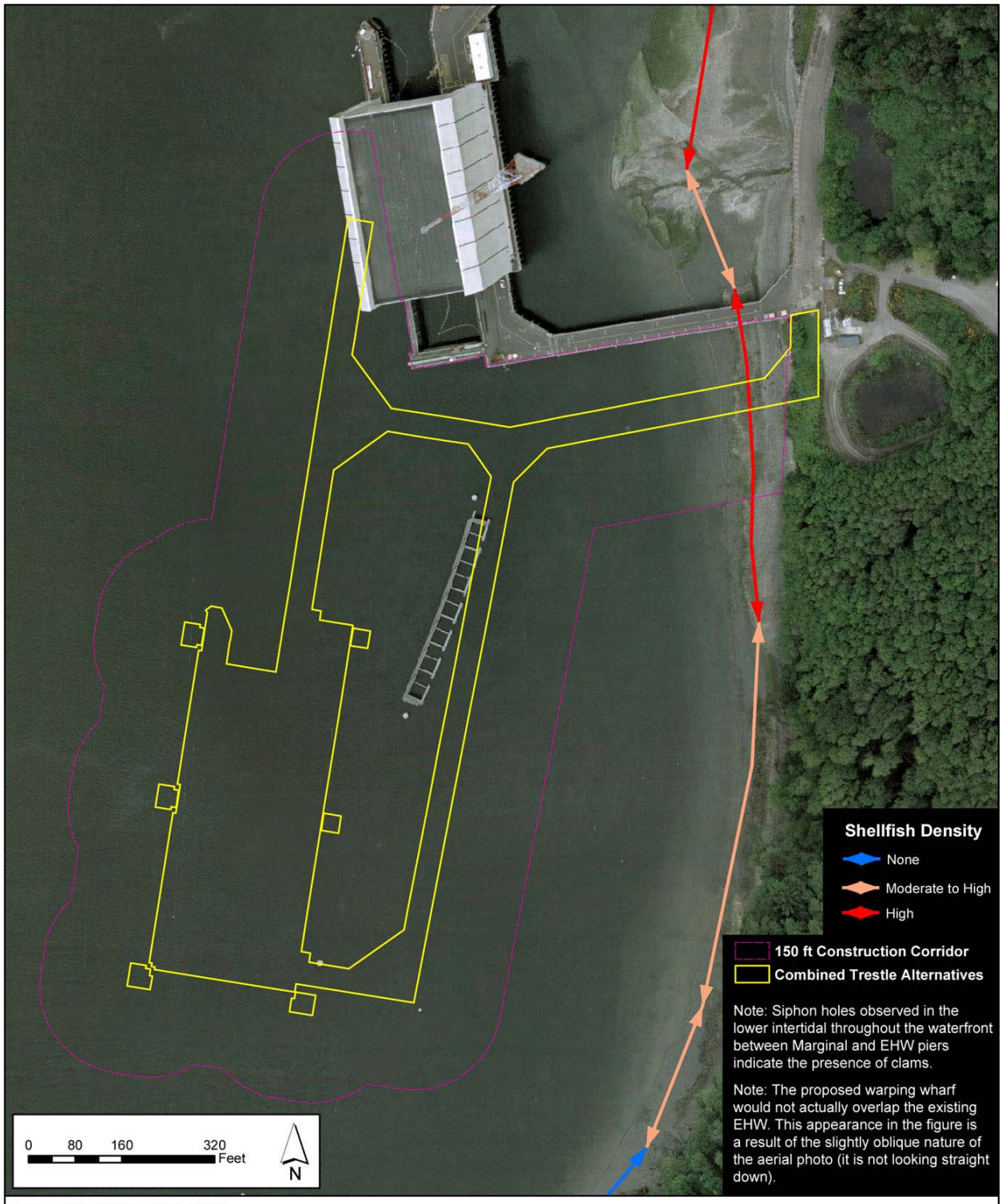
1. Total area of clams is not known because the entire subtidal area was not evaluated during field surveys; however, in limited surveys conducted in 2007, clam siphons were detected primarily in water depths greater than 15 feet where softer, unconsolidated sediments tended to occur.
2. The impact area for the benthic community includes the oyster bed and the area in the pile footprint; thus, the oyster bed and pile footprint areas are subsets of the benthic community.

Another possible source for construction-related impacts to benthic and shellfish resources would be from accidental debris spills from barges or construction platforms into Hood Canal. Debris spills could smother benthic organisms. The Navy would require the construction contractor to prepare and implement a Debris Management Plan with procedures for retrieving and cleaning up any accidental spills. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups.

3.7.2.1.1.1 DISTURBANCE FROM PLACEMENT OF PILES

Construction of Alternative 1 would impact benthic communities through disruption of the sediment surface, which would result in at least partial loss of the community in the affected area. Barges used during construction typically have drafts of up to 3 feet (amount of barge below the water surface) and would normally operate in water depths of 6 feet or more to prevent grounding. The barges would be at the construction site for up to 3 years and would cause shading under the barges, which could impact survival of the benthic community. An oyster bed (approximately 2.4 acres) occurs to the south of the southern trestle of the existing EHW (Figure 3.7–2). Piles for the trestles for Alternative 1 of the EHW-2 would be placed in this bed and oysters and other benthic organisms in the pile footprints would be permanently lost. Assuming a 150-foot construction corridor, up to 0.48 acre of this oyster bed would be disturbed during construction.

Some benthic organisms would be physically crushed and lost in the footprints of the barge anchors and spuds, as well as the piles. Construction activities would also cause turbidity and sediment redeposition that would impact the benthic community. The area within the 150-foot construction corridor would have higher levels of turbidity and disturbed sediments that would settle on top of the existing benthic community (see discussion of suspended sediments in Section 3.2.2.1, under Turbidity). Suspension and surface deposit feeders would be the most susceptible to burial. Mobile infaunal deposit feeders would be more likely to survive burial due to their ability to burrow upward through the newly deposited material. Based on various studies of critical burial depths for different benthic organisms, critical burial depths appear to range from 2 inches for suspension and surface deposit feeders, to 12 inches for active burrowers (Maurer et al. 1978; Nichols et al. 1978). Burial depths in the construction area may exceed 2 inches in limited areas but would not approach 12 inches except in localized areas, such as where anchors and spuds would be placed.



Source: Delwiche et al. 2008

Figure 3.7−2. Disturbance Area for Shellfish from Construction of the Combined Trestle Alternatives (1 and 2)

Filter- and suspension-feeding invertebrates (e.g., bivalves, tunicates, crustaceans, and some polychaetes) may close their shells, suspend feeding, or increase feeding rates in response to turbidity increases (LaSalle et al. 1991; Cruz-Rodriguez and Chu 2002). Marine invertebrates have been shown to be tolerant of relatively high suspended solid concentrations over periods of hours to days, with adverse impacts limited to prolonged exposures (e.g., continuously up to 21 days) and/or to high concentrations (e.g., fluid mud) (reviews in LaSalle et al. 1991; O'Connor 1991; Clarke and Wilber 2000; and Wilber and Clarke 2001). However, the length of time for construction (5 days per week for 7 months in each of 2 to 3 years) and the increased turbidity levels would likely result in short- to long-term loss of localized areas of the benthic community within 150 feet of the EHW-2 project site.

Complete loss, however, would be limited to highly disturbed areas (e.g., small areas disturbed by anchor and spud placement). Most affected areas would experience some reduction in diversity and abundance of benthic species. Opportunistic species, such as small tubiculous, surface-dwelling polychaetes, would be favored for recolonization where sediments accumulate.

Previous studies of dredged and other disturbed sites show that benthic and epibenthic invertebrates rapidly recolonize disturbed bottom areas within 2 years of disturbance (CH2M Hill 1995; Parametrix 1994b, 1999; Anchor Environmental 2002; Romberg 2005). The benthic organisms lost due to turbidity and bottom disturbances by barges, tugboats, anchors, and spuds would be expected to become reestablished over a 3-year period after sediment disturbance at the site has ceased.

3.7.2.1.1.2 NOISE

Indirect impacts associated with increased noise and vibration during pile driving would occur during construction. As described for underwater noise impacts in Section 3.4.2.1, peak noise levels of 210 dB_{PEAK} re1µPa and average 195 RMS levels of dB_{RMS} re1µPa would occur within 7 feet of piles being driven with an impact hammer while using a bubble curtain or other noise attenuating device. No studies have been identified that document invertebrate response to pile driving. Although there are few studies of noise impacts to invertebrates, available information suggests a variety of species (crabs, shrimp, clams, mussels, squid, sea cucumbers) tolerate temporary exposures to increased sound levels within the range expected with pile driving without long-term adverse impacts (Stocker 2001; Christian et al. 2003; Moriyasu et al. 2004; Kent and McCauley 2006).

Sound thresholds associated with sublethal physiological or behavioral responses are not well understood and apparently vary among invertebrate species. For example, egg development of snow crabs was delayed by exposure to seismic air gun peak sound levels of 201 to 227 dB_{PEAK} (Christian et al. 2003), but no impacts to Dungeness crab larvae were observed at mean sound pressures as high as 231 dB_{RMS} (Pearson et al. 1994). Continuous exposure of sand shrimp in aquaria to a high sound-level increase (30 dB in the 25 to 400 Hz bandwidth) resulted in sublethal behavioral changes and reduced growth and reproduction (review in Moriyasu et al. 2004). Consequently, invertebrates may experience acoustic stress and disturbance as a result of impact hammer pile driving. Based on evidence from the limited scientific studies conducted to date, reproductive impairment of some invertebrate species, in the form of delayed egg maturity, could result from pile driving for Alternative 1. These impacts would not be expected to extend beyond the duration of pile driving (approximately 200 to 400 days), and the peak sound levels with the potential to cause these impacts would occur only within the 7-foot radius around any pile being proofed with an impact hammer. As described in Chapter 2, most of the piles would be driven

using the vibratory method, which would result in much lower noise levels (180 dBRMS re 1µPa at 33 feet) that are not expected to result in impacts to benthic species.

3.7.2.1.2 OPERATION/LONG-TERM IMPACTS

The overwater structures of Alternative 1 would increase shading in the immediate area by 6.3 acres (Table 3.7–2). Regional studies have shown that light-blocking overwater structures can directly impact benthic productivity in underlying substrates (Simenstad et al. 1999). For Alternative 1, the shaded area would be functionally decreased due to design elements incorporated into the structure, especially along the trestle. These elements include the height of the fixed structures over the water (approximately 15.2 feet above MLLW), orientation of the wharf and longest trestles along a generally north-south alignment. Water depths at the main wharf and warping wharf (greater than 80 feet below MLLW) would be too deep for the submarines to contribute to operational shading or for prop wash from submarines or tug boats to disturb the benthic habitat.

Drainage water from the wharf/ordnance operations area would be collected, run through oil/water separators, released to a detention pond or other stormwater management facility, and then discharged to Hood Canal in accordance with an NPDES permit (see discussion of water quality impacts in Section 3.2.2.1). Therefore, WDOE stormwater standards would be maintained. The risk of spills during operation would be minimized through adherence to COMNAVREGNWINST 5090.1, Integrated Contingency Plan, Annex G and inclusion of an oil containment boom surrounding the site. Containment practices would be consistent with the existing Bangor waterfront structures, including the use of in-water containment booms and response plans. Therefore, operation of the EHW-2 would not degrade water quality or impact benthic and shellfish communities.

Placement of piles would result in the long-term conversion of up to 0.21 acre of soft-bottom to hard-bottom habitat. However, the piles would increase the available in-water surface area and create colonization sites for hard-bottom species such as mussels (*Mytilus* sp.) and sea anemones that would attach to the piles (the fouling community). The new community also would support other species such as copepods, amphipods, annelids, gastropods, and predatory sea stars that feed and take refuge in the newly created environment (Kozloff 1983; Cohen et al. 1998; Brooks 2004; Cordell 2006; PSAT 2006). The decrease in soft-bottom habitat and increase in hard substrate habitat would result in a localized change in species composition (Glasby 1999; Atilla et al. 2003), but would not result in substantial loss of biological productivity in the area due to the creation of vertical structure for colonization. Colonization of new hard surfaces would begin within months (Schoener and Schoener 1981; Kozloff 1983; Goyette and Brooks 2001; Brooks 2004). A study of wooden piles at a Pacific Northwest location found that the pile community had twice as many species and nearly eight times the density as is typically found in Pacific Northwest sediments (Brooks 2004). However, steel piles would not be expected to attain the same epifaunal diversity as wood piles because steel loses more heat than wood during cold winter conditions, resulting in possible unfavorable conditions for the animals (Brooks 2009, personal communication).

As discussed for hydrography and sediment impacts in Section 3.1.2.1, and Section 3.3.2.1, the wharf and trestles would induce sediment deposition along the shoreline behind the new structure, as has occurred behind the existing EHW. This would result in establishment of organisms typical of coarse to fine sediments in areas currently characterized as more cobbly substrate. This may have a beneficial impact for the prey of juvenile salmon. It is unlikely that

this sediment deposition would result in any coarsening of sediments. Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components (no pile replacement) as required. Measures would be employed to minimize the likelihood of discharging contaminants to the marine environment (Water Quality, Section 3.2.2). These activities would not affect benthic and shellfish communities.

3.7.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.7.2.2.1 CONSTRUCTION

As described in Chapter 2, Alternative 2 differs from Alternative 1 in that it uses a larger number of smaller piles for construction of the wharf. Impacts to benthic communities would be similar to those described for Alternative 1 except that there would be more disturbances to the seafloor due to pile placement (up to 1,460 piles vs. up to 1,250 piles for Alternative 1, although the acreage of the pile footprints would be nearly identical). In addition, there would be additional days of pile driving (275 to 550 vs. 200 to 400), which would likely require more in-water work seasons (3 to 4 vs. 2 to 3).

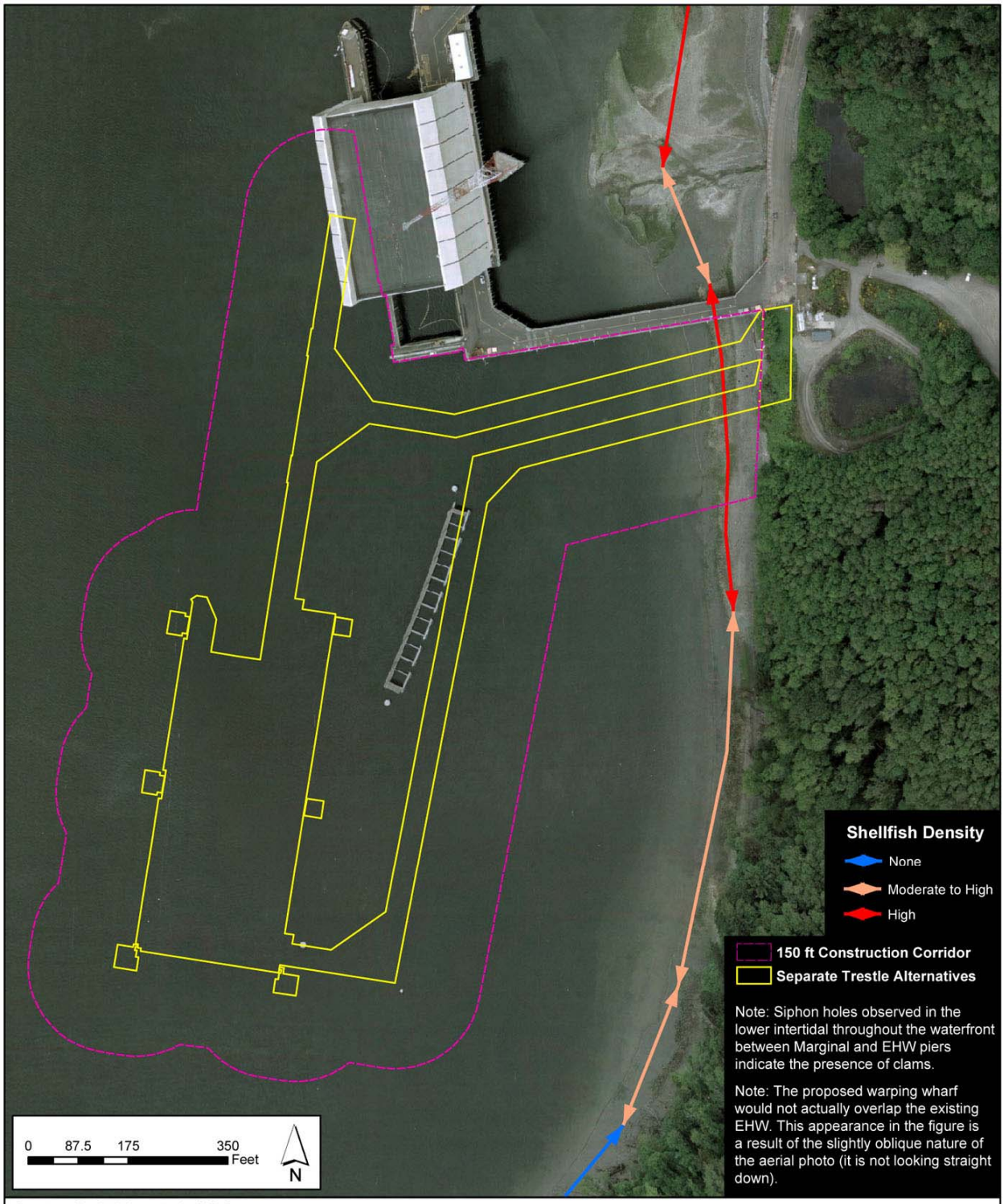
3.7.2.2.2 OPERATION/LONG-TERM IMPACTS

Operational impacts to benthic organisms from the EHW-2 would primarily be due to shading effects. Conversion of soft bottom to hard bottom would be almost identical to Alternative 1. Because the shading footprints of the wharf in both Alternatives 1 and 2 would be the same, operational impacts to benthic communities including shellfish would be the same as those for Alternative 1. Water depths at the main wharf and warping wharf (greater than 80 feet below MLLW) would be too deep for the submarines to contribute to operational shading or for prop wash from submarines or tug boats to disturb benthic habitat. Maintenance impacts would be the same as described for Alternative 1.

3.7.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.7.2.3.1 CONSTRUCTION

Direct impacts associated with placement of the piles and assembly of the wharf and trestles would be similar to those described for construction of Alternative 1. However, there would be more disturbances to the seafloor due to pile placement (up to 1,290 piles vs. up to 1,250 piles for Alternative 1, although the acreage of the pile footprints would be nearly identical) (Figure 3.7–3, Table 3.7–3). Impacts associated with turbidity increases and sediment resuspension would also be similar, with total seafloor in the construction corridor approximately 0.1 acre more for Alternative 3 (25.8 acres) than for Alternative 1 (25.7 acres). The total area of the oyster bed disturbed during construction would be slightly greater for Alternative 3 (0.52 acre) than for Alternative 1 (0.48 acre). As with Alternative 1, indirect impacts associated with increased noise and vibration during pile driving, including possible delays to invertebrate egg maturation (Christian et al. 2003), would be limited to the period of construction and would not be permanent. The period of impact, when in-water construction is taking place, would be slightly longer for Alternative 3 (210 to 420 pile driving days) than for Alternative 1 (200 to 400 pile driving days).



Source: Delwiche et al. 2008

Figure 3.7−3. Disturbance Area for Shellfish from Construction of the Separate Trestle Alternatives (3 and 4)

Table 3.7–3. Benthic and Shellfish Resources Impacted by the Separate Trestle Alternatives (3 and 4)

PARAMETER	POTENTIAL CONSTRUCTION IMPACT AREA (ACRES)	OPERATIONAL SHADING AREA (ACRES)
Benthic Community Area[1]	25.8	6.6
Oyster Bed Area[2]	0.52	0.09
Soft-bottom benthic habitat area in pile footprint	0.21	N/A

1. Total area of clams is not known because the entire subtidal area was not evaluated during field surveys; however, in limited surveys conducted in 2007, clam siphons were detected primarily in water depths greater than 15 feet where softer, unconsolidated sediments tended to occur.
2. The impact area for the benthic community includes the oyster bed; thus, the oyster bed area is a subset of the benthic community area.

3.7.2.3.2 OPERATION/LONG-TERM IMPACTS

As described for Alternative 1, placement of piles would result in long-term conversion of soft-bottom to hard-bottom habitat. As with Alternative 1, the piles would effectively increase available in-water surface area and create sites of colonization for hard-bottom species. Water depths at the main wharf and warping wharf (greater than 80 feet below MLLW) would be too deep for the submarines to contribute to operational shading or for prop wash from submarines or tug boats to disturb benthic habitat. Maintenance impacts would be the same as described for Alternative 1.

Impacts to benthic and shellfish resources due to changes in shading would be the same as for Alternative 1 with the exception that the overwater trestle length would be slightly longer and the aquatic area shaded would be slightly greater due to the larger total overwater area (6.6 vs. 6.3 acres) (Table 3.7–3). Shading of the shellfish bed (0.09 acre) would be approximately 56 percent greater for Alternative 3 because there would be two trestle lengths (40 feet wide each) crossing the shellfish bed rather than just one (48 feet wide). Because of the slightly larger number of piles for this alternative, the area of sediment deposition would be also be larger than for Alternative 1 (see discussion of sediment impacts in Section 3.3.2.3.2), with a corresponding shift in the benthic community from soft-bottom to hard-bottom species.

3.7.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.7.2.4.1 CONSTRUCTION

As described in Chapter 2, Alternative 4 differs from Alternative 1 in that it uses a larger number of smaller piles for construction of the wharf and a separate rather than combined trestle system. Impacts to benthic communities would be similar to those described for Alternative 1 except that disturbances to the seafloor due to pile placement would be greater (up to 1,500 piles vs. up to 1,250 piles for Alternative 1, although the pile footprints would be nearly identical). In addition, there would be additional pile driving days (290 to 570 vs. 200 to 400), which would likely require more in-water work seasons (3 to 4 vs. 2 to 3).

3.7.2.4.2 OPERATION/LONG-TERM IMPACTS

Operational impacts to benthic organisms from the EHW-2 would primarily be due to shading effects and the long-term conversion of soft-bottom to hard-bottom habitat. The shading footprints of the wharf and trestles in Alternative 4 would be similar, although slightly greater than Alternative 1 (Table 3.7–3, Figure 3.7–3). Conversion of soft-bottom to hard-bottom habitat would be approximately the same as for Alternative 1 (0.21 acre). Water depths at the main wharf and warping wharf (greater than 80 feet below MLLW) would be too deep for the submarines to contribute to operational shading or for prop wash from submarines or tug boats to disturb benthic habitat. Maintenance impacts would be the same as described for Alternative 1.

3.7.2.5 Alternative 5: Combined Trestle, Floating Wharf

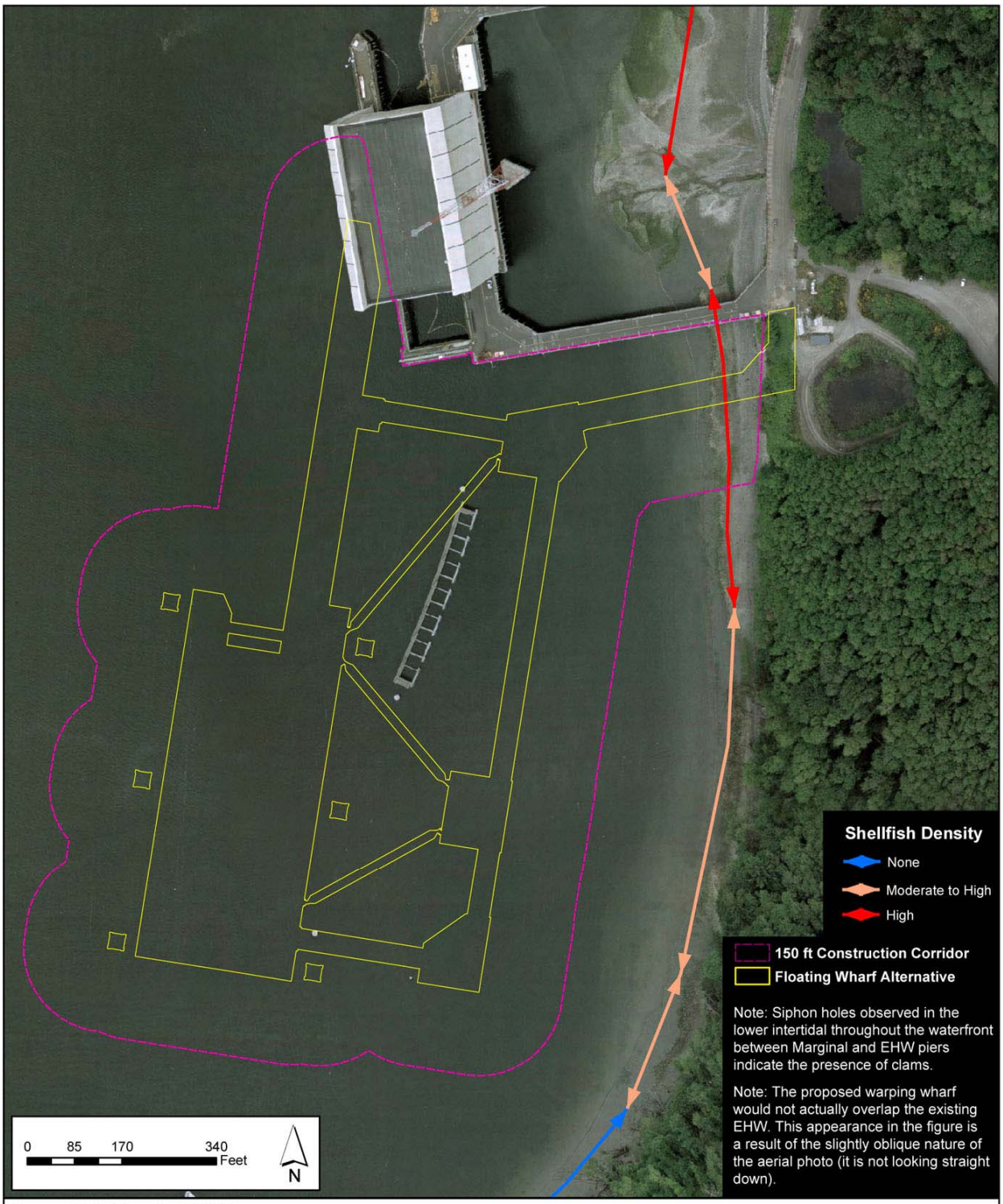
3.7.2.5.1 CONSTRUCTION

Construction impacts to benthic species would primarily be due to loss of soft-bottom habitat from pile placement, disturbance to the soft-bottom habitat from propeller wash, increased turbidity and suspended solids, and increased noise and vibration during pile placement. Impacts to benthic communities from construction of Alternative 5 would be similar to those described for Alternative 1. The main differences would be in the size of the construction corridor, which would be approximately 14 percent larger under Alternative 5, and in the significantly smaller number of piles (up to 440 vs. up to 1,250) (Figure 3.7–4, Table 3.7–4) that would be used in construction. The number of pile driving days would be less for Alternative 5 (135 to 175 days) than for Alternative 1 (200 to 400 days) and therefore impacts due to noise would be reduced under this alternative. The area of benthic invertebrates lost in the pile footprint would be approximately 0.077 acre under Alternative 5 compared to 0.21 acre for Alternative 1. As with Alternative 1, any increases in turbidity (see discussion of water quality impacts in Section 3.2.2.1) would be localized and limited to bottom waters, and would not result in adverse impacts to the benthic community along the Bangor waterfront.

Table 3.7–4. Benthic and Shellfish Resources Impacted by the Floating Wharf Alternative

PARAMETER	POTENTIAL CONSTRUCTION IMPACT AREA (ACRES)	OPERATIONAL SHADING AREA (ACRES)
Benthic Community Area[1]	29.4	8.5
Oyster Bed Area[2]	0.47	0.076
Soft-bottom benthic habitat area in pile footprint	0.077	N/A

1. Total area of clams is not known because the entire subtidal area was not evaluated during field surveys; however, in limited surveys conducted in 2007, clam siphons were detected primarily in water depths greater than 15 feet where softer, unconsolidated sediments tended to occur.
2. The impact area for the benthic community includes the oyster bed; thus, the oyster bed area is a subset of the benthic community.



Source: Delwiche et al. 2008

Figure 3.7−4. Disturbance Area for Shellfish from Construction of the Floating Wharf Alternative (5)

3.7.2.5.2 OPERATION/LONG-TERM IMPACTS

Operation impacts to benthic species would primarily be due to overwater shading and permanent replacement of soft-bottom habitat with hard-bottom habitat due to the installation of piles. Alternative 5 would shade 2.2 acres more benthic habitat than Alternative 1 and the wharf would be floating rather than elevated, which would reduce light penetration beneath the structure. However, the majority of the additional shading would be from the wharf structures, which would be located over deep water areas where light penetration to the seafloor is limited. Therefore, operational impacts to the benthic community due to shading from Alternative 5 would be similar to that described for Alternative 1. Long term conversion of soft-bottom to hard-bottom habitat would be significantly less under Alternative 5 (0.077 acre) than Alternative 1 (0.21 acre). Water depths at the main wharf and warping wharf (greater than 80 feet below MLLW) would be too deep for the submarines to contribute to operational shading or for prop wash from submarines or tug boats to disturb benthic habitat. Maintenance impacts would be the same as described for Alternative 1.

3.7.2.6 No-Action Alternative

There would be no direct loss or disturbance of the soft-bottom benthic habitat or further conversion to hard surface habitat under the No-Action Alternative. Therefore, there would be no impacts to the benthic community.

3.7.2.7 Mitigation Measures and Regulatory Compliance

The following current practices would minimize impacts to benthic communities and shellfish:

- An oil containment boom would encircle the area during construction to minimize potential impacts from an accidental oil spill.
- Construction barges would maintain minimal draft requirements to prevent grounding. Measures would be put in place to avoid seafloor disturbance from underwater line drag and anchor drag in the construction area. Areas outside of the 150-foot construction corridor would be protected by the exclusion of construction equipment and activities.

The Mitigation Action Plan described in Appendix F would compensate for impacts of the EHW-2 to benthic communities.

The only regulation specific to benthic communities and shellfish is the Washington State water fecal coliform standards for protection of shellfish for human consumption and health. The proposed action would not result in an increase in fecal coliforms or violation of these standards (see discussion of water quality impacts in Section 3.2.2.1). However, because the benthic community serves as a food resource for juvenile salmonids and other fish and invertebrate species, the Navy included impacts to the benthic community as part of its consultation with NMFS under the ESA and MSA. The Navy concluded consultation with NMFS on ESA and MSA on September 29, 2011. The Navy has submitted a JARPA to USACE and WDOE, requesting a permit under CWA Section 404.

3.7.3 Summary of Impacts

Impacts to benthic communities including shellfish associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.7–5.

Table 3.7–5. Summary of Impacts to Benthic Communities Including Shellfish

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO BENTHIC COMMUNITIES INCLUDING SHELLFISH
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Temporary disturbance of community in maximum of 25.7 acres; loss of 0.21 acre of benthic organisms in pile footprints; construction would be conducted over 2 to 3 in-water work seasons (200–400 days of in-water pile driving). *Operation/Long-term Impacts:* Overwater shading (6.3 acres) may slightly affect sessile benthic organism productivity; permanent loss of 0.21 acre of soft-bottom habitat, increase in hard surface habitat on piles.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Temporary disturbance of community in maximum of 25.7 acres; loss of benthic organisms in pile footprints (0.21 acre), more in-water pile driving days (275–550 vs. 200–400) than Alternative 1, and an additional in-water work season (3 to 4 vs. 2 to 3). *Operation/Long-term Impacts:* Overwater shading (6.3 acres) may slightly affect benthic organism productivity; similar permanent loss of soft-bottom habitat (0.21 acre).
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Slightly greater temporary disturbance of community in maximum of 25.8 acres, more in-water pile driving days (210–420 vs. 200–400) compared to Alternative 1; construction would be conducted over 2 to 3 in-water work seasons. *Operation/Long-term Impacts:* Slightly more overwater shading (6.6 acres) than Alternative 1 but similar permanent loss of soft-bottom habitat (0.21 acre).
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Slightly greater temporary disturbance of community in maximum of 25.8 acres, more in-water pile driving days (290–570 vs. 200–400) compared to Alternative 1; construction would be conducted over 3 to 4 in-water work seasons. *Operation/Long-term Impacts:* Slightly more overwater shading (6.6 acres) than Alternative 1, but similar permanent loss of soft-bottom habitat (0.21 acre).
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Slightly greater area of temporary disturbance of community in maximum of 29.4 acres, a smaller loss of 0.08 acre of benthic organisms in pile footprints, and fewer in-water pile driving days (135–175 vs. 200–400) than Alternative 1; construction would be conducted over 2 in-water work seasons. *Operation/Long-term Impacts:* Includes more overwater shading (8.5 acres), but smaller permanent loss of soft-bottom habitat (0.08 acre).
No-Action Alternative	No impact.

Table 3.7–5. Summary of Impacts to Benthic Communities Including Shellfish (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO BENTHIC COMMUNITIES INCLUDING SHELLFISH
Mitigation: Under all alternatives, the Mitigation Action Plan (see Appendix F) would compensate for the impacts of the EHW-2. • The proposed current practices would minimize construction impacts.	
Consultation and Permit Status: • The Navy included impacts to the benthic community as part of its consultation with NMFS under the ESA and concluded consultation on September 29, 2011. • The Navy included impacts to the benthic community as part of its consultation with NMFS under the MSA and concluded consultation on September 29, 2011. • The Navy has submitted a JARPA to USACE and WDOE, requesting a permit under CWA Section 404.	

3.8 MARINE FISH

Two federal acts, the ESA of 1973 (16 USC 1531 et seq.) and the MSA (16 USC 1801-1882 et seq.), require federal agencies to consult with NMFS about activities proposed, funded, authorized, or undertaken that may affect federally listed fish species, designated critical habitat, and EFH. The ESA also protects the designated critical habitat of listed species. The MSA, through the EFH provision, protects the waters and substrate necessary for spawning, breeding, feeding, or growth to maturity of certain commercially managed fisheries species.

ENDANGERED SPECIES ACT

If federal activities could potentially affect ESA-listed species, agencies are required to consult with NMFS and/or USFWS. The Navy submitted a biological assessment (Naval Facilities Engineering Command [NAVFAC] 2011b) and concluded consultation with NMFS (Biological Opinion issued September 29, 2011) and USFWS (Biological Opinion issued November 16, 2011). As discussed in Section 3.8.1.1, seven threatened or endangered marine fish species have the potential to occur in the waters of northern Hood Canal (Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bull trout, bocaccio [a species of rockfish], canary rockfish, and yelloweye rockfish). Green sturgeon and Pacific smelt, two additional threatened or endangered species, were considered but eliminated from further analysis because they are not known to occur in Hood Canal (NMFS 2009; Longenbaugh 2010, personal communication).

Primary Constituent Elements for Chinook and Hood Canal summer-run Chum salmon:

In the final rule designating critical habitat for 12 evolutionarily significant units (ESUs)/ distinct population segments (DPS) of salmonids in Washington, Oregon, and Idaho, published on September 2, 2005 (70 Federal Register [FR] 52630), NMFS defined the six (6) primary constituent elements (PCEs) to be essential for the conservation of these listed salmonids (including Puget Sound Chinook and Hood Canal summer-run chum). All lands identified as essential and designated as critical habitat contain one or more of the PCEs. Although critical habitat occurs in northern Hood Canal waters adjacent to the base, NBK at Bangor is excluded from critical habitat designation for ESA-listed Puget Sound Chinook salmon by federal law (70 FR 52630). However, certain projects may have activities of sufficient nature to impact critical habitat outside of the base boundaries and therefore it is important to assess the project activities potential to impact these PCEs.

For the proposed EHW-2, the nearest critical habitat designated for Puget Sound Chinook and Hood Canal summer-run chum salmonids is located immediately south and north of the NBK at Bangor base boundary along the nearshore. In estuarine and nearshore marine areas, critical habitat includes areas contiguous with the shoreline from the line of extreme high water out to a depth no greater than 30 meters (100 feet) relative to MLLW (70 FR 52684). Within these areas, the PCEs essential for the conservation of these ESUs are those sites and habitat components that support one or more life stages, including:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
2. Freshwater rearing sites with: (i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) Water quality and forage supporting juvenile development; and (iii) Natural cover such as shade,

submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

3. Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival;
4. Estuarine areas free of obstruction and excessive predation with: (i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.
5. Nearshore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.
6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.
7. The proposed EHW-2 would have no effect on PCE Numbers 1, 2, 3, 4, and 6. The nearshore marine areas, described in greater detail below, would experience temporary increases in underwater noise levels. This habitat is important for juvenile salmonids and returning adults. Since in-water work would be performed during the months when juvenile salmon are unlikely to be present, the underwater noise levels are unlikely to rise to the level that would preclude migration or force juveniles into deeper water where predation is more likely.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The MSA (16 USC § 1801-1881 et seq.), through the EFH provision, protects waters and substrate necessary for federally managed (commercially harvested) fisheries in Washington waters. Federal agencies are required to consult with NMFS about activities that may adversely affect EFH for species protected under the MSA.

In addition to the federal agencies that regulate threatened and endangered fish species, the Point No Point Treaty tribes (PNPTT) are co-managers with WDFW in regulating harvest management and supplementation programs for the Hood Canal summer-run chum ESU (71 FR 47180). The PNPTT include the Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes, who have treaty rights to Usual and Accustomed (U&A) fishing across the summer-run chum geographic range (71 FR 47180). Additional groups that contribute to and oversee recovery planning include the Puget Sound Technical Recovery Team (PSTRT) and the Hood Canal Coordinating Council (HCCC), respectively (71 FR 47182).

Consultation and Permit Compliance Status. The Navy submitted a biological assessment (NAVFAC 2011b) and EFH assessment (NAVFAC 2011a). NMFS issued a Biological Opinion and EFH conservation recommendations on September 29, 2011. The Navy submitted a statutory response requirement on November 23, 2011, whereby the Navy agreed to conduct all recommendations, as proposed in the NMFS Biological Opinion, MSA Consultation section. USFWS issued a Biological Opinion on November 16, 2011. Impact-reducing measures required by these Biological Opinions are described in Section 3.8.2.7.

3.8.1 Existing Environment

Hood Canal is known to support at least 250 species of marine fish, including anadromous species (salmonids) that live part of their life cycle in fresh water (Schreiner et al. 1977; Miller and Borton 1980; Prinslow et al. 1980; Bax 1983; Salo 1991; Bhuthimethee et al. 2009a; Burke Museum 2010). Common fish species known or expected to occur in Hood Canal are listed in Appendix D. Seven threatened or endangered marine fish species have the potential to occur in the waters of northern Hood Canal, and are discussed separately under the Threatened and Endangered Species section below (Section 3.8.1.1). Non-ESA-listed marine fish have been categorized into three groups (salmonids, forage fish, and other marine fish) to facilitate a discussion of similar species, and are discussed in Section 3.8.1.2. Non-ESA-listed salmonids include both naturally spawning and hatchery-released salmon and trout species. Forage fish are those species that are considered a vital food resource to salmonids and other fish predators and are discussed in Section 3.8.1.3. Other marine fish include all other species ranging from benthic dwelling (demersal) to shallow-water species. Other marine fish are discussed in Section 3.8.1.4.

Seven salmonid species occur within the marine waters of Hood Canal: Chinook salmon, chum salmon, coho salmon, pink salmon, steelhead, bull trout, and cutthroat trout. Five hatcheries augment salmon populations by releasing Chinook, chum, coho, and pink salmon into Hood Canal. In 2006, approximately 34 million hatchery salmonids were released in Hood Canal to support the multi-million-dollar sport, commercial, and tribal salmon fisheries in the region (SAIC 2006, see Appendix L). These releases included approximately 25.1 million chum, 6.7 million Chinook, 1.6 million coho, and 467,000 pink salmon. Release dates vary from April 1 to June 1, depending on species and release location (SAIC 2006; Regional Mark Processing Center 2009). As hatcheries are not required to mark 100 percent of all salmonids released, unmarked hatchery fish captured along the Bangor shoreline are indistinguishable from naturally spawned fish (SAIC 2006; Bhuthimethee et al. 2009a). This is particularly problematic when estimating the distinction between seasonal occurrence and abundance of naturally spawned summer-run chum, naturally spawned fall-run chum, and hatchery-released chum salmon (SAIC 2006; Bhuthimethee et al. 2009a; see Appendix L).

Forage fish species present along the Bangor shoreline primarily include Pacific herring, surf smelt, and Pacific sand lance. In addition, over 45 other non-salmonid finfish species occur in the vicinity of the EHW-2 project site (SAIC 2006; Bhuthimethee et al. 2009a).

A review of past Hood Canal fish studies indicates that nearly 250 fish species have been identified in the marine waters of Hood Canal (Schreiner et al. 1977; Miller and Borton 1980; Prinslow et al. 1980; Bax 1983; Salo 1991; Bhuthimethee et al. 2009a; Burke Museum 2010). Species more prevalent in deeper offshore habitats ranged from a variety of rockfish species, Pacific hake, walleye pollock, wolfeel, skates, sharks, lanternfish, snailfish, and flatfish species. Recent fish surveys in nearshore habitats along the Bangor shoreline have documented the occurrence of juvenile salmonids and forage fish, as well as a variety of other species, including perches, gunnels, pricklebacks, sculpins, pipefish, threespine sticklebacks, tubesnouts, and juvenile flatfish species (Bhuthimethee et al. 2009a).

Fish habitat along the Bangor waterfront has been characterized as diverse and healthy based on analyses of fish species richness, composition, abundance, and size distribution; fish habitat includes marine waters, estuaries, and streams (URS 1994). Of particular importance are the freshwater outlets from Hunter's Marsh, Devil's Hole, and Cattail Lake that provide warmer, nutrient-rich fresh water in these areas. This warmer water supports dense marine vegetation and

benthic communities, which provide refuge and food sources for marine fish, including juvenile salmon.

3.8.1.1 Threatened and Endangered Marine Fish and Essential Fish Habitat

This section discusses species-specific life history information and occurrence of ESA-listed salmonids and rockfish. The marine habitat requirements for listed Hood Canal salmonids, described under Puget Sound Chinook salmon in Section 3.8.1.1.1.2, is applicable to both ESA-listed and non-listed Hood Canal salmonids. Table 3.8–1 provides the federal listing and whether critical habitat is designated near the Bangor waterfront.

Table 3.8–1. Federally Listed Threatened and Endangered Marine Fish in Kitsap County

FISH	FEDERAL LISTING	CRITICAL HABITAT	CRITICAL HABITAT DESIGNATED IN NORTHERN HOOD CANAL
Puget Sound Chinook	Threatened *70 FR 37160, June 28, 2005*	Designated Depth -30 meters *70 FR 52630, September 2, 2005*	Designated along the shoreline to depth of -30 meters except not along Bangor waterfront
Hood Canal summer-run chum	Threatened *64 FR 14508, March 25, 1999*	Designated Depth -30 meters *70 FR 52630, September 2, 2005*	Designated along the shoreline to depth of -30 meters except not along Bangor waterfront
Puget Sound steelhead	Threatened *72 FR 26722, May 11, 2007*	Under development	N/A
Bull trout	Threatened *64 FR 58909, November 1, 1999*	Designated Depth -33 feet (-10 meters) *75 FR 63898 October 18, 2010* Effective *November 17, 2010*	Designated along the shoreline to depth of -33 feet (-10 meters). The closest critical habitat occurs along the western and northern shores of Dabob Bay beyond Hazel Point, at the southern tip of Toandos Peninsula, which is outside of the area affected by the proposed action.
Bocaccio	Endangered *75 FR 22276, April 28, 2010*	Not designated	N/A
Canary rockfish	Threatened *75 FR 22276, April 28, 2010*	Not designated	N/A
Yelloweye rockfish	Threatened *75 FR 22276, April 28, 2010*	Not designated	N/A

3.8.1.1.1 PUGET SOUND CHINOOK

3.8.1.1.1.1 SPECIES DESCRIPTIONS

The Puget Sound Chinook salmon ESU was listed as federally threatened under the ESA in 1999 (64 FR 14308), with the threatened listing reaffirmed in 2005 (70 FR 37160). Critical habitat was designated for Puget Sound Chinook shortly thereafter in 2005 (70 FR 52685).

Average adult Chinook escapement (number of fish surviving to reach spawning grounds or hatcheries) in recent years is relatively low, particularly for the mid-Hood Canal stock, for which average escapements were typically below the low escapement threshold of 400 Chinook fish (WDFW 2002). Reduced viability and listing of these specific stocks were attributed to habitat loss and degradation, hatcheries, and harvest management issues. Additionally, DO levels in portions of Hood Canal are at a historic low, which is a concern and future threat to recovery of the Hood Canal stocks of this and all other Hood Canal salmonid ESUs (70 FR 76445). DO levels at the Bangor waterfront are discussed in Section 3.2.1.2.

Chinook salmon are one of the least abundant salmonids occurring along the Bangor shoreline (Figure 3.8–1). Offshore tow-netting and beach seine surveys during the 1970s (Schreiner et al. 1977; Prinslow et al. 1980; Bax 1983; Salo 1991), and nearshore beach seine surveys from 2005–2008 (SAIC 2006; Bhuthimethee et al. 2009a), have found that Chinook salmon migrating from southern Hood Canal streams and hatcheries occur most frequently along the Bangor waterfront from late May to early July. Beginning in 2005 an attempt was made to replicate the offshore sampling conducted in the 1970s to confirm those findings; however, the floating Port Security Barrier (a security requirement), combined with strong tides, precluded effective sampling. As a result, the offshore occurrence and distribution for all fish species is based on those earlier studies. The description of the nearshore occurrence of fish is based on the 2005–2008 surveys.

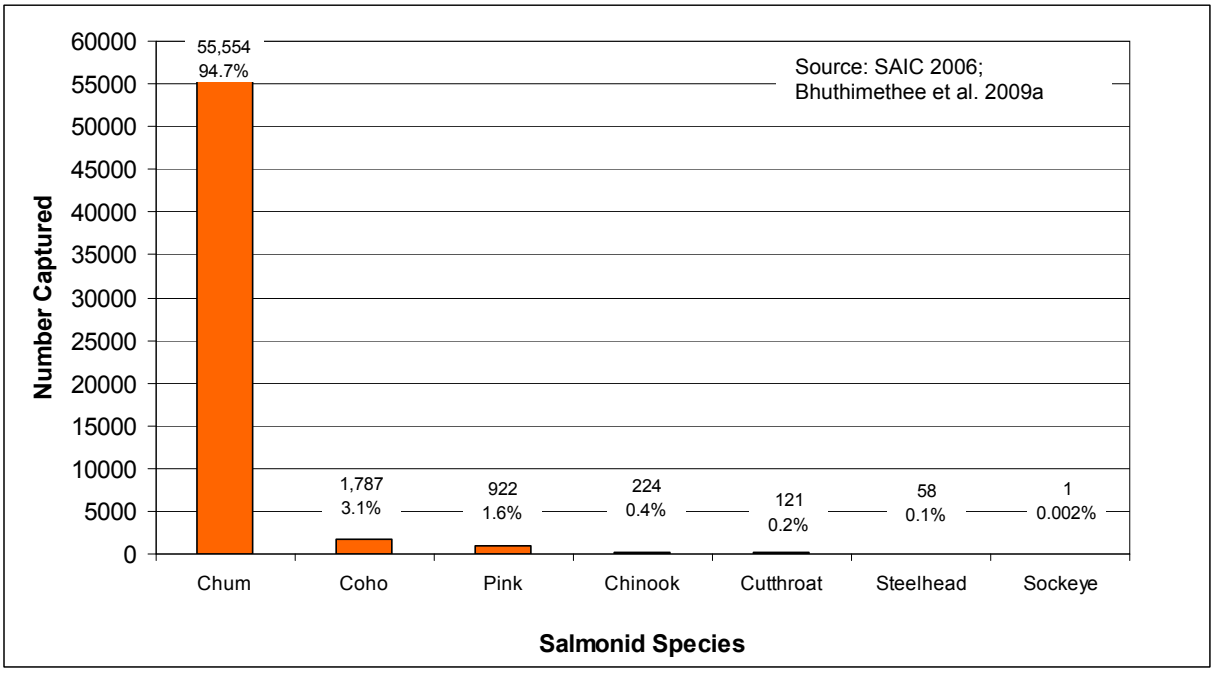


Figure 3.8–1. Salmonids, in Order of Abundance, Captured During 2005–2008 Bangor Beach Seine Surveys

Emergent Chinook fry, like fry of other Pacific salmonids, depend on shaded, nearshore habitat, with slow-moving currents, where they forage on drift organisms, including insects and zooplankton (Healey 1991). Smolts (juveniles that have transitioned from fresh water to salt water) usually migrate to estuarine areas within the first year, approximately 3 months after emergence from spawning gravel (in general, April through July with population variability). Appendix E provides a compilation of information to date regarding the out-migration timing of

juvenile Puget Sound Chinook along the Bangor shoreline, and within the greater Hood Canal region. This peak out-migration occurs from May to early July (see Appendix E).

Appendix E provides detailed information regarding the in-migration and spawn timing of adult Puget Sound Chinook past NBK at Bangor, and within the greater Hood Canal region. Adult Chinook salmon enter Hood Canal waters from August to October to begin spawning in their natal streams in September with peak spawning occurring in October.

3.8.1.1.1.2 SALMONID MARINE HABITAT REQUIREMENTS

Salmonids are most abundant in Hood Canal during the spring juvenile salmonid out-migration (Schreiner et al. 1977; Prinslow et al. 1980; Bax 1983; Salo 1991; SAIC 2006; Bhuthimethee et al. 2009a), when these fish are dependent on nearshore habitats for foraging and refuge. NMFS, USFWS, and the Pacific Fisheries Management Council have prepared guidance on the evaluation of properly functioning conditions (PFCs) for salmonids in freshwater systems. Although this *Matrix of Pathways Indicators* has only been constructed for freshwater and not for marine systems, marine and estuarine habitat requirements for juvenile and adult salmonids have been described by many authors (Fresh et al. 1981; Shepard 1981; Healey 1982; Levy and Northcote 1982; Weitkamp et al. 2000).

Ideally, reliable stock-specific habitat requirements would exist for all populations of listed species that would allow the impacts of an action to be quantified in terms of population impacts (NMFS 1999). However, as stated in the Habitat Approach, an August 1999 supplement to the National Oceanic and Atmospheric Administration (NOAA) Fisheries guidance document *Making Endangered Species Act Determinations of Effects for Individual or Grouped Action at the Watershed Scale* (NMFS 1996), in the absence of population-specific information, an assessment must define the biological requirements of a listed fish species. These requirements are defined in terms of PFCs, which are described as the sustained presence of natural habitat-forming processes necessary for the long-term survival of the species through the full range of environmental variation (NMFS 1999). Table 3.8–2 provides a brief summary of these resources, the levels at which degradation is considered, supporting documentation, and the existing condition of the resource. While Table 3.8–2 is designed to specifically address the marine habitat requirements for salmonids, many of these same habitat indicators would similarly apply to habitat requirements for other marine fish species.

Indicators of PFCs vary in different landscapes based on unique physiological and geologic features (NMFS 1999). Since aquatic habitats are inherently dynamic, PFCs are defined by the persistence of natural processes that maintain habitat productivity at a level sufficient to ensure long-term survival, and are not necessarily defined by absolute thresholds and parameters (NMFS 1999).

Though described here under Puget Sound Chinook salmon, the PFCs described and analyzed below are sufficiently detailed to address the relevant PCEs for Chinook and Hood Canal summer-run chum salmon (see Regulatory Overview discussion above), in addition to EFH species, and other marine fish species not covered by ESA or MSA. PFC indicators are identified as described below.

Table 3.8–2. Salmonid Marine Habitat Requirements

INDICATORS	SUMMARY	SUPPORTING DOCUMENTS	EXISTING CONDITIONS ON NBK AT BANGOR
WATER AND SEDIMENT QUALITY			
Turbidity	Maximum one-day turbidity increases exceed 5 NTU above background when the background is below 50 NTU for at-risk conditions. Maximum one-day turbidity increases exceed 10 NTU above background when the background is below 50 NTU for not properly functioning conditions (PFCs).	Beauchamp et al. 1983; Healey 1991; Sandercock 1991; Nightingale and Simenstad 2001a,b	Properly Functioning
Dissolved Oxygen	Dissolved oxygen concentrations between 4.0 and 7.0 mg/L constitute at-risk habitat. Concentrations below 4.0 mg/L are not properly functioning.	Reiser and Bjornn 1979; Beauchamp et al. 1983; WAC 173-201A	At Risk (in late-summer)
Other Water Quality Parameters	Localized waters where temperature, pH, or other parameters exceed conditions in adjacent surrounding waters are considered at risk. Section 303(d) of the CWA listed water bodies are defined as not properly functioning for the purpose of this assessment.	WDOE 2009c	Properly Functioning
Sediment Quality	Sediment contaminant concentrations established by WDOE are determined to be at risk. Contaminants at or above toxic levels are not properly functioning.	WDOE 1990; WAC 173-204	Properly Functioning
PHYSICAL HABITAT			
Physical Barriers	An at-risk habitat is considered to contain few overwater structures that represent little or no barrier to juvenile salmon. A not properly functioning habitat is defined as habitat that contains multiple structures along a shoreline that represent at least a partial barrier to juvenile salmon.	Weitkamp et al. 2000; Nightingale and Simenstad 2001a	Not Properly Functioning
Substrate/ Armoring	Shorelines with minor armoring by riprap and low density shoreline development are considered at risk. Shoreline areas containing extensive armoring are not properly functioning.	Prinslow et al. 1980; Fresh et al. 1981; Thom et al. 1994; Nightingale and Simenstad 2001a,b; KCDNR 2001; Williams and Thom 2001	At Risk
Refugia	An at-risk habitat consists of some reduction in size, number, and/or connectivity fragmented by development. A not properly functioning habitat condition exists when adequate habitat refugia do not exist.	NMFS 1996; Nightingale and Simenstad 2001a,b; Williams and Thom 2001	At Risk

Table 3.8–2. Salmonid Marine Habitat Requirements (continued)

INDICATORS	SUMMARY	SUPPORTING DOCUMENTS	EXISTING CONDITIONS ON NBK AT BANGOR
	BIOLOGICAL HABITAT		
Prey Availability	Sediments containing a benthic community that was altered from its natural state are considered at risk. Sediments that have an impaired ability to support benthic invertebrates are not properly functioning.	Bax et al. 1978; Fresh et al. 1981; Kjelson et al. 1982; Healey 1991	At Risk
Aquatic Vegetation	If an area historically contained vegetation but the vegetation is degraded by disturbance, then the habitat is considered at risk. Habitat without previously occurring vegetation as a result of shoreline development is considered not properly functioning.	Simenstad and Cordell 2000; Nightingale and Simenstad 2001a,b; Garono and Robinson 2002; Shafer 2002	At Risk
	UNDERWATER NOISE		
Underwater Noise	At risk habitats are those that experience underwater noise levels elevated above background, natural levels but remain insufficient to alter fish behavior or cause injury. Not properly functioning habitats include those that are, with regularity, exposed to underwater noise sufficient to alter fish behavior or injury.	Hastings 2002; Hastings and Popper 2005; Popper et al. 2006; WSDOT 2007	At Risk

WATER AND SEDIMENT QUALITY

As described in greater detail in Section 3.2, turbidity along the Bangor shoreline meets water quality standards and is considered properly functioning (Table 3.8–2). DO levels meet the extraordinary standard for surface waters (3 to 20 feet in depth) year round and for deep water (66 to 197 feet in depth) most of the year, although deeper waters can drop to a fair standard in late summer (Hafner and Dolan 2009; Phillips et al. 2009; HCDOP 2009b). Due to the decreased levels of DO in late summer-early fall, DO conditions are considered at risk (Table 3.8–2). Temperature, pH, and other water quality parameters meet water quality standards and there is no known water contamination at the EHW-2 project site (see Section 3.2).

Existing nearshore current patterns along the shoreline at the EHW-2 project site, primarily driven by tidal exchange, are described in greater detail in Section 3.1.1.3. The nearest freshwater source to these waters is the Hunter's Marsh system, located immediately behind the existing EHW structure. The strong tides and currents, combined with a small outflow from the marsh, result in well-mixed waters at the EHW-2 project site, with no habitat that acts as an estuary.

Sediment investigation studies have shown that marine sediments in the vicinity of the EHW-2 project site are composed of gravelly sands with some cobbles in the intertidal zone, transitioning to silty sands in the subtidal zone (Hammermeister and Hafner 2009). In general, sediment characterization studies along the waterfront demonstrated that organic contaminants, metals, PAHs, phthalates, phenols, and some chlorinated pesticides occur at concentrations

below the cleanup thresholds (see Section 3.3). As a result, sediment quality in the vicinity of the EHW-2 project site is considered properly functioning (Table 3.8–2).

PHYSICAL HABITAT

Physical Barriers

The seven existing in-water structures along the waterfront (Carderock Pier, Service Pier, KB Docks, Delta Pier, Marginal Wharf, the existing EHW, and the Magnetic Silencing Facility [MSF]) likely act as migrational barriers to shoreline migrating juvenile salmon. Although there are many nearshore structures in the southern portion of Hood Canal, primarily smaller docks, NBK at Bangor represents the only industrial waterfront within the Hood Canal area of Puget Sound. Within northern Hood Canal, nearshore development is limited. A few docks and a small pier occur at Seabeck, more than 8 miles to the south, and the Hood Canal Bridge, approximately 7 miles north of the MSF. The remainder of the northern Hood Canal shoreline is generally undeveloped. For the Marginal Wharf, the large number of piles, their close spacing, the low height-over-water design, and the nearshore location of the wharf likely make this the greatest barrier to migrating juvenile salmon. Most of the other structures, including the existing EHW, have been designed to have the majority of their overwater structures farther offshore, have a greater height-over-water, and an increased separation between piles. Recent fish surveys have captured large numbers of salmonids behind and along the shoreline immediate to the north of each structure, including Marginal Wharf (SAIC 2006; Bhuthimethee et al. 2009a), suggesting juvenile salmonids are able to migrate around, or through, these structures. Although statistical analyses of those surveys did not indicate a significant barrier effect of these nearshore structures (Bhuthimethee et al. 2009a), they were designed to detect the occurrence, distribution, and habitat use of nearshore fish species, and did not include a study design specific for detecting the potential barrier effects of nearshore NBK at Bangor structures. Therefore, as these structures include both in-water physical structures and overwater lighting considered as potential barriers to juvenile salmonid migration in Puget Sound (Simenstad et al. 1999; Nightingale and Simenstad 2001a), nearshore physical barriers to juvenile salmonid migration along the Bangor waterfront are considered not properly functioning (Table 3.8–2).

Substrate/Armoring

Substrate armoring is most important in the nearshore intertidal and shallow subtidal (30 feet below MLLW to 12 feet above MLLW) habitat used by juvenile salmon as a migratory pathway. Shoreline armoring occurring over 12 feet above MLLW would have little or no impact to the migratory pathway for fish. For the entirety of Hood Canal, an estimated 27 percent of the shoreline is classified as modified (e.g., containing bulkheads, shoreline armoring, docks, etc.) (Puget Sound Partnership 2008). This number is slightly lower for the Kitsap County shoreline where an estimated 25 percent is modified. An estimated 6 percent of the Bangor shoreline considered as modified (Judd 2010). Riprap that occurs within the migratory pathway along the waterfront includes some portion of the shorelines immediately shoreward of KB Docks, Delta Pier, Marginal Wharf, and the MSF. Existing shoreline armoring at the EHW-2 project site occurs adjacent to the existing EHW structure and trestles. However, all existing shoreline armoring in this area occurs at a tidal elevation greater than 12 feet above MLLW, above the migratory pathway for juvenile salmonids, and is only inundated during the highest tides of the year. Each of the seven nearshore docks, piers, or wharves along the Bangor waterfront includes some number of piles that occur within the migratory pathway. The presence of these piles alters

the nearshore substrate and is, therefore, considered armoring. As a result, substrate/armoring along the Bangor waterfront is considered at risk (Table 3.8–2).

Refugia

The shoreline along NBK at Bangor varies in composition from one dominated by sand, oyster shells, and cobble to one containing shoreline armoring. The shoreline near the EHW-2 project site includes many fallen trees and shrubs. Much of this fallen vegetation is inundated and provides refuge for juvenile salmonids migrating along this shoreline during higher tides. In addition, narrow bands of eelgrass that occur in the shallow subtidal zone (Morris et al. 2009) offer foraging and refuge opportunities for juvenile salmonids at lower tidal elevations. However, due to the presence of seven large nearshore in-water structures along the Bangor waterfront, and the impacts of these structures to nearshore physical (benthic community) and biological functions (eelgrass shading), refugia habitat is limited in the immediate vicinity of these structures. As a result, refugia along the Bangor waterfront are considered at risk (Table 3.8–2).

BIOLOGICAL HABITAT

Prey Availability

The large majority of salmonids that occur along the Bangor waterfront are juveniles, recently emerged from their natal streams, migrating toward the Pacific Ocean (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009a). At these smaller sizes, juvenile salmonids prefer small benthic invertebrate prey, although larger age-0 fish will prey on smaller fish. Other species, notably coho salmon, occur as larger age-1 fish during their out-migration, and use larval and juvenile forage fish as a food resource during their migration. Subadult and adult salmonids use juvenile and adult forage fish, among other species, as a food resource (Healy 1991; Salo 1991; Sandercock 1991). A detailed description of forage fish life history and occurrence, including prey resources such as benthic invertebrates used extensively by the younger, more abundant, juvenile salmonids, is provided in Section 3.8.1.3.

The presence of small invertebrate prey resources such as harpacticoid copepods, gammarid and corophoid amphipods, which are preferred juvenile salmon prey sources (Healey 1991; Salo 1991; Webb 1991a,b; Fujiwara and Highsmith 1997; HCCC 2005), indicate an epibenthic community capable of providing suitable food resources during the juvenile salmon out-migration along the Bangor shoreline. As described in Section 3.7 (Benthic Communities and Shellfish), benthic organisms, including a number of preferred amphipod species, are abundant and diverse at the EHW-2 project site. However, the seven nearshore docks, piers, or wharves that occur along the Bangor waterfront include piles and overhead shading of benthic habitat. The presence of the existing piles results in a direct habitat change from soft-bottom benthic habitat to hard substrate (e.g., concrete). In addition, the existing overwater trestles and decking result in direct shading and reduced productivity of benthic habitat in the immediate vicinity of these structures. Therefore, the productivity of these habitats is reduced from their pre-development condition and is considered at risk (Table 3.8–2).

Aquatic Vegetation

Juvenile salmonids use nearshore marine aquatic vegetation, notably eelgrass, as forage and refuge habitat during their migration from natal streams (Simenstad and Cordell 2000; Nightingale and Simenstad 2001a,b; Shafer 2002). The existing marine vegetation community is

considered to be healthy and diverse at the EHW-2 project site, as described in Section 3.5. Similar to benthic and forage fish spawning habitat, more aquatic vegetation habitat likely would have been present prior to the nearshore construction of the existing piers or wharves. It can be assumed that, at a minimum, the reduction in light attenuation due to the presence of these overwater structures limits the suitability of benthic habitats in their immediate vicinity to support healthy aquatic vegetation. As a result, aquatic vegetation along the Bangor waterfront is considered at risk (Table 3.8–2).

UNDERWATER NOISE

Elevated underwater noise from anthropogenic sources has been found to alter the distribution, behavior and health of fish that are present during these conditions (Hastings 2002; Hastings and Popper 2005; Popper et al. 2006). The existing underwater noise along the Bangor waterfront is attributed to a variety of both natural and human-related sources and is described in greater detail in Section 3.4.1.1. Average underwater noise levels measured along the Bangor waterfront are elevated over ambient conditions due to waterfront operations, but are within the minimum and maximum range of measurements taken at similar environments within Puget Sound (see Section 3.4.1.1). However, as underwater noise associated with the waterfront activities is elevated above ambient condition, underwater noise is considered at risk (Table 3.8–2).

3.8.1.1.1.3 CRITICAL HABITAT DESCRIPTION

A final designation of Puget Sound Chinook salmon critical habitat was published on September 2, 2005, with an effective date of January 2, 2006 (70 FR 52685). Nearshore marine waters within Hood Canal were included as part of this designation. Although critical habitat occurs in northern Hood Canal waters adjacent to the base, NBK at Bangor is excluded from critical habitat designation for ESA-listed Puget Sound Chinook salmon by federal law (70 FR 52630). As a result, no Puget Sound Chinook salmon critical habitat occurs in the immediate vicinity of the EHW-2, although critical habitat does occur within northern Hood Canal as shown in Figure 3.8–2. The closest critical habitat occurs immediately beyond the northern and southern base boundaries.

3.8.1.1.2 HOOD CANAL SUMMER-RUN CHUM SALMON

3.8.1.1.2.1 SPECIES DESCRIPTION

The Hood Canal summer-run chum salmon ESU was federally listed as threatened under the ESA in 1999, and the threatened listing was reaffirmed in 2005 (70 FR 37160) (Table 3.8–1). Critical habitat was also designated for Hood Canal summer-run chum ESU in 2005, and the NMFS recovery plan for this species was adopted on May 24, 2007 (72 FR 29121). The Hood Canal summer-run chum ESU includes all naturally spawned populations of summer-run chum salmon in Hood Canal and its tributaries. The only active fish hatchery that currently provides summer-run chum salmon to Hood Canal is the Quilcene National Fish Hatchery.

Historically, there were 16 stocks within the Hood Canal summer-run chum ESU, eight of which are extant (six in Hood Canal and two in the eastern Strait of Juan de Fuca) with the remaining eight extinct (71 FR 47180). Supplementation programs are currently ongoing at three of the extinct stock locations (two in Hood Canal) to effectively reintroduce the summer-run chum back to their historic range, and these stocks are recognized as part of the ESU (HCCC 2005).

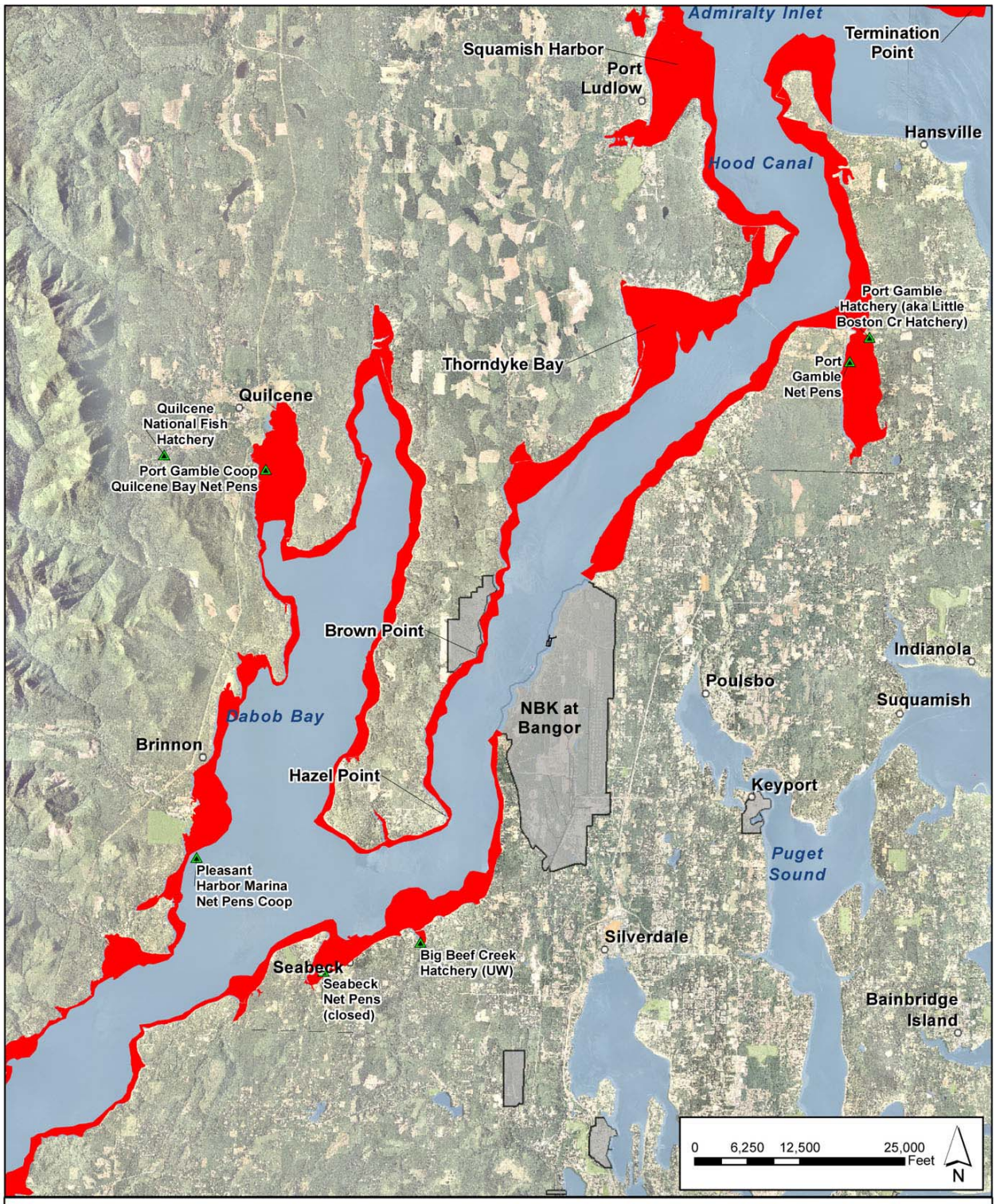


Figure 3.8–2. Puget Sound Chinook and Hood Canal Summer-Run Chum Salmon Critical Habitat for Hood Canal Nearshore Marine Areas

Reduced viability, lower survival, and listing of extant stocks of summer-run chum and recent stock extinctions in Hood Canal are attributed to the combined impacts of three primary factors: (1) habitat loss and degradation, (2) climate change, and (3) increased fishery harvest rates (HCCC 2005). An additional factor cited in WDFW and PNPTT (2000) and HCCC (2005) was impacts associated with the releases of hatchery salmonids, which compete with naturally spawning stocks for food and other resources.

During out-migration, fry move within the nearshore corridor and into and out of sub-estuaries with the tides, most likely in search of food resources (Hirschi et al. 2003). At a migration rate of 4.4 miles per day, the majority of chum emigrants from southern Hood Canal exit the canal to the north 14 days after their initial emergence in seawater (WDFW and PNPTT 2000). Appendix E provides a summary of the presence and out-migration timing of juvenile summer-run chum from Hood Canal. Juvenile summer-run chum are expected to occur near the proposed EHW–2 site from late January through early June.

Approximately one month separates peak spawn timing of the early (summer) and later (fall) runs of chum salmon in Hood Canal (Johnson et al. 1997). Summer-run chum are, in part, distinguished from fall chum populations by their exclusive use of nearshore marine habitat early in the run period (early August to October). Summer-run chum adults return to Hood Canal from as early as August and September through the first week in October (Washington Department of Fisheries et al. 1993; WDFW and PNPTT 2000).

3.8.1.1.2.2 CRITICAL HABITAT DESCRIPTION

A final designation of Hood Canal summer-run chum salmon critical habitat was published on September 2, 2005, with an effective date of January 2, 2006 (70 FR 52685). Nearshore marine waters within Hood Canal were included as part of this designation. Although critical habitat occurs in northern Hood Canal waters adjacent to the base, NBK at Bangor is excluded from critical habitat designation for ESA-listed Hood Canal summer-run chum salmon by federal law (70 FR 52630). As a result, no Hood Canal summer-run chum salmon critical habitat occurs in the immediate vicinity of the EHW-2, although critical habitat does occur within northern Hood Canal as shown in Figure 3.8–2. The closest critical habitat occurs immediately beyond the northern and southern base boundaries.

3.8.1.1.3 PUGET SOUND STEELHEAD

3.8.1.1.3.1 SPECIES DESCRIPTION

The Puget Sound steelhead was listed in May 2007 under the ESA as a threatened DPS[5] (72 FR 26722). Stocks of the Puget Sound steelhead DPS are mainly winter-run, although a few small stocks of summer-run steelhead also occur (71 FR 15666). Eight stocks of winter-run and three stocks of summer-run Puget Sound steelhead occur in Hood Canal (WDFW 2002). Some stocks of Puget Sound steelhead in Hood Canal (i.e., hatchery supplementation or hatchery releases to non-native streams) may not be considered part of the DPS (71 FR 15668).

The origin and production type of all stocks of Puget Sound steelhead occurring in Hood Canal remain unresolved by the state and tribes (WDFW 2002). The 1996 status review (Busby et al. 1996) and more recent NMFS review for Puget Sound steelhead (Hard et al. 2007) included

[5] A DPS is discrete from other populations and important to its taxon. A group of organisms is discrete if it is "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, and behavioral factors" (DPS Policy; 61 FR 4722; February 7, 1996). Significance is measured with respect to the taxon (species or subspecies).

only three stocks of winter-run steelhead that occur in Hood Canal as native populations: (1) Tahuya winter steelhead, (2) Dewatto winter steelhead, and (3) Skokomish winter steelhead. Official determination for the proposed DPS listing has not been designated, and specifics on all stocks to be included in the DPS listing are forthcoming. In general, abundance of winter-run steelhead stocks in Hood Canal is low, with most stocks averaging less than 200 adult spawners per year (NMFS 2005).

Steelhead exhibit the most complex life history of any species of Pacific salmon. Steelhead can be freshwater residents (referred to as rainbow trout) or anadromous (referred to as steelhead), and, under some circumstances, they can yield offspring of the alternate life history form (72 FR 26722). Anadromous forms can spend up to 7 years in fresh water prior to smoltification and then spend up to 3 years in salt water prior to migrating back to their natal streams to spawn (Busby et al. 1996). In addition, steelhead may spawn more than once during their life span, whereas other Pacific salmon species generally spawn once and die.

Steelhead do not occur in large numbers along the Bangor shoreline (Figure 3.8–1). For example, juvenile steelhead captured in 2005 through 2008 beach seine surveys were one of the least abundant of the salmonids captured along the Bangor waterfront, accounting for less than 1 percent of the salmonid catch (SAIC 2006; Bhuthimethee et al. 2009a). Steelhead occur most frequently in the late spring and early summer months.

WINTER-RUN

Limited information is available regarding the timing of juvenile out-migration for winter-run steelhead in Hood Canal. WDFW suggests that juvenile out-migration of steelhead stocks in Hood Canal occurs from March through June, with peak out-migration during April and May (Johnson 2006, personal communication).

Most stocks of winter-run steelhead in Hood Canal (Skokomish, Hamma Hamma, Duckabush, Quilcene/Dabob Bay, and Dosewallips) spawn from mid-February to mid-June (WDFW 2002) (see Appendix E). Information published to date indicates adult spawn timing occurs from mid-February to early June.

SUMMER-RUN

Information regarding the timing of juvenile out-migration for summer-run steelhead in Hood Canal is not currently available. Spawn timing of summer-run steelhead in Hood Canal is not fully understood; however, spawning is believed to occur from February through April (WDFW 2002).

3.8.1.1.3.2 CRITICAL HABITAT DESCRIPTION

No critical habitat for Puget Sound steelhead has been designated but it is currently under development (72 FR 26722). Department of Defense (DoD) installations with current Integrated Natural Resources Management Plan (INRMPs) are exempted from critical habitat designation. The Draft Final NBK INRMP is currently under review by NOAA Fisheries. Therefore, no steelhead critical habitat occurs along the Bangor shoreline or within the project area. Conservation measures that provide protection to the species have been identified in the INRMP.

3.8.1.1.4 BULL TROUT

3.8.1.1.4.1 SPECIES DESCRIPTION

Currently, all populations of bull trout in the lower 48 states are listed as threatened under the ESA. Bull trout are in the char subgroup of salmonids and have both resident and migratory life histories (64 FR 58910). The Coastal-Puget Sound bull trout DPS reportedly contains the only occurrence of anadromous bull trout in the contiguous United States (64 FR 58912); Hood Canal is one of five geographically distinct regions within this DPS. All Hood Canal bull trout originate in the Skokomish River (WDFW 2004).

The food sources used by bull trout vary by life form, but in general, bull trout are considered opportunistic feeders (64 FR 58911). Both the resident and juvenile forms forage on aquatic and terrestrial insects, macro zooplankton, amphipods, mysids, crayfish, and small fish, whereas adult migratory bull trout primarily consume fish (including trout and salmon species), whitefish, yellow perch, and sculpin (64 FR 58911).

Resident bull trout remain in freshwater streams for their entire life cycle, whereas migratory bull trout, which have the potential to occur along the Bangor shoreline, spawn and rear in streams but migrate to marine waters as juveniles (64 FR 58910). Little information is known about the anadromous life history of bull trout. The spawning and early juvenile habitat requirements of bull trout are more specific than other salmonids, which may explain their patchy distribution (64 FR 58910). Important habitat features relevant to marine waters include cold water temperature (40 to 48°F), cover/shading, and intact migratory corridors (64 FR 58910). Reasons for declines and listing include habitat loss, degradation, and fragmentation, blocked migratory corridors (by dams or construction), introduced fish species (lake trout, brook trout, brown trout, and hatchery rainbow trout), and incidental harvest (64 FR 58910).

Bull trout in the Skokomish River system are thought to spawn from mid-September to December (WDFW 2004). It is not likely that bull trout migrate through the Bangor waterfront and past the EHW-2 project site (USFWS 2010). Neither historic nor recent juvenile fish surveys (using beach and lampara seines and tow nets) have captured bull trout (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009a). For the species as a whole, emergence of fry occurs from early April to May (64 FR 58910). Not enough is known to fully describe the duration of juvenile out-migration specifically for bull trout in Hood Canal (WDFW 2004).

3.8.1.1.4.2 CRITICAL HABITAT DESCRIPTION

Critical habitat was originally designated for bull trout in 2005 (70 FR 56212) with a final revision to this habitat published in 2010 (75 FR 63898). However, although both the original and revised final bull trout critical habitat occur in Hood Canal, neither designates waters north of Hazel Point, at the southeastern tip of Toandos Peninsula (Figure 3.8–3). Therefore, no bull trout critical habitat occurs along the Bangor shoreline, or within the project area. Based on this information, the Navy has determined no effect on bull trout critical habitat, and this is not analyzed further in this EIS.

Figure 3.8–3. Bull Trout Critical Habitat for Hood Canal Nearshore Marine Areas

3.8.1.1.5 BOCACCIO

3.8.1.1.5.1 SPECIES DESCRIPTION

Puget Sound bocaccio, a species of rockfish, were federally listed as endangered under the ESA in 2010 (75 FR 22276) (Table 3.8–1). Due to the recent listing, critical habitat has not yet been developed for bocaccio. WDFW published a revised DEIS titled: Puget Sound Rockfish Conservation Plan, on April 6, 2010. Threats to rockfish in Puget Sound include areas of low DO, commercial and sport fisheries (notably mortality associated with fishery bycatch), the reduction of kelp habitat necessary for juvenile recruitment (74 FR 18516), habitat disruption (including exotic species), derelict gear (notably lost or abandoned fishing nets), climate changes, species interactions (including predation and competition), diseases, and genetic changes (Drake et al. 2009; Palsson et al. 2009).

Although rockfish are typically long-lived, recruitment is generally poor as larval survival and settlement are dependent upon a variety of factors including marine currents, adult abundance, habitat availability, and predator abundance (Drake et al. 2009; Palsson et al. 2009). The combination of these factors has contributed to declines in the species within Georgia Basin and Puget Sound in the last few decades (74 FR 18516).

Bocaccio range from Punta Blanca, Baja California, to the Gulf of Alaska, Alaska (Love et al. 2002). They are believed to have commonly occurred along steep walls in most of Puget Sound prior to fishery exploitations, although they are currently very rare in these Puget Sound habitats (Love et al. 2002). Information on habitat requirements for most rockfishes is limited despite the years of research completed. Even less is known about bocaccio in Puget Sound (Drake et al. 2009; Palsson et al. 2009). In general, most adult rockfish are associated with high-relief, rocky habitats, which are limited in Hood Canal, while larval and juvenile stages of some rockfishes utilize open water and nearshore habitats as they grow. Reviews of rockfish habitat utilization in Puget Sound indicate that nearshore vegetated habitats are particularly important for some species of rockfish and serve as nursery areas for juveniles (Palsson et al. 2009; Bargmann et al. 2010).

Palsson et al. (2009) indicates that in Puget Sound waters recruitment habitats may include nearshore vegetated habitats, or deep-water habitats consisting of soft and low relief rocky substrates. Much of the information presented below on bocaccio life history and habitat use is derived from other areas where bocaccio occur. Palsson et al. (2009) provides the most comprehensive review of Puget Sound rockfish species distributions and the relative number of occurrences. This review relied heavily on Miller and Borton (1980) data, but also included the review of historical literature, fish collections, unpublished log records, and other sources. Palsson et al. (2009) noted bocaccio were only recorded 110 times in their review of historical studies, with most records being associated with sport catch from the 1970s in Tacoma Narrows and Appletree Cove (near Kingston). Only two records occurred for Hood Canal, both in the 1960s. Currently both sport and commercial fishing for rockfish in Hood Canal is prohibited, and no recent scientific surveys of these waters have occurred to document the recent prevalence of rockfish in these waters. Although there have been no confirmed observations of bocaccio in Puget Sound for approximately 7 years (74 FR 18516), Drake et al. (2009) concluded that it is likely that bocaccio occur in low abundances. As a result, bocaccio have the potential to be affected by the project and are, therefore, included in the analysis.

3.8.1.1.5.2 CRITICAL HABITAT DESCRIPTION

On April 28, 2010, three species of rockfish DPSs in Puget Sound were listed for protection under the ESA: Puget Sound/Georgia Basin DPS bocaccio (*Sebastes paucispinis*), Puget Sound/Georgia Basin DPS yelloweye rockfish (*S. ruberrimus*), and Puget Sound/Georgia Basin DPS canary rockfish (*S. pinniger*) (75 FR 22276). The final rule for this listing became effective July 27, 2010. NMFS indicated at the time of listing that, due to limited available information to assess impacts of the designation of conservation and the physical and biological features essential to conservation, critical habitat for these species has not been designated (75 FR 22276). However, no suitable adult rockfish habitat occurs in the immediate project vicinity (Palsson 2009, personal communication). Therefore, when the designation becomes effective, no rockfish critical habitat is anticipated to be proposed in the immediate vicinity of the proposed project.

3.8.1.1.6 CANARY ROCKFISH

3.8.1.1.6.1 SPECIES DESCRIPTION

Puget Sound canary rockfish were federally listed as threatened under the ESA in 2010 (75 FR 22276) (Table 3.8–1). Due to the recent listing, critical habitat has not yet been developed for canary rockfish. WDFW's April 2010 Puget Sound Rockfish Conservation Plan would be applicable for all rockfish in Puget Sound, including canary rockfish. The same stressors contributing to the decline of bocaccio affect canary rockfish in a similar manner (74 FR 18516; Drake et al. 2009; Palsson et al. 2009).

Canary rockfish range from Punta Blanca, Baja California, to the Shelikof Strait of Alaska, and are abundant from British Columbia to central California. Canary rockfish were once considered fairly common in the greater Puget Sound area (Kincaid 1919; Holmberg et al. 1962); however, little is known about their habitat requirements in these waters (Drake et al. 2009; Palsson et al. 2009). Recent reviews of Puget Sound rockfish and their habitats (Drake et al. 2009; Palsson et al. 2009; Bargmann et al. 2010) discuss habitat use by listed rockfish in general terms with little or no distinction between the species. Therefore, as discussed above for bocaccio, adult canary rockfish are considered associated with high-relief, rocky habitats, and larval and juvenile stages likely utilize open water and nearshore habitats. Much of the information presented below on canary rockfish life history and habitat use is derived from research from other areas where canary rockfish are more abundant. After review of historical rockfish records in Puget Sound, Palsson et al. (2009) noted 114 records of canary rockfish prior to the mid-1970s, with most records attributed to sport catch from the 1960s to 1970s in Tacoma Narrows, Hood Canal, San Juan Islands, Bellingham, and Appletree Cove. Within Hood Canal, 14 records occurred: 1 in the 1930s and at least 13 in the 1960s (Miller and Borton 1980). As mentioned for bocaccio, there is a moratorium on both sport and commercial fishing for rockfish in Hood Canal. With the absence of associated catch records, and limited scientific surveys of these waters, the prevalence of rockfish in waters adjacent to NBK at Bangor remains unknown. Drake et al. (2009) concluded that canary rockfish occur in low and decreasing abundances in Puget Sound. Therefore, canary rockfish have the potential to be affected by the project and are included in the analysis.

3.8.1.1.6.2 CRITICAL HABITAT DESCRIPTION

Critical habitat has not been designated for each of the three ESA-listed rockfish species, and is described in more detail for bocaccio in Section 3.8.1.1.5.2.

3.8.1.1.7 YELLOWEYE ROCKFISH

3.8.1.1.7.1 SPECIES DESCRIPTION

Puget Sound yelloweye rockfish were federally listed as threatened under the ESA in 2010 (75 FR 22276) (Table 3.8–1). Due to the recent listing, critical habitat has not yet been developed for yelloweye rockfish. WDFW's April 2010 Puget Sound Rockfish Conservation Plan would be applicable for all rockfish in Puget Sound, including yelloweye rockfish. The same stressors contributing to the decline of bocaccio affect yelloweye rockfish in a similar manner (74 FR 18516; Drake et al. 2009; Palsson et al. 2009).

Yelloweye rockfish are found from Ensenada, Baja California, to the Aleutian Islands in Alaska. They are abundant from southeast Alaska to central California but extremely rare in Puget Sound, Washington. Review of historical rockfish in Puget Sound by Palsson et al. (2009) noted 113 documented yelloweye rockfish records associated with sport catch. Of these records, 14 occurred in Hood Canal waters: 1 in the 1930s and 13 in the 1960s (Miller and Borton 1980). Kincaid (1919) reported yelloweye rockfish used to be relatively common in the deep waters of Puget Sound. Due to the moratorium on both sport and commercial fishing for rockfish in Hood Canal, the absence of associated recent catch records, and no recent scientific surveys of these waters, the prevalence of yelloweye rockfish in these waters remains unknown. As discussed above for canary rockfish, recent reviews of Puget Sound rockfish species and their habitats (Drake et al. 2009; Palsson et al. 2009; Bargmann et al. 2010) suggest little distinction between these rockfish species in terms of habitat use in Puget Sound. Therefore, as discussed above for bocaccio, adult yelloweye rockfish are considered associated with deeper, high-relief, rocky habitats, and larval and juvenile stages may utilize open water and nearshore habitats. Although little is known about their habitat requirements or use in Puget Sound waters (Drake et al. 2009; Palsson et al. 2009), yelloweye rockfish have the potential to be affected by the project and are, therefore, included in the analysis.

3.8.1.1.7.2 CRITICAL HABITAT DESCRIPTION

Critical habitat has not been designated for each of the three ESA-listed rockfish species, and is described in more detail for bocaccio in Section 3.8.1.1.5.2.

3.8.1.2 Non-ESA-Listed Salmonids

3.8.1.2.1 CHUM SALMON (FALL-RUN AND HATCHERY FISH)

Chum salmon is the most abundant salmonid that occurs along the Bangor shoreline, accounting for approximately 94.7 percent of the salmonid catch during the 2005 through 2008 surveys (Figure 3.8–1) (SAIC 2006; Bhuthimethee et al. 2009a). Chum salmon are also the most abundant hatchery fish reared in Hood Canal (SAIC 2006; Bhuthimethee et al. 2009a). As with pink salmon, chum salmon released from hatcheries are not marked (fin clipped). Thus, hatchery chum captured in Hood Canal surveys are indistinguishable in the field from naturally spawned chum (SAIC 2006; Bhuthimethee et al. 2009a).

Since fall-run and hatchery origin chum are indistinguishable from the ESA-listed summer-run chum without genetic analysis, their occurrence is presented in this section at a species level rather than as a seasonally distinguished ESU or run. Adult fall- and late-fall-run stocks of Hood Canal chum salmon return to their natal streams to spawn between November and January. Recently hatched out-migrating juvenile chum salmon have been captured along the Bangor shoreline from January through June (Schreiner et al. 1977; Salo et al. 1980; Bax 1983;

SAIC 2006; Bhuthimethee et al. 2009a), with peak catch from 2006 to 2008 occurring from March to April (SAIC 2006; Bhuthimethee et al. 2009a). Relatively small numbers of chum were captured in May and June of 2006, and no chum were captured from July through September, suggesting that the out-migration was completed by July (SAIC 2006). Similar to pink salmon, the small size of the juvenile chum salmon upon arrival to the marine environment in spring limits their out-migration distribution to the intertidal and shallow subtidal environment for both refuge and available food sources.

3.8.1.2.2 COHO SALMON

Coho salmon captured in beach seine surveys between 2005 and 2006 were the second most abundant salmonid occurring along the Bangor shoreline, accounting for approximately 3.1 percent of the salmonid catch (Figure 3.8–1) (SAIC 2006). There is a run-timing overlap between hatchery and naturally spawning coho during out-migration (Bhuthimethee et al. 2009a). In 2006, Hood Canal hatcheries released 1.6 million coho smolts from late April through early June (SAIC 2006). Although these hatchery fish were released at a time when naturally spawned coho also occur, approximately 82 percent of these released fish showed no external hatchery markings (data reviewed in SAIC 2006).

With some variability, coho salmon generally spawn in a 3-year cycle. Adult coho salmon migrate to their natal streams for spawning from mid-September to mid-November. Following a winter incubation period of 4 to 5 months, the free-swimming fry emerge from the gravel in the spring (Weitkamp et al. 1995). During spring of the second year, Hood Canal coho smolts migrate to sea. Due to the extended period of freshwater rearing time, juvenile coho are larger (2.8 to 3.5 inches) than some of the other co-occurring salmonids (e.g., chum and pink salmon at 1 to 1.6 inches) when they reach the waters of Hood Canal (SAIC 2006; Bhuthimethee et al. 2009a). As a result, coho are not as dependent on shallow waters for foraging and protection from predators and currents, and occur further offshore from the Bangor shoreline than other salmonids. These maturing coho spend an average of 16 to 20 months rearing in the ocean, then return to fresh water to spawn as 3-year-old adults (Sandercock 1991).

3.8.1.2.3 PINK SALMON

Pink salmon generally occur every other year (the majority out-migrate in even years), and were the third most abundant salmonid occurring along the Bangor shoreline in 2005–2006. This species accounted for approximately 1.6 percent of the total salmonid catch from 2005 to 2008 (Figure 3.8–1) (SAIC 2006). Though none of the NBK at Bangor streams support spawning populations of pink salmon, juveniles from southern Hood Canal stream systems migrate in a northerly direction and occur in the vicinity of the EHW-2 project site.

The Hoodsport Hatchery in southern Hood Canal rears pink salmon for release every other year at the end of the naturally spawned out-migration, usually in April. Currently this hatchery does not mark (fin-clip) pink salmon released in Hood Canal. As a result, recent surveys (2005 through 2008) were not able to distinguish between naturally produced and hatchery-reared pink salmon to determine differences in abundance, occurrence, or run-timing by source (SAIC 2006; Bhuthimethee et al. 2009a). Newly emerged pink salmon have been captured along the Bangor shoreline as early as January and as late as June, with a peak occurrence in March to April (Schreiner et al. 1977; Salo et al. 1980; SAIC 2006; Bhuthimethee et al. 2009a).

Adult pink salmon migrate from the ocean to their natal streams from August to September, with spawning occurring in freshwater gravel beds from September through October

(Heard 1991). Following their winter emergence from the gravel 4 to 5 months after spawning, pink salmon fry begin their migration to the marine waters of Hood Canal. Due to their small size (approximately 1.0 to 1.5 inches) when reaching the marine waters of NBK at Bangor (SAIC 2006; Bhuthimethee et al. 2009a), these juveniles out-migrate in the nearshore, seeking food and refuge from predators along the shallow intertidal and shallow subtidal shorelines.

3.8.1.2.4 CUTTHROAT TROUT

Cutthroat trout are considered uncommon along the Bangor shoreline (Schreiner et al. 1977; Bax et al. 1978, 1980; Salo et al. 1980; SAIC 2006), representing less than 1 percent of the salmonids caught from 2005 to 2008 (Figure 3.8–1) (SAIC 2006; Bhuthimethee et al. 2009a). Both juvenile and adult cutthroat trout have been captured along the Bangor shoreline throughout the year, but peak abundance was in May and June from 2005 to 2008 (SAIC 2006; Bhuthimethee et al. 2009a). At the Bangor waterfront, adult cutthroat were captured more frequently near the southern periphery and along the northern portion of the waterfront, away from the EHW-2 project site. This may be the result of adult cutthroat attraction to the fresh water exiting Cattail Lake and Devil's Hole.

Spawning for cutthroat trout takes place in freshwater streams. By 2 or 3 years of age, juvenile cutthroat begin to migrate to marine waters. Generally this migration occurs from March to June, with a peak out-migration in mid-May (Johnson et al. 1999). Upon entering marine waters, juvenile cutthroat form small schools and migrate along the nearshore waters. Some of these fish reside in Puget Sound whereas others enter coastal waters. Upon reaching maturity, cutthroat trout return to their natal streams for spawning, generally from July to December (Johnson et al. 1999). The spawned-out adults return to marine waters in late March or early April (Pacific States Marine Fisheries Commission 1996).

3.8.1.2.5 SOCKEYE SALMON

No documented runs of sockeye salmon occur within any of the tributaries of Hood Canal, with the nearest stock to Hood Canal occurring in Lake Washington (WDFW 2002). Although a lone 12-inch sockeye was captured along the Bangor waterfront in March of 2006 (SAIC 2006), this fish was likely a stray individual sockeye stock from either Lake Washington, Fraser River, or British Columbia (Ruggerone 2006, personal communication). No other sockeye salmon have been captured in surveys along the Bangor shoreline conducted in the 1970s or 2000s (Schreiner et al. 1977; Bax et al. 1978, 1980; Salo et al. 1980; SAIC 2006, Bhuthimethee et al. 2009a). Sockeye salmon are not discussed further in this document.

3.8.1.3 Forage Fish

Nearshore habitat requirements for forage fish are similar to those described in Section 3.8.1.1.1.2 for salmonids with respect to water and sediment quality, physical and biological habitat use, and underwater noise. One notable difference is that forage fish species use some areas of Puget Sound shorelines for spawning habitat, whereas salmonids use freshwater systems for spawning. Suitable spawning habitat for forage fish is species specific, and is discussed below for each species.

3.8.1.3.1 PACIFIC HERRING

Pacific herring (*Clupea pallasii*) are relatively small (9-inch) schooling fish distributed along the Pacific coast from Baja California, Mexico, to the Bering Sea and northeast to the Beaufort Sea, Alaska. Adult herring feed primarily on planktonic crustaceans, and juveniles prefer a diet

of crab and shrimp larvae. Herring are also an important food resource for other species in Puget Sound waters. The majority of herring spawning in Washington State waters occurs annually from late January through early April (Bargmann 1998). Herring deposit their transparent eggs on intertidal and shallow subtidal eelgrass and marine algae. Large spawning areas are found with patchy distribution in northern Hood Canal (Stick and Lindquist 2009). However, the only documented herring spawning grounds potentially affected by the project occur near Squamish Harbor (Figure 3.8–4). Pacific herring have been detected in small numbers during late winter months and large numbers in early summer months during recent surveys along the Bangor waterfront (SAIC 2006; Bhuthimethee et al. 2009a). These very large, but infrequent summer schools of herring comprise the majority of all forage fish that occur along the Bangor shoreline. During the 2005–2006 beach seine surveys, Pacific herring represented 73 percent of all forage fish captured, though these schools were captured in just a few sampling events (SAIC 2006). However, no herring were captured near the EHW-2 project site.

3.8.1.3.2 SURF SMELT

Surf smelt (*Hypomesus pretiosus*) are most abundant along the Bangor waterfront in late spring through summer (SAIC 2006; Bhuthimethee et al. 2009a). These small (9-inch) schooling fish are distributed along the Pacific coast from Long Beach, California, to Chignik Lagoon, Alaska. During the 2005–2006 beach seine surveys, surf smelt were the second most abundant forage fish captured, representing 20 percent of the total forage fish catch (SAIC 2006). Adult surf smelt feed primarily on planktonic organisms and have shown a preference for euphausiids. As with herring, these fish are an important component in Puget Sound, both as a food resource in the marine food web and as part of the commercial fishing industry.

In southern Hood Canal surf smelt spawn most frequently in the fall and winter. However, in many other regions of Puget Sound, including northern Hood Canal, spawning can occur year round. Although Penttila (1997) found no surf smelt spawning grounds along the Bangor waterfront in surveys conducted from May 1996 through June 1997, they may utilize the northern portion of Squamish Harbor (at the northern boundary of the area affected by the project) for spawning. Juvenile surf smelt have been found to rear in nearshore waters (Bargmann 1998) and were captured along the shoreline near the EHW-2 project site from January through the mid-summer months (SAIC 2006; Bhuthimethee et al. 2009a).

3.8.1.3.3 PACIFIC SAND LANCE

Pacific sand lance (*Ammodytes hexapterus*) were the third most abundant forage fish collected along the Bangor waterfront during recent surveys and comprised 7 percent of the total forage fish catch (SAIC 2006). The Pacific sand lance, another relatively small (8-inch) schooling fish, occurs throughout the coastal northern Pacific Ocean between the Sea of Japan and southern California, across Arctic Canada, and throughout the Puget Sound region. All life stages of sand lance feed on planktonic organisms, primarily crustaceans, with juveniles showing a preference for copepods. As with other forage fish, the Pacific sand lance is an important part of the trophic link between zooplankton and larger predators in local marine food webs. Bargmann (1998) indicated that 35 percent of all juvenile salmon diets and 60 percent of the juvenile Chinook diet comprised sand lance. Other regionally important species (such as Pacific cod, Pacific hake, and dogfish) feed heavily on juvenile and adult sand lance.

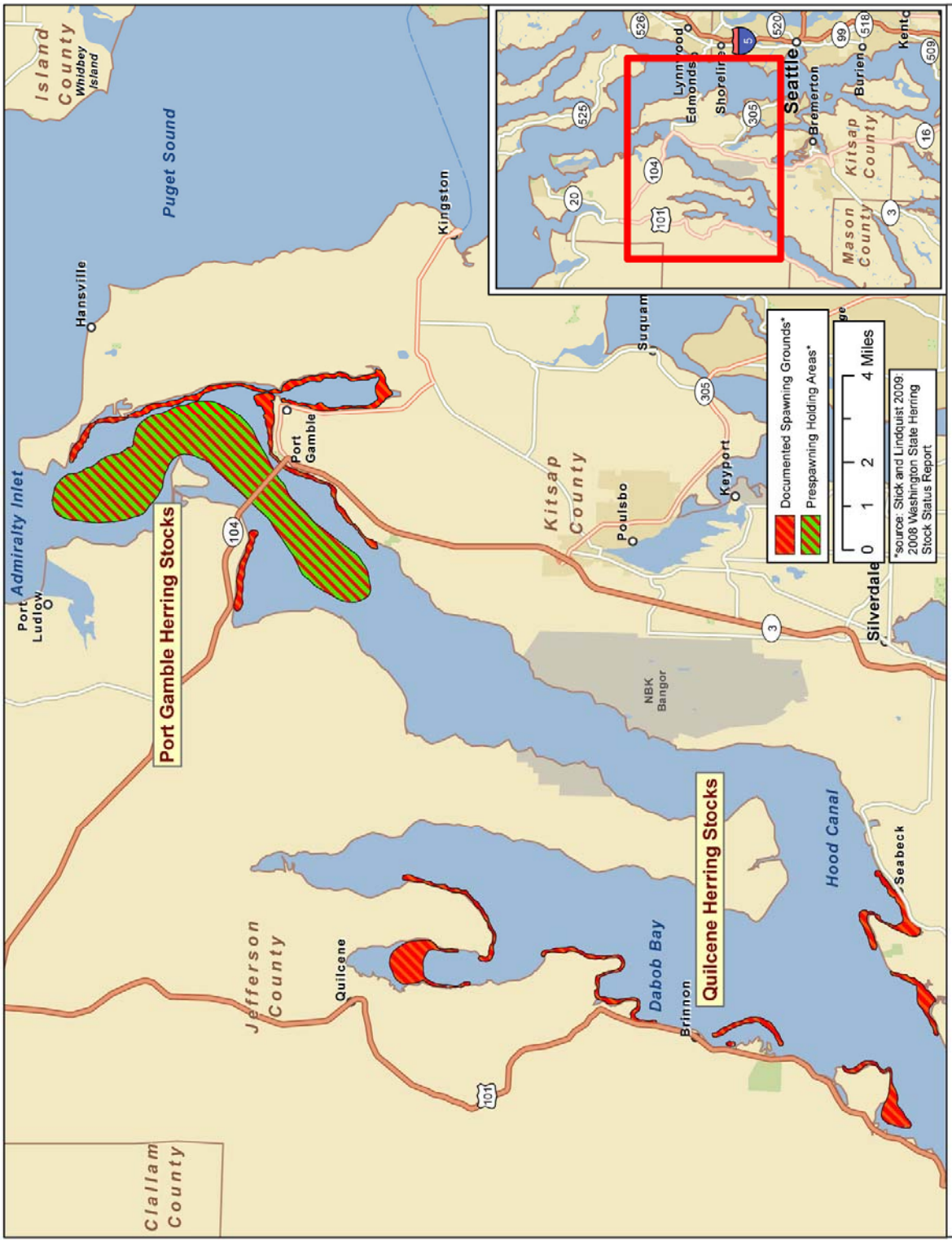


Figure 3.8–4. Port Gamble and Quilcene Bay Herring Stock Near NBK at Bangor

Pacific sand lance are the only forage fish species with spawning habitat documented along the Bangor shoreline, with the closest documented Pacific sand lance spawning sites to the proposed EHW-2 site being approximately 375 feet to the north of the site and 450 feet south of the site (Figure 3.8–5). Sand lance spawning activity occurs annually from early November through mid-February. Sand lance deposit eggs on a range of nearshore substrates, from soft, pure, fine sand beaches to beaches armored with gravel up to 1.2 inches in diameter; however, most spawning appears to occur on the finer-grained substrates (Bargmann 1998). Spawning occurs at tidal elevations ranging from 5 feet above to about the MHHW line. Similar to juvenile surf smelt, juvenile sand lance were collected near the EHW-2 project site from January through the mid-summer months (SAIC 2006; Bhuthimethee et al. 2009a). Most of these juveniles were captured in sheltered nearshore cove-like areas and were in schools mixed with surf smelt and larval sand lance. Because the sand lance spawns on sand gravel beaches in the upper intertidal zone throughout the increasingly populated Puget Sound basin, it is particularly vulnerable to the cumulative impacts from various types of shoreline development.

3.8.1.4 Other Marine Fish Species

In addition to the salmonids and forage fish previously discussed, the marine environment along the Bangor shoreline provides habitat for a variety of other species as well, including perches, gunnels, pricklebacks, pipefish, threespine sticklebacks, tubesnouts, and flatfish species (Navy 1988; SAIC 2006; Bhuthimethee et al. 2009a). For example, more than 44 non-salmonid finfish species from at least 21 families were recorded from nearshore fish surveys within the last 10 years at the Bangor waterfront (see Appendix D, Table 1) (SAIC 2006; Bhuthimethee et al. 2009a). The high species richness in these waters can be attributed to the habitat complexity of the nearshore environment. With some minor differences in habitat preferences, the marine habitat requirements for salmonids addressed in Section 3.8.1.1.1.2, would similarly apply to habitat requirements for other marine fish species. Some species prefer structured habitats and are found in the vicinity of the pile supports for wharves and piers. With some seasonal variability, the majority of the fish identified in recent surveys along the Bangor shoreline occur in these habitats year round.

Shallow-water flatfish species captured along the waterfront include starry flounder, juvenile soles, and sanddabs. Juveniles were observed in sandy areas and gently sloping bottoms associated with, or near, eelgrass beds and areas of dense sea lettuce (*Ulva* spp.) growth. The shallow subtidal habitats, where most fish were observed, include areas of extensive eelgrass and sea lettuce beds. Shiner perch dominate these habitats during the summer months, when they enter these waters to bear their young, and are one of the most abundant fish occurring along the waterfront (86 percent of all 2005 beach seine-caught fish [SAIC 2006]). These vegetated habitats also are areas where perches, gunnels, pricklebacks, pipefish, threespine sticklebacks, and tubesnouts were most prolific. In addition, the wharves and pier piles along the waterfront provided habitat for species such as lingcod, greenling, pile perch and threespine stickleback. Piles that support a fouling community with both marine invertebrates and vegetation likely serve as habitat for a variety of opportunistic fish species, including shiner perch, a variety of sculpin, gunnels, pricklebacks, and other opportunistic fish species. These structures are relatively shallow compared to habitats utilized by most adult rockfish species; therefore, it is unlikely that they utilize existing pilings and other structures as habitat.

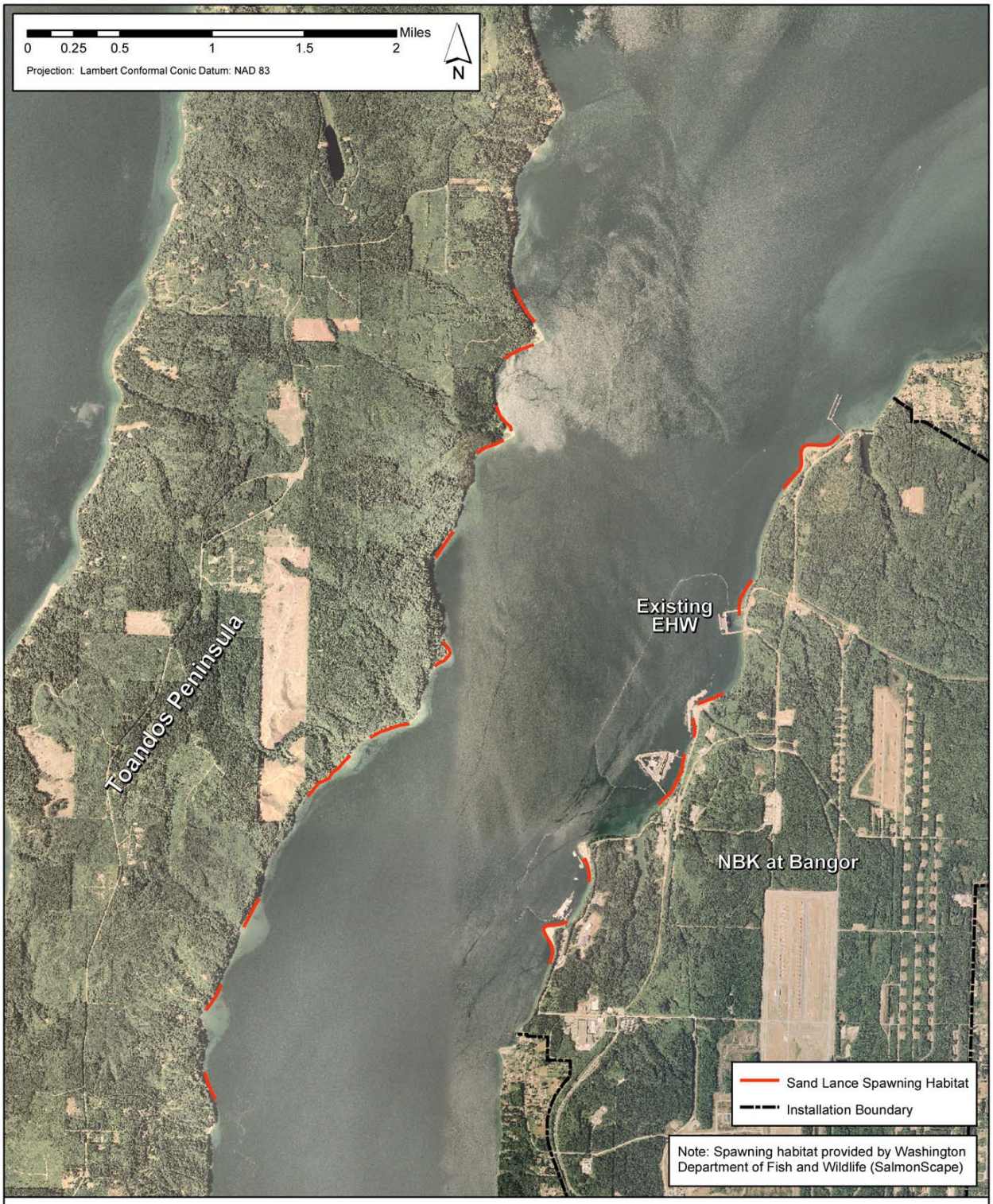


Figure 3.8–5. Pacific Sand Lance Spawning Habitat

Some of the nearly 250 fish species documented in the marine waters of Hood Canal (Miller and Borton 1980; Burke Museum 2010) occur at depths much greater than could be effectively sampled in nearshore fish surveys (Schreiner et al. 1977; Prinslow et al. 1980; Bax 1983; Salo 1991; Bhuthimethee et al. 2009a). Species that could occur in deeper offshore habitats affected by project actions likely include a variety of rockfish species, Pacific hake, walleye pollock, wolfeel, skates, sharks, ratfish, lanternfish, snailfish, and adult flatfish species.

3.8.1.5 Essential Fish Habitat

The Pacific Fishery Management Council (PFMC) has designated EFH for groundfish, coastal pelagic species, and salmon species (PFMC 1998, 2003, 2008). The federally managed species, lifestages, and habitats, as indicated by PFMC FMPs, are summarized for Hood Canal and the project vicinity (Table 3.8–3). Groundfish EFH is designated for species and lifestages and includes five primary habitats: the epipelagic zone of the water column (including macrophyte canopies and drift algae); unconsolidated sediments of mud and sand; hard bottom habitats of boulders, bedrock, and coarse deposits; mixed sediments of sand and rocks; and vegetated bottoms with algal beds, macrophytes, or rooted vascular plants (PFMC 2008, Appendix B4). The groundfish FMP provides habitat suitability probability maps indicating probability of occurrence of a total of 81 groundfish species in Hood Canal, including species with very low probability (less than 1 percent) of occurrence (PFMC 2008, Appendix B4). This list was refined for evaluation of the project site to a total of 51 groundfish species using two regional EFH reports: a recent, draft EFH assessment that addresses the project site (Navy 2010a), and a federally managed species list for Puget Sound from a recent, completed EFH assessment in the region (NMFS 2004). Two additional groundfish species were added to these project lists based on greater than 1 percent probability of occurrence in Hood Canal (soupfin shark, Pacific rattail). This ensures that an inclusive approach is taken to determining potential for adverse effects on EFH.

Coastal pelagic EFH consists of all marine and estuarine waters between the shoreline and the exclusive economic zone above the thermocline and falling between 10 and 26 degrees Celsius in temperature. The PFMC manages four coastal pelagic species, two of which (anchovy and market squid) occur in Hood Canal and the vicinity of the project site.

Salmon EFH includes all estuarine waters and substrates, including the nearshore and tidal submerged environments, and freshwater bodies historically accessible to salmon. The PFMC manages three salmonids that occur in Hood Canal: coho, Chinook, and pink salmon.

Table 3.8–3. Fish Species with Designated EFH in Puget Sound

Species	Applicable Life Stages	Designated Habitats
Groundfish		
Big skate	A,J,E	Unconsolidated bottom
Black rockfish	A,J	Artificial structure, hard bottom, vegetated bottom, epipelagic zone, tide pool
Blue rockfish	A,J,L	Hard bottom, vegetated bottom, epipelagic zone
Bocaccio	J,L	Hard bottom, epipelagic zone

Table 3.8–3. Fish Species with Designated EFH in Puget Sound (continued)

Species	Applicable Life Stages	Designated Habitats
Brown rockfish	A,J	Artificial structure, hard bottom, mixed bottom, vegetated bottom, epipelagic zone
Butter sole	A,J,L,E	Unconsolidated bottom, epipelagic zone
Cabezon	A,J,L,E	Hard bottom, tide pool, unconsolidated bottom, vegetated bottom, epipelagic zone
China rockfish	A,J	Hard bottom, vegetated bottom, epipelagic zone
Copper rockfish	A,J	Artificial structure, hard bottom, mixed bottom, vegetated bottom, epipelagic zone
English sole	A,J,E	Unconsolidated bottom, epipelagic zone
Flathead sole	A,J	Unconsolidated bottom
Kelp greenling	A,J,L,E	Hard bottom, vegetated bottom, epipelagic zone
Lingcod	A,J,L,E	Hard bottom, vegetated bottom, unconsolidated bottom, epipelagic zone
Longnose skate	A	Unconsolidated bottom
Pacific sanddab	A,J,L,E	Mixed bottom, unconsolidated, epipelagic zone
Pacific whiting (hake)	A,J	Epipelagic zone
Petrale sole	A,J,L,E	Unconsolidated bottom
Quillback rockfish	A,J,L	Artificial structure, mixed bottom, vegetated bottom, hard bottom, biogenic, epipelagic zone
Redstripe rockfish	A,J,L	Hard bottom, mixed bottom, epipelagic zone
Rex sole	A,J	Unconsolidated bottom
Rock sole	A,J,L,E	Unconsolidated bottom, mixed bottom, epipelagic zone
Sablefish	A,J,L,E	Unconsolidated bottom, epipelagic zone
Sand sole	A,J,L	Unconsolidated bottom, epipelagic zone
Silvergray rockfish	A	Hard bottom
Soupfin shark	A,J	Unconsolidated bottom, epipelagic zone
Spiny dogfish	A,J	Unconsolidated bottom, epipelagic zone
Splitnose rockfish	J,L	Epipelagic zone
Spotted ratfish	A,J,E	Hard bottom, unconsolidated bottom
Starry flounder	A,J,L,E	Unconsolidated bottom, epipelagic zone
Tiger rockfish	A,J,L	Hard bottom, epipelagic zone
Widow rockfish	A,J,L	Hard bottom, mixed bottom, epipelagic zone, unconsolidated bottom, vegetated bottom
Yelloweye rockfish	A,J,L	Hard bottom, mixed bottom, epipelagic zone, biogenic
Yellowtail rockfish	A,J	Hard bottom, unconsolidated bottom, vegetated bottom, epipelagic zone

Table 3.8–3. Fish Species with Designated EFH in Puget Sound (continued)

SPECIES	APPLICABLE LIFE STAGES	DESIGNATED HABITATS
Coastal Pelagic Species		
Anchovy	A,L,E	All estuarine waters above the thermocline and falling between 10 and 26 degrees Celsius
Market squid	A,L,E	Same as above
Salmon		
Coho	A,J	All estuarine waters and substrates, including the nearshore and tidal submerged environments, and freshwater bodies historically accessible to salmon
Chinook	A,J	Same as above
Pink	A,J	Same as above

Sources: PFMC 1998, 2003, 2008.
A = adult; E = eggs; J = juvenile; L = larvae.

3.8.2 Environmental Consequences

The evaluation of project-related effects on marine fish considers impacts to potentially occurring marine fish species, and those marine habitats upon which they are dependent for some portion of their life history, including foraging, refuge, migration, and reproduction. This section also includes an analysis of project-related effects on seven ESA-listed marine fish species.

The evaluation of impacts to marine fish and their habitat is based on whether the species is listed under the ESA, the species has important fishery value as a commercial or recreational resource (including EFH protected under the MSA), a specific group has particular sensitivity to the proposed action's activities, and/or a substantial or important component of the group's habitat would be lost. For threatened and endangered species, an effect determination of "may affect, likely to adversely affect" indicates an impact of concern.

Construction would impact marine habitats used by fish. The greatest impact during construction would occur during pile driving. Pile driving would exceed the underwater noise thresholds for fish, established for both behavior and injury, and result in the greatest potential for adverse impacts to marine fish. Positioning and anchoring the construction barges and pile driving units would locally increase turbidity, disturb benthic habitats and forage fish, and shade marine vegetation in the immediate project vicinity. Construction impacts to salmonid populations, which includes ESA-listed species, would be minimized by adhering to the in-water work period designated for northern Hood Canal waters, when less than 5 percent of all juvenile salmonids that occur in NBK at Bangor nearshore waters are expected to be present (SAIC 2006; Bhuthimethee et al. 2009a). The proposed project may also adversely affect EFH for coastal pelagic species, salmon, and groundfish; however, this analysis is provided separately in the Essential Fish Habitat Assessment (NAVFAC 2011a). Current practices to reduce the presence of ESA-listed fish and other fish during construction and observance of the in-water work window would reduce construction-related impacts.

In contrast to the short-term impacts of construction (ranging from as few as two, to as many as four in-water work seasons, depending on the alternative), operational impacts to marine fish would be permanent. The portions of trestles located in intertidal habitats would decrease habitat

value and present a barrier to shoreline-dependent juvenile salmon. In addition, the presence of the piles and overhead decking would reduce the biological productivity of the benthic community and marine vegetation, both of which are habitats used by marine fish, including salmonids and juvenile rockfish. The design of the trestles leading from the on-land support facility across the nearshore habitat would be constructed at a height above 15.2 feet MLLW. The EHW-2 platform would be constructed at a height above 13 feet MLLW. As a result, a band of nearshore shade would be cast from the trestle structures across the juvenile salmonid and forage fish migratory pathway.

The analysis for impacts to marine fish addresses both construction and operational impacts to habitat, migration, and predation of Pacific salmonids, forage fish, rockfish, and other marine fish. Due to similar nearshore marine habitat use, impact analyses for forage fish are considered the same as those described in detail for salmonids. Rockfish and other marine fish generally use different habitat types than salmonids and are discussed separately.

3.8.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.8.2.1.1 CONSTRUCTION

Marine habitats used by fish species that occur along the Bangor waterfront include offshore (deeper) habitat, nearshore habitats (intertidal zone and shallow subtidal zone), and other habitats, including piles used for structure and cover. The following sections describe how project-related effects on physical and biological factors would impact abundance and distribution of marine fish that could occur along the Bangor waterfront during construction.

3.8.2.1.1.1 THREATENED AND ENDANGERED MARINE FISH

Due to the similarity of life histories within ESA-listed species groups (salmonids and rockfish), impacts to ESA-listed species are discussed by listed species group rather than as individual species. As a result, the species group *ESA-Listed Hood Canal Salmonids* includes: Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, and bull trout. The species group *ESA-Listed Hood Canal Rockfish* includes bocaccio, yelloweye rockfish, and canary rockfish.

ESA-LISTED HOOD CANAL SALMONIDS

The potential impacts of the proposed project to Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, and bull trout and the nearshore habitats they use are discussed below. Some project-related impacts could indirectly impact salmonids through alteration of nearshore habitats (e.g., aquatic vegetation disturbance), whereas other impacts can directly affect a given fish should it be present during the construction period (e.g., underwater noise). While some construction-related impacts may permanently or temporarily degrade one marine habitat constituent, construction may have little or no impacts to other constituents. As noted above (Section 3.8.1.1.2.1), adult summer-run chum salmon are more dependent on nearshore marine habitats during their in-migration than other adult salmonid species. Therefore, adults of this species may be more affected by construction activity during their migration to natal streams than adults of other Hood Canal salmonids. Although juvenile salmonid species that are dependent on shoreline habitats as a migratory pathway (see Section 3.8.1.1.1.2) would not be able to avoid nearshore construction activities as easily as adults, the number of juvenile salmon present during construction would be minimized by utilizing the in-water work window for Tidal Reference Area 13, which occurs from July 16 to February 15 (WAC 220-110-271; USACE 2010a). Designated in-water work windows are based on the best available site-specific

information for protected fish species. Adherence to the in-water work window generally ensures that effects from the construction of in-water structures would have no more than a minimal direct effect on listed juvenile salmonids in the project area.

Salmonid Marine Habitat Requirements

Impacts to marine habitats used by ESA-Listed Hood Canal Salmonids would also be the same for all listed and non-ESA-listed salmonid species.

Water and Sediment Quality

As described in Section 3.3.2.1.1, the construction contractor would be required to retrieve and clean up any accidental debris spills as current practices and BMPs in accordance with the Debris Management Plan that would be developed and implemented per the Mitigation Action Plan (Appendix F). As with the in-water construction activities, any removal of in-water construction debris would occur during the approved in-water work window.

- *Turbidity:* As discussed in Section 3.2.2.1.1, construction-related impacts to water quality from Alternative 1 would be limited to temporary (2 to 3 in-water work seasons) and localized changes associated with resuspension of bottom sediments during pile installation. Although adults of most species of salmonid migrate further offshore, returning summer-run chum adults migrate along the nearshore and have a greater chance of encountering increased turbidity should they occur in the immediate project vicinity during in-water construction. While large increases in turbidity have the potential to damage fish gills, the proposed project would only result in small-scale increases of suspended sediments (see Section 3.2.2.1.1), and would not likely result in gill tissue damage to salmonids. Studies investigating similar impacts to steelhead and coho salmon from larger scale sediment dredging operations have shown that increased turbidity levels from these activities did not cause salmonid gill damage, although other adverse effects were evident (Redding et al. 1987; Servizi and Martens 1991). Redding et al. (1987) found that coho and steelhead were more susceptible to bacterial infection and displayed reduced feeding rates when exposed to elevated turbidity levels. Servizi and Martens (1991) found that coho were more susceptible to viral infections when exposed to elevated turbidity, and postulated that other impacts include reduced tolerance to environmental changes. Turbidity attributed to the bubble curtain is dependent on whether the bubble curtain unit design is confined or unconfined (see Section 3.2.2.1.1.3). Based on these findings from larger scale sediment operations, salmonids in the immediate project vicinity would not be expected to experience gill tissue damage due to increased turbidity associated with in-water activities, but may experience some reduction in fitness including the increased susceptibility to bacterial and viral infection. In addition, elevated turbidity could also decrease the availability of prey in the immediate vicinity, as well as reduce the ability of salmonids to detect and capture prey species, including forage fish.
- *Dissolved Oxygen:* Because concentrations of organic matter in NBK at Bangor sediments are low (see Section 3.2.2.1.1), resuspension of these sediments is not expected to alter or depress DO below levels required by water quality standards. In surveys conducted along the Bangor waterfront from 2005 to 2006, DO was measured at levels below the EQ standard of 7.0 mg/L, but not below the level considered to have adverse impacts to fish (5 mg/L) (Newton et al. 2002). Low DO measurements were uncommon and occurred in considerably deeper water (approximately 65 to 200 feet). These low DO measurements may be associated with the seasonally low DO levels known for the deeper waters of Hood Canal.

The construction of Alternative 1 would result in no measurable change to existing DO levels at the Bangor waterfront or in Hood Canal in general (see Section 3.2.2.1.1). This alternative would not result in violations of water quality standards for DO nor a local decrease in DO to a level impacting the health of fish and would, therefore, maintain water quality in the project vicinity (Table 3.8–4).

- *Other Water Quality Parameters:* The primary adverse impact to water quality from in-water construction activities, including pile installation, barge and tug anchoring, and propeller wash, is suspension of bottom sediments and formation of a turbidity plume in near-bottom waters. Resuspended sediments could cause the release of sediment-bound contaminants to near-bottom waters. However, sediments in the EHW-2 project site contain low concentrations of organic carbon (i.e., TOC) and are characterized as uncontaminated (Hart Crowser 2000; Foster Wheeler 2001; Navy 2005a; Hammermeister and Hafner 2009). Therefore, increases in chemical contaminant concentrations in marine waters as a result of sediment resuspension during pile installation would be minor. Because suspended sediment and contaminant concentrations would be low, and exposures would be limited to the 7-month in-water construction periods over three years, localized, acute, or chronic toxicity impacts would not occur.

  Construction of Alternative 1 would not impact water temperature or salinity because construction activities would not discharge a waste stream. Steel piles installed for Alternative 1 would be inert and would not contain creosote or other contaminants that could be toxic or biologically available.

  Stormwater runoff impacts and protective measures would be similar to those described above in Section 3.2.2.1.1 for water quality impacts. Therefore, construction activities associated with Alternative 1 would not result in significant adverse impacts to water temperature or salinity, and would not violate any water quality standards. Further, potential impacts of temporary reductions in water quality on juvenile salmonids would be minimized by following the permitted in-water work windows.

- *Sediment Quality:* Although some level of localized changes in sediment grain size is expected during construction activities for Alternative 1, such as fine-grained sediments dispersing and settling outside the EHW-2 project site, impacts to sediment quality would be limited and localized to the general project area (see discussion of sediment impacts in Section 3.3.2.1.1). Construction activities would not discharge contaminants or otherwise appreciably alter the concentrations of trace metal or organic contaminants in bottom sediments. Although sediments could be adversely impacted by oil spills during in-water construction, the existing NBK at Bangor spill prevention and response plans would reduce the potential for these spills. If an accidental spill should occur, emergency cleanup measures would be implemented immediately in accordance with state and federal regulations. These cleanup procedures would minimize impacts to the surrounding environment.

Table 3.8–4. Salmonid Marine Habitat Requirements for the EHW-2 Action Alternatives

Pathways and Indicators	Environmental Baseline			Impact of Construction			Impact of Operation		
	Properly Functioning	At Risk	Not Properly Functioning	Restore	Maintain	Degrade	Restore	Maintain	Degrade
Water and Sediment Quality									
Turbidity	X					X		X	
Dissolved Oxygen		X			X			X	
Other Water Quality Parameters	X				X			X	
Sediment Quality	X				X			X	
Physical Habitat									
Physical Barriers			X			X			X
Substrate/Armoring		X				X			X
Refugia		X				X			X
Biological Habitat									
Prey Availability		X				X			X
Aquatic Vegetation		X				X			X
Underwater Noise									
Underwater Noise		X				X		X	

Another possible source for construction-related impacts to water quality would be from accidental debris spills from barges or construction platforms into Hood Canal. Debris spills could impact bottom sediments and create nuisance conditions by adding materials that could represent obstructions. The facility response plan for the Bangor waterfront provides for responses to potential spills. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups.

Physical Habitat

- *Physical Barriers:* The impact of physical barriers to marine fish would be greatest in the habitats used by juvenile salmonids as a migratory pathway. Other than summer-run chum adults that show a preference for migrating along the nearshore, adult salmonids of other species are less dependent on nearshore habitats. Relative to younger age-classes, adult salmonids of all species have much greater mobility, and would not experience the same barrier effect as nearshore-dependent juvenile salmonids. Salmonids would likely migrate around this activity, with little or no overall delay in their movements. Nightingale and Simenstad (2001a) cite multiple studies that indicate juvenile salmon, notably fry, migrate within shallow nearshore waters. These studies have shown that smaller juveniles (e.g., fry less than 2 inches) migrate along the shoreline in waters less than 3 feet in depth (Schreiner 1977; Bax 1982; Whitmus 1985). Simenstad et al. (1999) refer to shallow-water habitat as "that portion of the nearshore estuarine and marine environment habitually occupied by migrating salmon fry (i.e., approximately 1 to 3 inches long), which includes the intertidal zone to approximately -6 feet MLLW." As juvenile salmonids, notably coho, become larger they move further off shore into deeper waters (Bax et al. 1980) where they encounter larger piers, wharves, and bulkheads (Nightingale and Simenstad 2001a).

  Up to 90 piles would be driven along an estimated 407-foot linear stretch extending from the shoreline to the EHW-2, well within the primary juvenile salmonid migratory pathway (12 feet above MLLW to 30 feet below MLLW). In this area, barrier impacts to salmonids include nearshore construction activity, vessel shading, barge anchoring and spud/anchor dragging, underwater noise, and small temporary plumes of increased suspended solids produced during pile driving activity that would occur over 2 to 3 in-water work seasons.

  All construction activities would be conducted during the in-water work window for Tidal Reference Area 13, which occurs from July 16 to February 15 (WAC 220-110-271; USACE 2010a). Fish surveys along the Bangor shoreline in the 1970s and 2005 to 2008 indicate that most (greater than 95 percent) of the juvenile salmonid migration is complete by this time (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009a). Returning adult salmonids, including the shoreline preferring summer-run chum, would likely alter their migration patterns somewhat to avoid any active in-water construction activity. However, although adult salmonids would likely avoid the immediate vicinity of in-water construction activity, this barrier affect would be minor and not prevent adult salmonids from migrating southward along the shore to their natal streams for spawning. Although the construction of Alternative 1 would occur at a time when salmonids are least abundant, the construction activities would represent an increase in the number of barriers and correspondingly degrade physical barrier conditions experienced by salmonids potentially present during the construction period.

- *Substrate/Armoring:* No placement of fill in the intertidal zone or armoring of the intertidal shoreline with riprap or other material would occur during construction of Alternative 1 (any shoreline armoring material would be placed above MHHW). Intertidal shoreline development would be limited to the construction of the pile-supported trestles extending from the existing on-land structures to the EHW and the upper intertidal excavation required for the construction of the abutment. Although the abutment excavation would occur at the uppermost bounds of the migratory habitat and would be backfilled upon abutment completion, it would represent a temporary degradation of upper intertidal habitat. Even summer-run chum adults are highly unlikely to utilize upper intertidal habitats in the vicinity of the abutment during their return migration. Those adults that may be present in these habitats may avoid the immediate area due to a combination of visual cues or in-water noise, but would experience little or no behavioral response effect or substantial delay in their migration. During the construction of Alternative 1, the piles supporting the trestles would also be driven in nearshore intertidal and shallow subtidal (30 feet below MLLW to 12 feet above MLLW) habitats used by juvenile salmon as a migratory pathway. This activity would, therefore, degrade substrate/armoring in the project vicinity.
- *Refugia:* NMFS (1996) identifies habitat fragmentation as a key issue for juvenile salmon refugia. This can include the loss or reduction of habitat connectivity due to the presence of a large number of structures along a shoreline restricting juvenile salmon movement between habitats used for foraging, refuge, and/or migration. Further, an increase in habitat fragmentation decreases the functionality of these habitats and their suitability in supporting marine fish species, including salmonids. Because most species of adult salmonids (other than summer-run chum) occur further offshore, and these older age classes are not as dependent on nearshore habitats for refuge as juveniles, construction activities would have little or no effect on habitats utilized as refugia by adult salmonids. Habitats utilized as refugia are not anticipated to be affected by construction vessel wakes in the project vicinity. Construction vessels, principally barges and tugs, would be limited to slow and controlled vessel speeds, and are not expected to produce wakes that would otherwise deteriorate nearshore refugia habitats. Any wakes that would be generated during this period would be consistent in scale with the naturally occurring wind-generated waves. As a result, nearshore-migrating juvenile salmonids are not anticipated to experience stranding from wakes generated by these slow-moving construction vessels. In addition, observation of the in-water work window would avoid almost all effects of construction vessels on migrating juveniles. Construction activities would reduce habitat connectivity between eelgrass and benthic habitats used by juvenile salmonids during out-migration both immediately north and south of the footprint along the nearshore. Therefore, salmonids would experience a decrease in refugia habitat due to the construction of Alternative 1.

<u>Biological Habitat</u>

- *Prey Availability:* As discussed in Section 3.8.1.1.2, both benthic invertebrate prey and forage fish are important food resources for juvenile salmonids. While this section addresses construction-related impacts from Alternative 1 to the localized benthic prey community, the discussion of impacts to the forage fish community is provided below in Section 3.8.2.1.1.3. The construction of Alternative 1 would result in localized and temporary reductions of the benthic community during pile placement (see discussion of

benthic community impacts in Section 3.7.2.1). During the construction period (estimated at two to three in-water construction seasons), juvenile salmonids would experience loss of available benthic prey at the EHW-2 project site due to the disturbance of pile installation, and barge use of spuds and anchors. Construction activities would also result in localized increases in TSS (see Section 3.2.2.1). The settling out of fine-grained solids could bury nearby benthic organisms and result in the loss or reduction of localized benthic productivity. Propeller wash from the support vessels may also temporarily disturb benthic habitats. During construction activities there would be some disturbance and temporary reduction of benthic community productivity in the immediate project vicinity (see Section 3.7.2.1). Benthic organisms lost due to bottom disturbances by barges, tugboats, anchors, spuds, and propeller wash would be expected to be reestablished over a 2-year period. Total anticipated benthic impacts would last 5 years (2 to 3 construction years, 2 years for reestablishment).

Although in-water work would occur during permitted work windows when few juvenile salmonids would be present, their benthic prey would not recover to existing conditions for a period of a few months for some species to a couple of years for the entire benthic community. Therefore, construction activities of Alternative 1 would degrade localized prey availability for migrating salmonids.

- *Aquatic Vegetation:* The aquatic vegetation habitat of principal concern for juvenile salmon foraging and refuge is eelgrass (*Zostera* sp.) (Simenstad et al. 1999; Nightingale and Simenstad 2001a,b; Redman et al. 2005). Intertidal and subtidal areas with extensive areas of eelgrass provide habitat for amphipods, copepods, and other aquatic invertebrates (Mumford 2007) used by juvenile salmonids as food resources. Copepods and other zooplankton represent the major food base for Puget Sound juvenile fish (Simenstad et al. 1979), including salmonids. In addition, at these small, vulnerable life stages, juvenile salmonids use these nearshore habitats as refuge from predators during their out-migration. Although the two largest eelgrass beds along the Bangor shoreline occur near Devil's Hole and Cattail Lake, a relatively narrow band of eelgrass occurs along nearly the entire shoreline (Morris et al. 2009). Eelgrass in the immediate vicinity of the EHW-2 project site occurs in a constricted nearshore band, with no large beds of eelgrass within 300 feet (Morris et al. 2009). This narrow nearshore strip of eelgrass would be adversely impacted by in-water construction activities during pile driving and decking installation. Turbidity and other water quality impacts would affect nearby eelgrass beds, potentially resulting in plant loss.

  The presence of the overwater barges and structures, and the shade they cast during construction, would limit the productivity of aquatic vegetation in the immediate project vicinity. During construction, eelgrass habitats would be affected, with some loss of function, due to barge shading, propeller wash, and anchoring (see discussion of marine vegetation impacts in Section 3.5.2.1). Although the proposed construction activities would result in impacts to eelgrass populations at the EHW-2 project site, the proposed marine habitat mitigation measures (see Section 3.5.2.7 and Appendix F) would compensate for impacts to eelgrass from the proposed action.

Underwater Noise

Construction of the trestles and wharf for Alternative 1 would result in increased underwater noise levels in Hood Canal, due primarily to the installation of support piles for these structures.

Some noise would also be generated with support vessels, small boat traffic, and barge-mounted equipment, such as generators. However, the most significant in-water noise potentially affecting marine fish would be created while driving piles using a single-acting diesel impact hammer. For each of the alternatives, the noise analysis is completed in a manner consistent for one barge being deployed for impact pile driving, with three separate barges using vibratory drivers operated concurrently. This approach minimizes the number of in-water construction seasons required to complete the project. A more detailed description of how the underwater noise measures were calculated is provided in Section 3.4.2.

With respect to underwater noise impacts to fish, the presence of an internal air sac to maintain buoyancy likely makes these species more susceptible to injury from underwater noise. This bladder (air sac) is susceptible to rapid expansion/decompression when a peak pressure wave from an underwater noise source is encountered. At a sufficient level this exposure is fatal for fish. However, underwater noise threshold criteria, established by a multi-agency working group, currently do not differentiate between species with air bladders and those without them (Fisheries Hydroacoustic Working Group 2008).

The following analysis for underwater noise impacts to fish assumes the concurrent operation of one impact hammer and three vibratory pile drivers, and assumes a soft-start[6] approach. The underwater noise threshold criterion for fish injury from a single impact hammer pile strike occurs at an SPL of 206 dBPEAK. However, almost all pile driving would be accomplished through vibratory methods, with every fourth to fifth pile "proofed" using an impact pile hammer. As described in Section 2.2.1, the maximum number of strikes in a given day would range from up to 1,000 strikes per day (1,000 daily strike scenario, which is the most likely scenario) to up to 6,400 strikes per day (6,400 daily strike scenario). Due to the necessity of multi-strikes, the analytical approach for determining underwater sound effects from impact hammer pile driving on fish requires using an accumulated SEL as the threshold. Therefore, a single strike analysis does not apply. The applicable criterion for injury to fish would be 187 dBSEL for a fish greater than 2 grams in weight and 183 dBSEL for a fish less than 2 grams in weight (Fisheries Hydroacoustic Working Group 2008) (Table 3.8–5).

Table 3.8–5. Fish Threshold Levels and Effect Ranges for the Concurrent Operation of One Impact Hammer and Three Vibratory Pile Drivers

FISH THRESHOLD LEVELS *	IMPACT RANGE FOR THRESHOLD EXCEEDANCE
206 dBPEAK (injury from single strike)	13 feet
187 dBSEL (injury to fish >2g) **	518 feet (1,000 strikes) 1,522 feet (6,400 strikes)†
183 dBSEL (injury to fish <2g) **	961 feet (1,000 strikes) 1,522 feet (6,400 strikes)†
150 dBRMS (behavioral for all fish)	11,024 feet

* Underwater noise thresholds are taken from Fisheries Hydroacoustic Working Group (2008).

** SPL exceedance distances assume the use of a bubble curtain.

† Underwater noise energy levels below 150 dBSEL do not accumulate.

[6] Soft starts for vibratory drivers require initial starts of 15 seconds at reduced energy followed by a 1-minute waiting period. This measure shall be repeated two additional times. Soft starts for impact hammers shall be one dry fire followed by a 1-minute waiting period. This procedure shall be repeated two additional times.

As indicated in Section 3.4.2.1.1.1, the NMFS underwater noise impact distance methodology establishes a limit on the maximum distance from the pile where injury to fishes is expected. NMFS has determined that underwater noise energy levels below 150 dBSEL do not accumulate. Therefore, the maximum distance at which injury thresholds would be exceeded (both 183 dBSEL and 187 dBSEL), regardless of the total number of hammer strikes, is where underwater noise levels fall below 150 dBSEL, or 1,522 feet (Table 3.8–5). Beyond this distance, no physical injury is expected. No injury threshold has been identified for vibratory pile driving.

In addition to injury thresholds, the Fisheries Hydroacoustic Working Group (2008) established underwater noise threshold criteria for behavioral impacts to fish, including startle response, at a level of 150 dBRMS. This behavioral threshold applies to both impact hammer and vibratory pile driving. During pile driving, the associated underwater noise levels would result in a behavioral response, including project area avoidance, and would have the potential to cause injury. Average underwater baseline noise levels acquired along the waterfront were measured at a level of 114 dB re 1µPa (Slater 2009). Sound during impact pile driving would be detected above the average background noise levels at any nearby location in Hood Canal with a direct acoustic path (e.g., line-of-sight from the driven pile to the receiver location). The 150 dBRMS re 1µPa behavioral threshold for the concurrent operation of one impact hammer and three vibratory pile drivers would be exceeded within a circle centered at the location of the driven pile out to a distance of approximately 11,024 feet (in a direct line-of-sight manner) (see Section 3.4.2.1.1.1, Table 3.8–5, Figure 3.8–6).

Fish in this area may display a startle response during initial stages of pile driving, and would likely avoid the immediate project vicinity during construction activities, including pile driving. Although the project would adhere to the permitted in-water work window for this portion of Hood Canal (July 16 to February 15) to minimize construction-related impacts to juvenile salmonids, some adult salmonids, including the shoreline-migrating summer-run chum salmon, would be expected to occur during periods of pile driving activity. However, field observation investigations of Puget Sound salmonid behavior, when present near pile driving projects, found little evidence that normally nearshore migrating salmonids move further offshore to avoid the general project area (Feist 1991; Feist et al. 1992). In fact, some studies indicate that construction site behavioral responses, including site avoidance, may be as strongly tied to visual stimuli as to underwater sound (Feist 1991; Feist et al. 1992; Ruggerone et al. 2008). Therefore, it could be assumed that salmonids may alter their normal behavior, including startle response and avoidance of the immediate project site, but their presence within most of the 11,024 feet line of sight disturbance area would not change.

To reduce the underwater noise levels and associated impacts to underwater organisms during active impact pile driving, a bubble curtain or other noise attenuating device would be deployed. Under these conditions, a fish less than 2 grams could be injured by noise levels from pile driving if it were present within 961 feet of a pile being driven under the 1,000 daily strike scenario and 1,522 feet under the 6,400 daily strike scenario (see Section 3.4.2, Table 3.8–5, Figure 3.8–6). Any fish greater than 2 grams could be injured by noise levels from pile driving if it were present within 518 feet of a pile being driven under the 1,000 daily strike scenario and 1,522 feet under the 6,400 daily strike scenario.

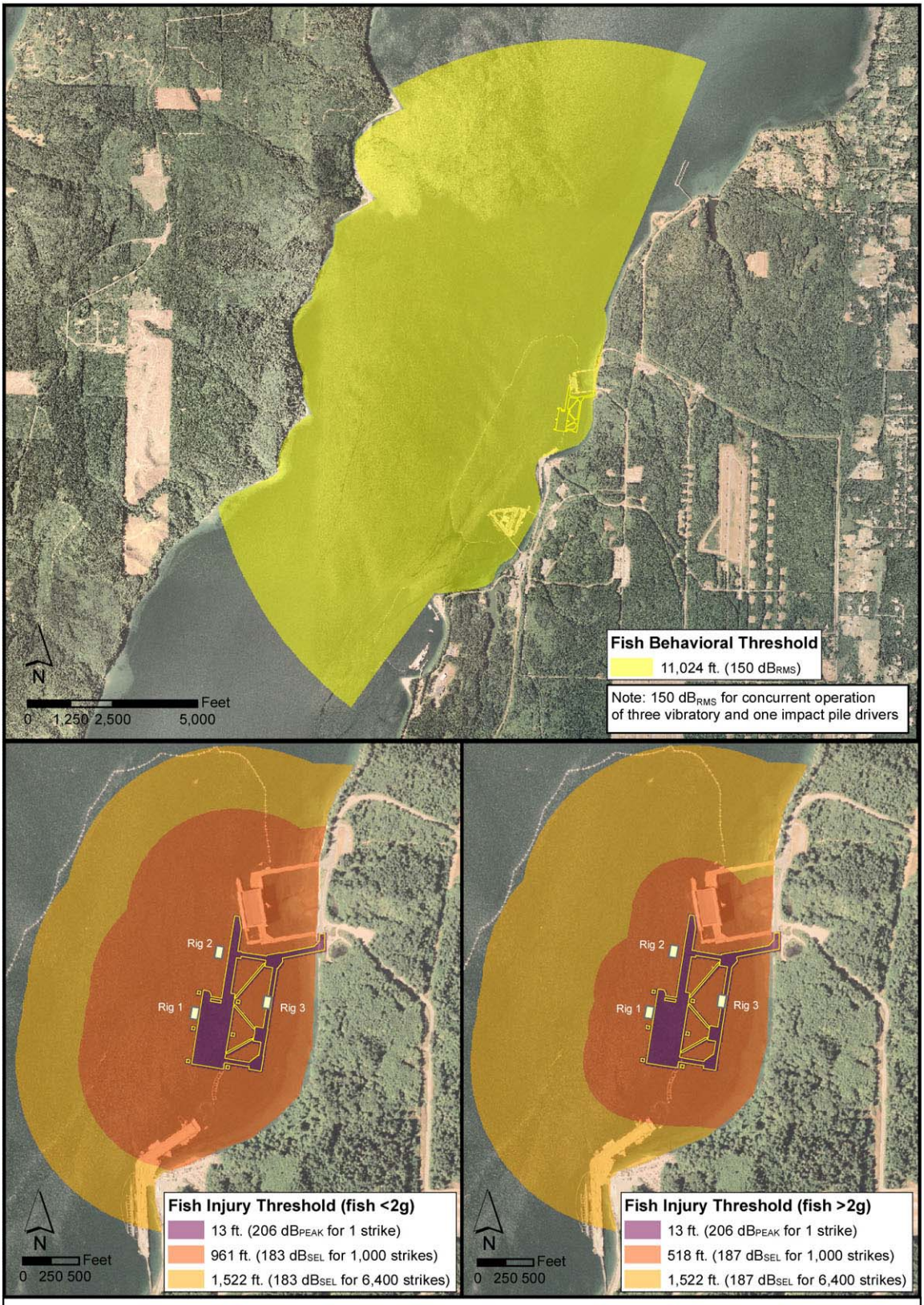


Figure 3.8–6. Total Affected Areas for Fish Due to Pile Driving Noise

To further minimize the underwater noise impacts during pile driving, vibratory pile drivers would be used to the maximum extent practicable for structural integrity to drive piles, and an impact hammer would primarily be used to proof load the piles to verify load bearing capacity and not as the primary means to drive piles. As mentioned above, no injury threshold has been identified for vibratory pile driving (Fisheries Hydroacoustic Working Group 2008).

Under Alternative 1, up to 1,250 permanent piles would be driven. This effort would require an estimated total of 200 to 400 pile driving days. In addition to the pile driving, other in-water work, including the barge activity during the construction of the wharf and trestle decks, also is required. For Alternative 1, 2 to 3 in-water work seasons would be required to complete marine construction. Additional vessel activity required for in-water construction would not elevate underwater noise above injury thresholds, but at very short ranges in the immediate vicinity of some of these vessels, fish may experience levels above the disturbance threshold.

All in-water construction activities would be conducted during the permitted in-water work window for this portion of Hood Canal (July 16 to February 15). Fish surveys along the Bangor shoreline in the 1970s and 2005 to 2008 indicate that greater than 95 percent of the juvenile salmonids in this part of Hood Canal are present outside of the work window (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009a) and would therefore not be impacted by pile driving. In addition, some juvenile salmonids similarly would be present, and be impacted by elevated underwater noise during construction activities. Adult salmonids returning to these waters, including summer-run chum salmon, would not be protected by the work windows and would experience elevated levels of underwater sound. Although the Navy would use mitigation measures to reduce underwater sound during pile driving, returning fish that would be present within the areas depicted in Figure 3.8–6 would be affected. Upon encountering elevated underwater sound, these fish would likely display either a startle response or behavioral disturbance, including avoiding the nearshore as a migratory pathway to their natal streams. To help protect these fish, a soft-start approach would be used during impact pile driving "proofing" efforts to allow time for fish to move away from the immediate project site (see mitigation measures for marine fish in Section 3.8.2.7), reducing the number of fish potentially exposed to harmful levels of underwater noise. The soft-start approach is an impact minimizing method recommended in Puget Sound by the natural resource agencies. However, during pile driving, underwater noise conditions for salmonids would be degraded, but upon completion of this portion of construction, underwater noise would return to levels more consistent with existing conditions.

Summary of Impacts and ESA-Listed Salmonid Determination

Construction of Alternative 1 may result in temporary (2 to 3 in-water work seasons) and localized impacts to water quality (notably increased turbidity), prey availability, benthic habitat conversion and loss, and aquatic vegetation loss at the EHW-2 project site. However, this alternative would not cause a violation of state water quality standards or reduction in sediment quality. In addition, the presence of the barges and in-water construction activities would represent a migratory barrier during construction. Pile driving activities would increase underwater noise above NMFS-established thresholds for fish. Because construction of Alternative 1 would occur during the approved in-water work window for northern Hood Canal when salmonids are least abundant (July 16 to February 15), these impacts would be minimized due to the low risk of exposure. However, due to impacts to physical and biological habitats used by ESA-listed salmonids, and the potential for even a small number of these fish

encountering noise levels above the threshold for harassment and/or injury, the Navy concludes that the appropriate effect determination for construction of Alternative 1 is "may affect, likely to adversely affect" Puget Sound Chinook, Hood Canal summer-run chum salmon, and Puget Sound steelhead. NMFS (2011) concluded that the project, as proposed, is not likely to jeopardize the continued existence of these species. Bull trout are unlikely to occur within the action area; therefore, the Navy concludes an effect determination of "may affect, not likely to adversely affect" for bull trout is appropriate. USFWS (2011) concurred that the action's foreseeable direct and indirect effects on the bull trout, their habitat, and prey base are insignificant.

ESA-Listed Salmonid Critical Habitat Evaluation

In the final rule designating critical habitat for 12 ESU/DPS of salmonids in Washington, Oregon, and Idaho, published on September 2, 2005 (70 FR 52630), NMFS defined the six PCEs to be essential for the conservation of these listed salmonids. The only two marine fish species with designated critical habitat within northern Hood Canal waters potentially affected by the proposed project are Puget Sound Chinook and Hood Canal summer-run chum salmon (see Table 3.8–1). Although critical habitat occurs in northern Hood Canal waters adjacent to the base, NBK at Bangor is excluded from critical habitat designation for ESA-listed Puget Sound Chinook and Hood Canal summer-run chum salmon by federal law (70 FR 52630). The only PCE that would be affected by the project is the nearshore marine area designation. This habitat is important for out-migrating juvenile salmonids and returning adults.

The only stressor that would reach waters within the nearshore marine area designation is underwater noise generated during pile driving. Based on underwater noise modeling above (see Section 3.4.2.1), the sound levels sufficient to cause fish injury (187 dB_{SEL} for a fish greater than 2 grams in weight and 183 dB_{SEL} for a fish less than 2 grams in weight), would not extend beyond the NBK at Bangor restricted area boundary, and therefore not into designated critical habitat. However, underwater noise sufficient to result in behavioral disturbance (150 dB_{RMS}) would extend beyond the NBK at Bangor restricted area (see Figure 1–2; estimated out to a distance of 3,500 feet from shore) and into these habitats. The 150 dB_{RMS} threshold for the concurrent operation of one impact hammer and three vibratory pile drivers would be exceeded within a circle centered at the location of the driven pile out to a distance of approximately 11,024 feet (in a direct line-of-sight manner) (see Section 3.4.2.1, Table 3.8–5, Figure 3.8–6).

Pile driving would occur during approved in-water work windows for Tidal Reference Area 13 (July 16 to February 15) (WAC 220-110-271; USACE 2010a) and when salmonids are least abundant. A mechanical soft-start approach would be used for both impact and vibratory pile driving. In addition, to minimize the amount of underwater noise from pile driving, a vibratory pile driver (instead of an impact hammer) would be used whenever possible, and a bubble curtain or other noise attenuating device would be used when operating the impact hammer (Section 3.8.2.7). Upon completion of this portion of construction, underwater noise would return to levels more consistent with existing conditions, well below the levels for behavioral disturbance of marine fish. Therefore, the Navy concludes that an effect determination of "may affect, likely to adversely affect" for Puget Sound Chinook and Hood Canal summer-run chum salmon critical habitat is appropriate. In their Biological Opinion, NMFS (2011) concluded that the proposed action is not likely to adversely modify designated critical habitat for the Puget Sound Chinook salmon and Hood Canal summer-run chum salmon.

ESA-LISTED HOOD CANAL ROCKFISH

Due to the similarity of life histories and habitat requirements between ESA-listed rockfish species, project-related impacts to these species are discussed by this species group rather than as individual species.

Threats to the recently listed bocaccio, yelloweye rockfish, and canary rockfish include areas of low DO, commercial and sport fisheries (notably mortality associated with fishery bycatch), the reduction of kelp habitat necessary for juvenile recruitment (74 FR 18516), habitat disruption (including exotic species), derelict gear, climate changes, species interactions (including predation and competition), diseases, and genetic changes (Drake et al. 2009; Palsson et al. 2009). The combination of these factors, in addition to the rockfish's particular life history traits, has contributed to declines in rockfish species within Georgia Basin and Puget Sound in the last few decades (74 FR 18516).

Rockfish Habitat Requirements

Larval and juvenile rockfish are dependent on a variety of habitat factors, including suitable current patterns for larval transport to suitable recruitment habitat (i.e., kelp, eelgrass), good water quality, and abundant food resources (Palsson et al. 2009). Due to typically poor rockfish dispersal between basins, if habitat suitable for adult rockfish does not exist within a specific area, the abundance of adults will be low, as will the recruitment of juveniles into adjacent juvenile habitat. As rockfish have complex life history patterns that use specific food and habitat requirements at each life history stage (larval, juvenile, adult), effects on the habitats used at each stage can affect the long-term presence of these species in local and adjacent waters.

As the EHW-2 would not increase commercial or sport fisheries, nor increase the presence of derelict gear, fish disease, or climate or genetic change, these limiting factors are not discussed further.

Currents

Rockfish larvae are pelagic (live in the water column), with their movements somewhat manipulated by prevailing currents within a given basin (Palsson et al. 2009). Even if adults are abundant and a strong class of larvae is produced in a given year, recruitment to suitable habitat can be limited, because larval survival and settlement are dependent upon a wide variety of unpredictable chance events, including current, climate, the abundance of predators, suitable recruitment habitat, and other chance events (Drake et al. 2009). Therefore, current patterns play a large role in the recruitment and distribution of rockfish larvae within, and between, water basins (Palsson et al. 2009).

As summarized for coastal systems by Drake et al. (2009), onshore current, eddies, upwelling shadows, and other localized circulation patterns create conditions that retain larvae rather than disperse them. In addition, the shallow sill (approximately 165 feet deep) at the mouth of Hood Canal further limits the circulation and exchange of water between this basin and the waters of the Strait of Juan de Fuca and central Puget Sound (Babson et al. 2006). As a result, Puget Sound basins, including Hood Canal, have greater retention of, and reliance upon, intra-basin rockfish larvae than coastal systems (Drake et al. 2009).

As discussed in Section 3.1.2.1.1.3, small-scale and temporary (over periods of hours) changes in current direction and intensity of flow are anticipated during construction. However, the overall circulation pattern and velocities into the nearshore and marine deeper water areas

along the Bangor waterfront would be relatively unaffected. Thus, in-water construction activity would have limited and localized effects on circulation and currents, with limited effects on rockfish larval recruitment.

Due to the limited and localized scale of project effects on currents, construction of the EHW-2 would not modify currents at a scale that would affect juvenile rockfish recruitment within northern Hood Canal waters.

Water Quality

Palsson et al. (2009) indicate that rockfish may avoid waters with DO conditions below 2 mg/L and temperatures greater than 11°C (Palsson et al. 2009). In 2002, 2003, 2004, and 2006 low-DO fish kills occurred in southern Hood Canal (Newton et al. 2007; Palsson et al. 2009). Rockfish, notably copper rockfish, experienced high mortality, with estimates of up to a quarter of all copper rockfish present at a southern Hood Canal marine preserve killed by these conditions (Palsson et al. 2009). However, within Hood Canal both the chronic and episodic events of low DO are typically limited to southern Hood Canal, with this pattern not as prevalent in northern Hood Canal waters (Newton et al. 2007), including off NBK at Bangor. When conditions are not suitable at depths where they are normally present, rockfish relocate to depths with more suitable conditions (Drake et al. 2009; Palsson et al. 2009), or face suffocation.

As mentioned for salmonids, the construction of the EHW-2 would maintain the existing DO concentrations in the project vicinity. Therefore, rockfish would not be subjected to any increases in respiratory distress or alter their distribution in response to DO reductions. The construction of the EHW-2 would not result in water temperature increases. Therefore, rockfish would not experience elevated water temperatures as a result of the EHW-2.

Limited information is available on the effects of turbidity on rockfish. However, the effects on rockfish would likely be similar to those described above for salmonids. Although construction activities would temporarily increase suspended solids, the levels would be insufficient to cause severe gill irritation or result in fish loss through mortality, and would return to existing conditions following the completion of in-water construction. If rockfish should encounter turbidity plumes with high levels of suspended sediment during construction activities, they would likely avoid these small plumes.

Habitat Alteration

Effects on rockfish from habitat alteration can affect interrelated stressors identified by Drake et al. (2009) and Palsson et al. (2009), including suitable habitat, competition, and predation. Limited or altered habitat could also affect prey availability and exotic species presence.

- *Suitable Habitat:* As noted above, juvenile rockfish (as young as three to four months old) recruit to nearshore habitats that include algae-covered rocks or sandy areas with eelgrass or drift algae (Mitchell and Hunter 1970; Leaman 1976; Boehlert 1977; Shaffer et al. 1996; Johnson et al. 2003; Hayden-Spear 2006). While these studies indicate that the fish recruit to natural habitat encountered in offshore surface waters, other studies have found that post-larval juvenile rockfish also recruit to manmade in-water structures (Emery et al. 2006; Love et al. 2005, 2006). Palsson et al. (2009) notes that structured habitat is "extremely" limited within Puget Sound waters. In addition, these types of

structures also serve as habitat for sub-adult and adult lingcod, rockfish, and greenling (Love et al. 2002), which are potential predators of juvenile rockfish.

Marine vegetation potentially used for juvenile rockfish recruitment habitat would also be affected during construction (see Section 3.5.2.1). No dredging or removal of existing high-relief structured habitat potentially used by rockfish would occur during construction.

- *Predation:* The construction activity is not expected to increase recruitment of rockfish predators to the project area or create a physical environment that increases the susceptibility of rockfish to their predators. Barge movement, pile driving, decking installation, and other construction activities would create visual and auditory stimuli that most fish and fish predators would avoid. In addition, because the three listed rockfish species generally prefer deeper water habitats than occur within the construction footprint of the EHW-2, their presence, even in the absence of construction activity would be limited at best. Therefore, the construction activities of Alternative 1 are not expected to increase predation upon juvenile or subadult rockfish.
- *Competition:* Construction activities would not create an environment that would increase competition between rockfish and other marine fish species. In addition to the construction footprint occurring in waters shallower than rockfish generally prefer, construction activities would create visual and auditory stimuli that most fish would avoid, including rockfish competitors. Therefore, construction activities of Alternative 1 are not expected to increase competition between listed rockfish and their competitors.
- *Prey Availability:* During construction, bottom disturbance would result in decreased prey availability (see Section 3.7.2.1.1) for juvenile rockfish. Construction of the EHW-2 would not decrease plankton used as a primary food source for larval rockfish (see Section 3.6.2.1.1). Some prey species for older, larger rockfish, such as surf perch and forage fish, may experience a decrease in habitat availability during construction due to the disturbance of vegetated marine habitats. As a result, older age classes of rockfish, should they be present in the immediate project vicinity, may experience a similar decrease in this small fish prey base during construction activities and associated underwater noise during pile driving. However, upon completion of pile driving, underwater noise levels would return to levels consistent with current conditions, and these prey species would no longer be expected to avoid the immediate project vicinity.

  Therefore, construction of Alternative 1 could temporarily affect juvenile rockfish prey within the immediate project vicinity. Planktonic food sources for larval rockfish are not expected to be affected. Therefore, some reduction of rockfish prey resources would occur during construction activities.
- *Exotic Species:* Exotic organisms, including nonindigenous marine vegetation replacing existing native marine vegetation (notably eelgrass or kelp) in Puget Sound waters could pose a threat to rockfish survival (Drake et al. 2009; Palsson et al. 2009). Currently *Sargassum muticum*, a nonindigenous brown alga, is ubiquitous in Puget Sound nearshore waters where rocks and cobbles are present (Britton-Simmons 2004). Whether *S. muticum* affects rockfish settlement is not currently known (Palsson et al. 2009). Drake et al. (2009) suggest a possible threat to Hood Canal rockfish from *Ciona savignyi*, an invasive tunicate rapidly expanding its range in Hood Canal and further notes that

invasive tunicates elsewhere have had widespread unspecified adverse effects on rocky-reef fishes, including rockfish.

The construction of the EHW-2 would not increase the prevalence of exotic species in Hood Canal waters. None of the piles or decking for this alternative have previously existed in marine waters elsewhere, and therefore have no attached exotic organisms. In addition, the vessels used during construction would originate within Puget Sound waters and comply with U.S. Coast Guard regulations designed to minimize the spread of exotic species. Therefore, construction of the EHW-2 under Alternative 1 is not anticipated to facilitate the introduction, spread, or prevalence of exotic organisms along the Bangor shoreline or the Hood Canal basin.

Underwater Noise

An additional project effect on rockfish not outlined as a stressor in Drake et al. (2009), but briefly mentioned in Palsson et al. (2009), is elevated levels of underwater noise. In a caged fish study, investigating the effects of a seismic air gun on five species of rockfish (*Sebastes* sp.), Pearson et al. (1992) found that behaviors varied between species, although in general, fish formed tighter schools and remained somewhat motionless.

Skalski et al. (1992) found the average rockfish catch for hook and line surveys decreased by 52 percent when following the noise produced from a seismic air gun at the base of rockfish aggregations. Fathometer observations showed that the rockfish schools did not disperse, but remained aggregated in schooling patterns similar to those prior to exposure to this noise. However, these aggregations did elevate themselves in the water column, away from the underwater noise source. Hastings and Popper (2005) indicate there are no reliable hearing data on rockfish, nor is it currently possible to predict their hearing capabilities based on morphology.

A much more detailed description of the effects on fish from anticipated underwater noise levels expected during construction is provided above for salmonids. Currently, underwater noise impact thresholds do not differentiate between fish species (Fisheries Hydroacoustic Working Group 2008). Although salmonids and rockfish have very different appearances and life histories, both groups use internal air sacs to maintain buoyancy. This is important as the swim bladder (air sac) is susceptible to rapid expansion/decompression when a peak pressure wave from an underwater noise source is encountered. At a sufficient level this exposure is fatal for either species group. Therefore, it is likely that noise effects on rockfish would be similar to noise effects on salmon.

Consequently, as described above for salmonids, rockfish present within 11,024 feet of the project area (in a direct line-of-sight manner) during the concurrent operation of one impact hammer and three vibratory pile drivers would be exposed to underwater noise levels above the behavioral disturbance threshold. In addition, rockfish greater than 2 grams present within 518 feet (for 1,000 strikes) and 1,522 feet (for 6,400 strikes) and less than 2 grams present within 961 feet (for 1,000 strikes) and 1,522 feet (for 6,400 strikes) of the project area during concurrent pile driving operations would be exposed to noise levels sufficient to cause injury.

Summary of Impacts and ESA-Listed Rockfish Determination

As mentioned above in Section 3.8.1, bocaccio, yelloweye rockfish, and canary rockfish are rare in Hood Canal waters and, although they have the potential to occur within the project area, are generally limited in Hood Canal by the lack of suitable habitat. Construction of the EHW-2

would result in small-scale changes in current velocity and flow around the in-water vessels. However, this effect would be too small and localized to alter existing nearshore currents or normal rockfish larval recruitment along the Bangor shoreline. Minor, temporary (2 to 3 in-water work seasons), and localized effects on water quality (notably small increases in turbidity) would occur, primarily during construction, but are not expected to decrease DO concentrations or increase water temperatures.

The installation of the EHW-2 structures would disturb soft-bottom habitat, including some loss of aquatic vegetation in the immediate project vicinity. However, the activity with the greatest potential for adverse effects on ESA-listed rockfish is pile driving. Pile driving activities would increase underwater noise above established thresholds for fish. Estimated impact ranges for rockfish experiencing underwater noise levels sufficient to cause disturbance or injury are described in greater detail above. Because the potential exists for bocaccio, yelloweye rockfish, and canary rockfish to encounter noise levels above the threshold for harassment and/or injury, the effect determination for construction of the EHW-2 under Alternative 1 concluded by the Navy is "may affect, likely to adversely affect" for bocaccio, yelloweye rockfish, and canary rockfish. NMFS (2011) concluded that the project, as proposed, is not likely to jeopardize the continued existence of these species.

3.8.2.1.1.2 NON-ESA-LISTED SALMONIDS

Construction-related impacts to non-ESA-listed salmonids and their habitats would be similar to those described above for ESA-Listed Salmonids. Utilizing approved in-water work windows would also minimize impacts to non-ESA-listed salmonids, including hatchery fish, due to their infrequent presence during this work window, resulting in limited exposure to construction activities. However, because elevated noise during pile driving would occur during the construction of Alternative 1, habitat use, distribution, or migration of non-ESA-listed salmonids along the Bangor shoreline would be adversely affected.

3.8.2.1.1.3 FORAGE FISH

The nearest identified forage fish spawning sites to Alternative 1 piles are approximately 375 feet to the north of the site and 450 feet south of the site (Figure 3.8–5). The temporary increase of suspended solids during pile driving and other in-water construction activities (2 to 3 in-water work seasons) would be expected to remain in the vicinity of the project but would not be high enough to adversely impact the spawning success of the nearest forage fish (sand lance) spawning habitat. However, forage fish that are in the area during this time would be exposed to increased levels of turbidity. In addition, during construction and until the vegetation and benthic communities have recovered from disturbance due to construction activities, impacts to these communities would reduce available forage and refuge habitats for forage fish species. Further, pile driving activities would create underwater noise levels that could injure or disturb fish present within the impact threshold zones during the period of construction (see discussion of underwater noise impacts in Section 3.4.2.1).

3.8.2.1.1.4 OTHER MARINE FISH SPECIES

Marine fish species that are found near the project area share the same habitats as salmonids and with a few exceptions, would experience similar project-related impacts from the construction of Alternative 1 as those described for salmonids. As described above, construction of Alternative 1 is not anticipated to violate water or SQS in the project area.

Project impacts to physical habitat would include an increase in nearshore structures through intertidal and subtidal habitats. While nearshore structures oriented perpendicular to the shoreline can represent a migrational barrier to species migrating along the shoreline, such as juvenile salmonids and forage fish, other species of marine fish present along the Bangor waterfront generally do not exhibit similar shoreline migrations (Hart 1973; Wydoski and Whitney 2003). Shiner perch is one of the most abundant other marine fish species in the project area and shows the greatest amount of migration near the Bangor shoreline. However, their migration is not along the shoreline, but between shallow nearshore waters in the spring to bear their young and deeper offshore waters to over-winter (Hart 1973). Due to the majority of the structure occurring offshore, and the trestle's orientation parallel to their migration pathway, the construction of this alternative would have little impact to the movement of this species.

Benthic habitats used for marine fish foraging and rearing would be affected by construction activities (see Section 3.7.2.1.1). Similar to salmonids, many non-salmonid fish species use forage fish as a food resource. As a result, any reduction in forage fish use of the site would reduce the local food resources of some non-salmonid fish species present in this area. Marine vegetation communities would also be affected during construction of Alternative 1 (see Section 3.5.2.1.1). Other marine fish species that have been found to frequent these marine vegetation habitats along the Bangor shoreline include shiner perch, gunnels, pricklebacks, sticklebacks, and sculpin (SAIC 2006; Bhuthimethee et al. 2009a). The construction impacts to these habitats would be expected to result in a corresponding loss of productivity in benthic organisms that use these habitats for foraging, refuge, and reproduction (see Section 3.7.2.1.1) and a subsequent loss in available benthic food resources for these species.

Similar to salmonids, marine fish present within 11,024 feet of the project area (in a direct line-of-sight manner) during the concurrent operation of one impact hammer and three vibratory pile drivers would be exposed to underwater noise levels above the behavioral disturbance threshold. In addition, fish greater than 2 grams present within 518 feet (for 1,000 strikes) and 1,522 feet (for 6,400 strikes) and less than 2 grams present within 961 feet (for 1,000 strikes) and 1,522 feet (for 6,400 strikes) of the project area during concurrent pile driving operations would be exposed to noise levels sufficient to cause injury.

The in-water work window is designed to protect migrating juvenile salmonids. However, some of the most abundant non-salmonid or forage fish species captured in these waters, including juvenile and adult shiner perch, juvenile English sole, gunnels, pricklebacks, sticklebacks, and sculpin (SAIC 2006), are present during allowable in-water work periods. These fish would likely avoid the immediate project vicinity during the period of in-water construction. Average underwater baseline noise levels acquired near the NBK at Bangor Marginal Wharf facility, which is near the location of the EHW-2 project site, were measured at a level of 114 dB_{RMS} re 1µPa (Slater 2009). Sound during impact pile driving would be detected above the average background noise levels at any location in Hood Canal with a direct acoustic path (i.e., "line of sight" from the driven pile to the receiver location). To the west of the EHW-2 project site, Toandos Peninsula bounds the extent of sound travel within the construction area. Therefore, geography would not allow direct sound path propagation south of Brown Point, or north of Termination Peninsula at the western terminus of the Hood Canal Bridge adjacent to Squamish Harbor. Locations beyond these points would receive substantially lower noise levels since there is no direct sound path, and thus no impacts would be observed.

Some fish may avoid the area, particularly closer to the location of the in-water work, or alter their normal behavior while in this area. However, studies have shown that some fish species

may habituate to underwater noise (Feist 1991; Feist et al. 1992; Ruggerone et al. 2008) and would continue to be present within the behavioral disturbance zone (out to a maximum distance of 11,024 feet). These impacts would occur only during the in-water work window (July 16 to February 15) and during allowable pile driving times (from July 16 to September 15, between 2 hours after sunrise and 2 hours before sunset; between September 16 and February 15, daylight hours). Upon completion of the pile driving effort, the underwater noise from construction would diminish and return to levels more consistent with existing conditions.

3.8.2.1.1.5 ESSENTIAL FISH HABITAT

As described in more detail in the Essential Fish Habitat Assessment (NAVFAC 2011a), the primary construction-related impacts of concern for EFH species and their habitats include underwater noise generated from pile driving, marine benthic and vegetation community disturbance, substrate disruption from pile driving, barge anchoring, and spud deployment, and water column and substrate shading from construction barges and structures. Shading effects would affect eelgrass and kelp beds, which provide suitable habitat areas for various life stages of some EFH species. Mitigation measures for the protection of salmonids (see Section 3.8.2.7), including the use of noise attenuation measures (i.e., bubble curtain) during all impact hammer pile driving operations, would similarly protect EFH species from underwater noise generated during pile driving.

Pile driving noise would result in behavioral disturbance or injury to designated EFH species. Short-term and long-term construction-related impacts to eelgrass and macroalgae beds, and to the benthic community, could affect EFH fish species directly, and all species indirectly through effects on prey resources. The presence of the nearshore construction activity could interfere with nearshore habitats utilized by juvenile salmon during their migration. However, use of approved in-water work windows would minimize these effects.

Based on a review of the EFH species known or likely to occur in Hood Canal, findings pertaining to EFH species occurrence in waters along the Bangor waterfront based on site-specific fish surveys, review of the life histories, habitat requirements, and potential conservation measures from the FMPs, as well as review of the mitigation measures developed to prevent adverse effects on ESA-listed fish species, it is concluded that the current project approach and mitigation measures sufficiently address concerns pertaining to the potential for adverse construction-related effects on EFH species. The Navy concludes that construction of the EHW-2 may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH. NMFS (2011) in their MSA review concluded that the proposed project may adversely affect each of the salmonid, groundfish, and coastal pelagic EFH. However, in this review NMFS (2011) included three conservation recommendations, a subset of the ESA take statement's terms and conditions, to avoid, minimize, or otherwise offset potential adverse effects of the proposed project on EFH. The Navy submitted a statutory response requirement in November 2011, whereby the Navy agreed to conduct all recommendations, as proposed in the NMFS Biological Opinion, MSA Consultation section.

3.8.2.1.2 OPERATION/LONG-TERM IMPACTS

Marine habitats used by fish species that are present along the Bangor waterfront include offshore (deeper) habitat, nearshore habitats (intertidal zone and shallow subtidal zone), and manmade structures, such as piles used for cover. The primary impacts to marine fish from operation of Alternative 1 would include an increase in nearshore substrate/armoring, the alteration of nearshore habitats including some reduction in natural refugia, an increase of

physical barriers in the nearshore environment, some reduction in prey availability, a reduction in the forage fish community, and a decrease in nearshore aquatic vegetation. The following sections describe how each of these factors would impact abundance and distribution of marine fish that could occur along the Bangor waterfront during operation of Alternative 1.

Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components (no pile replacement) as required. Measures would be employed to prevent discharges of contaminants to the marine environment. These activities would not affect marine fish.

3.8.2.1.2.1 THREATENED AND ENDANGERED MARINE FISH

ESA-LISTED HOOD CANAL SALMONIDS

Marine Salmonid Habitat Requirements

Water and Sediment Quality

- *Turbidity/Dissolved Oxygen:* Operation of Alternative 1 would be similar to operation of the existing EHW, with little or no impact to localized temperature, salinity, DO, or turbidity (see discussion of operational impacts to water quality in Section 3.2.2.1.2). Waterfront vessel activity would not be expected to increase relative to existing conditions. In addition, BMPs implemented to minimize the degradation of water and sediment quality due to operation of the EHW-2 would be consistent with similar practices at the existing EHW. Stormwater runoff from the new berthing pier would be collected and treated with an oil/water separator system, released to a detention pond or other stormwater management facility, and then discharged to Hood Canal in accordance with an NPDES permit (see Section 3.2.2.1.2). Therefore, operation of Alternative 1 would continue to maintain turbidity and DO conditions.
- *Other Water Quality Parameters:* Operation of Alternative 1 would be similar to operation of the existing EHW, with limited potential to degrade water quality (see Section 3.2.2.1.2). Operation of Alternative 1 could entail risks of accidental releases of fuel, sewage or oil wastes, explosives, cleaning solvents, munitions, and other contaminants that, if spilled, would impact water quality in Hood Canal. However, these risks would be comparable to those associated with current operation of the existing EHW. Operation of Alternative 1 would implement BMPs to minimize spill risks.

  Stormwater runoff during operation phases would be treated as described under the previous discussion for turbidity/DO. Discharges that comply with the permit limits would not adversely impact marine water quality for Alternative 1.

  Waterfront vessel activity would not be expected to increase relative to existing conditions. In addition, BMPs implemented to minimize the degradation of water quality due to operation of the EHW-2 would be consistent with similar practices at the existing EHW. Therefore, operation of Alternative 1 would continue to maintain existing water quality conditions.
- *Sediment Quality:* The piles supporting the wharf and trestles for Alternative 1 would reduce current speeds, thereby promoting both localized erosion and settling and accumulation of fine-grained sediments in the immediate project vicinity (see discussion of operational impacts to sediment quality in Section 3.3.2.1.2). Because sediments

within the project area are considered uncontaminated, the operation of Alternative 1 would not degrade existing conditions.

Physical Habitat

- *Physical Barriers:* Because adult salmonids are generally less dependent on nearshore habitats (aside from summer-run chum adults) and also have much greater mobility, they would not experience the same barrier effect as nearshore-dependent juvenile salmonids from the presence of the nearshore structures. Should they encounter these structures, they could migrate around the entire structure or through the piles, with little or no overall delay in their movements. There is some disagreement in the scientific literature regarding the scale and possible impacts of piles and overwater structures on juvenile salmonids when encountering these structures during shoreline migration and habitat use (Simenstad et al. 1999; Weitkamp et al. 2000; NMFS 2004). Some studies indicate that structures (such as the in-water piles, wharves, and overhead trestles of Alternative 1) would represent barriers to shoreline-dependent juvenile salmon migrating along the Bangor shoreline (Salo et al. 1980; Simenstad et al. 1999; Nightingale and Simenstad 2001a; and Southard et al. 2006). Juvenile salmonids have been shown to avoid crossing the shade/light line created by an overhead pier/dock (as summarized in Simenstad et al. 1999; Nightingale and Simenstad 2001a; and Southard et al. 2006). This hesitation is a behavioral response likely adapted to avoid predation by ambush predators occurring within the shaded environment. The addition of another shade/light line along the shoreline could, therefore, potentially increase habitat available for ambush predators of salmonids. However, the height-over-water of a structure, such as a wharf or trestle, is the most important design aspect for allowing increased light availability under that structure (Burdick and Short 1999). The design of the trestles leading from the on-land support facility across the nearshore habitat and eventually to the EHW-2 platform would be constructed at a height 15.2 feet above MLLW. As a result, a band of nearshore shade would be cast from the structures across the juvenile salmonid and forage fish migratory pathway. This effect would be greatest at higher tides when the height-over-water would range from 1 to 5 feet. This daytime shadow effect would occur roughly 4.9 percent of all daylight hours during their nearshore out-migration (see Section 3.8.2). This shade barrier would result in behavioral responses by juvenile salmonids, including the delay of seaward migration and, possibly, juvenile salmonids attempting to migrate around the end of the structure. These deeper, offshore waters have the potential to expose juvenile salmonids to higher predation rates than would occur along their normal nearshore pathway.

  Nightingale and Simenstad (2001a) indicate that shade-related impacts can be further reduced by increasing the spacing between piles and using piles constructed of a light-refracting material (i.e., concrete, steel) instead of light-absorbing alternatives (i.e., wood). The trestles for Alternative 1 would be supported by steel piles with 25-foot spacing between each pile along the trestles, and approximately 40 feet between piles on opposite sides of the trestles, minimizing the shade cast by these supporting piles.

  Another barrier to juvenile salmon migration is the artificial lighting that would illuminate the trestles and the EHW-2. Studies have shown that salmonids have been attracted toward, and congregate around, structures with artificial lighting, thereby delaying their migration (Prinslow et al. 1980; Simenstad et al. 1999; Nightingale and

Simenstad 2001a). The active industrial Bangor waterfront supports seven major piers and docks, averaging nearly 150,000 sq ft each. Each structure is supplied with artificial lighting for both industrial operations and security measures. The largest piers at the Bangor waterfront are outfitted with more than 100 industrial overhead, security, doorway, and walkway lights. The addition of overhead lighting units along the EHW-2 wharf and trestles would increase the lighting over existing conditions. As a result, the additional lighting needed to illuminate the wharf and trestles would add to the artificial lighting barrier impact to nearshore migrating juvenile salmonids.

The wharf and trestle decking would create an overwater structure and introduce shade to a previously unshaded area. The construction design, specifically the low height-over-water of 1 to 5 feet at high tide, would likely affect nearshore salmonid and forage fish behavior. Design aspects that help to minimize, but not eliminate, the barrier effect on migrating salmonids includes 25-foot spacing between piles. Piles would be driven in an area where they currently do not exist. Artificial lighting would be introduced in an area where it currently does not exist. Therefore, operation of Alternative 1 would degrade the physical barrier conditions within the project area.

- *Substrate/Armoring:* As discussed for construction impacts to marine fish in Section 3.8.2.1.1, Alternative 1 would include up to 90 trestle-supporting piles through the nearshore juvenile salmonid migration pathway. The presence of these piles in a nearshore location where they currently do not exist indicates that the operation of Alternative 1 would degrade the nearshore substrate/armoring conditions within the project area.
- *Refugia:* The presence of the EHW-2 structure would further fragment existing nearshore habitat. However, adult salmonids are not as dependent on these nearshore habitats for refuge as juvenile salmonids, and would be expected to experience little or no loss of refugia. Although the majority of the structure occurs offshore, out of the nearshore migratory path used by juvenile salmonids, the trestles have the potential to restrict juvenile salmon movement between habitats used for foraging, refuge, and migration (NMFS 1996). This increase in habitat fragmentation may reduce some functionality of these habitats and their suitability in supporting marine species, including salmonids.

Biological Habitat

- *Prey Availability:* Alternative 1 would result in the increase of shaded marine habitat (see Section 3.7.2.1.2). As addressed below in Aquatic Vegetation, impacts to eelgrass habitats would require mitigation (see Section 3.5.2.1.2). In addition to project-related effects on eelgrass, there would be some additional long-term impacts to, or loss of, green and red macroalgae habitat due to shading. The loss or reduction of algae results in a corresponding decrease in the productivity of epiphytes and benthic invertebrates that use this habitat. Although the majority of habitat conversion and shading occurs offshore, away from the nearshore migratory pathway of juvenile salmonids (12 feet above MLLW to 30 feet below MLLW), these fish would be expected to experience some loss in the availability of benthic prey due to the presence of Alternative 1, as described above. Operation of Alternative 1 would degrade prey availability for migrating salmonids.
- *Aquatic Vegetation:* The Mitigation Action Plan described in Appendix F would compensate for impacts to eelgrass from operation of the EHW-2. As a result, following

successful mitigation, the presence of Alternative 1 is not expected to substantially reduce eelgrass habitats available to juvenile salmon migrating along the Bangor shoreline. However, in addition to shading impacts to eelgrass, the trestles would shade existing green and red macroalgae habitats (see Section 3.5.2.1.2). Therefore, operation of Alternative 1 would degrade marine vegetation habitats.

Underwater Noise

Operation of Alternative 1 would not increase vessel activity or nearshore activity relative to existing conditions and thus would not increase vessel-related underwater noise. Some increase in underwater noise would occur from cranes, generators, compressors, or other machinery operating on Alternative 1 in the nearshore habitats used by juvenile salmonids. However, this noise increase would not raise background noise above the thresholds of injury or behavior for fish.

Summary of Impacts and ESA-Listed Salmonids Determination

Operation of Alternative 1 would result in adverse impacts to: substrate/armoring, refugia, physical barriers, current patterns, prey availability, forage fish community, and aquatic vegetation, which are indicators that are considered important for salmonids. As a result, the Navy concludes that the appropriate effect determination for operation of Alternative 1 is "may affect, likely to adversely affect" Puget Sound Chinook, Hood Canal summer-run chum salmon, and Puget Sound steelhead. NMFS (2011) concluded that the project, as proposed, is not likely to jeopardize the continued existence of these species. As bull trout are unlikely to occur within the action area, the Navy concludes an effect determination of "may affect, not likely to adversely affect" for bull trout is appropriate. USFWS (2011) concurred that the action's foreseeable direct and indirect effects on the bull trout, their habitat, and prey base are insignificant.

ESA-Listed Salmonid Critical Habitat Evaluation

Although critical habitat occurs in northern Hood Canal waters adjacent to the base, NBK at Bangor is excluded from critical habitat designation for ESA-listed Puget Sound Chinook salmon and Hood Canal summer-run chum salmon by federal law (70 FR 52630). As no change to operational stressors is anticipated with the proposed project, there would be no operational effect on Puget Sound Chinook or Hood Canal summer-run chum salmon critical habitat.

ESA-LISTED HOOD CANAL ROCKFISH

Rockfish Habitat Requirements

Currents

As discussed above for salmonids, due to the presence of the piles, operations under Alternative 1 would have minor and local effects on flow in the immediate vicinity of the piles. However, the overall flow of water into the nearshore and deeper water areas adjacent to the EHW-2 project site would not be impeded by the structures. As a result, due to the limited and localized scale of project effects on currents, the operation of the EHW-2 would not modify currents at a scale that would affect rockfish recruitment within northern Hood Canal waters.

Water Quality

As discussed above for salmonids, the operation of the EHW-2 under Alternative 1 would maintain the existing DO levels in the project vicinity. Therefore, rockfish would not be subjected to any increases in respiratory distress or alter their distribution in response to DO reductions. In addition, the operation of the EHW-2 would not result in water temperature increases over existing conditions. Operation of the EHW-2 is not anticipated to elevate levels of suspended solids sufficient to degrade water quality (see Section 3.2.2.1.2).

Habitat Alteration

Effects on rockfish from habitat alteration can affect three interrelated stressors identified by Drake et al. (2009) and Palsson et al. (2009), including suitable habitat, competition, and predation. Limited or altered habitat could also affect prey availability and exotic species presence.

- *Suitable Habitat:* Some loss of marine vegetation, potentially used for juvenile rockfish recruitment, would occur due to the overwater shading from the proposed structures. Shade-related effects would occur due to the low overwater height of the trestles, 1 to 5 feet at high tide (15.2 feet above MLLW). Operations would not be expected to inhibit kelp growth because none currently occurs in the footprint of the EHW-2 structure (see Section 3.5.2.1.2).

  Alternative 1 would result in the placement of up to 1,250 piles to support the EHW-2 structure. These piles could serve as post-larval juvenile rockfish recruitment habitat. In Hood Canal, suitable structured habitat for rockfish recruitment is very limited (PSAT 2007a; Palsson et al. 2009), with existing marine reserves accounting for almost 20 percent of the available nearshore rocky habitat (PSAT 2007a). The closest rocky habitat suitable for recruitment is located near Pleasant Harbor 9 miles to the south, and a rock pile near the Hood Canal Bridge, approximately 7 miles to the north. The lack of suitable recruitment habitat largely contributes to the patchy and limited distribution and abundance of rockfish in Hood Canal. Although there are substantial difficulties comparing the loss of marine vegetation to addition of manmade structures as habitat for juvenile rockfish recruitment, it is likely that the loss of marine vegetation habitat is offset, to some degree, by the addition of structured habitat. Whether the change in habitat type would be a net benefit or detriment to rockfish is unknown.

- *Predation:* The same piers that would serve as a potential recruitment benefit to juvenile bocaccio, yelloweye rockfish, and canary rockfish would also serve as habitat for rockfish predators (i.e., lingcod, larger sub-adult and adult rockfish). Baskett et al. (2006) found that, prior to commercial fishing pressure, predation and competition shaped the rockfish community structure. This was primarily due to intraguild predation, including large adult rockfish preying upon smaller *Sebastes* members, as well as predation by lingcod. Beaudreau and Essington (2007, 2009) found that rockfish comprise 11 percent of adult lingcod diet by mass. These studies showed that in structured habitats protected from fishing (i.e., marine reserves), lingcod can limit the prevalence of rockfish through predation. The average size and abundance of lingcod in the existing NBK at Bangor pier habitats is unknown, but the EHW-2 could result in increased predation on juvenile rockfish. Further, it is unknown if the benefit of these structures for suitable recruitment habitat would be equivalent to any potential loss of juvenile rockfish to these predators.

- *Competition:* Habitat modification due to the EHW-2 would result in a benthic-to-structure community shift, and may result in habitat more suitable for one species of rockfish over others. As noted above, juvenile rockfish can be present in shallow, nearshore waters over rocks with algae or in sandy areas with eelgrass or drift algae. The presence of the more structured habitat may promote competition with species that use these habitat types for recruitment and rearing. Whether the existing benthic habitat or the proposed structured habitat would be more beneficial to rockfish cannot be determined at this time.

  Palsson et al. (2009) note that, in the absence of fishing pressure, the more aggressive copper and quillback rockfish species appear to limit the prevalence of brown rockfish. Both of these rockfish species appear to be more prevalent in Hood Canal waters than any of the three proposed rockfish species, and may outcompete other *Sebastes* species for the limited structured habitat. Therefore, due to natural factors, including intraguild competition, an increase in suitable structured habitat would not necessarily result in a corresponding increase of listed rockfish abundance in the project area.

- *Prey Availability:* The EHW-2 would not decrease plankton used as a primary food source for larval bocaccio, yelloweye rockfish, and canary rockfish. The in-water structure would reduce the size and suitability of some habitats, notably marine vegetation used by forage fish, and shiner perch (juvenile/sub-adult rockfish food resources). However, it would provide structure used by other potential prey base species, including the invertebrate fouling community, crabs, juvenile rockfish, perches, sculpins, and greenling (Hueckel and Stayton 1982; Nightingale and Simenstad 2001a; Love et al. 2002). Whether the small local shift in community type would have a corresponding effect on rockfish cannot be determined at this time.

  Due to the construction and operation of the EHW-2 under Alternative 1, benthic-obligate juvenile rockfish prey within the immediate project vicinity could decrease in abundance, whereas structure-dependent juvenile rockfish and their associated prey organisms could increase. It is not known which of these effects would be greater. Therefore, a small, local change in the type of prey resources available would be likely, but with an unknown effect on total prey availability.

- *Exotic Species:* The operation of the EHW-2 under Alternative 1 would not introduce exotic species from foreign water bodies or increase the prevalence of existing exotic species in Hood Canal waters. Further, operation of the EHW-2 would not create chronic disturbances that would facilitate colonization by nonindigenous species. Therefore, operation of the EHW-2 under Alternative 1 is not anticipated to facilitate the spread or prevalence of exotic organisms along the Bangor shoreline, or the Hood Canal basin.

Underwater Noise

As discussed above for salmonids, the operation of Alternative 1 would not increase vessel activity or nearshore activity relative to existing conditions and thus would not increase vessel-related underwater noise. Noise from cranes, generators, compressors, or other machinery operating on the Alternative 1 pier would increase underwater sound levels. However, this noise increase would not raise background noise levels above the thresholds of injury or behavior for fish. This alternative would result in an increase in underwater noise over existing conditions in the nearshore habitats, but this increase is not expected to affect rockfish presence or habitat use at the EHW-2 project site.

Summary of Impacts and ESA-Listed Rockfish Determination

As discussed in greater detail in the sections above, operation of Alternative 1, would not result in adverse impacts to water quality or increase the prevalence of exotic species. Although bocaccio, yelloweye rockfish, and canary rockfish are extremely rare in Hood Canal waters, the presence of Alternative 1 structures would shade benthic habitats, inhibiting the growth of marine vegetation potentially used for rockfish recruitment. In addition, the structure-supporting piles would convert the existing soft-bottom benthic habitat to one with in-water structures, and could affect local prey availability as well as the potential to increase recruitment of juvenile bocaccio, yelloweye rockfish, canary rockfish, and rockfish competitors and predators. In addition, the operation of Alternative 1 would increase underwater noise over existing conditions. As a result, the Navy concludes that the appropriate effect determination for operation of Alternative 1 is "may affect, likely to adversely affect" for bocaccio, yelloweye rockfish, and canary rockfish. NMFS (2011) concluded that the project, as proposed, is not likely to jeopardize the continued existence of these species.

3.8.2.1.2.2 NON-ESA-LISTED SALMONIDS

Impacts described above for ESA-listed salmonids due to operation of Alternative 1 would apply to all salmonids. Therefore, operation of Alternative 1 would likely adversely affect the habitat use, distribution, or migration of non-ESA-listed salmonids along the Bangor shoreline.

3.8.2.1.2.3 FORAGE FISH

Operation of Alternative 1 would have little or no impact to forage fish spawning habitats or their reproductive success because no surf smelt or Pacific herring spawning grounds occur along the 4.3-mile long Bangor waterfront (Penttila 1997; Stout et al. 2001), and the nearest Pacific sand lance spawning occurs approximately 375 feet to the north of the site and 450 feet south of the site (Figure 3.8–5, Section 3.8.1.3) (WDFW 2008). Barrier impacts to forage fish migration due to the presence of in-water structures would be similar in scope to those described above for salmonids. Artificial lighting could result in minor delays or alteration of forage fish migration, similar to salmonids. In addition, the presence of artificial light could increase the nighttime predation of forage fish by predators. Nearshore vessel activity associated with the new structure would not increase over existing conditions. Underwater noise associated with operation of Alternative 1 would not increase to levels that would disturb forage fish (see discussion of operational impacts to underwater noise in Section 3.4.2.1.2). Additionally, localized distribution of the plankton community (the primary forage fish food resource) may take place, but these species would continue to be present in the project vicinity (see Section 3.6.2.1.2). However, as discussed above for salmonids, operation of Alternative 1 would adversely impact and reduce the function of nearshore benthic habitats. In addition, the presence of the piles would result in a physical barrier effect on nearshore migrating fish, including forage fish.

3.8.2.1.2.4 OTHER MARINE FISH SPECIES

With a few exceptions, marine fish species that are found near the project area share the same habitats as salmonids and would experience project-related impacts from operation of Alternative 1 similar to those described for salmonids. As described above for salmonids, operation of Alternative 1 would maintain water and sediment quality in the project area (see Section 3.2.2.1.2).

Project impacts to physical habitat would include an increase in nearshore structures through intertidal and subtidal habitats. The presence of these structures would result in localized

decreases in currents around the piles. The shading of marine vegetation and benthic habitats would be expected to result in a corresponding loss of productivity in benthic organisms that use these habitats for forage, refuge, and reproduction. That could lead to a corresponding loss in available benthic food resources. While some fish species (e.g., flatfish such as starry flounder and English sole) would experience a reduction in flat benthic habitat suitable for their life history, others (e.g., pile perch, greenling) would experience an increase in habitat suitable for their life history (Hart 1973).

As discussed for construction, the presence of nearshore structures represents a migration barrier to salmonids and forage fish. However, few other species occurring along the Bangor waterfront exhibit shoreline migration patterns similar to those of salmonids (Hart 1973). For example, shiner perch, the most abundant non-salmonid or forage fish captured in these waters (SAIC 2006; Bhuthimethee et al. 2009a), over-winter in deeper offshore waters and migrate into nearshore waters in the spring to bear their young (Hart 1973). The location of this project does not occur in an area where shiner perch have been abundant in surveys (SAIC 2006; Bhuthimethee et al. 2009a), so operation of this alternative would have little or no impact to the movement of this species.

3.8.2.1.2.5 ESSENTIAL FISH HABITAT

EFH species and habitats, with few exceptions, would experience project-related impacts from operation of Alternative 1 similar to those described for salmonids. As described above for salmonids, operation of Alternative 1 would maintain water and sediment quality in the project area (see Section 3.2.2.1.2).

Long-term impacts to physical habitat would include an increase in overwater and in-water structures. The shading of marine vegetation and benthic habitats would be expected to result in a corresponding loss in habitat suitability and productivity for some species. Introduction of artificial lighting could affect the behavior of species such as migrating juvenile salmon. While some fish species (e.g., starry flounder and English sole) would experience a reduction in flat benthic habitat, others (e.g., cabezon) would experience an increase in high-relief habitat more suitable for their life history. The in-water structures would represent a long-term nearshore migrational barrier to juvenile salmonids. However, few other EFH species occurring along the Bangor waterfront exhibit similar shoreline migration patterns to those of salmonids and would therefore not experience a barrier effect. Based on these impacts, the Navy concludes that operation of the EHW-2 may adversely affect salmonid and groundfish EFH but would not adversely affect coastal pelagic EFH. NMFS (2011) in their MSA review concluded that the proposed project may adversely affect each of the salmonid, groundfish, and coastal pelagic EFH. However, NMFS (2011) included three conservation recommendations (see 3.8.2.7.1.4 and Appendix I), a subset of the ESA take statement's terms and conditions, to avoid, minimize, or otherwise offset potential adverse effects of the proposed project on EFH. The Navy submitted a statutory response requirement in November 2011, whereby the Navy agreed to conduct all recommendations, as proposed in the NMFS Biological Opinion, MSA Consultation section.

3.8.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.8.2.2.1 CONSTRUCTION

As described below in more detail, some differences in construction-related impacts exist between Alternatives 1 and 2. In general, impact assessment for each of the marine salmonid

habitat elements (water and sediment quality, physical habitats, biological habitats, and underwater noise) would be the same for both alternatives.

3.8.2.2.1.1 THREATENED AND ENDANGERED MARINE FISH

ESA-LISTED HOOD CANAL SALMONIDS

Marine Salmonid Habitat Requirements

Water and Sediment Quality

The predicted construction-related impacts from Alternative 2 on water and sediment quality would be similar to those for Alternative 1 (see Sections 3.2.2.1.1 and 3.3.2.1.1). Although Alternative 2 would use a larger number of smaller piles and is likely to require more in-water seasons for the construction of the wharf further offshore (3 to 4 vs. 2 to 3), the fish window precludes in-water construction occurring at a time when juvenile salmonids would be prevalent. Therefore, project-related effects on nearshore water and sediment quality used by salmonids under Alternative 2 would be the same as those described for Alternative 1.

Physical Habitat

Alternative 2 physical habitat effects would be similar to those described for Alternative 1. However, a larger number of smaller piles would be driven during construction of the wharf and trestles. The pile footprint would be slightly less, but would require additional days of pile driving and is likely to require more in-water seasons than Alternative 1. Because these minor differences would not substantially increase or decrease project-related impacts to marine fish, the overall effects on these species would be similar to those described for Alternative 1.

Biological Habitat

Because the nearshore trestle design and construction of Alternative 2 would be the same as Alternative 1, impacts to the nearshore benthic community (see Section 3.7.2.2.1) and aquatic vegetation (see Section 3.5.2.2.1) used by juvenile salmonids and forage fish would also be the same. The increase in the number of piles driven under Alternative 2 is not expected to introduce or increase the prevalence of exotic species to Hood Canal waters. Therefore, other than the increased exposure to underwater noise from additional pile driving days, the impacts to nearshore biological habitats used by salmonids under Alternative 2 would be the same as those described for Alternative 1.

Underwater Noise

Due to the required methods to install piles, underwater noise impact ranges for fish disturbance and injury for impact hammer and vibratory techniques would be the same, regardless of alternative. For underwater noise effects on fish, the greatest difference between alternatives is the number of piles driven and the in-water construction duration. Although nearshore designs are the same, the Alternative 2 requires a greater number of smaller piles for the wharf (1,460) than Alternative 1 (1,250). As a result, Alternative 2 may require additional pile driving days (275 to 550) compared to Alternative 1 (200 to 400).

Alternative 2 is likely to require more in-water work seasons for marine construction compared to Alternative 1. The additional vessel activity required for in-water construction

would not elevate noise above injury thresholds, but at very short ranges in the immediate vicinity of some of these vessels, fish may experience levels above the disturbance threshold.

Summary of Impacts and ESA-Listed Salmonids Determination

The construction-related effects of Alternative 2 on NBK at Bangor marine habitats, described above for salmonids, would be similar to those described for Alternative 1. Because the minor differences would neither increase or decrease species level threshold or habitat effects, the Alternative 2 effect determination on threatened and endangered fish species would be the same as described for Alternative 1. Therefore, the Navy concludes that the appropriate effect determination for construction of Alternative 2 is "may affect, likely to adversely affect" for Puget Sound Chinook, Hood Canal summer-run chum salmon, and Puget Sound steelhead. As bull trout are unlikely to occur within the action area, the Navy concludes an effect determination of "may affect, not likely to adversely affect" for bull trout is appropriate. The Biological Opinion determinations for protected species and habitats issued by the Services are provided under Alternative 1 (Section 3.8.2.1). A description of the reasonable and prudent measures and terms and conditions from these opinions is provided in Section 3.8.2.7, Mitigation Measures and Regulatory Compliance.

ESA-Listed Salmonid Critical Habitat Evaluation

Similar to Alternative 1, the only Alternative 2 stressor that would reach waters within the nearshore marine area PCE designation for Puget Sound Chinook and Hood Canal summer-run chum salmon critical habitat is underwater noise generated during pile driving. Underwater noise sufficient to result in behavioral disturbance, but not sufficient to cause injury, would extend beyond the NBK at Bangor restricted area boundary, and thus into critical habitat for ESA-listed salmonids (see Section 3.4.2, Table 3.8–5, Figure 3.8–6).

The same mitigation measures described for Alternative 1 would be employed during Alternative 2 to minimize the effects of underwater noise from pile driving (Section 3.8.2.7). Upon completion of construction, underwater noise would return to levels more consistent with existing conditions, well below the levels for behavioral disturbance of marine fish. Therefore, the Navy concludes that an effect determination of "may affect, likely to adversely affect" for Puget Sound Chinook and Hood Canal summer-run chum salmon critical habitat is appropriate.

ESA-LISTED HOOD CANAL ROCKFISH

Impacts to currents, water quality, and habitats during the construction of Alternative 2 would be similar to those described for Alternative 1. The greatest difference between the alternatives is that up to 550 in-water pile driving days would be required under Alternative 2. In addition, Alternative 2 is likely to require more in-water work seasons. However, these differences are insufficient to alter the effect determination on ESA-listed Hood Canal rockfish and their habitats determined for Alternative 1. Therefore, the appropriate effect determination for construction of Alternative 2 is "may affect, likely to adversely affect" for bocaccio, canary rockfish, or yelloweye rockfish along the Bangor shoreline.

3.8.2.2.1.2 NON-ESA-LISTED SALMONIDS

Construction-related impacts to non-ESA-listed salmonids and their habitats would be similar to those described above for ESA-Listed Salmonids. Complying with the permitted in-water work window would also minimize impacts to non-ESA-listed salmonids, including hatchery fish, due to their infrequent occurrence during this work window and limited exposure to

construction activities. However, due to the elevated noise during pile driving, the construction of Alternative 2 would likely adversely affect the habitat use, distribution, or migration of non-ESA-listed salmonids along the Bangor shoreline.

3.8.2.2.1.3 FORAGE FISH

Impacts to forage fish due to construction of Alternative 2 would be similar to those described for Alternative 1. Because the total number of piles for Alternative 2 (1,460) is greater than for Alternative 1 (1,250), the number of days forage fish would experience elevated noise levels would similarly increase (up to 550 days vs. up to 400 days).

3.8.2.2.1.4 OTHER MARINE FISH SPECIES

Impacts to other marine fish species from Alternative 2 would be similar to those described for Alternative 1. However, differences include a larger number of smaller piles for construction of the Alternative 2 wharf compared to Alternative 1. Although the pile footprint would be slightly less, there would be additional days of pile driving required for Alternative 2, which would likely require more in-water work seasons. These minor differences would not substantially increase or decrease project-related impacts to other marine fish species and the overall effects on these species would be similar to those described for Alternative 1.

3.8.2.2.1.5 ESSENTIAL FISH HABITAT

Impacts to EFH species and their habitats from the construction of Alternative 2 would be similar to those described for Alternative 1. However, differences include a larger number of smaller piles for construction of the Alternative 2 wharf than for Alternative 1. Although the pile footprint would be slightly less, additional days of pile driving would be necessary and would likely require more in-water work seasons. These minor differences would not substantially increase or decrease project-related impacts to other EFH species or their habitats, and overall effects would be similar to those described for Alternative 1. Based on these impacts, the Navy concludes that construction of the EHW-2 may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH.

3.8.2.2.2 OPERATION/LONG-TERM IMPACTS

Maintenance of the EHW-2 under Alternative 2 would have similar impacts to marine fish as Alternative 1.

3.8.2.2.2.1 THREATENED AND ENDANGERED MARINE FISH

ESA-LISTED HOOD CANAL SALMONIDS

Marine Salmonid Habitat Requirements

Water and Sediment Quality

The long-term impacts to water (see Section 3.2.2.2.2) and sediment quality (see Section 3.3.2.2.2) from operation of Alternative 2 would be the same as for Alternative 1. Therefore, the operation of Alternative 2 would not result in degraded water or sediment quality in habitats used by salmonids.

Physical Habitat

Since the Alternative 2 trestle alignment through the nearshore environment used by juvenile salmonids is the same as for Alternative 1, the long-term operational impacts to nearshore physical habitats would also be the same.

Biological Habitat

Because the shading footprints of the overwater structures in both alternatives would be the same, operational impacts to prey availability (see Section 3.7.2.2.2) and marine vegetation (see Section 3.5.2.2.2) from Alternative 2 would be the same as those described for Alternative 1. In addition, trestle alignment is the same for both alternatives, so potential effects on forage fish spawning habitats, nearshore habitat use, and migration would also be the same (Section 3.8.2.2.2.3).

Underwater Noise

Due to the same level of vessel and wharf activity under each alternative, underwater noise generated during operations, described in more detail for Alternative 1, would be the same for each alternative.

Summary of Impacts and ESA-Listed Salmonids Determination

The operational effects of Alternative 2 on nearshore NBK at Bangor marine habitats, described above for salmonids, would be similar to those described for Alternative 1 due to the similar nearshore designs. Minor differences would neither increase or decrease species level threshold or habitat effects, and the Alternative 2 effect determination on threatened and endangered fish species would be the same as described for Alternative 1. Therefore, the Navy concludes the appropriate effect determination for operation of Alternative 2 is "may affect, likely to adversely affect" for Puget Sound Chinook, Hood Canal summer-run chum salmon, and Puget Sound steelhead. As bull trout are unlikely to occur within the action area, the Navy concludes an effect determination of "may affect, not likely to adversely affect" is appropriate for bull trout. The Biological Opinion determinations for protected species and habitats issued by the Services are provided under Alternative 1 (Section 3.8.2.1). A description of the reasonable and prudent measures and terms and conditions from these opinions is provided in Section 3.8.2.7, Mitigation Measures and Regulatory Compliance.

ESA-Listed Salmonid Critical Habitat Evaluation

As mentioned for Alternative 1, although critical habitat occurs in northern Hood Canal waters adjacent to the base, NBK at Bangor is excluded from critical habitat designation for ESA-listed Puget Sound Chinook salmon and Hood Canal summer-run chum salmon by federal law (70 FR 52630). Since no change to operational stressors is anticipated with the proposed project, there would be no operational effect on Puget Sound Chinook or Hood Canal summer-run chum salmon critical habitat.

ESA-LISTED HOOD CANAL ROCKFISH

Similar to what was described for the operation of Alternative 1, the operation of Alternative 2 would not result in adverse impacts to water quality or increase the prevalence of exotic species. The greatest difference between the two alternatives is the increase in piles required under Alternative 2 (up to 1,460 vs. up to 1,250 for Alternative 1). It is currently unknown whether an increase in piles and, therefore, structured habitat, would alter rockfish recruitment, competition, or predation. Although the number of piles would increase for this alternative, this difference is considered insufficient to alter the effect determination on ESA-listed Hood Canal rockfish and their habitats determined for Alternative 1. Therefore, the Navy concludes the appropriate effect determination for operation of Alternative 2 is "may affect, likely to adversely affect" for bocaccio, canary rockfish, or yelloweye rockfish.

3.8.2.2.2.2 NON-ESA-LISTED SALMONIDS

Impacts described above for ESA-listed salmonids due to operation of Alternative 2 would apply to all salmonids. Therefore, operation of Alternative 2 would likely adversely affect the habitat use, distribution, or migration of non-ESA-listed salmonids along the Bangor shoreline.

3.8.2.2.2.3 FORAGE FISH

Because the effects on nearshore water and sediment quality, physical habitat, biological habitat, and underwater noise in both alternatives would be the same, operational impacts to forage fish from Alternative 2 would be the same as those described for Alternative 1. In addition, as the trestle alignment is the same for both alternatives, potential effects on forage fish spawning habitats, nearshore habitat use, and migration would also be the same.

3.8.2.2.2.4 OTHER MARINE FISH SPECIES

Operational impacts to other marine fish species from Alternative 2 would be similar to those described for salmonids and other marine fish species from Alternative 1. Differences include a larger number of smaller piles and a slightly smaller total pile footprint than Alternative 1. These minor differences would not substantially increase or decrease operational impacts to other marine fish species, so the overall effects of Alternative 2 on these species would be similar to those described for Alternative 1.

3.8.2.2.2.5 ESSENTIAL FISH HABITAT

Operational impacts to EFH species and their habitats from the operation of Alternative 2 would be similar to those described for salmonids and other marine fish species from Alternative 1. The total overwater area is the same for both alternatives. Differences include a larger number of smaller piles and a slightly smaller total pile footprint than Alternative 1. Minor differences between alternatives would not substantially increase or decrease operational impacts to EFH species or their habitats. Therefore, the overall effects of Alternative 2 would be similar to those described for Alternative 1. Based on these impacts, the Navy concludes that operations of the EHW-2 may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH.

3.8.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.8.2.3.1 CONSTRUCTION

3.8.2.3.1.1 THREATENED AND ENDANGERED MARINE FISH

ESA-LISTED HOOD CANAL SALMONIDS

Marine Salmonid Habitat Requirements

Water and Sediment Quality

Impacts to marine water and sediment quality from in-water construction of Alternative 3 would be short-term, localized, and similar to those associated with Alternative 1 (see Sections 3.2.2.3.1 and 3.3.2.3.1). The entrance and exit trestles would be built separately, but would only result in a slight increase in total piles and a minor increase in turbidity levels. Turbidity associated with Alternative 3 would be short-term and localized, with no violation of water or sediment quality standards. The additional piles would be installed in water depths of 30 feet below MLLW out of the juvenile salmon migratory pathway. Although it would require

a few more days to complete pile driving under Alternative 3, the overall duration of in-water work activities would be the same as Alternative 1.

Physical Habitat

Overall construction impacts to nearshore currents and freshwater/saltwater mixing locations from the construction of Alternative 3 would be similar to Alternative 1 (see Section 3.1.2.3.1). Alternative 3 would require a greater disturbance of nearshore physical habitats during construction and substantially more nearshore piles to be installed (up to 160) compared to Alternative 1 (up to 90). The additional piles and longer nearshore construction duration needed in nearshore habitats under Alternative 3 would increase substrate armoring and physical barriers compared to Alternative 1. Due to the increased nearshore construction activities under Alternative 3, juvenile salmonid habitats would experience a decrease in nearshore physical habitat conditions compared to Alternative 1.

Biological Habitat

The construction of Alternative 3 would potentially disturb up to 0.49 acre of eelgrass compared to 0.43 acre for Alternative 1 (see Section 3.5.2.3) due to trestles crossing these habitats at two different locations. Construction-related impacts to kelp and green and red macroalgae would be similar between both alternatives. The total benthic habitat disturbed in the construction corridor is only slightly greater for Alternative 3 compared to Alternative 1, and the period of impact, when in-water construction is taking place, would be similar between these two alternatives. However, the total overwater area in benthic habitats used for food and refuge by nearshore-migrating juvenile salmonids is approximately doubled in Alternative 3 (0.8 acre) compared to Alternative 1 (0.4 acre). Alternative 3 would increase in the number of nearshore piles (up to 160) compared to Alternative 1 (up to 90) and nearshore construction duration.

Underwater Noise

Underwater noise impact ranges for fish disturbance and injury for impact hammer and vibratory techniques would be the same, regardless of alternative due to the required methods to install piles. In addition, in-water construction activities for each alternative would be conducted during the allowable in-water work period (July 16 to February 15) to minimize the potential effects of construction of juvenile salmonids.

The greatest difference between alternatives, with respect to underwater noise effects on fish, is the number of piles driven, and the in-water construction duration. The Alternative 3 design requires slightly more piles (up to 1,290) than Alternative 1 (up to 1,250). As a result, Alternative 3 may require additional pile driving days (210 to 420) compared to Alternative 1 (200 to 400) and would likely require the same number of in-water work seasons as Alternative 1 (2 to 3).

Summary of Impacts and ESA-Listed Hood Canal Salmonids Determination

Construction-related effects of Alternative 3 on NBK at Bangor marine habitats would be similar to those described for Alternative 1. Minor differences would neither increase nor decrease species level threshold or habitat effects, as described above for salmonids, and the Alternative 3 effect determination on threatened and endangered fish species would be the same as described for Alternative 1. Therefore, the Navy concludes the appropriate effect determination for construction of Alternative 3 is “may affect, likely to adversely affect” for Puget Sound Chinook, Hood Canal summer-run chum salmon, and Puget Sound steelhead. As

bull trout are unlikely to occur within the action area, the Navy concludes an effect determination of "may affect, not likely to adversely affect" for bull trout is appropriate. The Biological Opinion determinations for protected species and habitats issued by the Services are provided under Alternative 1 (Section 3.8.2.1). A description of the reasonable and prudent measures and terms and conditions from these opinions is provided in Section 3.8.2.7, Mitigation Measures and Regulatory Compliance.

ESA-Listed Salmonid Critical Habitat Evaluation

As discussed for Alternative 1, the only stressor that would reach waters within the nearshore marine area PCE designation for Puget Sound Chinook and Hood Canal summer-run chum salmon critical habitat is underwater noise generated during pile driving. Underwater noise sufficient to result in behavioral disturbance, but not sufficient to cause injury, would extend beyond the NBK at Bangor restricted area boundary and into critical habitat for ESA-listed salmonids (see Section 3.4.2, Table 3.8–5, Figure 3.8–6).

The same mitigation measures described for Alternative 1 would be employed for Alternative 3 to minimize the effects of underwater noise from pile driving (Section 3.8.2.7). Upon completion of construction, underwater noise would return to levels more consistent with existing conditions, well below the levels for behavioral disturbance of marine fish. Therefore, the Navy concludes that an effect determination of "may affect, likely to adversely affect" for Puget Sound Chinook and Hood Canal summer-run chum salmon critical habitat is appropriate.

ESA-LISTED HOOD CANAL ROCKFISH

Impacts to currents, water quality, and habitats during the construction of Alternative 3 would be similar to those described for Alternative 1. The greatest difference between the two alternatives is the increase in overwater structures and piles due to the additional nearshore trestle. However, these differences due to the presence of the separate trestles are insufficient to alter the effect determination on ESA-listed Hood Canal rockfish and their habitats determined for Alternative 1. Therefore, the Navy concludes the appropriate effect determination for construction of Alternative 3 is "may affect, likely to adversely affect" for bocaccio, canary rockfish, or yelloweye rockfish along the Bangor shoreline.

3.8.2.3.1.2 NON-ESA-LISTED SALMONIDS

Construction-related impacts to non-ESA-listed salmonids and their habitats would be similar to those described above for ESA-Listed Salmonids. Observation of the in-water work window would also minimize impacts to non-ESA-listed salmonids, including hatchery fish, due to their infrequent occurrence during this work window and limited exposure to construction activities. However, due to the elevated noise during pile driving, the construction of Alternative 3, similar to Alternative 1, would likely adversely affect the habitat use, distribution, or migration of non-ESA-listed salmonids along the Bangor shoreline.

3.8.2.3.1.3 FORAGE FISH

The construction-related effects of Alternative 3 on NBK at Bangor marine habitats would be similar to those described for Alternative 1. Temporary increase of suspended solids during in-water construction (2 to 3 in-water work seasons) would not be high enough to adversely impact the spawning success of the nearest forage fish (sand lance) spawning habitat, at a distance of 375 feet. Pile driving activities would create underwater noise levels sufficient to injure or disturb fish present within the impact threshold zones during the period of construction

(see Section 3.4.2.1.1). The total pile driving duration for Alternative 3 would be similar to Alternative 1.

3.8.2.3.1.4 OTHER MARINE FISH SPECIES

Impacts to other marine fish species from the construction of Alternative 3 would be similar to those described for Alternative 1. However, differences include an increase in the total number of piles driven and pile driving duration, compared to Alternative 1. Alternative 3 requires more nearshore construction compared to Alternative 1, so disturbances to marine vegetation and benthic community habitats may also increase. For species that seasonally occur in nearshore habitats (e.g., shiner perch and juvenile English sole), Alternative 3 would have a greater impact to the function and availability of this habitat in the nearshore environment compared to Alternative 1.

3.8.2.3.1.5 ESSENTIAL FISH HABITAT

Impacts to EFH species and their habitats from the construction of Alternative 3 would be similar to those described for Alternative 1. However, differences include an increase in the total number of piles driven and pile driving duration, compared to Alternative 1. Because Alternative 3 requires much more nearshore construction compared to Alternative 1, disturbances to marine vegetation and benthic community habitats may also increase. For EFH species that seasonally occur in nearshore habitats (e.g., starry flounder and juvenile English sole), Alternative 3 would have a greater impact to the function and availability of this habitat in the nearshore environment compared to Alternative 1. Based on these impacts, the Navy concludes that construction of the EHW-2 may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH.

3.8.2.3.2 OPERATION/LONG-TERM IMPACTS

Maintenance of the EHW-2 under Alternative 3 would have similar impacts to marine fish as Alternative 1.

3.8.2.3.2.1 THREATENED AND ENDANGERED MARINE FISH

ESA-LISTED HOOD CANAL SALMONIDS

Marine Salmonid Habitat Requirements

Water and Sediment Quality

The predicted impacts from Alternative 3 operations on the water and sediment quality would be the same as those described for Alternative 1 (see Sections 3.2.2.3.2 and 3.3.2.3.2). The operation of this alternative would not result in any direct discharges into Hood Canal or in activities that would have direct or indirect impacts to water or sediment quality.

Physical Habitat

Overall operational impacts to nearshore currents and freshwater/saltwater mixing locations from the operation of Alternative 3 would be similar to Alternative 1. Alternative 3 would also have more piles (1,290) compared to Alternative 1 (1,250). However, within the juvenile salmon migratory pathway, Alternative 3 requires substantially more nearshore piles (up to 160) than Alternative 1 (up to 90). The presence of Alternative 3 would shade 0.8 acre of nearshore habitat, compared to 0.4 acre under Alternative 1. Due to the increased number of piles in nearshore habitats under Alternative 3 compared to Alternative 1, juvenile salmonids would experience a

greater modification of substrate conditions and associated nearshore refugia habitat conditions compared to Alternative 1. Juvenile salmonids migrating in nearshore areas along NBK at Bangor under Alternative 3 would also experience an increase in migrational barriers from the physical presence of the piles, as well as the overwater shade barrier compared to Alternative 1.

Biological Habitat

Compared to the operational effects of Alternative 1, Alternative 3 has a slight increase in the total number of piles needed, but a substantial increase in nearshore habitat shaded by overwater structures and nearshore piles. Shading of nearshore marine vegetation communities during operation of Alternative 3 would be slightly greater than under Alternative 1. With the exception that the overwater trestle length for Alternative 3 would be slightly longer and the aquatic area shaded would be slightly greater due to the larger total overwater area (6.6 vs. 6.3 acres) compared to Alternative 1, impacts to benthic resources due to changes in shading would be the same as for Alternative 1. Because of the larger number of nearshore piles for this alternative, the impact to prey availability in the nearshore migratory pathway of juvenile salmonids would be greater under Alternative 3 than Alternative 1.

Underwater Noise

Due to the same level of vessel and wharf activity under each alternative, underwater noise generated during operations, described in more detail for Alternative 1, would be the same for each alternative.

Summary of Impacts and ESA-Listed Salmonids Determination

The operation-related effects of Alternative 3 on NBK at Bangor marine habitats would be similar to those described for Alternative 1. The differences that would affect these species, notably the increase in nearshore piles and shaded habitats, would neither increase nor decrease species level threshold or habitat effects. Therefore, the Navy concludes the appropriate effect determination for operation of Alternative 3 is “may affect, likely to adversely affect” for Puget Sound Chinook, Hood Canal summer-run chum salmon, and Puget Sound steelhead. As bull trout are unlikely to occur within the action area, the Navy concludes an effect determination of “may affect, not likely to adversely affect” for bull trout is appropriate. The Biological Opinion determinations for protected species and habitats issued by the Services are provided under Alternative 1 (Section 3.8.2.1). A description of the reasonable and prudent measures and terms and conditions from these opinions is provided in Section 3.8.2.7, Mitigation Measures and Regulatory Compliance.

ESA-Listed Salmonid Critical Habitat Evaluation

As mentioned for Alternative 1, although critical habitat occurs in northern Hood Canal waters adjacent to the base, NBK at Bangor is excluded from critical habitat designation for ESA-listed Puget Sound Chinook salmon and Hood Canal summer-run chum salmon by federal law (70 FR 52630). Since no change to operational stressors is anticipated with the proposed project, there would be no operational effect on Puget Sound Chinook or Hood Canal summer-run chum salmon critical habitat.

ESA-LISTED HOOD CANAL ROCKFISH

The greatest difference between Alternative 1 and 3 is the increased nearshore overwater shading under Alternative 3 (0.8 acre) compared to Alternative 1 (0.4 acre). It is currently unknown whether these habitats are used by ESA-listed rockfish as recruitment habitats. However, this difference is considered insufficient to alter the effect determination on ESA-listed Hood Canal rockfish and their habitats determined for Alternative 1. Therefore, the Navy concludes the appropriate effect determination for operation of Alternative 3 is "may affect, likely to adversely affect" for bocaccio, canary rockfish, or yelloweye rockfish.

3.8.2.3.2.2 NON-ESA-LISTED SALMONIDS

Impacts described above for ESA-listed salmonids due to operation of Alternative 3 would apply to all salmonids. Therefore, operation of Alternative 3 would likely adversely affect the habitat use, distribution, or migration of non-ESA-listed salmonids along the Bangor shoreline.

3.8.2.3.2.3 FORAGE FISH

Due to the increase in the number of nearshore piles and increased nearshore habitat impacts under Alternative 3 compared to Alternative 1, Alternative 3 would have a greater effect on forage fish than Alternative 1. Because the nearest documented forage fish spawning sites to Alternative 3 piles are approximately 375 feet to the north of the site and 400 feet south of the site (Figure 3.8–5), the operation of Alternative 3 would have little or no impact to forage fish spawning habitats or their reproductive success. However, as discussed for salmonids, a greater number of nearshore piles under Alternative 3 would increase the barrier for nearshore forage fish migration compared to Alternative 1. The effects of artificial lighting and underwater noise associated with operations would be the same as described for Alternative 1. In addition, the localized distribution of the plankton (the primary forage fish food resource) would continue to occur at baseline levels in the project vicinity.

3.8.2.3.2.4 OTHER MARINE FISH SPECIES

Impacts to other marine fish species from the operation of Alternative 3 would be similar to those described for Alternative 1. However, one difference includes an increase in the number of nearshore piles necessary, compared to Alternative 1. Although the total overwater area is similar between the two alternatives, Alternative 3 would result in much more nearshore shading (0.8 acre) than Alternative 1 (0.4 acre). For species that seasonally occur in nearshore habitats (e.g., shiner perch and juvenile English sole) Alternative 3 would have a greater impact to the function and availability of this habitat in the nearshore environment compared to Alternative 1.

3.8.2.3.2.5 ESSENTIAL FISH HABITAT

Operational impacts to EFH species and their habitats from the operation of Alternative 3 would be similar to those described for Alternative 1. However, one difference includes an increase in the number of nearshore piles, compared to Alternative 1. Although the total overwater area is similar between the two alternatives, Alternative 3 would result in much more nearshore shading (0.8 acre) than Alternative 1 (0.4 acre). For EFH species that seasonally occur in nearshore habitats (e.g., starry flounder and juvenile English sole) Alternative 3 would have a greater impact to the function and availability of this habitat in the nearshore environment compared to Alternative 1. Based on these impacts, the Navy concludes that operations of the EHW-2 may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH.

3.8.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.8.2.4.1 CONSTRUCTION

3.8.2.4.1.1 THREATENED AND ENDANGERED MARINE FISH

ESA-LISTED HOOD CANAL SALMONIDS

Marine Salmonid Habitat Requirements

Water and Sediment Quality

Impacts to marine water and sediment quality from in-water construction of Alternative 4 would be short-term, localized, and similar to those associated with Alternative 1 (see Sections 3.2.2.4.1 and 3.3.2.4.1). Alternative 4 would require additional days (290 to 570 days) to complete pile driving compared to Alternative 1 (200 to 400 days). As a result, the total construction duration would likely require more in-water work seasons (3 to 4) than Alternative 1 (2 to 3). The design would require an increase in total piles (up to 1,500 vs. up to 1,250), with a consequent increase in turbidity levels. The turbidity would be short-term and localized, with no violation of water or sediment quality standards.

Physical Habitat

Compared to Alternative 1, Alternative 4 would require a greater disturbance of nearshore physical habitats during construction as it requires substantially more nearshore piles to be installed (up to 160) than Alternative 1 (up to 90). The additional piles and longer nearshore construction duration needed in nearshore habitats under Alternative 4 would increase substrate armoring and physical barriers compared to Alternative 1. Due to the increased nearshore construction activities under Alternative 4, juvenile salmonid habitats would experience a decrease in nearshore physical habitat conditions compared to Alternative 1.

Biological Habitat

The construction of Alternative 4 would potentially disturb up to 0.49 acre of eelgrass compared to 0.43 acre for Alternative 1 (see Section 3.5.2.4.1) due to trestles crossing these habitats at two different locations. Construction-related impacts in terms of kelp and green and red macroalgae disturbed would be similar between both alternatives. The total benthic habitat disturbed in the construction corridor is only slightly greater for Alternative 4 than for Alternative 1, while the period of impact from in-water construction would be similar between these two alternatives. However, the total overwater area in benthic habitats used for food and refuge by nearshore-migrating juvenile salmonids is approximately doubled in Alternative 4 (0.8 acre) compared to Alternative 1 (0.4 acre). Alternative 4 would increase the number of nearshore piles compared to Alternative 1 and would increase the nearshore construction duration as well.

Underwater Noise

The greatest difference between alternatives, with respect to underwater noise effects on fish, is the number of piles driven, and the in-water construction duration, with more piles being installed for Alternative 4 (1,500) compared to Alternative 1 (1,250). Consequently, Alternative 4 would require more days to complete pile driving than Alternative 1. The total construction duration would likely require more in-water work seasons than Alternative 1. As a

result, the duration of underwater noise sufficient to disturb or injure fish during the construction of Alternative 4 would be greater than under Alternative 1.

Summary of Impacts and ESA-Listed Salmonid Determination

The construction-related effects of Alternative 4 on NBK at Bangor marine habitats would be similar to those described for Alternative 1. As these minor differences would neither increase nor decrease species level threshold or habitat effects, the Alternative 4 effect determination on threatened and endangered fish species would be the same as described for Alternative 1. Therefore, the Navy concludes the appropriate effect determination for construction of Alternative 4 is "may affect, likely to adversely affect" for Puget Sound Chinook, Hood Canal summer-run chum salmon, and Puget Sound steelhead. As bull trout are unlikely to occur within the action area, the Navy concludes an effect determination of "may affect, not likely to adversely affect" is appropriate for bull trout. The Biological Opinion determinations for protected species and habitats issued by the Services are provided under Alternative 1 (Section 3.8.2.1). A description of the reasonable and prudent measures and terms and conditions from these opinions is provided in Section 3.8.2.7, Mitigation Measures and Regulatory Compliance.

ESA-Listed Salmonid Critical Habitat Evaluation

As mentioned for Alternative 1, the only stressor that would reach waters within the nearshore marine area PCE designation for Puget Sound Chinook and Hood Canal summer-run chum salmon critical habitat is underwater noise generated during pile driving. Underwater noise sufficient to result in behavioral disturbance, but not sufficient to cause injury, would extend beyond NBK at Bangor restricted area boundary, and thus into critical habitat for ESA-listed salmonids (see Section 3.4.2, Table 3.8–5, Figure 3.8–6).

The same mitigation measures described for Alternative 1 would be employed to minimize the effects of underwater noise from pile driving (Section 3.8.2.7). Upon completion of construction, underwater noise would return to levels more consistent with existing conditions and well below the levels for behavioral disturbance of marine fish. Therefore, the Navy concludes that an effect determination of "may affect, likely to adversely affect" for Puget Sound Chinook and Hood Canal summer-run chum salmon critical habitat is appropriate.

ESA-LISTED HOOD CANAL ROCKFISH

Impacts to currents, water quality, and habitats during the construction of Alternative 4 would be similar to those described for Alternative 1. Construction-related differences between the two alternatives that potentially affect rockfish include the increase in overwater structures and piles due to the additional nearshore trestle. Alternative 4 would require more piles and pile driving days than Alternative 1. In addition, the total duration of marine construction under Alternative 4 would likely require more in-water work seasons than Alternative 1. However, these differences are insufficient to alter the effect determination on ESA-listed Hood Canal rockfish and their habitats determined for Alternative 1. Therefore, the Navy concludes the appropriate effect determination for construction of Alternative 4 is "may affect, likely to adversely affect" for bocaccio, canary rockfish, or yelloweye rockfish.

3.8.2.4.1.2 NON-ESA-LISTED SALMONIDS

Construction-related impacts to non-ESA-listed salmonids and their habitats would be similar to those described above for ESA-Listed Salmonids. Observation of the in-water work window would also minimize impacts to non-ESA-listed salmonids, including hatchery fish, due to their

infrequent occurrence during this work window, resulting in limited exposure to construction activities. However, due to the elevated noise during pile driving, construction of Alternative 4 would likely adversely affect habitat use, distribution, or migration of non-ESA-listed salmonids along the Bangor shoreline.

3.8.2.4.1.3 FORAGE FISH

Construction-related effects of Alternative 4 on NBK at Bangor marine habitats would be similar to those described for Alternative 1. Temporary increases of suspended solids during in-water construction (3 to 4 in-water work seasons) would not be high enough to adversely impact the spawning success of the nearest forage fish (sand lance) spawning habitat, at a distance of 375 feet. Pile driving activities would create underwater noise levels sufficient to injure or disturb fish present within the impact threshold zones during the period of construction (see Section 3.4.2.1.1). The total pile driving duration for Alternative 4 would be greater than for Alternative 1. Therefore, Alternative 4 would likely require more in-water work seasons than Alternative 1. Although impacts to forage fish spawning habitats would be negligible under both alternatives, forage fish would experience greater duration of construction-related impacts under Alternative 4 than under Alternative 1.

3.8.2.4.1.4 OTHER MARINE FISH SPECIES

Impacts to other marine fish species from the construction of Alternative 4 would be similar to those described for Alternative 1. However, differences include an increase in the total number of piles driven and pile driving duration compared to Alternative 1. As Alternative 4 requires much more nearshore construction compared to Alternative 1, disturbances to marine vegetation and benthic community habitats are also greater under Alternative 4 than under Alternative 1. For species that seasonally occur in nearshore habitats (e.g., shiner perch and juvenile English sole), Alternative 4 would have a greater impact to the function and availability of this habitat in the nearshore environment compared to Alternative 1.

3.8.2.4.1.5 ESSENTIAL FISH HABITAT

Impacts to EFH species and their habitats from the construction of Alternative 4 would be similar to those described for Alternative 1. However, differences include an increase in the total number of piles driven and pile driving duration compared to Alternative 1. Because Alternative 4 requires much more nearshore construction compared to Alternative 1, disturbances to nearshore marine vegetation and benthic community habitats would also be greater under Alternative 4 compared to Alternative 1. For EFH species that seasonally occur in nearshore habitats (e.g., starry flounder and juvenile English sole), Alternative 4 would have a greater impact to the function and availability of this habitat in the nearshore environment compared to Alternative 1. Based on these impacts, the Navy concludes that construction of the EHW-2 may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH.

3.8.2.4.2 OPERATION/LONG-TERM IMPACTS

Maintenance of the EHW-2 under Alternative 4 would have similar impacts to marine fish as Alternative 1.

3.8.2.4.2.1 THREATENED AND ENDANGERED MARINE FISH

ESA-LISTED HOOD CANAL SALMONIDS

Marine Salmonid Habitat Requirements

Water and Sediment Quality

Impacts to water and sediment quality from operations of Alternative 4 would be the same as for Alternative 1 (see Sections 3.2.2.4.2 and 3.3.2.4.2). This alternative would not have direct or indirect adverse impacts to water or sediment quality.

Physical Habitat

Overall operational impacts to nearshore currents and freshwater/saltwater mixing locations from the operation of Alternative 4 would be similar to Alternative 1. Alternative 4 also has a substantial increase in the total number of piles compared to Alternative 1 (up to 1,500 vs. up to 1,250). Additionally, within the juvenile salmon migratory pathway, Alternative 4 requires more nearshore piles than Alternative 1. The presence of Alternative 4 would shade 0.8 acre of nearshore habitat, compared to 0.4 acre under Alternative 1. Due to the increased number of piles in nearshore habitats under Alternative 4 compared to Alternative 1, juvenile salmonids would experience a greater modification of substrate conditions and associated nearshore refugia habitat conditions compared to Alternative 1. Juvenile salmonids migrating along the nearshore under Alternative 4 would also experience an increase in migrational barriers from the physical presence of the piles, as well as the overwater shade barrier due to the presence of the second trestle, compared to Alternative 1.

Biological Habitat

Alternative 4 has a slight increase in the total number of piles needed, but a substantial increase in nearshore habitat shaded by overwater structures and nearshore piles compared to the operational effects of Alternative 1. Shading of nearshore marine vegetation during operation of Alternative 4 would be increased compared to Alternative 1 due to the presence of the additional nearshore trestle (see Section 3.5.2.4.2). The permanent area of shading over the existing eelgrass bed would also be greater under Alternative 4 than Alternative 1. Because of the larger number of nearshore piles for this alternative, the impacts to prey availability in the nearshore migratory pathway of juvenile salmonids would be greater under Alternative 4 than Alternative 1.

Underwater Noise

Due to the same level of vessel and wharf activity under each alternative, underwater noise generated during operations, described in more detail for Alternative 1, would be the same for each alternative.

Summary of Impacts and ESA-Listed Salmonids Determination

The operation-related effects of Alternative 4 on marine habitats within NBK at Bangor would be similar to those described for Alternative 1. The differences that would affect these species, notably the increase in nearshore piles and shaded habitats, would neither increase nor decrease species level threshold or habitat effects. Therefore, the Navy concludes the appropriate effect determination for operation of Alternative 4 is “may affect, likely to adversely affect” for Puget Sound Chinook, Hood Canal summer-run chum salmon, and Puget Sound

steelhead. As bull trout are unlikely to occur within the action area, therefore, an effect determination of "may affect, not likely to adversely affect" is appropriate for bull trout. The Biological Opinion determinations for protected species and habitats issued by the Services are provided under Alternative 1 (Section 3.8.2.1). A description of the reasonable and prudent measures and terms and conditions from these opinions is provided in Section 3.8.2.7, Mitigation Measures and Regulatory Compliance.

ESA-Listed Salmonid Critical Habitat Evaluation

As mentioned for Alternative 1, although critical habitat occurs in northern Hood Canal waters adjacent to the base, NBK at Bangor is excluded from critical habitat designation for ESA-listed Puget Sound Chinook salmon and Hood Canal summer-run chum salmon by federal law (70 FR 52630). As no change to operational stressors is anticipated with the proposed, there would be no operational effect on Puget Sound Chinook or Hood Canal summer-run chum salmon critical habitat.

ESA-LISTED HOOD CANAL ROCKFISH

Similar to what was described in greater detail for the operation of Alternative 1, the operation of Alternative 4 would not result in adverse impacts to water quality or increase the prevalence of exotic species. Differences between Alternative 1 and 4 include the increased nearshore overwater shading under Alternative 4 compared to Alternative 1, and additional piles. It is currently unknown whether these nearshore habitats are used by ESA-listed rockfish as recruitment habitats. It is also unknown whether an increase in the number of piles and, therefore, structured habitat, would alter rockfish recruitment, competition, or predation in the project vicinity. However, this difference is considered insufficient to alter the effect determination on ESA-listed Hood Canal rockfish and their habitats determined for Alternative 1. Therefore, the Navy concludes the appropriate effect determination for operation of Alternative 4 is "may affect, likely to adversely affect" for bocaccio, canary rockfish, or yelloweye rockfish along the Bangor shoreline.

3.8.2.4.2.2 NON-ESA-LISTED SALMONIDS

Impacts described above for ESA-listed salmonids due to operation of Alternative 4 would apply to all salmonids. Therefore, operation of Alternative 4 would likely adversely affect the habitat use, distribution, or migration of non-ESA-listed salmonids along the Bangor shoreline.

3.8.2.4.2.3 FORAGE FISH

Alternative 4 would have a greater effect on forage fish than Alternative 1 due to the increase in the number of nearshore piles under Alternative 4 compared to Alternative 1 and increased nearshore habitat impacts. The nearest documented forage fish spawning sites to Alternative 4 piles are approximately 375 feet to the north of the site and 400 feet south of the site (Figure 3.8–5), so the operation of Alternative 4 would have little or no impact to forage fish spawning habitats or their reproductive success. However, as discussed for salmonids, a greater number of nearshore piles under Alternative 4 would increase the barrier for nearshore forage fish migration compared to Alternative 1. The effects of artificial lighting and underwater noise associated with operations would be similar to those described for Alternative 1. In addition, the localized distribution of the plankton (the primary forage fish food resource) would continue to occur at baseline levels in the project vicinity.

3.8.2.4.2.4 OTHER MARINE FISH SPECIES

Impacts to other marine fish species from the operation of Alternative 4 would be similar to those described for Alternative 1. However, one difference includes an increase in the number nearshore piles necessary, compared to Alternative 1. Although the total overwater area is similar between the two alternatives, Alternative 4 would result in much more nearshore shading (0.8 acre) than Alternative 1 (0.4 acre). For species that seasonally occur in nearshore habitats (e.g., shiner perch and juvenile English sole) Alternative 4 would have a greater impact to the function and availability of this habitat in the nearshore environment compared to Alternative 1.

3.8.2.4.2.5 ESSENTIAL FISH HABITAT

Operational impacts to EFH species and their habitats from the operation of Alternative 4 would be similar to those described for Alternative 1. However, one difference includes an increase in the number of nearshore piles necessary for Alternative 4 compared to Alternative 1. Although the total overwater area is similar between the two alternatives, Alternative 4 would result in much more nearshore shading (0.8 acre) than Alternative 1 (0.4 acre). For species that seasonally occur in nearshore habitats (e.g., starry flounder and juvenile English sole), Alternative 4 would have a greater impact to the function and availability of this habitat in the nearshore environment compared to Alternative 1. Based on these impacts, the Navy concludes that operations of the EHW-2 may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH.

3.8.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.8.2.5.1 CONSTRUCTION

3.8.2.5.1.1 THREATENED AND ENDANGERED MARINE FISH

ESA-LISTED HOOD CANAL SALMONIDS

Marine Salmonid Habitat Requirements

Water and Sediment Quality

Alternative 5 would require far fewer piles (up to 440 total) for the wharf than the other alternatives. As a result, the potential for construction-related impacts to water and sediment quality for Alternative 5 would be limited to short-term and localized changes and would be much less and of shorter duration than the other alternatives, with the exception of the No-Action Alternative. Sediment resuspension during construction of the trestles would be similar to but much shorter (135 to 175 days vs. 200 to 400 days) in duration than Alternative 1. Construction activities would not result in persistent increases in turbidity levels or cause changes that would violate water or sediment quality standards.

Physical Habitat

The construction of Alternative 5 would result in greater total overwater area (8.5 acres vs. 6.3 acres) and double the overwater area in the nearshore (0.8 acre vs. 0.4 acre) than Alternative 1. As a result, the construction of Alternative 5 would disturb approximately double the nearshore physical habitat than the construction of Alternative 1. Due to fewer total piles required for the offshore construction of the wharf, the duration and disturbance during in-water construction would be reduced. However, more piles would occur in the nearshore environment for Alternative 5 than for Alternative 1 (140 vs. 90). Although the pile driving duration would increase the potential barrier effect relative to existing conditions, this activity would occur

during the in-water work window, when salmonids are least abundant. Because the design for Alternative 5 includes more structures in the nearshore environment than Alternative 1, construction-related impacts to physical habitats in the nearshore juvenile salmonid migratory pathway would also be greater.

Biological Habitat

The greatest difference between the two alternatives occurs offshore, with Alternative 5 disturbing less total sea floor (0.04 acre) due to pile placement than Alternative 1 (0.2 acre). However, this difference is much farther offshore than juvenile salmon typically occur during their out-migration, and is expected to result in little difference in salmonid behavior between the two alternatives. In addition, the nearshore trestle design and construction of Alternative 5 would double the overwater area in the nearshore (0.8 acre vs. 0.4 acre) compared to Alternative 1. Shallow water habitats potentially disturbed during this nearshore construction are much greater for the construction of Alternative 5 (6.5 acres) than for Alternative 1 (3.7 acres). As a result, the construction-related impacts to the nearshore habitats used by juvenile salmonids and forage fish would also be greater. Therefore, Alternative 5 would have a greater, impact to nearshore habitats compared to Alternative 1.

Underwater Noise

Due to the required methods to install piles, underwater noise impact ranges for fish disturbance and injury for impact hammer and vibratory techniques would be the same, regardless of alternative. In addition, in-water construction activities for each alternative would be conducted during the allowable in-water work period, July 16 to February 15, to minimize the potential effects of construction of juvenile salmonids.

The greatest difference between alternatives, with respect to underwater noise effects on fish, is the number of piles driven, and the in-water construction duration. The Alternative 5 design requires fewer total piles (up to 440) than Alternative 1 (up to 1,250). As a result, Alternative 5 would only require 135 to 175 days over two in-water work seasons to complete pile driving compared to 200 to 400 days over 2 to 3 seasons for Alternative 1.

Summary of Impacts and ESA-Listed Salmonids Determination

The construction-related effects of Alternative 5 on NBK at Bangor marine habitats would be similar to those described for Alternative 1. As these minor differences would neither increase nor decrease species level threshold or habitat effects, the Alternative 5 effect determination on threatened and endangered fish species be the same as described for Alternative 1. Therefore, the Navy concludes the appropriate effect determination for construction of Alternative 5 is "may affect, likely to adversely affect" for Puget Sound Chinook, Hood Canal summer-run chum salmon, and Puget Sound steelhead. As bull trout are unlikely to occur within the action area, the Navy concludes an effect determination of "may affect, not likely to adversely affect" is appropriate for bull trout. The Biological Opinion determinations for protected species and habitats issued by the Services are provided under Alternative 1 (Section 3.8.2.1). A description of the reasonable and prudent measures and terms and conditions from these opinions is provided in Section 3.8.2.7, Mitigation Measures and Regulatory Compliance.

ESA-Listed Salmonid Critical Habitat Evaluation

As mentioned for Alternative 1, the only stressor that would reach waters within the nearshore marine area PCE designation for Puget Sound Chinook and Hood Canal summer-run

chum salmon critical habitat is underwater noise generated during pile driving. Underwater noise sufficient to result in behavioral disturbance, but not sufficient to cause injury, would extend beyond the bounds of NBK at Bangor restricted area, and thus into critical habitat for ESA-listed salmonids (see Section 3.4.2, Table 3.8–5, Figure 3.8–6).

The same mitigation measures described for Alternative 1 would be employed to minimize the effects of underwater noise from pile driving during construction of Alternative 5 (Section 3.8.2.7). Upon completion of construction, underwater noise would return to levels more consistent with existing conditions, well below the levels for behavioral disturbance of marine fish. Therefore, the Navy concludes that an effect determination of "may affect, likely to adversely affect" for Puget Sound Chinook and Hood Canal summer-run chum salmon critical habitat is appropriate.

ESA-LISTED HOOD CANAL ROCKFISH

Impacts to currents, water quality, and habitats during the construction of Alternative 5 would be similar to those described for Alternative 1. The greatest construction-related difference between the two alternatives is fewer piles; as a result, fewer pile driving days would be required for Alternative 5. However, these differences are insufficient to alter the effect determination on ESA-listed Hood Canal rockfish and their habitats determined for Alternative 1. Therefore, the Navy concludes the appropriate effect determination for construction of Alternative 5 is "may affect, likely to adversely affect" for bocaccio, canary rockfish, or yelloweye rockfish along the Bangor shoreline.

3.8.2.5.1.2 NON-ESA-LISTED SALMONIDS

Construction-related impacts to non-ESA-listed salmonids and their habitats would be similar to those described above for ESA-Listed Salmonids. Compliance with the established in-water work window would also minimize impacts to non-ESA-listed salmonids, including hatchery fish, due to their infrequent occurrence during this work window, resulting in limited exposure to construction activities. However, due to the elevated noise during pile driving, construction of Alternative 5 would likely adversely affect the habitat use, distribution, or migration of non-ESA-listed salmonids along the Bangor shoreline.

3.8.2.5.1.3 FORAGE FISH

The nearest identified forage fish spawning sites would not experience below standard water or sediment quality. The effects of artificial lighting on forage fish for Alternative 5 would be similar to those described for Alternative 1. Because the total number of piles for Alternative 5 is less than for Alternative 1, the number of days forage fish would experience elevated noise levels would similarly decrease. Therefore, although nearshore impacts to benthic and marine vegetation communities and documented forage fish spawning sites would be greater than Alternative 1, Alternative 5 would actually decrease the duration of potential forage fish exposure to underwater noise from pile driving.

3.8.2.5.1.4 OTHER MARINE FISH SPECIES

Impacts to other marine fish species from the construction of Alternative 5 would be similar to those described for Alternative 1. Differences include an increase in the total overwater area (8.5 vs. 6.3 acres) and a decrease in the total number of piles necessary, and duration of pile driving, compared to Alternative 1. Shallow water habitats potentially disturbed by the construction of Alternative 5 (6.5 acres) would be greater than for Alternative 1 (3.7 acres).

Therefore, other marine fish species that seasonally occur in nearshore habitats (e.g., shiner perch and juvenile English sole) during the in-water work window would experience an increase in the amount of nearshore disturbance during construction, although there would be a decrease in the total number of days of exposure to underwater sound.

3.8.2.5.1.5 ESSENTIAL FISH HABITAT

The majority of impacts to EFH species and their habitats from the construction of Alternative 5 would be similar to those described for Alternative 1. Differences include an increase in the total overwater area (2.2 acres) and a decrease in the total number of piles necessary (approximately 810 fewer) and duration of pile driving, compared to Alternative 1. Shallow-water habitats potentially disturbed by the construction of Alternative 5 (6.5 acres) would be greater than for Alternative 1 (3.7 acres). Therefore, during the in-water work window, EFH species that seasonally occur in nearshore habitats (e.g., starry flounder and juvenile English sole) would experience an increase in the amount of nearshore disturbance, although there would be a decrease in the total number of days of exposure to underwater sound. Based on these impacts, the Navy concludes that construction of the EHW-2 may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH.

3.8.2.5.2 OPERATION/LONG-TERM IMPACTS

Maintenance of the EHW-2 under Alternative 5 would have similar impacts to marine fish as Alternative 1.

3.8.2.5.2.1 THREATENED AND ENDANGERED MARINE FISH

ESA-LISTED HOOD CANAL SALMONIDS

Marine Salmonid Habitat Requirements

Water and Sediment Quality

The predicted operational impacts from Alternative 5 on nearshore water and sediment quality would be similar to those for Alternative 1 (see Sections 3.2.2.5.2 and 3.3.2.5.2).

Physical Habitat

Alternative 5 would result in greater total overwater area (8.5 acres vs. 6.3 acres) and double the overwater area in the nearshore (0.8 acre vs. 0.4 acre) compared to Alternative 1. As a result, the overall operational impacts to nearshore physical habitats from Alternative 5 would be greater than Alternative 1. The floating wharf would generally occur over waters with a depth greater than 60 feet. The effects of artificial lighting and underwater noise associated with operations would be similar to those described for Alternative 1. Therefore, the wharf itself would represent little barrier to nearshore migrating juvenile salmonids. The floating wharf and nearshore, trestle-supporting piles would represent little, if any, barrier to adult salmonids returning to spawn. Although Alternative 5 requires fewer piles for the offshore portion of the wharf than Alternative 1, there is an increase (140 vs. 90) in the number of piles in the nearshore juvenile salmonid migratory pathway. As a result, because of the increased number of structures in the nearshore design for Alternative 5 compared to Alternative 1, operational impacts to physical habitats in the nearshore juvenile salmonid migratory pathway would also be greater.

Biological Habitat

Since the nearshore trestle design of Alternative 5 would double the overwater area in nearshore habitats utilized by juvenile salmonids compared to Alternative 1 (0.8 acre vs. 0.4 acre), operational impacts to the nearshore benthic and aquatic vegetation communities used by juvenile salmonids would also be greater. Alternative 5 would shade 2.2 more acres of benthic habitat than Alternative 1 and the wharf would be floating rather than elevated, which would reduce light penetration beneath the structure. Operational impacts to eelgrass habitats would be similar between the two alternatives. Alternative 5 would result in greater losses of kelp (0.02 acre vs. 0 acre), green macroalgae (0.02 acre vs. 0.13 acre), and red macroalgae (0.06 acre vs. 0 acre) due to shading than Alternative 1. Since adult salmonids do not have the same dependence on these nearshore habitats for foraging and refuge as juvenile salmonids, adult fish would experience little, if any, adverse effects from the modification of nearshore biological habitats. However, the operational effects of Alternative 5 on nearshore habitats used by juvenile salmonids would be greater than Alternative 1.

Underwater Noise

Due to the same level of vessel and wharf activity under each alternative, underwater noise generated during operations, described in more detail for Alternative 1, would be the same for each alternative.

Summary of Impacts and ESA-Listed Salmonids Determination

The operation-related effects of Alternative 5 on NBK at Bangor marine habitats would be similar to those described for Alternative 1. The presence of the large floating wharf would increase the total overwater area relative to Alternative 1, even though the wharf generally occurs over habitats deeper than those used for juvenile salmonid migration. The greater footprint of the nearshore trestles, relative to Alternative 1, would correspondingly result in an increase in impacts to nearshore benthic and marine vegetation communities used by juvenile salmonids. Nevertheless, these differences would neither increase nor decrease species level threshold or habitat effects, and the Alternative 5 effect determination on threatened and endangered fish species would be the same as described for Alternative 1. Therefore, the Navy concludes the appropriate effect determination for operation of Alternative 5 is "may affect, likely to adversely affect" for Puget Sound Chinook, Hood Canal summer-run chum salmon, and Puget Sound steelhead. As bull trout are unlikely to occur within the action area, the Navy concludes an effect determination of "may affect, not likely to adversely affect" is appropriate for bull trout.

ESA-Listed Salmonid Critical Habitat Evaluation

As mentioned for Alternative 1, although critical habitat occurs in northern Hood Canal waters adjacent to the base, NBK at Bangor is excluded from critical habitat designation for ESA-listed Puget Sound Chinook salmon and Hood Canal summer-run chum salmon by federal law (70 FR 52630). As no change to operational stressors is anticipated with the proposed project, there would be no operational effect on Puget Sound Chinook or Hood Canal summer-run chum salmon critical habitat.

ESA-LISTED HOOD CANAL ROCKFISH

Similar to what was described in greater detail for the operation of Alternative 1, the operation of Alternative 5 would not result in adverse impacts to water quality or increase the prevalence of

exotic species. The biggest difference between the two alternatives with respect to rockfish is the smaller number of piles required to support Alternative 5. It is unknown whether the greater number of piles and, therefore, structured habitat required under Alternative 1 would alter rockfish recruitment, competition, or predation in the project vicinity. However, this difference is considered insufficient to alter the effect determination on ESA-listed Hood Canal rockfish and their habitats determined for Alternative 1. Therefore, the Navy concludes the appropriate effect determination for operation of Alternative 5 is "may affect, likely to adversely affect" for bocaccio, canary rockfish, or yelloweye rockfish along the Bangor shoreline.

3.8.2.5.2.2 NON-ESA-LISTED SALMONIDS

Impacts described above for ESA-listed salmonids due to operation of Alternative 5 would apply to all salmonids. Therefore, operation of Alternative 5 would likely adversely affect the habitat use, distribution, or migration of non-ESA-listed salmonids along the Bangor shoreline.

3.8.2.5.2.3 FORAGE FISH

Due to the nearshore location of Alternative 5, operational impacts to the nearshore benthic and aquatic vegetation communities used by forage fish are greater than Alternative 1. However, forage fish spawning sites occur sufficiently distant to remain unaffected by the operation of Alternative 5. The effects of artificial lighting and underwater noise associated with operations would be similar to those described for Alternative 1.

3.8.2.5.2.4 OTHER MARINE FISH SPECIES

Nearshore impacts to other marine fish species from the operation of Alternative 5 would be greater than for Alternative 1. The increase in the total overwater area occurs away from the shoreline, with the wharf generally occurring over habitats where water depths are greater than 60 feet. There would be an increase in the total number of trestle-supporting nearshore piles necessary, compared to Alternative 1. As mentioned above for salmonids, benthic and marine vegetation impacts due to the increased nearshore presence of the trestle would be greater under Alternative 5 than Alternative 1. Therefore, although other marine fish species of fish would experience fewer impacts due to fewer total piles under Alternative 5 relative to Alternative 1, they would experience a greater loss of nearshore habitats potentially used for juvenile rearing.

3.8.2.5.2.5 ESSENTIAL FISH HABITAT

Operational impacts to EFH species and their habitats from the operation of Alternative 5 would be similar in magnitude to those described for Alternative 1. The increase in the total overwater area and a decrease in the total number of piles necessary, compared to Alternative 1, occurs away from the shoreline. As mentioned above for salmonids, benthic and marine vegetation impacts due to the increased nearshore presence of wharf and trestle would be greater under Alternative 5 than Alternative 1. Therefore, although EFH species of fish would experience less of an impact due to fewer total piles under Alternative 5 relative to Alternative 1, they would experience a greater loss of nearshore habitats potentially used for juvenile rearing. Based on these impacts, the Navy concludes that operations of the EHW-2 may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH.

3.8.2.6 No-Action Alternative

There would be no construction or operation impacts to marine fish, EFH species, or their habitats under the No-Action Alternative. Therefore, there would be no impact to the marine fish or EFH communities.

3.8.2.7 Mitigation Measures and Regulatory Compliance

Mitigation measures developed to prevent adverse effects on marine vegetation habitats (see Section 3.5.2.7), benthic communities (see Section 3.7.2.7), and ESA-listed fish species (see above) sufficiently address concerns pertaining to the potential adverse effects on EFH species and their habitats. The following mitigation measures apply to marine fish and EFH species (measures identified below under ESA and MSA compliance are not repeated here):

- The pile driving contractor would use a mechanical soft-start approach to begin impact pile driving. This technique uses low hammer energy values to provide time for fish to hear the noise and react to it by moving away from the sound and avoiding injury. Each day impact pile driving occurs, a soft-start time of 20 to 30 minutes would initiate the activity. The soft-start procedure would also be repeated for any non-driving periods longer than 40 minutes.
- During construction, a vibratory pile driver would be used whenever possible to drive piles. An impact hammer would be used to proof load the piles to verify load bearing capacity and would not be used as the primary means to drive piles.
- The Mitigation Action Plan described in Appendix F would compensate for impacts of the EHW-2 to eelgrass, which is used by salmonids along the Bangor shoreline (see Section 3.5.2.7).
- The Mitigation Action Plan described in Appendix F would compensate for impacts of the EHW-2 to nearshore habitats used by marine fish along the Bangor shoreline.
- Mitigation measures developed to prevent adverse effects on marine vegetation habitats (see Section 3.5.2.7), benthic communities (see Section 3.7.2.7), and ESA-listed fish species (see above) sufficiently address concerns pertaining to the potential adverse effects on EFH species and their habitats.

The Navy submitted a biological assessment (NAVFAC 2011b) and EFH assessment (NAVFAC 2011a) in compliance with the ESA and MSA to both NMFS and USFWS. NMFS issued a Biological Opinion and EFH conservation recommendations on September 29, 2011. Marine fish species addressed by this opinion include: Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer-run chum salmon, and Puget Sound/Georgia Basin DPSs of yelloweye rockfish, canary rockfish, and bocaccio. In addition, the NMFS Biological Opinion addresses project-related effects on EFH as required by the MSA. USFWS issued a Biological Opinion on November 16, 2011. A summary of the details provided in the respective Biological Opinions is provided below.

3.8.2.7.1 ESA COMPLIANCE

3.8.2.7.1.1 REASONABLE AND PRUDENT MEASURES FROM NMFS BIOLOGICAL OPINION

"Reasonable and prudent measures" are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02). "Terms and conditions" implement the reasonable and prudent measures (50 CFR 402.14). These must be carried out for the exemption in Section 7(o)(2) to apply.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such

incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of ESA-listed salmonids and rockfish species:

- Reasonable and Prudent Measure 1: Minimize the incidental take of listed salmonid and rockfish species from the effects of pile driving.
- Reasonable and Prudent Measure 2: Ensure completion of a monitoring and reporting program to confirm that the take exemption for the proposed action is not exceeded, and that the terms and conditions in the incidental take statement (ITS) are effective in minimizing incidental take.

3.8.2.7.1.2 TERMS AND CONDITIONS FROM NMFS BIOLOGICAL OPINION

In order to be exempt from the prohibitions of Section 9 of the Act, the Navy must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

The following terms and conditions are required for the implementation of Reasonable and Prudent Measure 1:

1. Conduct all pile driving activities (vibratory and impact) during the following period: July 16 to February 15.
2. Utilize sound attenuation measure(s) (some type of bubble curtain) for all impact pile driving activities.
3. Ensure that sound levels, measured at mid-depth at 33 feet (10 meters) from the pile driving activity, do not exceed: (1) a cumulative SEL of 213 dB (re 1 μPa^2 sec) on any day of up to 35 days of impact pile driving; (2) a cumulative SEL of 208 dB (re 1 μPa^2 sec) on any day of up to 136 days of impact pile driving; (3) a cumulative SEL of 206 dB (re 1 μPa^2 sec) on any day of up to 2 days of impact pile driving; (4) a cumulative SEL of 205 dB (re 1 μPa^2 sec) on any day of up to 205 days of impact pile driving; and (5) a cumulative SEL of 201 dB (re 1 μPa^2 sec) on any day of up to 22 days of impact pile driving.

The following terms and conditions are required for the implementation of Reasonable and Prudent Measure 2:

1. Implement the Navy's final Acoustic Monitoring Plan. The Navy has not finalized their Acoustic Monitoring Plan. The Acoustic Monitoring Plan will include the submission of a report to NMFS regarding the results of acoustic monitoring.

If a sick, injured, or dead specimen of a threatened or endangered species is found in the action area, the finder must notify NMFS Law Enforcement at (206) 526-6133 or (800) 853-1964, through the contact person identified in the transmittal letter for this opinion, or through the NMFS Washington State Habitat Office. The finder must take care in handling sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder should carry out instructions provided by Law Enforcement to ensure evidence intrinsic to the specimen is not disturbed unnecessarily.

3.8.2.7.1.3 USFWS BIOLOGICAL OPINION

In their Biological Opinion, USFWS (2011) concurred that "the action's foreseeable direct and indirect effects to the bull trout, their habitat, and prey base are insignificant." Therefore, no reasonable and prudent measures or terms and conditions specific to bull trout were required.

3.8.2.7.2 MSA COMPLIANCE

3.8.2.7.2.1 ESA CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02). The following discretionary conservation measures proposed by NMFS (2011) are intended to assist the Navy in avoiding or minimizing the effects on listed species from this action and in fulfilling the Navy's legal obligation to conserve listed species and the ecosystems on which they depend:

1. NMFS recommends that the Navy investigate sound attenuation technologies that are potentially superior to current standard practices and use the best available underwater sound attenuation technology for any actions involving impact pile driving in the presence of ESA-listed species.
2. NMFS recommends that the Navy conduct weekly forage fish surveys, per WDFW guidance, along the beach of the project area from Marginal Wharf to the existing EHW beginning in late September of each in-water work window. And if forage fish eggs are found, NMFS recommends that the Navy not conduct any impact pile driving for that week.
3. The Navy has proposed to participate in an in-lieu fee (ILF) mitigation program to meet their requirements under the CWA. In the event that an ILF program is not established in Hood Canal in time for use as mitigation for the proposed action, other mitigation options will be considered. NMFS recommends that project(s) implemented as mitigation for the proposed action are selected from priority actions within the existing approved salmon recovery plans (Hood Canal Summer Chum Recovery Plan, Puget Sound Chinook Salmon Recovery Plan).

3.8.2.7.2.2 ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS

NMFS believes that the ESA reasonable and prudent measure limiting the effects of elevated sound levels on affected fish would be appropriately protective of their EFH. Therefore, NMFS (2011) incorporated the ESA terms and conditions as EFH conservation recommendations necessary to avoid, mitigate, or offset the impact of the proposed action on EFH. The EFH conservation recommendations are identical to those described above for Reasonable and Prudent Measure 1 in Section 3.8.2.7.1.2.

NMFS expects that full implementation of these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects, approximately 3,433 acres of designated EFH for Pacific coast salmon, Pacific coast groundfish, and coastal pelagic species.

3.8.2.7.3 NAVY RESPONSE

The Navy will comply with all non-discretionary findings (reasonable and prudent measures and terms and conditions) outlined in the NMFS (2011) Biological Opinion. Per Section 7 of the ESA, conservation recommendations are discretionary and not mandatory. However, if funding is available, forage fish surveys, as suggested in the NMFS ESA conservation recommendations, could be conducted to obtain better baseline survey information to support the NBK at Bangor natural resources program.

Impact pile driving will not cease if forage fish eggs are detected. If pile driving does not stay on schedule, an additional in-water work window would be required, which would result in a greater adverse effect on the species.

NMFS (2011) provided a list of MSA conservation recommendations that are a subset of the NMFS ESA terms and conditions on project construction. These recommendations will minimize project effects on EFH. The Navy has submitted a statutory response requirement (included in Appendix I of this FEIS) whereby the Navy agreed to conduct all recommendations, as proposed in the NMFS Biological Opinion, MSA Consultation section.

3.8.3 Summary of Impacts

Impacts to marine fish associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.8–6.

Table 3.8–6. Summary of Impacts to Marine Fish

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE FISH
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Temporary degradation of habitat (2 to 3 in-water work seasons); and pile driving impacts (200–400 pile driving days) (pile driving would only occur during approved in-water work windows when juvenile salmon are generally not present). Potential disturbance of up to 0.43 acre of eelgrass habitat. *Operation/Long-term Impacts:* Localized changes in fish habitat including barrier effect on juvenile migratory fish. *ESA:* The Navy concludes the appropriate effect determination for construction and operation is “may affect, likely to adversely affect” for Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, bocaccio, canary rockfish, and yelloweye rockfish. In their Biological Opinion, NMFS (2011) concluded that the project as proposed (Alternative 1) is not likely to jeopardize the continued existence of these species. The Navy concludes the appropriate effect determination for construction and operation is “may affect, not likely to adversely affect” for bull trout, but the proposed action would have no effect on bull trout critical habitat. In their Biological Opinion, USFWS (2011) concurred that the action's foreseeable direct and indirect effects on the bull trout, their habitat, and prey base are insignificant. The Navy concludes the appropriate critical habitat effect determination is “may affect, likely to adversely affect” for Puget Sound Chinook and Hood Canal summer-run chum salmon (critical habitat for Puget Sound steelhead has not been designated). In their Biological Opinion, NMFS (2011) concluded that the proposed action (Alternative 1) is not likely to adversely modify designated critical habitat for the Puget Sound Chinook salmon and Hood Canal summer-run chum salmon. Critical habitat has not been designated for the rockfish species. *EFH:* The Navy concludes that impacts from construction and operation may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH. NMFS (2011), in their MSA review, concluded that the proposed action (Alternative 1) may adversely affect each of the salmonid, groundfish, and coastal pelagic EFH. However, in this review NMFS (2011) included three conservation recommendations, a subset of the ESA take statement’s terms and conditions, to avoid, minimize, or otherwise offset potential adverse effects of the proposed project on EFH.

Table 3.8–6. Summary of Impacts to Marine Fish (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE FISH
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Temporary degradation of habitat; longer duration of such degradation and pile driving noise impacts than Alternative 1 due to more in-water pile driving days (275–550 vs. 200–400) and an additional in-water work season (3 to 4 vs. 2 to 3) (pile driving would only occur during approved in-water work windows when juvenile salmon are generally not present). Potential disturbance of up to 0.43 acre of eelgrass habitat. *Operation/Long-term Impacts:* Localized changes in fish habitat including barrier effect on juvenile migratory fish. *ESA:* The Navy concludes the appropriate effect determination for construction and operation is "may affect, likely to adversely affect" for Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, bocaccio, canary rockfish, and yelloweye rockfish. The Navy concludes the appropriate effect determination for construction and operation is "may affect, not likely to adversely affect" for bull trout, but this alternative would have no effect on bull trout critical habitat. The Navy concludes the appropriate critical habitat effect determination is "may affect, likely to adversely affect" for Puget Sound Chinook and Hood Canal summer-run chum salmon (critical habitat for Puget Sound steelhead has not been designated). Critical habitat has not been designated for the rockfish species. The Biological Opinion determinations for protected species and habitats issued by the Services are provided above in the summary for Alternative 1. *EFH:* The Navy concludes that impacts from construction and operation may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH. The Biological Opinion determinations for protected species and habitats issued by the Services are provided above in the summary for Alternative 1.

Table 3.8–6. Summary of Impacts to Marine Fish (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE FISH
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Temporary degradation of habitat; slightly longer duration of such degradation and pile driving noise impacts than Alternative 1 due to more in-water pile driving days (210–420 vs. 200–400) (pile driving would only occur during approved in-water work windows when juvenile salmon are generally not present). Potential disturbance of up to 0.49 acre of eelgrass habitat. *Operation/Long-term Impacts:* Compared to Alternative 1, greater impacts to shallow-water habitat including shallow-water shading (0.8 vs. 0.4 acre) and shading of algae. Slightly greater impacts to eelgrass (0.16 vs. 0.9 acre). Due to the increase in nearshore structures, there would be greater nearshore habitat impacts, including greater nearshore shading and migrational barriers than Alternative 1. *ESA:* The Navy concludes the appropriate effect determination for construction and operation is "may affect, likely to adversely affect" for Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, bocaccio, canary rockfish, and yelloweye rockfish. The Navy concludes the appropriate effect determination for construction and operation is "may affect, not likely to adversely affect" for bull trout, but this alternative would have no effect on bull trout critical habitat. The Navy concludes the appropriate critical habitat effect determination is "may affect, likely to adversely affect" for Puget Sound Chinook and Hood Canal summer-run chum salmon (critical habitat for Puget Sound steelhead has not been designated). Critical habitat has not been designated for the rockfish species. The Biological Opinion determinations for protected species and habitats issued by the Services are provided above in the summary for Alternative 1. *EFH:* The Navy concludes that impacts from construction and operation may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH. The Biological Opinion determinations for protected species and habitats issued by the Services are provided above in the summary for Alternative 1.

Table 3.8–6. Summary of Impacts to Marine Fish (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE FISH
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Temporary degradation of habitat; longer duration (290–570 vs. 200–400 days) of such degradation and in-water pile driving impacts than Alternative 1; an additional in-water work season (3 to 4 vs. 2 to 3) (pile driving would only occur during approved in-water work windows when juvenile salmon are generally not present). Potential disturbance of up to 0.49 acre of eelgrass habitat. *Operation/Long-term Impacts:* Compared to Alternative 1, greater impacts to shallow-water habitat including shallow-water shading (0.8 vs. 0.4 acre) and shading of algae. Slightly greater impacts to eelgrass (0.16 vs. 0.9 acre). Due to the increase in nearshore structures, there would be greater nearshore habitat impacts, including greater nearshore shading and migrational barriers than Alternative 1. *ESA:* The Navy concludes the appropriate effect determination for construction and operation is “may affect, likely to adversely affect” for Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, bocaccio, canary rockfish, and yelloweye rockfish. The Navy concludes the appropriate effect determination for construction and operation is “may affect, not likely to adversely affect” for bull trout, but this alternative would have no effect on bull trout critical habitat. The Navy concludes the appropriate critical habitat effect determination is “may affect, likely to adversely affect” for Puget Sound Chinook and Hood Canal summer-run chum salmon (critical habitat for Puget Sound steelhead has not been designated). Critical habitat has not been designated for the rockfish species. The Biological Opinion determinations for protected species and habitats issued by the Services are provided above in the summary for Alternative 1. *EFH:* The Navy concludes that impacts from construction and operation may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH. The Biological Opinion determinations for protected species and habitats issued by the Services are provided above in the summary for Alternative 1.

Table 3.8–6. Summary of Impacts to Marine Fish (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE FISH
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Temporary degradation of habitat; shorter duration of such degradation and pile driving impacts compared to Alternative 1 due to fewer in-water pile driving days (135–175 vs. 200–400) (pile driving would only occur during approved in-water work windows when juvenile salmon are generally not present). Potential disturbance of up to 0.67 acre of eelgrass habitat. *Operation/Long-term Impacts:* Compared to Alternative 1, greater impacts to shallow-water habitat including shallow-water shading (0.8 vs. 0.4 acre) and shading of algae. Same long-term impacts to eelgrass. Less offshore fish habitat would be affected in the vicinity of the wharf compared to Alternative 1 due to fewer piles. *ESA:* The Navy concludes the appropriate effect determination for construction and operation is "may affect, likely to adversely affect" for Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, bocaccio, canary rockfish, and yelloweye rockfish. The Navy concludes the appropriate effect determination for construction and operation is "may affect, not likely to adversely affect" for bull trout, but this alternative would have no effect on bull trout critical habitat. The Navy concludes the appropriate critical habitat effect determination is "may affect, likely to adversely affect" for Puget Sound Chinook and Hood Canal summer-run chum salmon (critical habitat for Puget Sound steelhead has not been designated). Critical habitat has not been designated for the rockfish species. The Biological Opinion determinations for protected species and habitats issued by the Services are provided above in the summary for Alternative 1. *EFH:* The Navy concludes that impacts from construction and operation may adversely affect salmonid and groundfish EFH, but would not adversely affect coastal pelagic EFH. The Biological Opinion determinations for protected species and habitats issued by the Services are provided above in the summary for Alternative 1.
No-Action Alternative	No impact.

Table 3.8–6. Summary of Impacts to Marine Fish (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE FISH
Mitigation: Under all alternatives, the Mitigation Action Plan (see Appendix F) would compensate for the impacts to aquatic resources. The following mitigation measures would reduce direct impacts to marine fish. • A bubble curtain or other noise attenuating device would be used for impact hammer pile driving. • A mechanical soft-start approach would be used when initiating impact and vibratory pile driving. • Other measures to prevent adverse effects on marine vegetation habitats (see Section 3.5.2.7), benthic communities (see Section 3.7.2.7), and ESA-listed fish species (see above) would minimize potential adverse effects on EFH species and their habitats.	
Consultation and Permit Status • The Navy submitted a biological assessment and EFH assessment. NMFS issued a Biological Opinion and EFH conservation recommendations on September 29, 2011. USFWS issued a Biological Opinion on November 16, 2011. A description of the reasonable and prudent measures and terms and conditions from these opinions is provided in Section 3.8.2.7, Mitigation Measures and Regulatory Compliance.	

3.9 MARINE MAMMALS

Marine mammals discussed in this section include species of several mammalian orders that are adapted to life in the marine environment. Cetaceans, including whales, dolphins, and porpoises, live exclusively in aquatic environments, whereas pinnipeds (seals and sea lions) rest and bear their young on marine shorelines. Other marine mammals such as sea otters and sirenians are not discussed in this section because they do not occur in the project area. Terrestrial mammals like river otters and mink that primarily occur in freshwater environments are discussed in Section 3.15, Wildlife.

The ESA (7 USC §36 and 16 USC §1531 et seq.) protects fish, wildlife, and plant species that are listed as threatened or endangered in the United States or elsewhere. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking or approving actions that may jeopardize listed species. The ESA also protects the designated critical habitat of listed species from adverse modification or destruction. NMFS is authorized to oversee compliance with the ESA for federally listed marine mammals. Marine mammal ESA species include Steller sea lions and southern resident killer whales, which could potentially occur in the vicinity of the EHW-2 project site (Table 3.9–1). The ESA also protects the designated critical habitat of listed species. The Navy submitted a biological assessment (NAVFAC 2011b) and consulted formally with NMFS under the ESA because the proposed action would potentially affect listed species. NMFS issued a Biological Opinion in September 2011 stating that the proposed action is not likely to jeopardize the continued existence of the Steller sea lion or adversely affect the southern resident killer whale. No ITS for marine mammals was included in the Biological Opinion because NMFS Headquarters has not yet authorized incidental take under the MMPA (see below). Following issuance of authorizations for marine mammals under the MMPA, NMFS may amend the ESA Biological Opinion to include an ITS for marine mammals.

The Marine Mammal Protection Act (16 USC 1361 et seq., as amended) places a moratorium on the taking and importation of all marine mammal species in the project area, including ESA-listed species, with provisions for allowing incidental take and other regulated takings (Table 3.9–2). The MMPA defines "take" as harass, kill, or capture, among other actions. NMFS administers the MMPA for all 10 of the species of cetaceans, seals, and sea lions that occur in the vicinity of the EHW-2 project site. An Incidental Harassment Authorization (IHA) or Letter of Authorization (LOA) may be issued for projects involving taking of marine mammals due to harassment. Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment) (50 CFR, Part 216 Subpart A, Section 216.3-Definitions). The Navy submitted an IHA application to NMFS in May 2011 and submitted several addenda to the application, the last of which was in December 2011. The proposed rule on the IHA application was published in the FR on December 21, 2011, for public comment, and the Navy is in consultation with NMFS over conditions of the authorization.

Consultation and Permit Compliance Status. The Navy submitted a biological assessment (NAVFAC 2011b) and consulted with NMFS in compliance with the ESA. NMFS issued a Biological Opinion for ESA-listed marine mammal species on September 29, 2011, but did not

include an ITS pending authorization of the proposed action under the MMPA. With regard to compliance with the MMPA, the Navy, has submitted an IHA application for the first year of construction, and will prepare and submit additional MMPA authorization applications to cover subsequent years of the project.

Table 3.9–1. Marine Mammals Historically Sighted in Hood Canal

SPECIES	STOCK(S)[1,2]	SEASON(S) OF OCCURRENCE	RELATIVE OCCURRENCE[3]
Harbor seal	Washington inland waters stock	Year-round; resident species in Hood Canal	Common
California sea lion	U.S. stock	Late summer to late spring (August – early June)	Common
Steller sea lion	Eastern U.S. stock	Late fall to late spring (October – mid April)	Common
Dall's porpoise	California/Oregon/ Washington stock	Year-round	Rarely present
Harbor porpoise	Washington inland waters stock	Year-round	Occasionally present
Killer whale	Eastern North Pacific Transient and Eastern North Pacific Southern Resident	Year-round	Transients: rarely present Residents: no sightings since 1995
Gray whale	Eastern North Pacific stock	Year-round	No recent sightings
Minke whale	California/Oregon/ Washington stock	Spring, summer, and fall	No recent sightings
Northern elephant seal	California breeding stock	Summer/fall	No recent sightings
Humpback whale	Eastern North Pacific stock	Spring/fall	An individual observed several times in Hood Canal beginning January 27, 2012. Otherwise, no recent sightings.

Sources: Osborne et al. 1988; Calambokidis and Baird 1994; Osmek et al. 1998; Jeffries et al. 2000; Jeffries 2006, personal communication; Laake 2006, personal communication; and NMFS marine mammal stock assessment reports (Carretta et al. 2007).

1. NMFS marine mammal stock assessment reports at: http://www.nmfs.noaa.gov/pr/sars/species.htm.
2. Inland waters of Washington State include: Strait of Juan de Fuca to Cape Flattery, San Juan Islands, Puget Sound, and Hood Canal.
3. Common: Consistently present either year-round (harbor seal) or during non-breeding season (California sea lion and Steller sea lion); Occasionally present: Documented at irregular intervals; Rarely present: sporadic sightings, not occurring on a yearly basis.

3.9.1 Existing Environment

Ten marine mammal species that have historically occurred within Hood Canal are listed in Table 3.9–1. Three of these species are federally listed under the ESA (southern resident killer whale, Steller sea lion, and humpback whale) (Table 3.9–2). California sea lions and harbor seals are the most prevalent species of marine mammals in the vicinity of the Bangor waterfront. Steller sea lions are seasonal visitors to the Bangor waterfront, but appear consistently in small numbers (maximum number observed was 6 individuals) during those times. Harbor porpoise are occasionally present in Hood Canal and transient stock killer whale and Dall's porpoise are rarely present. After a period of at least 15 years with no confirmed sightings of humpback whale in Hood Canal, an individual was observed in several locations including Dabob Bay several times during the week beginning January 27, 2012. This occurrence was likely a stray individual outside the normal range for this species in Washington inland waters; because this was an exceptional occurrence in Hood Canal, humpback whale was not carried forward in this analysis. Gray whale, minke whale, northern elephant seal, and southern resident stock killer whale could potentially occur in Hood Canal, but have not been confirmed in at least 15 years; therefore, gray whales, minke whales, and northern elephant seals have been excluded from further analysis. Southern resident killer whales, while not detected in Hood Canal since 1995, have been carried forward in the analysis because their primary prey items (i.e., salmonids) occur within Hood Canal and may be adversely affected by the proposed action.

Beginning in April 2008, Navy personnel have recorded sightings of marine mammals including California sea lion, Steller sea lion, and harbor seal during land-based observations at known sea lion haul-outs along the Bangor waterfront. In addition, boat-based opportunistic sightings along portions of the Bangor waterfront during the course of beach seine fish surveys during the spring/summer of 2007 detected two marine mammal species (harbor seal and California sea lion) (Agness and Tannenbaum 2009a). Boat-based protocol marine wildlife surveys conducted during July through September 2008 (12 surveys) and November through May 2009/2010 (12 surveys) (Tannenbaum et al. 2009a, 2011a) detected four marine mammal species (harbor seal, California sea lion, harbor porpoise, and Dall's porpoise). The Navy conducted marine mammal surveys during the Test Pile Program during late August to late October 2011, including surveys during pile driving activity in the vicinity of the existing EHW and baseline surveys in northern Hood Canal and Dabob Bay in the absence of pile driving. These surveys detected harbor seal, California sea lion, Steller sea lion, and harbor porpoise.

The following sections present more detailed information, including acoustics information and local occurrence records, for species that have been confirmed in Hood Canal. Other species that may potentially occur in Hood Canal are briefly described.

3.9.1.1 ESA-Listed Marine Mammal Species

Of the listed marine mammals (Table 3.9–2) that could potentially occur in Hood Canal, only the Steller sea lion has been observed near the EHW-2 project site. The humpback whale detected on January 27, 2012, in Hood Canal was an exceptional occurrence that was not carried forward in this analysis.

Table 3.9–2. Federally Listed Threatened and Endangered Marine Mammals Occurring or Potentially Occurring in Hood Canal

WILDLIFE	FEDERAL LISTING[1]	CRITICAL HABITAT	CRITICAL HABITAT AT BASE
Steller sea lion (Eastern DPS[1])	Threatened *55 FR 49204, November 26, 1990*	Designated *58 FR 45269, August 27, 1993*	No, closest critical habitat is at rookeries in southern Oregon
Southern resident killer whale	Endangered *70 FR 69903 November 18, 2005*	Designated (> 20 feet deep) *71 FR 69054 November 29, 2006*	No, closest critical habitat is 8.5 miles northeast of base

1. DPS = Distinct population segment that is discrete from other populations and important to its taxon. A group of organisms is discrete if it is "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, and behavioral factors" (DPS Policy; 61 FR 4722; February 7, 1996). Significance is measured with respect to the taxon (species or subspecies).

3.9.1.1.1 STELLER SEA LION

3.9.1.1.1.1 STATUS

The Steller sea lion was listed as threatened under the ESA in 1990 (55 FR 49204), and critical habitat was designated 3 years later (58 FR 45269). The Steller sea lion is distributed from Japan through the North Pacific, including the Aleutian Islands, central Bering Sea, Gulf of Alaska, southeast Alaska, and south to central California (55 FR 49204). In 1997, USFWS reclassified the Steller sea lion into distinct western and eastern population segments based on demographics and genetics, as authorized by NMFS (62 FR 30772). The eastern DPS remains on the threatened list (62 FR 30772), and includes the species' distribution in southeast Alaska and Canada (east of 144°West Longitude). There is no designated critical habitat for the species in Washington.

3.9.1.1.1.2 RANGE OF EASTERN DPS OF STELLER SEA LION

There are no known rookeries in Washington State, but eastern DPS Steller sea lions are present along the outer coast of Washington at four major haul-out sites year round (NMFS 2008a). These animals are most likely immature or non-breeding adults from rookeries in other areas (NMFS 2008a), which include the southern coastline of Vancouver Island. Steller sea lions are occasionally present in Puget Sound at the Toliva Shoals haul-out site in south Puget Sound (Jeffries et al. 2000) and a haul-out near Marrowstone Island (NMFS 2010). Along the Bangor waterfront, Steller sea lions were observed hauled out on submarines at Delta Pier occasionally from 2008 through 2010 during winter and spring months (Bhuthimethee 2008, personal communication; Navy 2010b).

3.9.1.1.1.3 POPULATION SIZE

The eastern DPS has continuously increased at an annual rate of 3 percent over the past 30 years. Angliss and Outlaw (2008) estimated the eastern DPS at 48,519 individuals. An update to this estimate (from approximately 58,334 to 72,223 individuals) was provided recently by Allen and Angliss (2011).

3.9.1.1.1.4 BEHAVIOR AND ECOLOGY

Steller sea lions occupy all marine water habitats for foraging and use manmade structures (jetties, buoys, rafts, floats and vessels (Jeffries et al. 2000, Navy 2010b) and natural sites (islands, rocky shorelines) for haul out. They are opportunistic predators, feeding primarily on

fish and cephalopods, and their diet varies geographically and seasonally (Merrick et al. 1997). Foraging habitat is primarily shallow, nearshore and continental shelf waters; rivers; and also deep waters (Reeves et al. 2008; Scordino 2010). All reported occurrences of Steller sea lions along the Bangor waterfront have been of animals hauled out on submarines, but it may be assumed that they also forage in surrounding waters. Their prey is not well documented in inland waters but they are expected to be opportunistic foragers similar to California sea lions.

3.9.1.1.1.5 ACOUSTICS

Like all pinnipeds, the Steller sea lion is amphibious; while all foraging activity takes place in the water, breeding behavior is carried out on land in coastal rookeries (Mulsow and Reichmuth 2008). On land, territorial male Steller sea lions regularly use loud, relatively low-frequency calls/roars to establish breeding territories (Schusterman et al. 1970; Loughlin et al. 1987). The calls of females range from 0.03 to 3 kHz, with peak frequencies from 0.15 to 1 kHz; typical duration is 1.0 to 1.5 sec (Campbell et al. 2002). Pups also produce bleating sounds. Individually distinct vocalizations exchanged between mothers and pups are thought to be the main way in which mothers reunite with their pups upon returning to crowded rookeries following foraging at sea (Mulsow and Reichmuth 2008).

Mulsow and Reichmuth (2008) measured the unmasked aerial hearing sensitivity of one male Steller sea lion. The range of best hearing sensitivity was between 5 and 14.1 kHz. Maximum sensitivity was found at 10 kHz, where the subject had a mean threshold of 7 dB re 20 µPa. The underwater hearing threshold of a male Steller sea lion was significantly different from that of a female. The peak sensitivity range for the male was from 1 to 16 kHz, with maximum sensitivity (77 dB re 1µPa-m) at 1 kHz. The range of best hearing for the female was from 16 to above 25 kHz, with maximum sensitivity (73 dB re 1µPa-m) at 25 kHz. However, because of the small number of animals tested, the findings could not be attributed to either individual differences in sensitivity or sexual dimorphism (Kastelein et al. 2005).

3.9.1.1.2 SOUTHERN RESIDENT KILLER WHALE

3.9.1.1.2.1 STATUS

Southern resident killer whales were listed as endangered under the ESA in 2005 (70 FR 69903), a recovery plan was approved in 2008 (73 FR 4176), and critical habitat was designated in 2006 (71 FR 69054). A combination of natural factors including ocean conditions, reductions in prey resources, disturbance from vessel traffic, and toxins most likely contributed to the whales' decline (NMFS 2008b). Critical habitat for the southern resident killer whale does not include Hood Canal (NMFS 2006), and NMFS has not confirmed any sightings of this whale stock in these waters since 1995 (NMFS 2008b). Ongoing genetic and morphological studies of Puget Sound killer whales indicate that southern resident killer whales are a distinct population. Although their geographic ranges overlap considerably with transient and northern resident killer whales, which inhabit the Strait of Georgia and coastal British Columbia, they appear not to associate or interbreed with the other killer whale populations (Ford et al. 2000).

3.9.1.1.2.2 RANGE OF SOUTHERN RESIDENT KILLER WHALE

The southern resident killer whale stock consists of three pods (J, K, and L) that reside primarily in Puget Sound, the Strait of Juan de Fuca, and the Strait of Georgia (British Columbia) during the spring, summer, and fall. Limited information on their winter distribution is available, but various pods have been observed in coastal waters off Vancouver Island, the mouth of the Columbia River, and as far south as Monterey Bay, California (Ford et al. 2000;

Krahn et al. 2004; Black 2011). Southern resident killer whales have not been seen in Hood Canal in over 15 years and are considered unlikely to occur at the project site.

3.9.1.1.2.3 POPULATION SIZE

In July 2010 the population consisted of 87 individuals (Center for Whale Research 2010). There have been no confirmed sightings of southern resident killer whales in Hood Canal since 1995 (Unger 1997; Bain 2006; NMFS 2006).

3.9.1.1.2.4 BEHAVIOR AND ECOLOGY

Unlike transient whales, which prey on marine mammals, southern residents consume primarily salmonids (especially Chinook salmon), Pacific halibut, rockfish species, and Pacific herring in inland waters (Ford and Ellis 2005; Hanson et al. 2010).

3.9.1.2 Non-ESA-Listed Marine Mammal Species

3.9.1.2.1 HARBOR SEAL

3.9.1.2.1.1 SPECIES RANGE

Harbor seals are the only species of marine mammal that is consistently abundant and considered resident in Hood Canal (Jeffries et al. 2003). The geographic distribution of harbor seals includes the U.S. west coast from Baja California north to British Columbia and coastal Alaska, including southeast Alaska, the Aleutian Islands, the Bering Sea, and the Pribilof Islands (Carretta et al. 2007).

3.9.1.2.1.2 POPULATION SIZE

Harbor seals are the most abundant marine mammal in Hood Canal (Jeffries et al. 2003). The population of harbor seals in Hood Canal is a closed population, meaning they do not have much movement outside of Hood Canal (London 2006). The abundance of harbor seals in Hood Canal has stabilized in recent decades, and the population may have reached its carrying capacity in the mid-1990s with an approximate abundance of 1,000 harbor seals (Jeffries et al. 2003).

3.9.1.2.1.3 BEHAVIOR AND ECOLOGY

Harbor seals have been observed swimming in the waters along NBK at Bangor in every month of surveys conducted from 2007 to 2010 (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a). Harbor seals use all marine habitats; the intertidal zone and manmade structures are used for haul-out activities, and subtidal nearshore marine, inland marine deeper water habitats, and the lower reaches of rivers are used for foraging (Reeves et al. 2008) (Table 3.9–3). The main haul-out locations for harbor seals in Hood Canal are located on river delta and tidal exposed areas at Quilcene, Dosewallips, Duckabush, Hamma Hamma, and Skokomish River mouths, with the closest haul-out area 10 miles southwest of NBK at Bangor at the Dosewallips River mouth (London 2006). The closest opportunistic haul-out location along the Bangor waterfront is the pontoons of the security fence close to Delta Pier, which is approximately 1 mile south of the existing EHW facility. Harbor seals have not been observed hauling out in the intertidal zone at the Bangor waterfront but have been observed hauled out on manmade structures such as the floating security fences, buoys, barges, vessels, and logs (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a).

Harbor seals mate at sea and females gave birth during the spring and summer; although the "pupping season" varies by latitude. In coastal and inland regions of Washington, pups are born

from April through January. Pups are generally born earlier in the coastal areas and later in the Puget Sound/Hood Canal region (Calambokidis et al. 1991; Jeffries et al. 2000). Suckling harbor seal pups spend as much as 40 percent of their time in the water (Bowen et al. 1999). On August 5, 2011, a harbor seal gave birth on the wavescreen dock at Carderock Pier, several miles south of the EHW-2 project site. This was the first documented birth at NBK at Bangor.

Harbor seals are opportunistic foragers and their diverse diet varies by location and season (review in NMFS 1997; Lance and Jeffries 2006, 2007; Luxa 2008). Their diet in Puget Sound includes many of the prey resources that are present in the nearshore and deeper waters of NBK at Bangor, including Pacific hake and Pacific herring, and adult and out-migrating juvenile salmonids. Harbor seals in Hood Canal are known to feed on returning adult salmon, including threatened summer-run chum, where the average percent escapement of summer-run chum consumed primarily by harbor seals over 5 years of study was 8 percent (London 2006).

3.9.1.2.1.4 ACOUSTICS

In the air, harbor seal males produce a variety of relatively low-frequency vocalizations, including snorts, grunts, and growls. Male harbor seals produce communication sounds in the frequency range of 100 to 1,000 Hz (Richardson et al. 1995). Harbor seals hear almost equally as well in air as underwater and had lower underwater sound detection thresholds at lower frequencies (below 64 kHz) than California sea lions (Kastak and Schusterman 1998). This difference is thought to make harbor seals more vulnerable to low-frequency manmade sounds such as ships and oil platforms. In air, harbor seals have functional hearing of frequencies from 75 Hz to 30 kHz (Southall et al. 2007) and are most sensitive from 6 to 16 kHz (Richardson 1995; Terhune and Turnbull 1995; Wolski et al. 2003).

Adult males also produce low frequency underwater grunts, growls, and roars during the breeding season that typically range up to 4 kHz (Hanggi and Schusterman 1994). In water, their functional hearing ranges from 75 Hz to 75 kHz, with peak sensitivities between 700 Hz and 20 kHz (Southall et al. 2007).

3.9.1.2.2 CALIFORNIA SEA LION

3.9.1.2.2.1 SPECIES RANGE

The geographic distribution of California sea lions includes a breeding range from Baja California to southern California. The non-breeding distribution extends from Baja California north to Alaska for males, and encompasses waters of California and Baja California for females (Reeves et al. 2008; Maniscalco et al. 2004). Female California sea lions do not migrate to the Pacific Northwest but remain year round in waters off the coast of California or Mexico (Jeffries et al. 2000). The primary California sea lion rookeries are located on the California Channel Islands of San Miguel and San Nicolas (Le Boeuf and Bonnell 1980; Bonnell and Dailey 1993). Adult and subadult male California sea lions migrate to Pacific Northwest waters as far north as Vancouver Island during the early fall and remain until late spring when most return to breeding rookeries in California and Mexico (Mate 1975; Jeffries et al. 2000; Lowry and Forney 2005).

3.9.1.2.2.2 POPULATION SIZE

An estimated 3,000 to 5,000 California sea lions migrate to Washington and British Columbia waters during the non-breeding season from September to May (Jeffries et al. 2000). Peak numbers of up to 1,000 sea lions occur in Puget Sound (including Hood Canal) during this time period (Jeffries et al. 2000). During the most recent aerial survey for population counts of

California sea lions within the inland waters of Washington State, no regular haul-out sites were documented to exist within Hood Canal (Jeffries et al. 2000). However, recent information, including observations by Navy personnel at the Bangor waterfront and from boat surveys for marine mammals along the waterfront, has documented that they haul out opportunistically at areas within Hood Canal.

3.9.1.2.2.3 BEHAVIOR AND ECOLOGY

A variety of haul-out substrates are used by California sea lions, from rocky outcrops to beaches, as well as manmade structures such as navigational buoys (Jeffries et al. 2000). On November 23, 2009, as many as 58 California sea lions were observed hauled out on manmade structures (submarines, the floating security fence, and barges) at the Bangor waterfront (Navy 2010b). California sea lions have also been observed swimming in Hood Canal in the vicinity of the EHW-2 project site on several occasions and likely forage in both nearshore marine and inland marine deeper water habitats. However, the closest opportunistic haul-out locations at the Bangor waterfront are the submarines docked at Delta Pier and the pontoons of the security fence in that vicinity, which are located approximately one mile south of the EHW-2 project site.

Like harbor seals, California sea lions are opportunistic foragers whose diet varies by season and location. In the greater Puget Sound region, California sea lions primarily prey on Pacific hake and Pacific herring (London 2006). In some locations where sea lions and salmon runs co-exist, California sea lions also feed on returning adult and out-migrating juvenile salmonids (review in London 2006).

3.9.1.2.2.4 ACOUSTICS

On land, California sea lions make raucous barking sounds, with most of the sound energy occurring at less than 2 kHz (Schusterman 1974). Males vary both the number and rhythm of their barks depending on the social context; the barks appear to control the movements and other behavior patterns of nearby conspecifics (Schusterman 1977). Females produce barks, squeals, belches, and growls in the frequency range of 0.25 to 5 kHz, while pups make bleating sounds at 0.25 to 6 kHz. California sea lions produce two types of underwater sounds: clicks (or short-duration sound pulses) and barks (Schusterman et al. 1966, 1967; Schusterman and Baillet 1969). All underwater sounds have most of their energy below 4 kHz (Schusterman et al. 1967).

California sea lions appear to be better adapted for in-air hearing than underwater hearing at frequencies below 64 kHz (Kastak and Schusterman 1998). The range of maximal hearing sensitivity underwater is between 1 and 28 kHz (Schusterman et al. 1972). Functional underwater high frequency hearing limits are between 35 and 40 kHz, with peak sensitivities from 15 to 30 kHz (Schusterman et al. 1972). The California sea lion shows relatively poor hearing at frequencies below 1 kHz (Kastak and Schusterman 1998). Peak hearing sensitivities in air are shifted to lower frequencies; the effective upper hearing limit is approximately 36 kHz (Schusterman 1974). The best range of sound detection is from 2 to 16 kHz (Schusterman 1974). Kastak and Schusterman (2002) determined that hearing sensitivity generally worsens with depth—hearing thresholds were lower in shallow water, except at the highest frequency tested (35 kHz), where this trend was reversed.

3.9.1.2.3 DALL'S PORPOISE

3.9.1.2.3.1 SPECIES RANGE

The geographic range of Dall's porpoises extends across the North Pacific Ocean from the U.S. border with Mexico, north to the Bering and Okhotsk Seas, and through the central North Pacific to the Sea of Japan in the east (Reeves et al. 2008). Dall's porpoises occur in temperate waters and are found in shelf, slope, and offshore habitats but may spend time at nearshore habitat during winter months (Reeves et al. 2008). The species occurs in Puget Sound (Osmek et al. 1995, 1998) but rarely occurs in Hood Canal (Jeffries 2006, personal communication). A Dall's porpoise was observed in deeper water along the Bangor shoreline in summer 2008 (Tannenbaum et al. 2009a). No Dall's porpoises were sighted during construction monitoring or baseline line transect surveys conducted in Hood Canal from late August to late October 2011 during the Test Pile Program.

3.9.1.2.3.2 POPULATION SIZE

The NMFS population estimate for the California/Oregon/Washington stock is the geometric mean of estimates from 2005 (Forney 2007) and 2008 (Barlow 2010), or 42,000 (coefficient of variation [CV]=0.33) animals (Carretta et al. 2011). Additional numbers of Dall's porpoise occur in the inland waters of Washington State but the most recent estimate obtained in 1996 (900 animals; CV=0.40) (Calambokidis et al. 1997) was not included in the overall estimate of abundance for this stock due to the need for more up-to-date information. The species is thought to have increased in Puget Sound and Hood Canal in recent years (Calambokidis 2010, personal communication).

3.9.1.2.3.3 BEHAVIOR AND ECOLOGY

Groups of Dall's porpoises generally include fewer than 10 individuals and are fluid in composition, probably aggregating for feeding (Jefferson 1990 and 1991; Houck and Jefferson 1999). Dall's porpoises become sexually mature at 3.5 to 8 years of age (Houck and Jefferson 1999) and give birth to a single calf after 10 to 12 months. Breeding in Puget Sound typically occurs in the spring and summer (Angell and Balcomb 1982). In the North Pacific, there is a strong summer calving peak from early June through August (Ferrero and Walker 1999), and a smaller peak in March (Jefferson 1990).

Dall's porpoises can be opportunistic feeders but primarily consume schooling forage fish. They are known to eat squid, crustaceans, and fishes such as eelpout, herring, pollock, whiting, and sand lance (Walker et al. 1998).

3.9.1.2.3.4 ACOUSTICS

Like the harbor porpoise, Dall's porpoise is a "high-frequency" cetacean; that is, its auditory range includes very high frequencies (estimated auditory bandwidth for this category is 200 Hz to 180 kHz) (Southall et al. 2007). Only short duration pulsed sounds have been recorded for Dall's porpoise (Houck and Jefferson 1999); this species apparently does not whistle often (Richardson et al. 1995). Dall's porpoises produce short duration (50 to 1,500 msec), high-frequency, narrow band clicks, with peak energies between 120 and 160 kHz (Jefferson 1988). There are no published data on the hearing abilities of this species.

3.9.1.2.4 HARBOR PORPOISE

3.9.1.2.4.1 SPECIES RANGE

Along the Pacific coast, this species occurs from Monterey Bay, California, north to the Aleutian Islands and west to Japan (Reeves et al. 2008). The harbor porpoise is a coastal species found in fjords, bays, estuaries, and harbors (Reeves et al. 2008), using nearshore marine and inland deeper water marine habitats. Harbor porpoises are known to occur in Puget Sound year round (Osmek et al. 1996, 1998; Carretta et al. 2007), and may be present anywhere in Hood Canal year round. A harbor porpoise was observed in deeper water along the Bangor shoreline in late spring 2010 (Tannenbaum et al. 2011a) within the Waterfront Restricted Area (WRA) in the vicinity of the existing EHW. Overall, these nearshore surveys indicated a low occurrence of harbor porpoise within the waters adjacent to the base. However, recent marine mammal surveys conducted during the Test Pile Program indicate that the abundance of harbor porpoises within Hood Canal in the vicinity of NBK at Bangor is much more robust than anticipated from previous surveys and anecdotal evidence (preliminary data). During these surveys, while harbor porpoise presence in the immediate vicinity of the base (i.e., within 1 kilometer [km]) remained low, harbor porpoises were frequently sighted within several kilometers of the base, mostly to the north or south of the project area, but occasionally directly across Hood Canal from the proposed EHW-2 project site, adjacent to the Toandos Peninsula.

3.9.1.2.4.2 POPULATION SIZE

Surveys from 2002 and 2003 for the inland waters stock of harbor porpoise yielded a corrected abundance estimate of 10,682 individuals (Carretta et al. 2011). Osmek et al. (1998) suggested harbor porpoise abundance in other inland waters of northern Washington and British Columbia (Strait of Juan de Fuca and San Juan Islands) had likely not declined over the past 5 years. A substantial decline in the abundance of harbor porpoise occurred in southern Puget Sound after the 1940s and no harbor porpoises were sighted during surveys in 1991 and 1994 in southern Puget Sound (Osmek et al. 1995, 1996). Harbor porpoise observations in northern Hood Canal have increased in recent years (Calambokidis 2010, personal communication). Based on observations during trackline transect surveys conducted to date as part of the Test Pile Program, harbor porpoise sightings in the deeper water of Hood Canal ranged from 0 to 11 individuals, with an average of approximately 6 animals sighted per day (preliminary data).

3.9.1.2.4.3 BEHAVIOR AND ECOLOGY

Harbor porpoises are usually seen in small groups of 2 to 5 animals. Little is known about their social behavior. Studies of this species in the Gulf of Maine showed that they mature at an earlier age, reproduce more frequently, and live for shorter periods than other toothed whales (Read and Hohn 1995). Females reach sexual maturity at 3 to 4 years and may give birth every year for several years in a row. Calves are born in late spring (Read 1990; Read and Hohn 1995). Dall's and harbor porpoises appear to hybridize relatively frequently in the Puget Sound area (Willis et al. 2004).

Harbor porpoises can be opportunistic foragers but primarily consume schooling forage fish (Osmek et al. 1996; Bowen and Siniff 1999; Reeves et al. 2008). Along the coast of Washington, they primarily feed on Pacific herring (C*lupea pallasii*), market squid, and smelts (Gearin et al. 1994).

3.9.1.2.4.4 ACOUSTICS

The harbor porpoise, like killer whales and Dall's porpoise, uses high-frequency sounds for echolocation, and lower frequency signals for social interactions (Southall et al. 2007). Harbor porpoise vocalizations include clicks and pulses with peak energy at frequencies from 120 to 140 kHz (Tyack and Clark 2000; Hansen et al. 2008). Electrophysiological tests of their hearing range showed that the high frequency range may be as great as 130 kHz (Bibikov 1992). Popov et al. (1986) found evidence for two frequency ranges of best sensitivity: 20–30 kHz and 120–130 kHz. More recent psycho-acoustic studies found the range of best hearing to be 16–140 kHz, with a reduced sensitivity around 64 kHz (Kastelein et al. 2002). Maximum sensitivity occurs between 100 and 140 kHz (Kastelein et al. 2002). Peak echolocation frequencies were in the range of 120–130 kHz (Bibikov 1992; Kastelein et al. 2002), which corresponds to their maximum hearing sensitivity range (100–140 kHz) (Kastelein et al. 2002).

3.9.1.2.5 TRANSIENT KILLER WHALE

3.9.1.2.5.1 SPECIES RANGE

The geographical range of the West Coast stock of transient killer whales includes the northeast Pacific, with a preference for coastal waters of southern Alaska and British Columbia (Krahn et al. 2002). This stock spends most of its time along the outer coast, but on occasion they enter inland waters of Washington and British Columbia. Transient killer whales were observed in Hood Canal in 2003 and 2005, but prior to these occurrences, transients were rarely seen in Hood Canal. The 2003 occurrence consisted of 11 killer whales seen for 59 days between January and March, and the 2005 event consisted of 6 killer whales seen for 172 days between January and June (London 2006).

3.9.1.2.5.2 POPULATION SIZE

The West Coast stock population size has been estimated through photographic datasets and is thought to include a minimum of 354 individuals (Allen and Angliss 2011). A recent mark-recapture estimate for the West Coast Transient population, excluding whales from California, resulted in an estimate of 243 (95 percent probability interval = 180–339) in 2006 (DFO 2009). This estimate applies to the population of West Coast Transient whales that occur in southeastern Alaska, British Columbia, and northern Washington (Allen and Angliss 2011). However, the number in Washington waters at any given time is probably fewer than 20 individuals (Wiles 2004).

3.9.1.2.5.3 BEHAVIOR AND ECOLOGY

Transient killer whales feed on marine mammals and some seabirds, but apparently do not consume fish, unlike southern resident killer whales (Morton 1990; Baird and Dill 1996; Ford et al. 1998, 2005; Ford and Ellis 1999). While present in Hood Canal, transient killer whales preyed on harbor seals in the subtidal zone of the nearshore marine and inland marine deeper water habitats (London 2006). Other observations of foraging transient killer whales indicate that they prefer to forage for pinnipeds in shallow, protected waters (Heimlich-Boran 1988; Saulitis et al. 2000).

3.9.1.2.5.4 ACOUSTICS

Killer whales produce several types of underwater sounds, including: (1) clicks used for echolocation, (2) highly variable whistles produced while whales socialize, and (3) pulsed signals generated at high repetition rates (Ford 1987). Both behavioral and auditory brainstem response measurements indicate they can hear in a frequency range of 1 to 100 kHz and are most

sensitive at 20 kHz. This is one of the lowest maximum-sensitivity frequencies known among toothed whales (Szymanski et al. 1999).

Killer whales are "mid-frequency" cetaceans; that is, their echolocation signals use a frequency range that is somewhat lower than some of the other odontocetes such as Dall's porpoise and harbor porpoise. Source levels of echolocation signals range between 195 and 224 dB re 1μPa-m peak-to-peak, with dominant frequencies ranging from 20 to 60 kHz (Au et al. 2004). Social signals generally use a lower frequency range. Whistles range from 1.5 to 18 kHz (dominant frequency range 6–12 kHz) (Richardson et al. 1995). Pulsed sounds have frequencies ranging from 0.5 to 25 kHz (dominant frequency range: 1–6 kHz) (Ford 1987; Richardson et al. 1995). The most abundant and characteristic sound type produced by killer whales is pulsed signals, which are highly repetitive and fall into distinctive structural categories (Ford 1987). These are referred to as discrete calls, and one of their potential functions may be to help whales maintain contact while they are out of sight of each other (Ford and Ellis 1999).

The discrete call repertoire of Pacific Northwest transients is smaller than the repertoire of resident whales, with only four to six calls, none of which is used by resident whales. Every transient group shares at least two discrete calls, and most have all calls in common (Ford and Ellis 1999), although some regional differences exist. The lack of a well-developed dialect system in transients (compared to residents) perhaps results from the fluidity of their social structure (Ford and Ellis 1999). Moreover, transients are far quieter than residents when foraging, suggesting that transients must remain relatively silent to avoid alerting their prey because marine mammals are highly sensitive to sounds in the frequency range of sonar clicks (Barrett-Lennard et al. 1996).

3.9.1.3 Marine Mammal Habitats

Habitats used by marine mammals in the vicinity of the EHW-2 project site include intertidal and subtidal zones of the nearshore marine, inland marine deeper water, and manmade structures (i.e., marine vessels, piers, wharves, and associated structures that are in marine waters), as described in Table 3.9–3.

3.9.1.3.1 NEARSHORE MARINE HABITAT

3.9.1.3.1.1 INTERTIDAL ZONE

Marine mammals that haul out of water on intertidal habitat are pinnipeds (seals and sea lions); all other marine mammals potentially occurring in Hood Canal remain in the subtidal zone of nearshore marine water and inland marine deeper water habitats. In Hood Canal, harbor seals, and to a lesser extent California sea lions, haul out on intertidal substrates, including river deltas and rocky outcrops (Jeffries et al. 2000). River deltas in Hood Canal are more accessible for haul-out activities at high tides, when greater numbers of harbor seals haul out (Huber et al. 2001; London et al. 2002). There are no river deltas near the EHW-2 project site, and neither harbor seals nor California sea lions have been observed hauled out on intertidal substrates in this area (Agness and Tannenbaum 2009a).

Table 3.9–3. Marine Mammal Habitats in the Vicinity of the Project Site

HABITAT TYPE		HABITAT VALUE	RELATIVE OCCURRENCE OF SPECIES WITHIN THE PROJECT AREA [1,2,3]
Nearshore Marine	**Intertidal Zone**	Areas within the intertidal zone provide haul-out sites for seals and sea lions. In Hood Canal, haul-out sites are primarily on river deltas, which occur outside the Bangor waterfront.	**Common:** California sea lion, Steller sea lion, harbor seal
	Subtidal Zone	The subtidal zone of nearshore marine waters in Hood Canal provides foraging habitat for seals, sea lions, and transient killer whales. May provide foraging benefits for other marine mammals that occasionally occur in the area.	**Common:** California sea lion, Steller sea lion, harbor seal **Occasionally Present:** Harbor porpoise **Rarely Present:** Transient killer whale, Dall's porpoise
Inland Marine Deeper Water		Same as Subtidal Zone of the Nearshore Marine.	**Common:** California sea lion, Steller sea lion, harbor seal **Occasionally Present:**,Harbor porpoise **Rarely Present:** Transient killer whale, Dall's porpoise
Manmade Structures		Manmade structures at and near the EHW-2 project site represent unique haul-out habitat for California sea lions, which are not known to haul out in groups elsewhere in Hood Canal.	**Common:** California sea lion, Steller sea lion, harbor seal

Sources: Jeffries et al. 2000; Johnson and O'Neil 2001; Jeffries 2007, personal communication; Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; Navy 2010b.

1. Common: Consistently present either year round (harbor seal) or during non-breeding season (California sea lion and Steller sea lion).
2. Occasionally Present: Documented in Hood Canal at irregular intervals.
3. Rarely Present: Sporadic sightings, not occurring on a yearly basis.

3.9.1.3.1.2 SUBTIDAL ZONE

Marine mammals occurring or potentially occurring at the Bangor waterfront use the subtidal zone of nearshore habitat to forage for food resources, which range from crustaceans and zooplankton (gray whale) to fish (other whales, porpoises, seals, and sea lions) or other marine mammals (i.e., transient killer whales primarily consumed harbor seals during their recent occurrences in Hood Canal [London 2006]). Fish consumed by marine mammals in the nearshore include migrating salmonids, forage fish, and other fish species of the nearshore community.

Habitat features in the subtidal zone (such as river mouths and adjacent estuarine habitat) and physical processes (such as eddies and upwelling) can spatially aggregate the forage resources of marine mammals (Hunt and Schneider 1987). For example, during the in-migration of adult salmonids, estuaries and river mouths provide relatively dense concentrations of salmonid prey for seals and sea lions (London et al. 2002; London 2006). Availability of forage resources for marine mammals in the subtidal nearshore is affected by time scales including time of day, season, and year. For example, the availability of prey that vertically migrate in the water column varies based on time of day. Additionally, forage fish are more available during the spawning season and salmonids are more available during periods of migration.

3.9.1.3.2 INLAND MARINE DEEPER WATER HABITAT

Food resources previously described for the subtidal zone of nearshore habitat (e.g., fish including salmonids, forage and demersal fish, and harbor seals) also occur in the inland marine deeper water habitat. The common marine mammals in the vicinity of NBK at Bangor (harbor seals and California sea lions) opportunistically consume forage resources in inland marine deeper water habitat. Aggregation of forage resources in inland marine deeper waters can be affected by the same processes described for nearshore marine habitat, generally, resulting in a patchy distribution of forage resources for marine mammals and marine birds (see Section 3.10, Marine Birds) across time and space (Hunt and Schneider 1987).

3.9.1.3.3 MANMADE STRUCTURES

A floating fence along the Bangor waterfront and docked submarines are used as haul-out sites by California sea lions, harbor seals, and Steller sea lions. Submarines intermittently dock at four of the overwater structures for service, and both Steller and California sea lions have been observed hauled out on the above-water portion of the submarines at Delta Pier during these times. As many as 40 California sea lions have been observed hauled out on docked submarines, the pontoons that support the floating security fence, and other structures (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a; Navy 2010b).

3.9.2 Environmental Consequences

The evaluation of impacts to marine mammals considers the importance of the resource (i.e., legal, recreational, ecological, or scientific); the proportion of the resource affected relative to its occurrence in the region; the particular sensitivity of the resource to project activities; and the duration of environmental impacts or disruption. Impacts to resources are critical if:

- Habitats of high concern are adversely affected over relatively large areas;
- Disturbances to small, essential habitats would lead to regional impacts to a protected species; or
- Disturbances harass or impact the ability of species to acquire resources and ultimately impact the abundance or distribution of federally listed threatened or endangered species.

Both permanent habitat loss and temporary disturbance due to construction are concerns, as is continued or progressive habitat degradation.

In particular, underwater pile driving noise during the construction period has the potential to disrupt marine mammal foraging, resting, and transit in the vicinity of the EHW-2 during construction. The zone of impact due to construction noise is described in following sections. Other impacts to marine mammals such as changes in prey availability are anticipated to be highly localized to the construction area.

Impacts from operation of the EHW-2 include human activity over a larger area that is currently undeveloped and changes in prey availability at the site of the EHW-2. Operational impacts to marine mammals are anticipated to be highly localized to the EHW-2 site. Marine mammals are wide-ranging and have suitable habitat available along the Bangor waterfront and elsewhere in Hood Canal, relative to the area that might be impacted by operation of the EHW-2. Moreover, species documented in waterfront surveys along the Bangor shoreline appear to be capable of habituating to human activity. Although individuals may be affected by operations at the EHW-2, no significant impacts to marine mammal populations in Hood Canal are expected.

3.9.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

Construction of the EHW-2 would directly impact marine mammals primarily through underwater noise generated by pile driving. Underwater noise thresholds for behavioral disturbance and hearing-related injury impacts would be exceeded, as described below, with potential adverse impacts (takes) as defined by the MMPA.

Direct impacts from operation of the EHW-2 would include elevated underwater noise levels, increased human activity, and noise at the EHW-2. Long-term indirect impacts would result from localized changes in benthic prey population composition (see Section 3.7.2.1.2) and marine fish populations (see Section 3.8.2.1.2). Impacts to marine mammals from operation of this alternative are anticipated to be highly localized because marine mammals are wide-ranging and have a large foraging habitat available in Hood Canal, relative to the foraging area that might be impacted by operation of the EHW-2.

3.9.2.1.1 CONSTRUCTION

The primary impacts to marine mammals from construction of the EHW-2 would be associated with water quality changes (turbidity) in nearshore habitats, noise associated with impact and vibratory pile driving and other construction equipment, construction vessel traffic, and changes in prey availability. Since harbor seals are resident in Hood Canal, they would be present during the entire proposed construction season for the EHW-2. California sea lions are present from late summer (August) to late spring (June), which would overlap with 6 of the 7 months of in-water construction work. Steller sea lions are present from late fall (October) to spring (mid-April), which would overlap with approximately 4.5 months (October to February 15) of the 7 months of in-water construction work. Marine mammals are likely to avoid (indicating behavioral disturbance) the immediate vicinity of pile driving. The likelihood of adverse impacts to these species would be minimized through application of mitigation measures described in Section 3.9.2.7.

The following sections describe how each of these factors would impact abundance and distribution of marine mammals present or potentially present at the Bangor waterfront during construction.

3.9.2.1.1.1 WATER QUALITY

The construction corridor used in the analysis of effects to the seafloor (150 feet) is described in Section 3.1.2.1.1, Hydrography. Water quality would be impacted during tug and barge operations and installation of new piles because bottom sediments would be temporarily resuspended, as described in Section 3.2.2.1.1.3, Turbidity. Resuspended sediments would increase turbidity and reduce DO periodically during in-water construction activities, as discussed for water quality impacts in Section 3.2.2.1.1. The quantity and settling speed of resuspended sediments reflect the composition of sediments; in general, sediments at the EHW-2 project site are coarse-grained and are more resistant to resuspension and have a higher settling speed than fine-grained sediments. Calculations of sediment dispersion distance, using worst-case current velocity and residence time of sediment particles, indicate a likely spread of up to approximately 130 feet (see Section 3.2.2.1.1.3, Turbidity).

Re-suspended sediments could potentially include metals and organic contaminants that may be present in marine sediments. Sediment quality sampling was conducted at the EHW-2 project site during 2007 pursuant to guidelines established by the Washington State SMS (WAC 173-204) (Hammermeister and Hafner 2009). Sediment sampling included tests for a

large number of heavy metals, polycyclic aromatic hydrocarbons, chlorinated aromatics, pesticides, polychlorinated biphenyls (PCBs), and other compounds listed under the SMS. Sediment sampling at the EHW-2 project site indicated that sediment quality is generally good, and that levels of contaminants meet applicable state standards (see Section 3.3.1.2, Metals, and Section 3.3.1.3, Organic Contaminants) (Hammermeister and Hafner 2009). Thus, marine mammals exposed to resuspended sediments resulting from EHW-2 in-water construction are not likely to be impacted by contaminants.

The activities that generate suspended sediments would be short-term and localized and suspended sediments would disperse and/or settle rapidly. Moreover, marine mammals are expected to avoid the immediate construction area due to increased vessel traffic, noise and human activity, increased turbidity, and difficulty in finding prey. Therefore, no direct impacts to marine mammals are expected due to changes in water quality during construction.

3.9.2.1.1.2 VESSEL TRAFFIC

Vessel movements have the potential to affect marine mammals directly by accidentally striking or disturbing individual animals. For example, several studies have linked vessels with behavioral changes in killer whales in Pacific Northwest inland waters (Kruse 1991; Kriete 2002; Williams et al. 2002; Bain et al. 2006), although it is not well understood whether the presence and activity of the vessel, the vessel noise, or a combination of these factors produces the changes. It seems likely that both noise and visual presence of vessels play a role in prompting reactions from these animals. The probability and significance of vessel and marine mammal interactions is dependent on several factors including numbers, types, and speeds of vessels; the regularity, duration, and spatial extent of activities; and the presence/absence and density of marine mammals.

Behavioral changes in response to vessel presence include avoidance reactions, alarm/startle responses, temporary abandonment of haul outs by pinnipeds, and other behavioral and stress-related changes (such as altered swimming speed, direction of travel, resting behavior, vocalizations, diving activity, and respiration rate) (Watkins 1986; Würsig et al 1998; Terhune and Verboom 1999; Ng and Leung 2003; Foote et al. 2004; Mocklin 2005; Bejder et al. 2006; Nowacek et al. 2007). Some dolphin species approach vessels and are observed bow riding or jumping in the wake of a vessel (Norris and Prescott 1961; Shane et al 1986; Würsig et al. 1998; Ritter 2002). In other cases neutral behavior (i.e., no obvious avoidance or attraction) has been reported (review in Nowacek et al. 2007). Little is known about the biological importance of changes in marine mammal behavior under prolonged or repeated exposure to high levels of vessel traffic, such as increased energetic expenditure or chronic stress, which can produce adverse hormonal or nervous system effects (Reeder and Kramer 2005).

Marine mammals at the Bangor waterfront encounter vessel traffic associated with daily operations, maintenance, and security monitoring along the waterfront, and it is assumed that individuals that frequent the waterfront have habituated to existing levels of vessel activity. During construction of the EHW-2, several additional vessels would operate in the project area, including one derrick barge and one pile barge for pile driving, and one derrick barge and two material barges for deck construction (see Section 2.2.2), tug boats that would move barges into position, and small supporting boats. At any given time, there would be no more than two tugs and six smaller boats, plus barges as a result of construction activities. These vessels would operate at low speeds within the relatively limited construction zone and access routes during the in-water construction period. Low speeds are expected to reduce the impact of boat movements

in the construction zone during this period. Marine vessel traffic would potentially pass near marine mammals on an incidental basis, but short-term behavioral reactions to vessels are not expected to result in long-term impacts to individuals (such as chronic stress), or to marine mammal populations in Hood Canal.

Collisions of vessels and marine mammals, primarily cetaceans, are not expected during construction because vessel speeds would be low. All of the cetaceans likely to be present in the project area are fast-moving odontocete species that tend to surface at relatively short, regular intervals allowing for increased detectability and avoidance. Vessel impacts are more frequently documented in slower-moving cetaceans or those that spend extended periods of time at the surface, but these species are rarely encountered in Hood Canal (Section 3.9.1).

3.9.2.1.1.3 PREY AVAILABILITY

The prey base for the most common marine mammal species (harbor seal and California sea lion) in the project area includes a wide variety of small fish such as Pacific hake, Pacific herring, and juvenile salmonids, as well as adult salmonids, when available. Steller sea lions in the project area probably consume pelagic and bottom fish. Dall's porpoise and harbor porpoise are also occasionally seen in Hood Canal, where they probably feed on schooling forage fishes, such as Pacific herring, smelts, and squid. Transient killer whales consume marine mammals; in Hood Canal they prey on harbor seals. Southern resident killer whales do not occur in Hood Canal, but consume salmonids (with a strong preference for Chinook salmon) that originate in Hood Canal tributaries.

Impacts to prey availability for fish-eating marine mammals due to construction activities are discussed in detail for benthic communities (see Section 3.7.2.1.1) and marine fish (see Section 3.8.2.1.1). The greatest impacts to prey species during construction would result from benthic habitat displacement, resuspension of sediments, and behavioral disturbance due to pile driving noise. Injury and behavioral disturbance of fish species due to underwater pile driving noise would directly affect the prey base for marine mammals. Fish potentially would be disturbed by pile driving noise resulting from concurrent operation of vibratory and impact rigs within 11,024 feet of the centroid of pile driving noise (Section 3.8.2.1.1) but may actually avoid a much smaller area, as described in Section 3.8.2.1.1.1. Thus, prey availability within an undetermined portion of the impact zone for fish would be reduced during construction due to noise. Mitigation measures designed to minimize this effect are described in Section 3.8.2.7.

Anchoring of construction barges, propeller wash, and pile driving would locally displace or disturb benthic habitats and increase turbidity, while construction of decking would shade marine vegetation in the immediate project vicinity. All of these actions would indirectly affect marine mammals by degrading foraging and refuge habitat quality for prey species and reducing their invertebrate and forage fish prey base. In addition to impacts on the biological productivity of benthic organisms, construction would reduce the extent and degrade the quality of marine vegetation, adversely affecting availability of marine fish prey populations for marine mammals. Construction impacts to benthic habitats reflect the size of the construction zone. With Alternative 1, construction is expected to displace or disturb up to 25.7 acres of benthic habitat, including 1.0 acre of marine vegetation (primarily eelgrass beds and algae, but also a small portion of kelp beds) as described in Section 3.5.2.1, Marine Vegetation, Environmental Consequences.

Some of these effects described above, such as barge placement, increased turbidity, and pile driving noise would occur only during the in-water construction period and thus would be temporary (7 months for each of the 2 to 3 in-water work seasons) and localized. Long-term

effects on prey availability are described below in Section 3.9.2.1.2, Marine Mammals, Operation/Long-term Impacts.

While localized effects of project construction may affect the prey base of pinnipeds that occur in the project vicinity, in the overall context of the Hood Canal harbor seal and California sea lion populations, the affected area is too small to represent a significant adverse impact. With respect to the southern resident killer whale, the project has the potential to affect this population by indirectly affecting its prey base, which includes a disproportionate number of adult Chinook (Ford et al. 1998, 2010; Hanson et al. 2010). Available information on the proportion of Hood Canal Chinook salmon in the diet of southern resident killer whales indicates that it is about 20.4 percent in May (however, this is based on a sample size of 9), but less than 5 percent in other months (June to September) for which data are available. Adult Hood Canal Chinook salmon returns are subject to many variables, among which the effects of the EHW-2 are likely to be minor. Mitigation efforts, including scheduling in-water construction for the period when juvenile Chinook salmon are not present, and using a bubble curtain for impact pile driving, would minimize this potential adverse effect. Therefore, the project's effect on southern resident killer whale prey base would be insignificant, and not likely to adversely affect southern resident killer whales.

3.9.2.1.1.4 UNDERWATER NOISE

AMBIENT NOISE

Average underwater noise levels measured along the Bangor waterfront are elevated over ambient conditions due to waterfront operations, but are within the minimum and maximum range of measurements taken at similar environments within Puget Sound (see Section 3.4.1.1, Underwater Sound Levels). Existing underwater noise levels measured along the Bangor waterfront were measured at 114 dB re 1µPa (Slater 2009). Vessel noise includes narrowband tones at specific frequencies and broadband sounds with energy spread over a range of frequencies. Smaller vessels that would be used in construction tend to generate low-frequency noise below 5 kHz; for example, tugs operating barges generate sounds from 1 kHz to 5 kHz, and small crewboats generate strong tones up to several hundred Hz (Richardson et al. 1995).

As discussed in Section 3.4.2.1, underwater noise would be generated by construction support vessels, small boat traffic, and barge-mounted equipment such as cranes and generators, but the noise from these sources would not exceed existing underwater noise levels associated with routine operations along the Bangor waterfront (see Section 3.4.1.1). Underwater noise associated with pile driving activities (up to 1,250 permanent and 150 temporary piles) is likely to cause the most significant impacts to marine mammals present during construction of the EHW-2. Construction of Alternative 1 would result in increased underwater noise levels due to impact and vibratory pile driving. Piles would be installed primarily with a vibratory driver, with additional proofing of piles by an impact hammer. Vibratory pile driving of 48-inch steel piles would produce noise levels of approximately 180 dB_{RMS} re 1 µPa at 33 feet in the absence of noise mitigation devices. Impact pile driving using a single-acting diesel impact hammer would produce peak underwater noise levels of 210 dB_{PEAK} re 1 µPa and average RMS levels of 195 dB_{RMS} re 1 µPa at a distance of 33 feet from the pile in the absence of noise mitigation devices (see Section 3.4.2.1). Sound from impact pile driving would be detected above the average background noise levels at any location in Hood Canal with a direct acoustic path (i.e., line-of-sight from the driven pile to receiver location). Locations that have an intervening land mass would experience lower noise levels from pile driving. Most of the energy in pile driving sound underwater is contained in the

frequency range 25 Hz and 1.6 kHz, with the highest energy densities between 50 and 350 Hz (Reyff et al. 2002). In some studies, underwater pile driving noise has been reported to range up to 10 kHz with peak amplitude below 600 Hz (Laughlin 2005b). As described in Section 3.4.2.1, a noise attenuation device (bubble curtain) that reduces sound levels by 10 dB would be used for impact pile driving. Other mitigation measures for underwater pile driving noise, including a soft-start approach[7] to pile driving operations and marine mammal monitoring during pile driving, are described in Section 3.9.2.7.3 and the Mitigation Action Plan (Appendix F).

The access trestles and wharf would require approximately 1,250 hollow steel piles ranging from 24 inches to 48 inches. Most pile driving would be done during the first construction season, with lesser amounts in the following two seasons. Three construction seasons are assumed for Alternative 1, with overall project construction lasting 42 to 48 months.

SUSCEPTIBILITY OF MARINE MAMMALS TO UNDERWATER PILE DRIVING NOISE

Noise level (dB) and frequency (Hz) can affect the susceptibility of marine mammals to noise impacts. Functional hearing ranges and peak sensitivity ranges vary by species, as described in Section 3.9.1.1 and Section 3.9.1.2. Peak sensitivity of most marine mammal species that are present in Hood Canal is higher than the frequency range containing the greatest energy produced by impact pile driving. Nonetheless, pile driving noise is well within the functional hearing ranges of these marine mammals, and all of these species would be susceptible to auditory effects of underwater pile driving noise.

PHYSIOLOGICAL IMPACTS OF NOISE

Marine mammals are susceptible to physiological impacts from noise exposure including temporary or permanent loss of hearing sensitivity, or other physical injuries (Ketten 1995, 2000, 2004; Wartzok and Ketten 1999). Injury could consist of permanent hearing loss, referred to as permanent threshold shift (PTS), or other tissue damage. This type of injury has not been documented for pile driving or other construction-related noises because it is not feasible to measure pre- and post-exposure audiograms of individuals at construction sites. Temporary loss of hearing sensitivity, referred to as temporary threshold shift (TTS), has been documented in controlled settings using captive marine mammals exposed to strong SELs at various frequencies (Ridgway et al. 1997; Kastak et al. 1999; Finneran et al. 2005), but it has not been documented in wild marine mammals exposed to pile driving.

No physiological impacts are expected from pile driving operations occurring during construction of the EHW-2 for several reasons. First, vibratory pile driving, which is the primary installation method, does not generate high enough peak SPLs to produce physiological damage. Additionally, the noise attenuation devices that the Navy would employ (see Section 3.4.2.1) would greatly reduce the chance that a marine mammal may be exposed to SPLs that could cause physical harm. During impact pile driving, the Navy would employ a bubble curtain to attenuate initial SPL. Moreover, the Navy will have trained biologists monitoring a shutdown zone

[7] Soft starts for vibratory drivers require initial starts of 15 seconds at reduced energy followed by a 30-second waiting period. This measure shall be repeated two additional times. Soft starts for impact hammers shall be one dry fire followed by a 30-second waiting period. This procedure shall be repeated two additional times. The sequence of the soft-start procedures includes a minor deviation from those typically requested by the NMFS which utilize a longer waiting period (one minute vs. 30 seconds). The Navy consulted with NMFS regarding using a shorter waiting period (i.e. 30 seconds) and the Service found the Navy's reasoning to be valid and accepted the requested modification.

equivalent to the potential physiological injury zone (described in the Mitigation Action Plan (Appendix F) to reduce the potential for injury of marine mammals.

BEHAVIORAL RESPONSES TO NOISE

Behavioral responses to sound are highly variable and context specific. For each potential behavioral change, the magnitude of the change ultimately determines the severity of the response. A number of factors may influence an animal's response to noise, including its previous experience, its auditory sensitivity, its biological and social status, including age and sex, and its behavioral state and activity at the time of exposure. Characteristics of the noise, such as duration and whether the sounds start suddenly or gradually, play a role in determining the animal's response. Habituation occurs when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok et al. 2004). Animals are most likely to habituate to sounds that are predictable and unvarying. The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. Behavioral state may affect the type of response as well. For example, animals that are resting may show greater behavioral change in response to disturbing noise levels than animals highly motivated to remain in an area for feeding (Richardson et al. 1995; NRC 2003; Wartzok et al. 2004). Indicators of disturbance may include sudden changes in the animal's behavior or avoidance of the affected area. A marine mammal may show signs that it is startled by the noise and/or it may swim away from the sound source and avoid the area. Increased swimming speed, increased surfacing time, and cessation of foraging in the affected area would indicate disturbance or discomfort. Pinnipeds may increase their haul-out time, possibly to avoid in-water disturbance.

Controlled experiments with captive marine mammals showed pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway et al. 1997; Finneran et al. 2003). Observed responses of wild marine mammals to loud sound sources (typically seismic guns or acoustic harassment devices) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds 2002; also see reviews in Gordon et al. 2004; Wartzok et al. 2004; and Nowacek et al. 2007). Some studies of acoustic harassment and acoustic deterrence devices have found habituation in resident populations of seals and harbor porpoises (see review in Southall et al. 2007). Blackwell et al. (2004) found that ringed seals exposed to underwater pile driving sounds in the 153–160 dBRMS range tolerated this noise level and did not seem unwilling to dive. One individual was as close as 63 meters (207 feet) from the pile driving. Responses of two pinniped species to impact pile driving at the San Francisco-Oakland Bay Bridge East Span Seismic Safety Project were mixed (CALTRANS 2001, 2006, 2010). Harbor seals were observed in the water at distances of approximately 400 to 500 meters (1,300 to 1,640 feet) from the pile driving activity and exhibited no alarm responses, although several showed alert reactions, and none of the seals appeared to remain in the area. One of these harbor seals was even seen to swim to within 150 meters (500 feet) of the pile driving barge during pile driving. Several sea lions, however, were observed at distances of 500 to 1,000 meters (1,640 to 3,280 feet) swimming rapidly and porpoising away from pile driving activities. The reasons for these differences are not known, although Kastak and Schusterman (1998) reported that sea lions are more sensitive than harbor seals to underwater noise at low frequencies.

Studies of marine mammal responses to continuous noise, such as vibratory pile installation are limited. Marine mammal monitoring at the Port of Anchorage marine terminal

redevelopment project found no response of marine mammals swimming within the threshold distances for noise impacts to construction activities including pile driving (both impact hammer and vibratory driving) (Integrated Concepts & Research Corporation 2009). Most marine mammals observed during the two lengthy construction seasons were beluga whales; harbor seals, harbor porpoises, and Steller sea lions were observed in smaller numbers. Background noise levels at this port are typically at 125 dB.

A comprehensive review by Nowacek et al. (2007) of acoustic and behavioral responses to noise exposure concluded that one of the most common behavioral responses is displacement. To assess the significance of displacements, it is necessary to know the areas to which the animals relocate, the quality of that habitat, and the duration of the displacement in the event that they return to the pre-disturbance area. Short-term displacement may not be of great concern unless the disturbance happens repeatedly. Similarly, long-term displacement may not be of concern if adequate replacement habitat is available.

Responses to Pile Driving at the EHW-2 Project Site

Marine mammals encountering pile driving operations over the three project construction seasons would likely avoid affected areas in which they experience noise-related discomfort, limiting their ability to forage or rest there. As described in the section above, individual responses to pile driving noise are expected to be variable: some individuals may occupy the project area during pile driving without apparent discomfort but others may be displaced with undetermined long-term effects. Results of marine mammal monitoring for the Test Pile Program (preliminary data) indicated possible reactions of harbor seals, California sea lions, and harbor porpoise to Test Pile Program construction activities but did not indicate that the animals experienced behavioral harassment as defined by the MMPA (see below).

Avoidance of the affected area during pile driving operations would reduce the likelihood of injury impacts but would reduce access to foraging areas in nearshore and deeper waters of Hood Canal. Noise-related disturbance across the 1.5-mile width of Hood Canal may inhibit some marine mammals from transiting the area. Given the long duration of the project (200 to 400 days of pile driving over 2 to 3 construction seasons), there is a potential for displacement of marine mammals from the affected area due to these behavioral disturbances during the in-water construction season. However, habituation over time may occur, along with a decrease in the severity of responses. Also, since pile driving would only occur during daylight hours, marine mammals transiting the project area or foraging or resting in the project area at night would not be affected. Any potential impacts from pile driving activities could be experienced by individual marine mammals, but would not cause population level impacts or affect the continued survival of the species.

Underwater Sound Injury and Disturbance Thresholds

Since 1997, NMFS has used generic sound exposure thresholds to determine when an activity in the ocean that produces sound might harm a marine mammal (70 FR 1871). These thresholds are used to determine compliance with the MMPA (16 USC §1362 Sec. 3 (13)) and the ESA (7 USC §36 and 16 USC §1531 et seq.), but the effects determinations and language used to report exposure to harmful noise levels are different for the two statutes. The MMPA imposes a moratorium on the taking of marine mammals, where "take" means to harass, among other actions. The MMPA defines two levels of harassment, each of which has been assigned a noise exposure threshold. Injury-level thresholds apply in situations where the noise "has the

potential to injure a marine mammal or marine mammal stock in the wild" (Level A harassment) (16 USC §1362 Sec. 3 (18)(A)(i)); behavioral disturbance (harassment) thresholds are applied in situations where the noise "has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment) (16 USC §1362 Sec. 3 (18)(A)(ii)). The effects determination in the following analysis is expressed in numbers of marine mammals exposed to harassment as a result of construction and operation of the EHW-2. The Navy's application for an IHA from NMFS under the MMPA [Sec. 101(a)(5)(D)] (IHA Addendum #3 submitted in December 2011), lists the estimated number of marine mammals exposed to harassment incidental to construction and operation of the project.

The ESA provides broad protection from "take" for listed species and their habitats, but the process of determining project effects is different from the MMPA process. For construction and operation of the EHW-2, the Navy submitted a biological assessment of the potential effects of the project on listed species and critical habitat (NAVFAC 2011b), including an estimate of the exposure of listed species to project-related adverse effects and a justification of the effect determination for each species addressed. NMFS prepared a Biological Opinion in September 2011 stating that the project is not likely to jeopardize the continued existence of the Steller sea lion or adversely affect the southern resident killer whale. NMFS did not include an ITS for marine mammals because the authorization of incidental take of marine mammals is still pending under the MMPA by NMFS Headquarters. The agency may subsequently modify the Biological Opinion to include an ITS.

The following analysis of noise-related impacts to marine mammals provides calculations of incidental harassment exposures of all marine mammal species that occur in the project area, as required by the MMPA, as well as exposures of the sole ESA-listed species in the project area (Steller sea lion) to noise-related adverse effects of the project, as required by the ESA. "Take" under the MMPA and potential exposure to adverse effects under the ESA are calculated at two levels, injury exposure and behavioral harassment exposure, using the same threshold values for each level of noise exposure for each statute. The effects analysis uses the terms "injury exposure" and "behavioral harassment exposure" for both ESA effects and MMPA effects, and states the number of exposures that the Navy requested for each marine mammal species in its IHA application and future MMPA authorization applications.

For underwater noise, NMFS identified threshold criteria for determining injury exposure as 190 dBRMS re 1µPa for pinnipeds and 180 dBRMS re 1µPa for cetaceans (65 FR 16374-16379) (Table 3.9–4). Injury exposure criteria have been used by NMFS to define the impact zones for seismic surveys and impact hammer pile driving projects, within which project activities may be shut down if protected marine mammals are present (some examples are cited in 71 FR 4352, 71 FR 6041, 71 FR 3260, and 65 FR 16374). NMFS has identified different thresholds for exposure to behavioral harassment for impact pile driving (an impulsive noise impact) versus vibratory pile driving (a continuous noise impact).

For both cetaceans and pinnipeds, the behavioral harassment threshold for impact pile driving is 160 dBRMS re 1µPa, and the threshold for continuous noise such as vibratory pile driving is 120 dBRMS re 1µPa. In the case of concurrent operation of one impact hammer and three vibratory pile drivers, application of the 120 dBRMS re 1µPa threshold for continuous noise is the most conservative approach to the evaluation of behavioral harassment due to noise.

Table 3.9–4. Marine Mammal Injury and Disturbance Thresholds for Underwater and Airborne Sounds

Marine Mammals	Airborne Marine Construction Thresholds (Impact and Vibratory Pile Driving) (dB re 20 µPa unweighted)	Underwater Vibratory Pile Driving[2] Threshold (dB re 1 µPa)		Underwater Impact Pile Driving[3] Thresholds (dB re 1 µPa)	
	Disturbance Guideline Threshold[1]	Injury Threshold	Behavioral Harassment Threshold	Injury Threshold	Behavioral Harassment Threshold
Cetaceans (whales, dolphins, porpoises)	N/A	180 dBRMS	120 dBRMS	180 dBRMS	160 dBRMS
Pinnipeds (seals, sea lions, except harbor seal)	100 dBRMS	190 dBRMS	120 dBRMS	190 dBRMS	160 dBRMS
Harbor seal	90 dBRMS	190 dBRMS	120 dBRMS	190 dBRMS	160 dBRMS

dB = decibel; N/A = not applicable, no established threshold; RMS = root-mean-square.

1. Sound level at which pinniped haul-out disturbance has been documented. Not an official threshold, but used as a guideline.
2. Non-pulsed, continuous sound.
3. Impulsive sound.

Pile driving for the EHW-2 project is described in detail in Section 3.4.2.1. Up to three vibratory rigs could be operated concurrently with one impact hammer rig. Underwater noise source levels used for calculations were 195 dBRMS re 1 µPa at 33 feet for an impact hammer and 180 dBRMS re 1 µPa for each vibratory driver.

For the analysis of injury-level noise exposure of marine mammals, the combined sounds of the two pile driver types were treated as impulsive noise, because noise generated by the impact hammer this close to the pile driving activity would dominate over noise produced by the vibratory hammers. Using this approach, when multiple pile-driving rigs are operating concurrently, and assuming a properly functioning bubble curtain or other noise attenuating device is in place on the impact hammer rig, then construction of the EHW-2 would likely result in noise-related injury to pinnipeds and cetaceans within 16 feet and 72 feet from a driven pile, respectively (Table 3.9–5).

The areas encompassed by these threshold distances are shown in Table 3.9–5 and a representative scenario of areas affected by above-threshold noise levels for multiple pile driving rigs is shown in Figure 3.9–1. The one impact pile driver and three vibratory pile drivers may operate at the same time, but not at the same point. Therefore, the sound analysis is based on the impact and vibratory pile drivers operating simultaneously but at different locations within the proposed facility as shown in Figure 3.9–1. The larger injury threshold circle shown in Figure 3.9–1 represents the threshold around the impact pile driver, which is expected to be larger than the area around the vibratory drivers, even in a concurrent multiple pile driving rig analysis. Placement of pile driving rigs at other locations on the EHW-2 would generate above-threshold noise levels in other portions of the project area.

Table 3.9–5. Calculated[1] Maximum Distance(s) to the Underwater Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Noise Thresholds

	INJURY PINNIPEDS (190 dBRMS) [2]	INJURY CETACEANS (180 dBRMS) [2]	BEHAVIORAL DISTURBANCE CETACEANS & PINNIPEDS (160 dBRMS and 120 dBRMS) [2,3]
Distance to Threshold[1]	16 feet	72 feet	8.6 miles[4]
Area Encompassed by Threshold	0.00004 sq mi	0.0009 sq mi	16 sq mi

1. Distance to threshold calculation is based on concurrent operation of one impact hammer and three vibratory drivers.
2. Bubble curtain or other sound attenuating device assumed to achieve 10 dB reduction in SPLs. SPLs used for calculations were: 185 dB re 1 μPa at 33 feet for impact hammer with noise attenuator and 180 dB re 1 μPa for vibratory driver for 48-inch hollow steel pile. All sound levels are expressed in dBRMS re 1 μPa (see Section 3.4.2.1).
3. Distance to the 160 dBRMS behavioral disturbance zone for impulsive noise is combined with distance to the 120 dBRMS behavioral disturbance zone for continuous noise.
4. Calculated range (over 138 miles [mi]) is greater than actual sound propagation through Hood Canal due to intervening land masses. 8.6 miles is the greatest line-of-sight distance from pile driving locations unimpeded by land masses, which would block further propagation of sound.

Marine mammals are unlikely to be injured by pile driving noise at these short distances because the high level of human activity and vessel traffic would cause them to avoid the immediate construction area. Cetaceans in particular are unlikely to swim this close to manmade structures. Marine mammal monitoring during construction (Appendix F) would further serve to render exposure to injury from pile driving noise very unlikely.

For the analysis of behavioral harassment of marine mammals due to construction of the EHW-2, combined sounds of the two pile driver types would be dominated by impulsive noise from the impact pile hammer at locations closer to the pile driving activity, but the contribution of vibratory drivers would increase with increasing distance. At the 160 dB behavioral disturbance threshold [approximately 2,375 feet from the source] the influence of vibratory drivers would roughly equal the influence of the impact hammer. Beyond this distance, noise from the vibratory drivers would dominate out to the 120 dBRMS threshold.

Since the 160 dB threshold and the 120 dB threshold both indicate behavioral disturbance, pile driving effects in the two zones can be combined to estimate exposures of marine mammals to behavioral disturbance. Using this approach, when multiple pile-driving rigs are operating concurrently, assuming a properly functioning bubble curtain or other noise attenuating device is in place on the impact driver, then construction of the EHW-2 would likely result in behavioral harassment to pinnipeds and cetaceans within 8.6 miles (Table 3.9–5). The calculated distance is much greater than 8.6 miles (Table 3.9–5), but this is not realistic because intervening land masses would truncate the propagation of underwater pile driving sound (Figure 3.9–1).

The area encompassed by the truncated threshold distance is approximately 16 square miles around the pile drivers (Table 3.9–5). Marine mammals within this area would be susceptible to behavioral harassment due to pile driving operations.

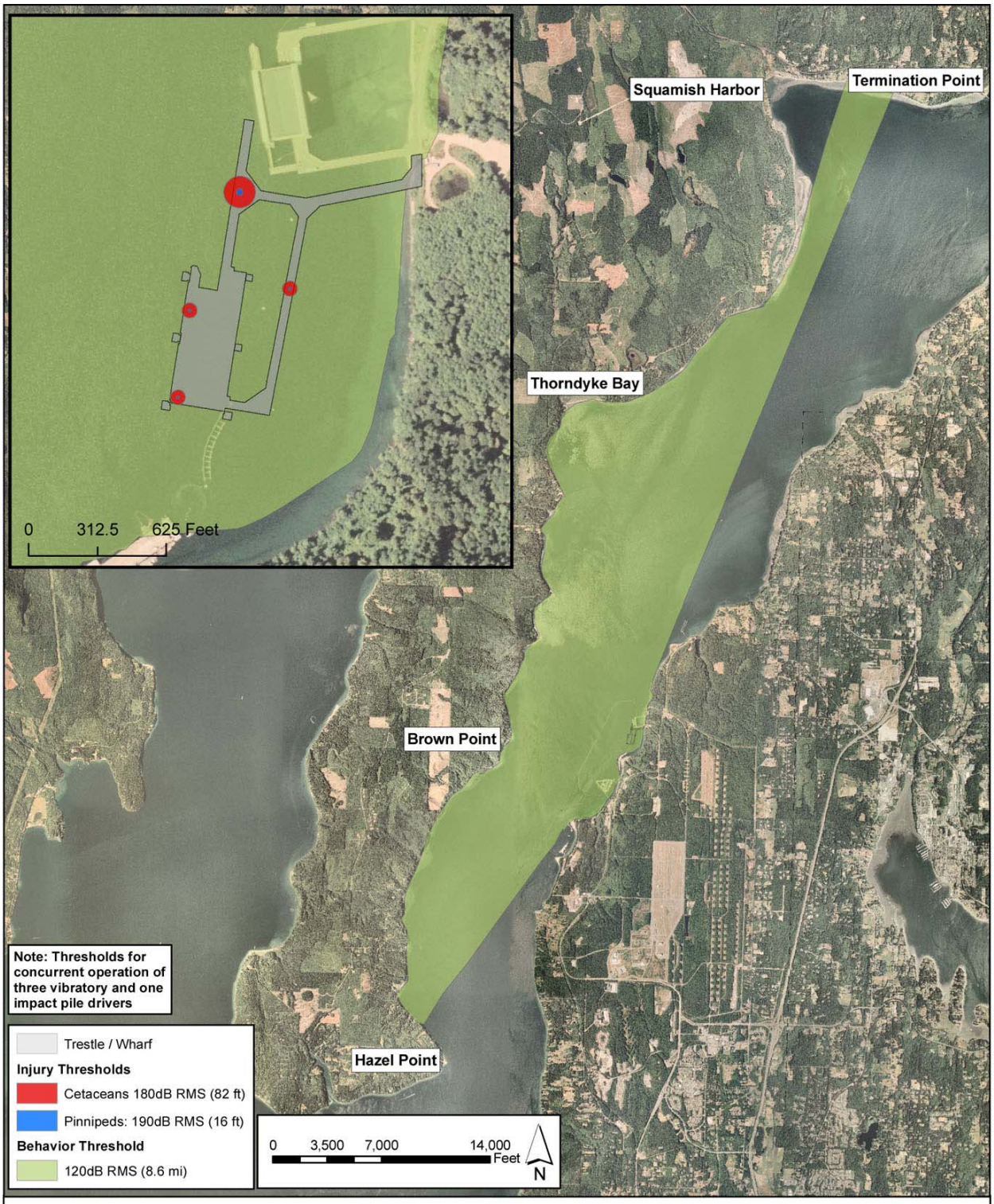


Figure 3.9−1. Representative View of Affected Areas for Marine Mammals Due to Underwater Pile Driving Noise

Injury exposure to intense underwater noise could consist of permanent hearing loss, referred to as PTS (permanent threshold shift), or other tissue damage. Temporary loss of hearing sensitivity in marine mammals (TTS) is another possible outcome of exposure to intense underwater noise that would be considered a form of behavioral harassment, as TTS is considered to be physiological fatigue rather than injury (Popper et al. 2006). TTS is an undesirable outcome of noise exposure because it can potentially affect communication and/or the ability to detect predators or prey. Behavioral harassment can also be indicated by actions such as avoidance of the construction area, changes in travel patterns, diving behavior, respiration, or feeding behavior.

NMFS' threshold criteria were developed from data that became available in 1998 and are currently under review, taking into account newer data on TTS, the expected offset between the TTS and PTS thresholds, differences in the acoustic sensitivities of different marine mammal groups, impacts of noise characteristics, and other relevant factors (70 FR 1871; Kastak and Schusterman 1996; Advisory Committee on Acoustic Impacts to Marine Mammals 2004; Miller et al. 2005; Southall et al. 2007). Thus, the criteria described above could change in the future.

3.9.2.1.1.5 AIRBORNE NOISE

Construction of the EHW-2 would result in increased airborne noise in the vicinity of the construction site, as discussed in Section 3.16.2.1.1. The highest noise source levels would be associated with impact pile driving (up to 1,250 piles in water and 55 upland piles), which are estimated to be 117 dB re 20 μPa (unweighted) at 50 feet from the pile for an impact hammer, and 95 dB re 20 μPa (unweighted) at 50 feet from the pile for vibratory pile driving. The dominant airborne noise frequencies produced by pile driving are between 50 and 1,000 Hz (WSDOT 2010a). Marine mammals that occur in the project area would be most affected by elevated airborne noise levels associated with impact pile driving, depending on their distance from pile driving activities. Airborne pile driving noise would have less impact to cetaceans because their heads are usually under water and noise from atmospheric sources does not transmit well under water (Richardson et al. 1995). Thus, airborne noise would primarily be an issue for pinnipeds that are swimming or hauled out in the project area. Mitigation measures for pile driving noise, including a soft-start approach to pile driving operations and marine mammal monitoring, are described in Section 3.9.2.7.3 and the Mitigation Action Plan (Appendix F).

Other construction activities and equipment would generate lower noise levels comparable to ambient levels elsewhere along the Bangor waterfront (see Ambient Noise, below). Operation of other types of construction equipment would produce airborne noise levels ranging from 78 to 90 A-weighted decibel (dBA) at 50 feet. In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet (see Section 3.16.2.1.1), but this noise level would be occasional. Activities that would generate elevated noise levels could include excavation for the abutment, pile driving for the abutment, road construction, placement of armor rock, and other uses of heavy equipment.

AMBIENT NOISE

Airborne noise levels on NBK at Bangor vary based on location but are estimated to range from 60 to 68 dBA during daytime hours (see Section 3.16.1.1). The highest levels of airborne noise are produced along the developed waterfront and at the ordnance handling areas where estimated noise levels range from 80 to 104 dBA at 50 feet. These higher noise levels are

produced by a combination of sound sources including heavy trucks, forklifts, cranes, marine vessels, mechanized tools and equipment, and other sound-generating industrial/military activities. All references to noise relate to noise in the air as opposed to underwater noise, and noise measurements are not corrected for distance unless specifically indicated.

SUSCEPTIBILITY OF MARINE MAMMALS TO AIRBORNE PILE DRIVING NOISE

In general, pinnipeds are less sensitive to airborne sound than are most terrestrial carnivores and less sensitive to underwater sound than strictly aquatic mammals (e.g., cetaceans), within the range of best sensitivity (Kastak and Schusterman 1998). Pinnipeds' hearing represents a compromise between aerial and aquatic adaptations, but the extent of adaptation for underwater hearing varies among pinniped families. California sea lions (members of the Otariidae, or eared seal family) appear to be better adapted to in-air hearing than underwater hearing, in comparison to harbor seals (members of the Phocidae, or hair seal family) which are better adapted to hearing underwater (Richardson et al. 1995; Kastak and Schusterman 1998). Within the range 100 Hz to 1.6 kHz, harbor seals hear nearly as well in air as underwater and had lower thresholds (i.e., greater sensitivity) than California sea lions (Kastak and Schusterman 1998). In air, harbor seals are most sensitive to frequencies between 6 and 16 kHz (Richardson et al. 1995; Terhune and Turnbull 1995; Wolski et al. 2003), but have functional hearing between 100 Hz and 30 kHz (Richardson et al. 1995; Kastak and Schusterman 1998). Thus, construction noise such as pile driving is well within the low-frequency range for this species. California sea lions are most sensitive at frequencies between 2 and 16 kHz (Schusterman 1974), and thus have functional hearing that includes lower-frequency construction noise (Kastak and Schusterman 1998).

BEHAVIORAL RESPONSES TO NOISE

A general discussion of behavioral responses to noise was provided in Section 3.9.2.1.1.4, Underwater Noise. Monitoring studies of hauled-out marine mammals near construction sites have generally reported negative results with respect to airborne noise (i.e., no apparent behavioral harassment) possibly because of habituation and the distances between the construction and the haul-out sites. Blackwell et al. (2004) reported that ringed seals hauled out as close at 500 meters (1,640 feet) from pile driving showed no adverse reaction. The marine mammal monitoring reports for the San Francisco-Oakland Bay Bridge East Span Seismic Safety Project (CALTRANS 2001, 2006, 2010) indicated that pile driving noise at the Yerba Buena Island haul-out was barely audible to human observers and did not appear to elicit reactions from harbor seals.

RESPONSES TO PILE DRIVING NOISE AT THE EHW-2 PROJECT SITE

Pinnipeds have habituated to existing airborne noise levels at Delta Pier on NBK at Bangor, where they regularly haul out on submarines and the floating security fences. The distance between the EHW-2 project site and haul-out sites is 3,000 feet or greater, which is beyond the airborne behavioral harassment threshold for pinnipeds that frequent the Bangor waterfront. Although no threshold has been identified for injury to marine mammals due to airborne sound, this is even less likely to occur because of the distance between the EHW-2 project site and haul-out locations.

Most likely, airborne sound would cause behavioral responses similar to those discussed above in relation to underwater noise. For instance, anthropogenic sound could cause hauled out pinnipeds to exhibit changes in their normal behavior, such as reduction in vocalizations, or cause them to temporarily abandon their usual or preferred locations and move farther from the

noise source. Pinnipeds swimming in the vicinity of pile driving may avoid or withdraw from the area, or show increased alertness or alarm (e.g., head out of the water, and looking around).

AIRBORNE SOUND HARASSMENT THRESHOLDS

As described above for *Underwater Sound Injury and Harassment Thresholds*, NMFS has used generic sound exposure thresholds to determine when an activity in the ocean that produces sound might result in impacts to a marine mammal such injury might occur (70 FR 1871). Construction-period airborne noise would have little impact to cetaceans because noise from airborne sources would not transmit as well underwater (Richardson et al. 1995); thus, noise would primarily be a problem for hauled-out pinnipeds near the EHW-2 project site. NMFS has identified behavioral harassment threshold criteria for airborne noise generated by pile driving for pinnipeds regulated under the MMPA. Injury threshold criteria for airborne noise have not been established. The behavioral harassment threshold for harbor seals is 90 dBRMS (unweighted) and for all other pinnipeds is 100 dBRMS (unweighted).

Airborne sound attenuation modeling for pile driving for the EHW-2 project is described in detail in Section 3.16.2.1.1. Up to three vibratory drivers could be operated concurrently with one impact hammer. Airborne noise source levels used for the calculations were 97 dBRMS re 20 µPa at 525 feet for an impact driver and 98 dBRMS re 20 µPa at 36 feet for a vibratory driver.

For the analysis of behavioral harassment of pinnipeds due to construction of the EHW-2, combined sounds of the two pile driver types would be dominated by impulsive noise from the impact pile hammer. Treating the combined noise from both types of pile driver as impulsive noise, when multiple pile driving rigs are operating concurrently, then construction of the EHW 2 would likely result in noise-related behavioral harassment to harbor seals at a distance of 1,184 feet, and to other pinnipeds (California sea lion and Steller sea lion) at a distance of 374 feet (Table 3.9–6). The areas encompassed by these threshold distances are shown in Table 3.9–6 and a representative scenario of areas affected by above-threshold noise levels for multiple pile driving rigs is shown in Figure 3.9–2. Other areas would be included in the above-threshold noise areas if the analysis was performed for pile driving rigs at other locations on the EHW-2.

Table 3.9–6. Calculated[1] Maximum Distances in Air to Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Noise Thresholds

	HARBOR SEAL (90 dBRMS)[2]	PINNIPEDS (SEALS, SEA LIONS, EXCEPT HARBOR SEAL) (100 dBRMS)[2]
Distance to Threshold[1]	1,184 feet	374 feet
Area Encompassed by Threshold	0.027 sq mi	0.002 sq mi

1. Distance to threshold calculation is based on concurrent operation of one impact hammer and three vibratory drivers.
2. SPLs used for calculations were: 97 dBRMS re 20 µPa at 160 meters (525 feet) (Blackwell et al. 2004) for impact hammer for 42-inch steel pile, and 98 dBRMS re 20 µPa for vibratory driver, for 36-inch steel pile (WSDOT 2010a). All sound levels expressed in dBRMS re 20 µPa. All distances calculated over water.

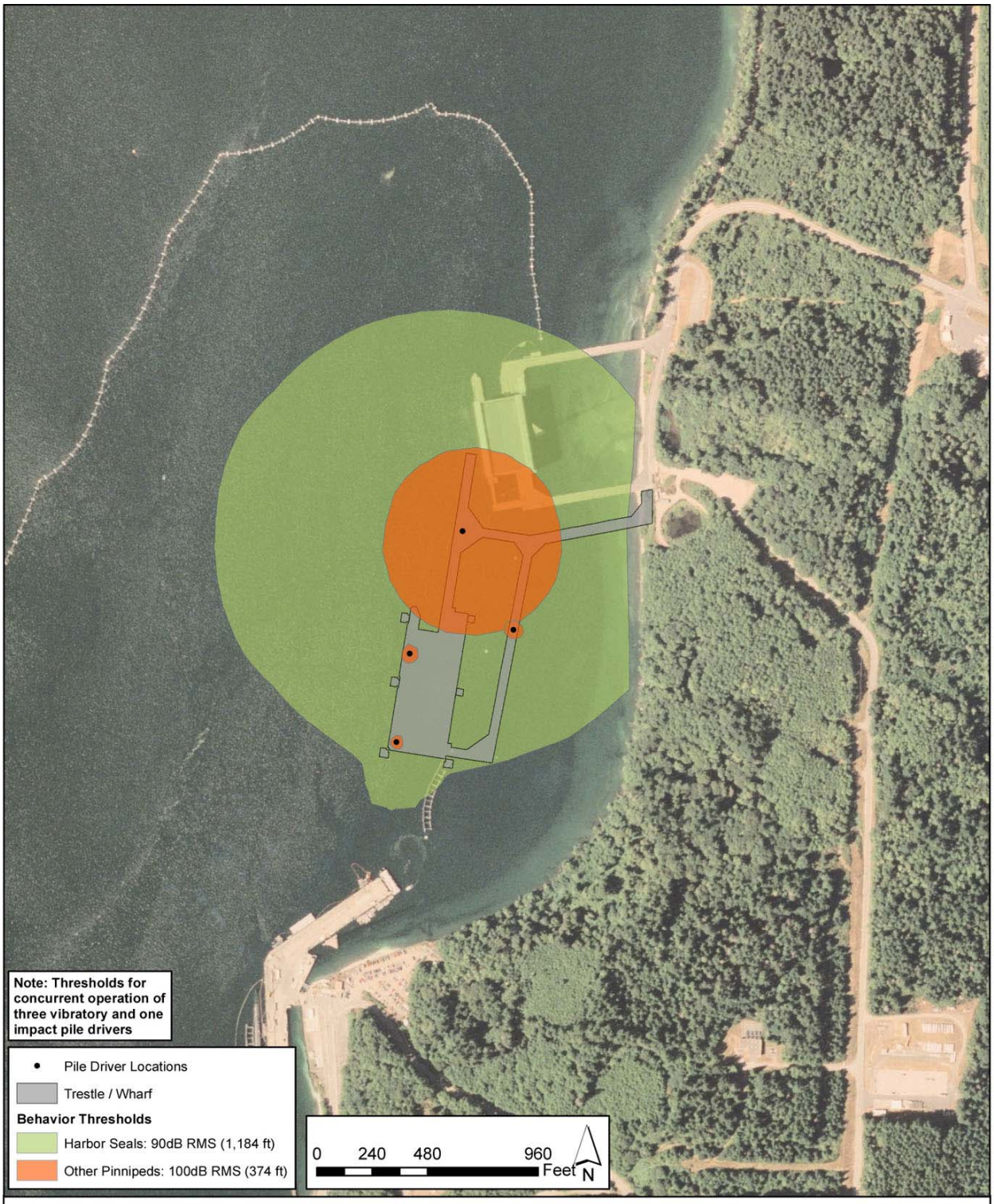


Figure 3.9−2. Representative View of Affected Areas for Marine Mammals Due to Airborne Pile Driving Noise

3.9.2.1.1.6 CALCULATIONS OF EXPOSURE OF MARINE MAMMALS TO NOISE IMPACTS

The analysis approach in the following section focuses on quantifying potential exposure of marine mammals to project impacts based on their density in the project area and the duration of project activities that may affect these species. The term *exposure* in this analysis signifies "take" under the MMPA as well as potential exposure to adverse effects under the ESA, as discussed in detail in Section 3.9.2.1.1.4. The following species are included in the analysis because their occurrence in Hood Canal has been confirmed by specific observations during the past decade: harbor seal, California sea lion, Steller sea lion (ESA-listed), Dall's porpoise, harbor porpoise, and transient killer whale (see Section 3.9.1 for marine mammal species accounts).

METHOD OF INCIDENTAL TAKING (MMPA) OR EXPOSURE TO ADVERSE EFFECTS (ESA)

Pile driving activities associated with construction of the EHW-2 as described in Section 3.9.2.1.1.4, Underwater Noise, and Section 3.9.2.1.1.5, Airborne Noise, have the potential to disturb or displace marine mammals, but injury is not anticipated given the methods of installation and measures designed to minimize the possibility of injury to marine mammals. The Mitigation Action Plan (Appendix F) provides more detail on the impact reduction and mitigation measures proposed. Vibratory pile drivers would be the primary method of installation, which are not expected to cause injury to marine mammals due to the relatively low source levels (less than 190 dB). Also, no impact pile driving would occur without a noise attenuating bubble curtain, or similar device, and pile driving would either not start or be halted if marine mammals approach the shutdown zone. Although the proposed action may affect the prey and other habitat features of marine mammals, none of these effects is expected to rise to the level of take under MMPA or ESA, as described in Sections 3.9.2.1.1.1 through 3.9.2.1.1.3. The ESA-listed southern resident killer whale was included in the analysis of indirect effects on its prey base in Section 3.9.2.1.1.3, but is not carried forward in the noise effects analysis because its occurrence has not been confirmed in Hood Canal for 15 years.

DESCRIPTION OF EXPOSURE CALCULATION

The calculations presented here rely on the best data currently available for marine mammal populations in Hood Canal. The population data used are discussed for species' potential exposure calculation in Section 3.9.2.1.1.7. A formula was developed for calculating potential exposure due to impact pile driving and applied to each group-specific noise impact threshold. The formula is founded on the following assumptions:

- Each species population is at least as large as any previously documented highest population estimate.
- Each species would be present in the project area during construction at the start of each day, based on observed patterns of occurrence in the absence of construction. The timeframe for takings would be 1 potential exposure per 24 hours.
- All pilings to be installed would have a noise disturbance distance equal to the piling that causes the greatest noise disturbance (i.e., the piling farthest from shore).
- Pile driving would occur every day of the 200 to 400 potential pile driving days (211 to 411 days for the airborne analysis to include 11 additional pile driving days for the abutment piles). Sound attenuation modeling assumes three vibratory rigs may be in operation at the same time.

- Some type of mitigation (i.e., bubble curtain or other noise attenuating device) would be used for impact pile driving.

The calculation for all marine mammal potential noise exposures is estimated by:

Exposure estimate = (n * ZOI)*200 to 400 (211 to 411 for airborne noise) days of total activity, where:
n = density estimate used for each species, and
ZOI[8] = noise threshold zone of influence (ZOI) impact area

The product of n*ZOI was rounded to the nearest whole number before multiplying by the number of pile driving days. If the product of n*ZOI rounds to zero, the number of exposures calculated was zero regardless of the number of pile driving days. The density calculation for marine mammals depends on the known or likely range of the species in Hood Canal (Sections 3.9.1.1 and 3.9.1.2) and is discussed in greater detail in the species-specific accounts in the following sections.

The ZOI impact area is the estimated range of impact to the noise criteria thresholds for both underwater and airborne noise. The distances specified in Tables 3.9–5 and 3.9–6 were used to calculate the overwater areas that would be encompassed within the threshold distances for injury or behavioral harassment (Tables 3.9–5 and 3.9–6). All calculations were based on the estimated threshold ranges using a bubble curtain with 10 dB attenuation as a mitigation measure for impact pile driving.

As described in Section 3.9.2.1.1.7 below with regard to the distances, the ZOIs for each threshold are not spherical and would be truncated by land masses, such as points of land on the Bangor shoreline and the Toandos Peninsula on the opposite shoreline, which would dissipate sound pressure waves (WSDOT 2010a).

The exposure assessment methodology is an estimate of the numbers of individuals exposed to the effects of pile driving activities exceeding NMFS established thresholds for underwater and airborne noise. Of significant note in these exposure estimates, additional mitigation methods were not quantified within the assessment and successful implementation of mitigation is not reflected in exposure estimates. Results from acoustic impact exposure assessments should be regarded as conservative overestimates that are strongly influenced by limited marine mammal population data.

3.9.2.1.1.7 Summary of Project Impacts and Estimated Exposures for Species Present in the Project Area

Steller Sea Lion

Steller sea lions may be present in Washington inland waters during the period from October to April, but all reported observations in Hood Canal have been of animals hauled out at the Bangor waterfront (Navy 2010b). Since surveys were initiated in April 2008, Navy surveys have documented Steller sea lions on submarines docked at Delta Pier North and Delta Pier South during the period from October to April (Navy 2010b and preliminary data) (Table 3.9–7). The maximum Steller sea lion group size seen at any given time was six individuals in November 2009. Recent observational data from daily surveys available from the Test Pile Program noted the presence of Steller sea lions along NBK at Bangor in October for the first time.

[8] Zone of Influence (ZOI) is the area encompassed by all locations where the sound pressure levels equal or exceed the threshold being evaluated.

Table 3.9–7. Steller Sea Lions (SSL) Observed on NBK at Bangor, April 2008–June 2010

	Number of Surveys with SSL present	Number of Surveys	Frequency of SSL presence at survey sites[1]	Monthly Average of Maximum Number Observed	Density (animals/sq km)[2]
January	4	25	0.16	1.0	0.024
February	1	28	0.04	0.5	0.012
March	4	28	0.14	1.0	0.024
April	5	38	0.13	1.3	0.031
May	0	44	0.00	0.0	0
June	0	44	0.00	0.0	0
July	0	31	0.00	0.0	0
August	0	29	0.00	0.0	0
September	0	26	0.00	0.0	0
October [3]	12	38	0.32	1.3	0.031
November	3	22	0.14	5.0	0.12
December	5	24	0.21	1.5	0.036
Totals	**31**	**377**	**Average: 0.095**	**Average Within In-Water Work Season: 1.16**	**Within In-Water Work Season: 0.028 (0.07/sq mi)**

1. Frequency is the number of surveys with Steller sea lions present/number of surveys conducted.
2. Density was calculated as the monthly average of the maximum number of individuals present during Navy surveys at Delta Pier divided by the area defined by the 120 dB behavioral harassment isopleth (16 square miles [sq mi]).
3. Data for October are from the monitoring conducted for the Test Pile Program in 2011.

Steller sea lions arrived on October 8 and were seen during surveys every day of the remaining 12 days of the project. Up to four individuals were sighted either hauled out at the submarines docked at Delta Pier or swimming in the waters just adjacent to the base. These sightings were incorporated into the data in Table 6-9 used to estimate the density of Steller sea lions for the month of October.

The Navy determined a reasonable area that Steller sea lions could be expected to utilize in the project area while swimming and foraging, based on available literature, in order to calculate in-water density for sound exposure modeling. Foraging trips of satellite-tracked adult western stock Steller sea lions in Alaska averaged 17 $\pm$ 5 km during summer, and 133 $\pm$ 60 km in winter (Merrick and Loughlin 1997). Eastern stock Steller sea lions were concentrated within 1 to 13 km (mean 7.0 km) of rookeries off the coast of California during summer and were observed 7 to 59 km offshore (mean 28.2 km) in autumn (Bonnell et al. 1983). Foraging ranges of young-of-the-year animals in Alaska averaged 30 km (Merrick and Laughlin 1997). Winter foraging ranges for adult male eastern stock Steller sea lions in Washington inland waters have not been reported, but can reasonably be expected to be as great as distances reported for females and immatures. Given these distances, the Navy concluded that it was reasonable to expect that Steller sea lions could travel 30 to 130 km when foraging in inland waters.

The project action area was defined as the calculated distance from EHW-2 pile driving locations to the behavioral harassment threshold (120 dB SPL) or the greatest line-of-sight distance (8.6 miles) that underwater sound waves could travel from pile driving locations unimpeded by land masses (Figure 3.9–1). The affected area was determined to be 16 square miles (Table 3.9–5). The Navy believes that it is reasonable to expect that Steller sea lions would forage within this area, given their reported foraging distances. Moreover, it is assumed that any sea lions swimming within this area would be potentially subject to exposure to elevated pile driving noise from the EHW-2 construction site. Because they are infrequently present in the project area, the density calculation for Steller sea lions uses the average of the monthly maximum number of individuals present during surveys at Delta Pier rather than the maximum number (6) ever observed (Navy 2010b). The average of the monthly maximum number present during the in-water work window is 1.16 animals. Therefore, the density used in the sound exposure analysis was calculated as the monthly average of the maximum number of Steller sea lions on NBK at Bangor (1.16 individuals) (Table 3.9–7) divided by the area encompassed by the maximum fetch of the project area (16 sq mile[mi]). The calculated density of Steller sea lions is 0.07 animal per sq mi.

With regard to the range of this species in Hood Canal and the project area, it is assumed that the opportunity to haul out on submarines docked at Delta Pier is a primary attractant for Steller sea lions in Hood Canal, as they have not been reported either hauled out or swimming, to the south of NBK at Bangor. Their haul-out site, submarines docked at Delta Pier (approximately 1 km from the EHW-2 construction area), is within the underwater distance threshold for behavioral harassment due to concurrent impact and vibratory pile driving (8.6 miles), but not within the airborne disturbance thresholds for concurrent impact and vibratory pile driving (374 feet for sea lions). It is assumed that animals swimming to and from the submarines may be exposed to disturbing noise levels primarily resulting from vibratory pile driving, as this zone (approximately 16 sq mi) is significantly larger than the affected areas for impact pile driving. Therefore, their range in Hood Canal is conservatively assumed to be the area encompassed by the underwater disturbance threshold for vibratory pile driving.

Exposures to underwater and airborne pile driving noise were calculated using the formula in Section 3.9.2.1.1.6. Table 3.9–8 depicts the number of potential behavioral harassment exposures that are estimated from concurrent vibratory and impact pile driving both underwater and in-air.

Based on the density analysis and using the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), an average of 1 individual Steller sea lion may experience SPLs on a given day that would qualify as behavioral harassment (Table 3.9–8). The density analysis assumes an even distribution of animals. However, in reality Steller sea lion distribution within the project area is patchy, with their occurrence concentrated near Delta Pier. As a result, it is more likely that more than one exposure would occur in a day. To ensure the Navy has adequate MMPA/ESA coverage during EHW-2 construction, the Navy increased the number of takes requested to 2 exposures per day of pile driving. Therefore, the total number of exposures over the entire pile driving period for this alternative is estimated to be 400–800 (all underwater) (Table 3.9–8).

Table 3.9–8. Number of Potential Exposures of Steller Sea Lions within Various Acoustic Threshold Zones, Alternative 1

Season	Density of Steller Sea Lions [1] (sq mi)	Underwater		Airborne
		Injury Threshold (190 dBrms)	Behavioral Harassment Threshold (160 dB and 120 dBrms) [2]	Behavioral Harassment Threshold (100 dBrms)
Mid-July – Mid-February	0.07	0	400 – 800[3]	0

1. Density was calculated as the monthly average of the maximum number of individuals present during surveys at Delta Pier divided by the area encompassed by the underwater harassment threshold for vibratory pile driving. The airborne exposure calculations assumed that 100 percent of the in-water densities were available at the surface to be exposed to airborne sound.
2. Distance to the 160 dBrms behavioral disturbance zone for impulsive noise is combined with distance to the 120 dBrms behavioral disturbance zone for continuous noise.
3. Steller sea lion distribution within the project area is patchy, with their occurrence concentrated near Delta Pier. Although only 1 exposure per day was calculated, it is more likely that more than one exposure would occur in a day. To ensure the Navy has adequate MMPA/ESA coverage during EHW-2 construction, the Navy increased the number of takes requested to 2 exposures per day of pile driving.

Construction impacts that would occur in the vicinity of Steller sea lion foraging and resting habitat include changes in water quality and increased turbidity impacts, loud noises from pile driving and equipment operation, increased human activity and presence, increased potential for an oil or fuel spill, floating debris, increased boat use, propeller wash, and decreased prey abundance in the immediate area of these activities. The distance from the haul-out location to the EHW-2 project site is over 3,000 feet. At this distance, construction noise, including pile driving noise, would be within the range of ambient noise from operations in the vicinity of Delta Pier. Steller sea lions would most likely avoid the immediate impact area around the EHW-2 project site during construction and may continue using manmade structures at Delta Pier as haul-out sites.

The prey base of Steller sea lions includes forage fish, which would be less available for predators within the fish injury exposure and behavioral harassment zones (described in Section 3.8.2.1.1) during the 7-month in-water construction window. The potential impact to Steller sea lions would be a temporary loss (over the 2 to 3 years of in-water construction) of foraging opportunities, and potential exposure to behavioral harassment as they transit the project area. Since Steller sea lions are occasionally present along the Bangor waterfront during the in-water construction window, and could be disturbed by underwater pile driving noise, the effect determination for project construction is "may affect, likely to adversely affect" for individual Steller sea lions. The affected area is negligible in contrast to the available foraging range for Steller sea lions in inland marine waters.

Marine mammal observers will be monitoring the shutdown and buffer zones (see Appendix F for a detailed discussion of mitigation measures) for the presence of marine mammals, and will alert work crews when to begin or stop work due to the presence of sea lions in or near the shutdown and buffer zones, reducing the potential for behavioral harassment. Based on the exposure analysis, few Steller sea lions are anticipated to experience airborne SPLs that would qualify as harassment.

CALIFORNIA SEA LION

No regular haul-outs of California sea lions were documented during aerial surveys of pinniped populations in Hood Canal (Jeffries et al. 2000). However, the Navy's observations of animals hauled out on vessels and manmade structures at the Bangor waterfront indicate that California sea lions are present in Hood Canal during much of the year with the exception of mid-June through August (Navy 2010b). During the in-water construction period (mid-July to mid-February), the largest daily attendance averaged for each month ranged from 24 individuals to 54 individuals. The largest monthly average (54 animals) was recorded in November, as was the largest daily count (58). The likelihood of California sea lions being present at the Bangor waterfront was greatest from October through May, when the frequency of attendance in surveys was at least 0.58.

Table 3.9–9. California Sea Lions Observed on NBK at Bangor, April 2008–June 2010

	Number of Surveys with California Sea Lion present	Number of Surveys	Frequency of California Sea Lion presence at survey sites[1]	Monthly Average of Maximum Number Observed	Density (animals/sq km)[2]
January	15	25	0.60	24.0	0.58
February	24	28	0.86	31.0	0.75
March	26	28	0.93	38.5	0.93
April	27	38	0.71	36.3	0.88
May	32	44	0.73	25.0	0.6
June	7	44	0.16	5.3	0.13
July	0	31	0.00	0.0	0.0
August	1	29	0.03	0.5	0.0
September	9	26	0.35	22.0	0.53
October	22	26	0.85	45.5	1.1
November	22	22	1.00	54.0	1.3
December	14	24	0.58	32.5	0.79
Totals	**199**	**365**	**Average: 0.55**	**Average Within In-Water Work Season: 26.2**	**Within In-Water Work Season: 0.63 (1.6/sq mi)**

The Navy determined a reasonable area in which this population could be expected to swim and forage, based on available literature on California sea lions, in order to calculate in-water density for sound exposure modeling. Costa (2007) found that foraging adult females (n = 32) in California traveled an average of 66.3 + 11 km from their rookery. Wintering males from the Columbia River (n = 14) traveled a maximum of 70 km from shore (Wright et al. 2010). Additional data from 12 adult males from mixed stocks in Washington had a maximum travel speed of 99 km (62 miles) per day (Wright et al. 2010). Given the distances reported in the literature (Costa 2007), the Navy concluded that it was reasonable to expect that California sea lions could travel between 55 and 100 km when foraging. Since these were straight-line distances, the area encompassed would be smaller. The project action area was defined as the

calculated distance from EHW-2 pile driving locations to the behavioral harassment threshold (120 dB SPL) or the greatest line-of-sight distance (8.6 miles) that underwater sound waves could travel from pile driving locations unimpeded by land masses (Figure 3.9–1). The affected area was determined to be 16 square miles (Table 3.9–5). The Navy believes that it is reasonable to expect that California sea lions would forage within this area, given their reported foraging distances. Moreover, it is assumed that any sea lions swimming within this area would be potentially subject to exposure to elevated pile driving noise from the EHW-2 construction site. Therefore, the density used in the sound exposure analysis was calculated as the monthly average of the maximum number of California sea lions at the Bangor waterfront (26.2 individuals) divided by the area encompassed by the underwater harassment threshold for vibratory pile driving (16 square miles). The airborne exposure calculations assumed that 100 percent of the in-water densities were available at the surface to be exposed to airborne sound.

Exposures to underwater and airborne pile driving noise were calculated using the formula in Section 3.9.2.1.1.6. Table 3.9–10 depicts the number of potential behavioral harassment exposures that are estimated from concurrent vibratory and impact pile driving both underwater and in-air.

Based on the density analysis and using the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), an average of 26 individual California sea lions may experience SPLs on a given day that would qualify as potential behavioral harassment. The total number of potential behavioral harassment exposures over the entire pile driving period for this alternative is estimated to be 5,200 to 10,400 (all underwater) (Table 3.9–10). California sea lions that are exposed to pile driving noise could exhibit behavioral reactions such as avoidance of the affected area, but they are unlikely to be injured by pile driving noise because they are unlikely to be within the injury threshold distance for pile driving noise (15 feet). Project effects on the species would be similar to those described for Steller sea lion.

Table 3.9–10. Number of Potential Exposures of California Sea Lions within Various Acoustic Threshold Zones, Alternative 1

Season	Density of California Sea Lions[1] (sq mi)	Underwater		Airborne
		Injury Threshold (190 dBRMS)	Behavioral Harassment Threshold[2] (160 dB and 120 dBRMS)	Behavioral Harassment Threshold (100 dBRMS)
Mid-July – Mid-February	1.6	0	5,200 – 10,400	0

1. Density was calculated as the monthly average of the maximum number of individuals present during surveys at Delta Pier divided by the area encompassed by the underwater harassment threshold for vibratory pile driving. The airborne exposure calculations assumed that 100 percent of the in-water densities were available at the surface to be exposed to airborne sound.
2. Distance to the 160 dBRMS behavioral disturbance zone for impulsive noise is combined with distance to the 120 dBRMS behavioral disturbance zone for continuous noise.

Marine mammal observers will be monitoring the shutdown and buffer zones during pile driving activities (see Appendix F for a detailed discussion of mitigation measures) for the presence of marine mammals, and will alert work crews when to begin or stop work due to the presence of sea lions in or near the shutdown and buffer zones, reducing the potential for behavioral harassment.

HARBOR SEAL

Harbor seals are the most abundant marine mammal in Hood Canal. Jeffries et al. (2003) provided a population estimate of 1,088 harbor seals in Hood Canal based on aerial survey data focused on Hood Canal haul-outs, and data obtained from tagged animals (Huber et al. 2001), which suggest that harbor seals spend an average of 35 percent of their time in the water versus hauled out on a daily basis. In order to estimate the underwater exposures from pile driving operations, the Navy estimated the proportion of the Hood Canal population that could be in the water and susceptible to exposure on a daily basis. The Navy assumed that the proportion of the population susceptible to exposure to underwater sound on a daily basis was 35 percent of the total population (35 percent of 1,008 animals, or approximately 381 individuals). The Navy recognizes that over the course of the day, while the proportion of animals in the water may not vary significantly, different individuals may enter and exit the water. However, fine-scale data on harbor seal movements within the project area on time durations of less than a day are not available.

Exposures to underwater pile driving noise were calculated using a density derived from the number of harbor seals that are present in the water at any one time (approximately 381 individuals), divided by the area of Hood Canal (112 square miles) (Huber et al. 2001; Jeffries et al. 2003). The density of harbor seals calculated in this manner (3.4 animals per square mile) is corroborated by results of the Navy's marine mammal boat surveys along the Bangor waterfront in 2008 and 2009/10, in which an average of 5 individual harbor seals was observed in the 1.5-square mile survey area (density = 3.3 animals per square mile) (Tannenbaum et al. 2009a, 2011a). Exposures to underwater noise were calculated with the formula in Section 3.9.2.1.1.6.

In order to analyze the potential for harbor seals to be disturbed by airborne noise associated with pile driving for EHW-2, the Navy evaluated the likelihood for harbor seals in the project area to be hauled out and/or swimming with their heads out of the water. While Huber et al. (2001) indicated that harbor seals typically spend 65 percent of their time hauled out, the Navy's waterfront surveys and boat surveys (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; Navy 2010b) found that it is rare for harbor seals to haul out along the Bangor waterfront. Although in-water sightings of harbor seals are common in the project area, available haul-out locations that would fall within the calculated airborne acoustic noise zone of influence (1,184 feet) are limited.

Harbor seals' ideal haul-out locations include intertidal or subtidal rock outcrops, sandbars, sandy beaches, peat banks in salt marshes, and manmade structures such as log booms, docks, and floats (Wilson 1978; Prescott 1982; Schneider and Payne 1983; Gilbert and Guldager 1998; Jeffries et al. 2000). The only structures within the airborne zone of influence (Figure 3.9–2) are the existing EHW wharf and Marginal Wharf, both of which are elevated more than 16 feet above MHHW and thus inaccessible to pinnipeds. The shoreline zone between these structures is a narrow area that is backed by a steep cliff face. Portions of the intertidal zone that are exposed at low tide are vegetated with eelgrass and macroalgae, which are not favored haul-out locations for harbor seals. Indeed, the Navy's boat surveys never detected any marine mammals hauled out along the Bangor shoreline (Tannenbaum et al. 2009a, 2011a). Harbor seals occasionally haul out on pontoons of the floating security fence, buoys, and barges within the WRA but have not been observed on submarines. These structures are located in the vicinity of Delta Pier and Marginal Pier, outside of the airborne zone of influence for the EHW-2. An observation of harbor seals hauled out on a log on the shoreline approximately 1,460 feet due south of the existing EHW represents the closest documented haul-out site to the proposed

EHW-2 construction site. This observation was in the vicinity of the southern end of the EHW-2 construction zone, but the log in question is no longer present. Therefore, on NBK at Bangor, harbor seals would primarily be exposed to airborne noise effects as they swim or rest in the water with their heads above the surface.

Based on the diving cycle of tagged harbor seals near the San Juan Islands, it is estimated that seals are on the surface approximately 16.4 percent of their total in-water duration (Suryan and Harvey 1998). Therefore, by multiplying the percentage of time spent at the surface (16.4 percent) by the total in-water population of harbor seals at any one time (approximately 381 individuals), the number of harbor seals with the potential to experience airborne impacts (approximately 63 individuals) can be obtained. Airborne exposures were calculated (see Section 3.9.2.1.1.6 for the formula) using a density derived from the number of harbor seals available at the surface (approximately 63 individuals), divided by the area of Hood Canal (112 square miles).

Table 3.9–11 depicts the number of behavioral harassment exposures that are estimated from vibratory and impact pile driving both underwater and in-air for each season.

Table 3.9–11. Number of Potential Exposures of Harbor Seals within Various Acoustic Threshold Zones, Alternative 1

Season	Density of Harbor Seals [1] (sq mi)	Underwater		Airborne
		Injury Threshold (190 dBrms)	Behavioral Harassment Threshold (160 dBrms and 120 dBrms) [2]	Behavioral Harassment Threshold (90 dBrms) [3]
Mid-July – Mid-February	3.4	0	10,800 – 21,600	0

1. Density was calculated as the number of individuals present in the water (not hauled out) in Hood Canal at any given time (Huber et al. 2001).
2. Distance to the 160 dBrms behavioral disturbance zone for impulsive noise is combined with distance to the 120 dBrms behavioral disturbance zone for continuous noise.
3. Harbor seal densities (0.56 per square mile) exposed to airborne noise were calculated using the percentage (16.4 percent) of animals in the water but on the surface (Suryan and Harvey 1998).

Based on the density analysis and using the most conservative criterion for behavioral disturbance (the 120 dB vibratory harassment threshold), up to 54 individual harbor seals may experience SPLs on a given day that would qualify as behavioral harassment. The total number of exposures over the entire pile driving period for this alternative is estimated to be 10,800 to 21,600 exclusively due to behavioral harassment related to underwater pile driving noise) (Table 3.9–11). Harbor seals exposed to pile driving noise could exhibit behavioral reactions such as avoidance of the affected area, but they are unlikely to be injured by pile driving noise because they are unlikely to be within the injury threshold distance for pile driving noise (15 feet). The prey base, especially juvenile salmonids and forage fish, would be affected by construction, and therefore harbor seals would experience a very localized reduction in their prey base during the 7-month in-water work season. Marine mammal observers will be monitoring the shutdown and buffer zones during pile driving activities (see Appendix F for a detailed discussion of mitigation measures) for the presence of marine mammals, and will alert work crews when to begin or stop work due to the presence of seals in or near the shutdown and buffer zones, reducing the potential for behavioral harassment.

TRANSIENT KILLER WHALE

Transient killer whales are uncommon visitors to Hood Canal. In 2003 and 2005, small groups of transient killer whales (6 to 11 individuals per event) visited Hood Canal to feed on harbor seals and remained in the area for significant periods of time (59 to 172 days) between the months of January and July (London 2006). These whales used the entire expanse of Hood Canal for feeding. No other confirmed sightings of transient killer whales in Hood Canal were found. Based on these data, the density for transient killer whales in Hood Canal for January to June was calculated to be 0.1 per square mile (a maximum of 11 individuals observed at one time divided by the area of the Hood Canal [112 square miles]). Given the rarity of transient killer whale visits in Hood Canal in the past decade, this density is a very conservative overestimate. It is assumed for the exposure analysis (see Section 3.9.2.1.1.6 for the formula) that transient killer whales could occur in Hood Canal, including the project area, at any time during the in-water work season.

Table 3.9–12 depicts the number of potential behavioral harassment exposures that are estimated from concurrent vibratory and impact pile driving both underwater and in air.

Table 3.9–12. Number of Potential Exposures of Transient Killer Whales within Various Acoustic Threshold Zones, Alternative 1

Season	Density of Transient Killer Whales [1] (sq mi)	Underwater	
		Injury Threshold (180 dBRMS)	Behavioral Harassment Threshold (160 dBRMS and 120 dBRMS) [2]
Mid-July – Mid-February	0.1	0	400 – 800

1. Density was calculated as the maximum number of individuals present at a given time during two visits in 2003 and 2005 (London 2006) divided by the area of Hood Canal (112 square miles).
2. Distance to the 160 dBRMS behavioral disturbance zone for impulsive noise is combined with distance to the 120 dBRMS behavioral disturbance zone for continuous noise.

Based on the density analysis and using the most conservative criterion for harassment (the 120 dB continuous noise harassment threshold), up to two individual killer whales may experience SPLs on a given day that would qualify as potential exposure to behavioral harassment. The total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 400 to 800 (Table 3.9–12). Transient killer whales that are exposed to pile driving noise could exhibit behavioral reactions such as avoidance of the affected area. Harassment from underwater noise impacts is not expected to be significant because it is estimated that only a small number of killer whales would ever be present in the project area. Additionally, marine mammal observers will be monitoring the shutdown and buffer zones (see Appendix F for a detailed discussion of mitigation measures) for the presence of marine mammals, and will alert work crews when to begin or stop work due to presence of killer whales in or near the shutdown and buffer zones, reducing the potential for behavioral harassment.

DALL'S PORPOISE

Dall's porpoise may be present in Hood Canal year round and are assumed to use the entire area. The Navy conducted boat surveys of the waterfront area from July to September 2008 (Tannenbaum et al. 2009a) and November 2009 to May 2010 (Tannenbaum et al. 2011a). During one of the surveys a single Dall's porpoise was sighted in August 2009 in the deeper waters off Carlson Spit. In the absence of an abundance estimate for the entire Hood Canal,

density was derived from the waterfront surveys using the number of individuals seen divided by total area of survey effort (18 surveys with approximately 1.5 square miles [3.9 sq km] of effort per survey, using strip transect surveys). Exposures were calculated using the formula in Section 3.9.2.1.1.6. Table 3.9–13 depicts the number of potential behavioral harassment exposures that are estimated from underwater vibratory and impact pile driving.

Table 3.9–13. Number of Potential Exposures of Dall's Porpoise within Various Acoustic Threshold Zones, Alternative 1

Season	Density of Dall's Porpoise [1] (sq mi)	Underwater	
		Injury Threshold (180 dBRMS)	Behavioral Harassment Threshold (160 dB RMS and 120 dBRMS) [2]
Mid-July – Mid-February	0.04	0	200 – 400[3]

1. Density was calculated as the number of individuals observed in 18 surveys of the 1.5-square mile Bangor waterfront area (Tannenbaum et al. 2009a, 2011a).
2. Distance to the 160 dBRMS behavioral disturbance zone for impulsive noise is combined with distance to the 120 dBRMS behavioral disturbance zone for continuous noise.
3. The number of behavioral disturbance exposures calculated for Dall's porpoise was zero. Dall's porpoises are rarely present in Hood Canal and only one was observed in 18 surveys of the waters off NBK at Bangor. Since this individual was observed in deeper offshore waters encompassed by the continuous noise behavioral disturbance zone (120 dB threshold), it is possible that an animal may be exposed to behavioral disturbance due to pile driving with one impact hammer and three vibratory drivers operating concurrently. Therefore, the Navy believes that additional disturbance exposures may occur due to multiple-rig pile driving based on possible exposure of 1 Dall's porpoise per day during pile driving, for a total of 200–400 behavioral disturbance exposures due to vibratory pile driving over the course of the project.

Based on the adjusted exposures in Table 3.9–11 for the 120 dB continuous noise harassment threshold, 1 individual Dall's porpoise may experience SPLs on a given day that would qualify as potential behavioral harassment. The total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 200 to 400 (Table 3.9–13). Harassment due to elevated underwater noise is not expected to be significant because it is estimated that only a small number of Dall's porpoise would ever be present in the project area. Additionally, marine mammal observers will be monitoring the shutdown and buffer zones (see Appendix F for a detailed discussion of mitigation measures) for the presence of marine mammals, and will alert work crews when to begin or stop work due to the presence of Dall's porpoises in or near the shutdown and buffer zones, reducing the potential for behavioral harassment.

Harbor Porpoise

Harbor porpoises may be present in Hood Canal year round and are assumed to use the entire area. The Navy conducted vessel-based line transect surveys in Hood Canal during the Test Pile Program in fall 2011. Over the course of the surveys, the total trackline length was 259.01 km. Sightings of harbor porpoises during these surveys were used to generate a density for Hood Canal (preliminary data). Based on guidance from other line transect surveys conducted for harbor porpoises using similar monitoring parameters (i.e., boat speed, number of observers) (Barlow 1988; Calambokidis et al. 1993; Caretta et al. 2001), the Navy determined the effective strip width for the surveys to be 1 km, or a perpendicular distance of 500 meters from the transect to the left or right of the vessel. The effective strip width was set at the distance at

which the detection probability for harbor porpoises was equivalent to one, which assumes that all individuals on a transect are detected. Only sightings occurring within the effective strip width were used in the density calculation. By multiplying the trackline length of the surveys by the effective strip width, the total area surveyed during the surveys was 259.01 sq km. Thirty five individual harbor porpoises were sighted within this area, resulting in a density of 0.135 animals per sq km. A correction factor of 0.54 derived from other similar line transect surveys (Barlow 1988; Calambokidis et al. 1993; Carretta et al. 2001), was applied to account for animals that could not be detected because they are submerged. This resulted in a density of 0.250 harbor porpoises per sq km (0.6 animals/sq mi). Exposures were calculated using the formula in Section 3.9.2.1.1.6. Table 3.9–14 depicts the number of potential behavioral harassment exposures that are estimated from underwater vibratory and impact pile driving.

Table 3.9–14. Number of Potential Exposures of Harbor Porpoise within Various Acoustic Threshold Zones, Alternative 1

Season	Density of Harbor Porpoise [1] (sq mi)	Underwater	
		Injury Threshold (180 dBRMS)	Behavioral Harassment Threshold (160 dB and 120 dBRMS) [2]
Mid-July – Mid-February	0.6	0	2,000 – 4,000

1. Density was calculated as the number of individuals observed in Test Pile Program surveys covering 259.01 sq km, corrected for detectability g(0) = 0.54 (preliminary data).
2. Distance to the 160 dBRMS behavioral disturbance zone for impulsive noise is combined with distance to the 120 dBRMS behavioral disturbance zone for continuous noise.

Based on the density analysis and using the most conservative criterion for behavioral harassment (the 120 dB vibratory harassment threshold), up to 10 individual harbor porpoises are expected to experience SPLs on a given day that would qualify as harassment.

The total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 2,000 to 4,000 (Table 3.9–14). Harassment due to elevated underwater noise is not expected to be significant because it is estimated that only a small number of harbor porpoises would ever be present in the project area. Additionally, marine mammal observers will be monitoring the shutdown and buffer zones (see Appendix F for a detailed discussion of mitigation measures) for the presence of marine mammals, and will alert work crews when to begin or stop work due to the presence of harbor porpoises in or near the shutdown and buffer zones, reducing the potential for behavioral harassment.

3.9.2.1.1.8 Summary of Marine Mammal Potential Exposures to Injury or Behavioral Harassment

Based on the modeling results presented above, the total number of potential exposures to injury or behavioral harassment for the six marine mammal species that may occur within the project area are presented below in Table 3.9–15.

Table 3.9–15. Alternative 1: Summary of Potential Exposures for All Species during the In-Water Pile Driving Season (Mid-July to Mid-February)

Species	Underwater			Airborne		Total
	Injury Threshold (190 dB)	Injury Threshold (180 dB)	Behavioral Harassment Threshold (160 dB and 120 dB)[1]	Behavioral Harassment Threshold (100 dB)*	Behavioral Harassment Threshold (90 dB)*	
Steller sea lion	0	N/A	400 – 800[2]	0	N/A	400 – 800[2]
California sea lion	0	N/A	5,200 – 10,400	0	N/A	5,200 – 10,400
Harbor seal	0	N/A	10,800 – 21,600	N/A	0	10,800 – 21,600
Transient killer whale	N/A	0	400 – 800	N/A	N/A	400 – 800
Dall's porpoise	N/A	0	200 – 400[3]	N/A	N/A	200 – 400[3]
Harbor porpoise	N/A	0	2,000 – 4,000	N/A	N/A	2,000 – 4,000
Total	**0**	**0**	**19,000 – 38,000**	**0**	**0**	**19,000 – 38,000**
*** Airborne harassment thresholds do not specify pile driver type.**						

1. Distance to the 160 dBRMS behavioral disturbance zone for impulsive noise is combined with distance to the 120 dBRMS behavioral disturbance zone for continuous noise.
2. Steller sea lion distribution within the project area is patchy, with their occurrence concentrated near Delta Pier. Although only 1 exposure per day was calculated, it is more likely that more than one exposure would occur in a day. To ensure the Navy has adequate MMPA/ESA coverage during EHW-2 construction, the Navy increased the number of takes requested to 2 exposures per day of pile driving.
3. The number of behavioral harassment exposures calculated for Dall's porpoise was zero. Dall's porpoises are rarely present in Hood Canal and only one was observed in 18 surveys of the waters off NBK at Bangor. Since this individual was observed in deeper offshore waters encompassed by the continuous noise behavioral harassment zone (120 dB threshold), it is possible that an animal may be exposed to behavioral harassment due to pile driving with one impact hammer and three vibratory drivers operating concurrently. Therefore, the Navy believes that harassment exposures may occur due to multiple-rig pile driving based on possible exposure of 1 Dall's porpoise per day during pile driving, for a total of 200–400 behavioral harassment exposures due to vibratory pile driving over the course of the project.

3.9.2.1.2 OPERATION/LONG-TERM IMPACTS

Under existing conditions, the Bangor waterfront produces an environment of complex and highly variable noise and visual disturbance for marine mammals. Although the operation of the EHW-2 would not result in an increase of boat traffic or human activity, it would nonetheless divert a portion of the existing activity and boat traffic into an area that currently has a much lower human presence than other developed areas of the waterfront (e.g., the existing EHW, Service Pier, or Delta Pier). Activities associated with this alternative would include traffic from submarines and other vessels, as well as increased visual disturbance from human activity, artificial light, and increased ambient noise levels because of vehicle traffic; use of equipment such as forklifts, generators, and cranes. Marine mammals such as harbor seals may initially avoid the immediate vicinity of the EHW-2, but it is likely that most individuals would become habituated to the post-construction noise levels, as they have habituated to noise levels at other developed portions of the waterfront.

California sea lions, Steller sea lions, and harbor seals use various manmade structures at the Bangor waterfront for hauling out, but cannot use the existing EHW, nor would they be able to use the new wharf, trestles as haul-out sites, as the decks of these structures would be approximately 13 feet above MHHW. The shoreline abutment would be a vertical structure 10 feet high and would not be accessible for hauling out. Armor rock placed at the base of the

abutment could potentially be accessible to marine mammals. However, since the shoreline in the project area is not used for hauling out by any pinniped species under existing conditions, it is unlikely that pinnipeds would haul out in the vicinity of the EHW-2 in the future.

Decreased habitat value for forage fish, salmonids, other finfish, and, to a lesser extent, shellfish could result in minor long-term impacts to marine mammal prey availability in the upper portion of Hood Canal. The increased surface area of Alternative 1 overwater structures (6.3 acres) would reduce biological productivity overall through shading and reduction in the size of eelgrass beds and other marine vegetation (approximately 0.13 acre), and impacting the prey base (benthic organisms, ground fish, and pelagic fish) in the intertidal, subtidal, and nearshore deeper water zones. In addition, the EHW-2 would create a barrier to movement of shoreline-dependent fishes such as juvenile salmonids and forage fishes. Increased lighting at the EHW-2 may affect prey availability, depending on the species, for marine mammals. Some fish may be attracted by artificial lighting, which may in turn attract predators, including marine mammals, and facilitate their feeding. Overall, a localized change to the prey base in terms of abundance and species composition for some marine mammals is expected. However, prey availability for marine mammals in the broader area of the inland waters of Washington State, which encompasses the foraging area of these species, would not ultimately be impacted by the construction and future operation of the EHW-2 facility. Overall, the effects on prey availability for marine mammals would be minor and localized. The Mitigation Action Plan (Appendix F) describes the marine habitat mitigation action that the Navy would undertake as part of the proposed action. This habitat mitigation action, including mitigation for eelgrass, would compensate for the impacts of the proposed action to marine habitat and species.

Adverse impacts of the EHW-2 would be limited to the small area including and adjacent to the trestle and wharf (approximately 6.3 acres). In the context of the Hood Canal marine mammal populations overall, the affected area is too small to constitute an adverse impact. Thus no additional MMPA take or ESA exposure to adverse effects is expected with operation of the EHW-2.

Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components as required (no pile replacement). These activities could affect marine mammals through noise impacts and increased human activity and vessel traffic. However, noise levels would not be appreciably higher than existing levels at the Bangor industrial waterfront. Measures would be employed (Section 3.2.2) to avoid discharge of contaminants to the marine environment. Therefore, maintenance would have negligible impacts to marine mammals.

3.9.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.9.2.2.1 CONSTRUCTION

As described in Chapter 2 (Table 2–1), Alternative 2 differs from Alternative 1 in that it would use a larger number of smaller piles for construction of the wharf. The trestle alignments and dimensions would be the same. For marine mammals, the primary construction-related concerns are impacts resulting from pile driving and other construction noise and activity, which would differ from Alternative 1 as follows:

- Alternative 2 requires more piles (up to 1,460) than Alternative 1 (1,250).
- The in-water construction period for Alternative 2 would be longer than for Alternative 1: 275 to 550 (286 to 561 for airborne noise) days of pile driving over 3 to 4 in-water work seasons vs. 200 to 400 (211 to 411 for airborne noise) days of pile driving over 2 to 3

in-water work seasons. As a result, more potential exposures of marine mammals to behavioral harassment are estimated with Alternative 2 (Table 3.9–16) than Alternative 1.

Therefore, Alternative 2 would expose marine mammals to noise disturbance, construction vessel traffic, water quality impacts, prey availability impacts, and human activity for a much longer period of time, although the affected area would be the same as Alternative 1. In particular, Alternative 2 would likely require more in-water construction seasons compared to Alternative 1. These differences would neither increase nor decrease noise harassment threshold distances; therefore, the effect determination on ESA-listed species (Steller sea lion) would be the same as described for Alternative 1. Because the number of pile driving days would be greater for Alternative 2, the number of potential exposures of marine mammals under the ESA and MMPA would be greater than for Alternative 1.

3.9.2.2.2 OPERATION/LONG-TERM IMPACTS

Both alternatives would have the same operations and overwater footprint (i.e. the area in which potential prey species would be affected by shading and habitat loss); thus, no differences are expected in terms of disturbance or prey availability for marine mammals. Therefore, operational impacts to marine mammals would be the same as those described for Alternative 1. Maintenance of the EHW-2 under Alternative 2 would have similar impacts to marine mammals as Alternative 1.

Table 3.9–16. Alternative 2: Summary of Potential Exposures for All Species during the In-Water Pile Driving Season (Mid-July to Mid-February)

	UNDERWATER			AIRBORNE		
SPECIES	Injury Threshold (190 dB)	Injury Threshold (180 dB)	Behavioral Harassment Threshold (160 dB and 120 dB)[1]	Behavioral Harassment Threshold (100 dB)*	Behavioral Harassment Threshold (90 dB)*	TOTAL
Steller sea lion	0	N/A	550 – 1100[2]	0	N/A	550 – 1,100[2]
California sea lion	0	N/A	7,150 – 14,300	0	N/A	7,150 –14,300
Harbor seal	0	N/A	14,850 – 29,700	N/A	0	14,850 –29,700
Transient killer whale	N/A	0	550 – 1,100	N/A	N/A	550 – 1,100
Dall's porpoise	N/A	0	275 – 550[3]	N/A	N/A	275 – 550[3]
Harbor porpoise	N/A	0	2,750 – 5,500	N/A	N/A	2,750 – 5,500
Total	**0**	**0**	**26,125 – 52,250**	**0**	**0**	**26,125 – 52,250**
*** Airborne harassment thresholds do not specify pile driver type.**						

1. Distance to the 160 dBRMS behavioral disturbance zone for impulsive noise is combined with distance to the 120 dBRMS behavioral disturbance zone for continuous noise.
2. Steller sea lion distribution within the project area is patchy, with their occurrence concentrated near Delta Pier. Although only 1 exposure per day was calculated, it is more likely that more than one exposure would occur in a day. To ensure the Navy has adequate MMPA/ESA coverage during EHW-2 construction, the Navy increased the number of takes requested to 2 exposures per day of pile driving.
3. The number of behavioral harassment exposures calculated for Dall's porpoise was zero. Dall's porpoises are rarely present in Hood Canal and only one was observed in 18 surveys of the waters off NBK at Bangor. Since this individual was observed in deeper offshore waters encompassed by the continuous noise behavioral harassment zone (120 dB threshold), it is possible that an animal may be exposed to behavioral harassment due to pile driving with one impact hammer and three vibratory drivers operating concurrently. Therefore, the Navy believes that harassment exposures may occur due to multiple-rig pile driving based on possible exposure of 1 Dall's porpoise per day during pile driving, for a total of 275–550 behavioral harassment exposures due to vibratory pile driving over the course of the project.

3.9.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.9.2.3.1 CONSTRUCTION

As described in Chapter 2 (Table 2–1), Alternative 3 differs from Alternative 1 in that it would use separate trestles to access the wharf rather than a combined trestle. The wharf configuration would be the same for both alternatives. For marine mammals, the primary construction-related concerns are impacts resulting from pile driving noise and other construction noise and activity, which would differ from Alternative 1 as follows:

- Alternative 3 requires more piles (up to 1,290) than Alternative 1 (1,250).
- The in-water construction period for Alternative 3 would be slightly longer than for Alternative 1: 210 to 420 (226 to 436 for airborne noise) days of pile driving over 2 to 3 in-water work seasons vs. 200 to 400 (211 to 411 for airborne noise) days of pile driving over 2 to 3 in-water work seasons. As a result, more potential exposures of marine mammals to behavioral harassment are estimated with Alternative 3 (Table 3.9–17) than Alternative 1.

Table 3.9–17. Alternative 3: Summary of Potential Exposures for All Species during the In-Water Pile Driving Season (Mid-July to Mid-February)

	UNDERWATER			AIRBORNE		
SPECIES	Injury Threshold (190 dB)	Injury Threshold (180 dB)	Behavioral Harassment Threshold (160 dB and 120 dB)[1]	Behavioral Harassment Threshold (100 dB)*	Behavioral Harassment Threshold (90 dB)*	TOTAL
Steller sea lion	0	N/A	420 – 840[2]	0	N/A	420 – 840[2]
California sea lion	0	N/A	5,460 – 10,920	0	N/A	5,460 – 10,920
Harbor seal	0	N/A	11,340 – 22,680	N/A	0	11,340 – 22,680
Transient killer whale	N/A	0	420 – 840	N/A	N/A	420 – 840
Dall's porpoise	N/A	0	210 – 420[3]	N/A	N/A	210 – 420[3]
Harbor porpoise	N/A	0	2,100 – 4,200	N/A	N/A	2,100 – 4,200[2]
Total	**0**	**0**	**19,950 – 39,900**	**0**	**0**	**19,950 – 39,900**
*** Airborne harassment thresholds do not specify pile driver type.**						

1. Distance to the 160 dBRMS behavioral disturbance zone for impulsive noise is combined with distance to the 120 dBRMS behavioral disturbance zone for continuous noise.
2. Steller sea lion distribution within the project area is patchy, with their occurrence concentrated near Delta Pier. Although only 1 exposure per day was calculated, it is more likely that more than one exposure would occur in a day. To ensure the Navy has adequate MMPA/ESA coverage during EHW-2 construction, the Navy increased the number of takes requested to 2 exposures per day of pile driving.
3 The number of behavioral harassment exposures calculated for Dall's porpoise was zero. Dall's porpoises are rarely present in Hood Canal and only one was observed in 18 surveys of the waters off NBK at Bangor. Since this individual was observed in deeper offshore waters encompassed by the continuous noise behavioral harassment zone (120 dB threshold), it is possible that an animal may be exposed to behavioral harassment due to pile driving with one impact hammer and three vibratory drivers operating concurrently. Therefore, the Navy believes that harassment exposures may occur due to multiple-rig pile driving based on possible exposure of 1 Dall's porpoise per day during pile driving, for a total of 210–420 behavioral harassment exposures due to vibratory pile driving over the course of the project.

- Thus, Alternative 3 would expose marine mammals to underwater noise disturbance, construction vessel traffic, water quality impacts, prey availability impacts, and human activity for a slightly longer period of time than Alternative 1. The extent of construction-period impacts to benthic habitats would be slightly larger: 25.8 acres for Alternative 3 compared to 25.7 acres for Alternative 1, but impacts to marine vegetation would be similar: approximately 0.9 acre for Alternative 1 and 1.0 acre for Alternative 3.
- These differences would neither increase nor decrease noise harassment threshold distances; therefore, the effect determination on ESA-listed species (Steller sea lion) would be the same as described for Alternative 1. Because the number of pile driving days would be greater for Alternative 3, the potential number of number of potential exposures of marine mammals under the ESA and MMPA would be greater than for Alternative 1.

3.9.2.3.2 OPERATION/LONG-TERM IMPACTS

Alternatives 1 and 3 would have the same operations, but the nearshore overwater footprint (i.e., the area in which potential prey species would be affected by shading and habitat loss) would be slightly greater with Alternative 3 (6.6 acres vs. 6.3 acres of total benthic habitat impacts for Alternative 3 compared to Alternative 1, of which 0.13 acre and 0.17 acre of marine vegetation would be affected, respectively). In the context of the wide ranges covered by marine mammals in general, differences in operational impacts to marine mammals of the two alternatives would be negligible. Maintenance of the EHW-2 under Alternative 3 would have similar impacts to marine mammals as Alternative 1.

3.9.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.9.2.4.1 CONSTRUCTION

As described in Chapter 2 (Table 2–1), Alternative 4 differs from Alternative 1 in that it would use a larger number of smaller piles for construction of the wharf, and a larger number of piles for the trestles. For marine mammals, the primary construction-related concerns are impacts resulting from pile driving, which would differ from Alternative 1 as follows:

- Alternative 4 requires more piles (up to 1,500) than Alternative 1 (1,250).
- The in-water construction period for Alternative 4 would be longer than for Alternative 1: 290 to 570 (306 to 586 for airborne noise) days of pile driving over 3 to 4 in-water work seasons vs. 200 to 400 (211 to 411 for airborne noise) days of pile driving over 2 to 3 in-water work seasons. As a result, more potential exposures of marine mammals to behavioral harassment are estimated with Alternative 3 (Table 3.9–18) than Alternative 1.
- Therefore, Alternative 4 would expose marine mammals to underwater noise disturbance, construction vessel traffic, water quality impacts, prey availability impacts, and human activity for a much longer period of time than Alternative 1. The extent of construction-period impacts to benthic habitats would be slightly larger: 25.8 acres for Alternative 4 compared to 25.7 acres for Alternative 1, but impacts to marine vegetation would be similar: approximately 0.9 acre for Alternative 1 and 1.0 acre for Alternative 4.

- These differences would neither increase nor decrease noise harassment threshold distances; therefore, the effect determination on ESA-listed species (Steller sea lion) would be the same as described for Alternative 4. Because the number of pile driving days would be greater for Alternative 4, the number of potential exposures of marine mammals under the ESA and MMPA would be greater than for Alternative 1.

3.9.2.4.2 OPERATION/LONG-TERM IMPACTS

Alternatives 1 and 4 would have the same operations, but the nearshore overwater footprint (i.e., the area in which potential prey species would be affected by shading and habitat loss) would be slightly greater with Alternative 4 (6.6 acres vs. 6.3 acres of total benthic habitat impacts for Alternative 4 compared to Alternative 1, of which 0.17 acre and 0.13 acre of marine vegetation would be affected, respectively). In the context of the wide ranges covered by marine mammals in general, differences in operational impacts to marine mammals of the two alternatives would be negligible. Maintenance of the EHW-2 under Alternative 4 would have similar impacts to marine mammals as Alternative 1.

Table 3.9–18. Alternative 4: Summary of Potential Exposures for All Species during the In-Water Pile Driving Season (Mid-July to Mid-February)

Species	Underwater			Airborne		Total
	Injury Threshold (190 dB)	Injury Threshold (180 dB)	Behavioral Harassment Threshold (160 db and 120 dB)[1]	Behavioral Harassment Threshold (100 dB)*	Behavioral Harassment Threshold (90 dB)*	
Steller sea lion	0	N/A	580 – 1,140[2]	0	N/A	580 – 1,140[2]
California sea lion	0	N/A	7,540 – 14,820	0	N/A	7,540 – 14,820
Harbor seal	0	N/A	15,660 – 30,780	N/A	0	15,660 – 30,780
Transient killer whale	N/A	0	580 – 1,140	N/A	N/A	580 – 1,140
Dall's porpoise	N/A	0	290 – 570[3]	N/A	N/A	290 – 570[3]
Harbor porpoise	N/A	0	2,900 – 5,700	N/A	N/A	2,900 – 5,700
Total	**0**	**0**	**27,550 – 54,150**	**0**	**0**	**27,550 – 54,150**
*** Airborne harassment thresholds do not specify pile driver type.**						

1. Distance to the 160 dBRMS behavioral disturbance zone for impulsive noise is combined with distance to the 120 dBRMS behavioral disturbance zone for continuous noise.
2. Steller sea lion distribution within the project area is patchy, with their occurrence concentrated near Delta Pier. Although only 1 exposure per day was calculated, it is more likely that more than one exposure would occur in a day. To ensure the Navy has adequate MMPA/ESA coverage during EHW-2 construction, the Navy increased the number of takes requested to 2 exposures per day of pile driving.
3. The number of behavioral harassment exposures calculated for Dall's porpoise was zero. Dall's porpoises are rarely present in Hood Canal and only one was observed in 18 surveys of the waters off NBK at Bangor. Since this individual was observed in deeper offshore waters encompassed by the continuous noise behavioral harassment zone (120 dB threshold), it is possible that an animal may be exposed to behavioral harassment due to pile driving with one impact hammer and three vibratory drivers operating concurrently. Therefore, the Navy believes that harassment exposures may occur due to multiple-rig pile driving based on possible exposure of 1 Dall's porpoise per day during pile driving, for a total of 290–570 behavioral harassment exposures due to vibratory pile driving over the course of the project.

3.9.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.9.2.5.1 CONSTRUCTION

As described in Chapter 2 (Table 2–1), Alternative 5 differs from Alternative 1 in that it would use a floating wharf supported by pontoons that would be wider than the pile-supported wharf in Alternative 1, but the combined trestles would be of similar dimensions. For marine mammals, the primary construction-related concerns are impacts resulting from pile driving, which would differ from Alternative 1 as follows:

- Significantly fewer piles would be required with Alternative 5 (up to 440 compared to up to 1,250 with Alternative 1).
- The in-water construction period for Alternative 5 would be significantly shorter than for Alternative 1: 135 to 175 (146 to 186 for airborne noise) days of pile driving over 2 in-water work seasons compared to 200 to 400 days over 2 to 3 in-water work seasons, respectively. As a result, fewer potential exposures of marine mammals to behavioral harassment are estimated with Alternative 5 (Table 3.9–19) than Alternative 1.

Table 3.9–19. Alternative 5: Summary of Potential Exposures for All Species during the In-Water Pile Driving Season (Mid-July to Mid-February)

SPECIES	UNDERWATER			AIRBORNE		TOTAL
	Injury Threshold (190 dB)	Injury Threshold (180 dB)	Behavioral Harassment Threshold (160 dB and 120 dB[1])	Behavioral Harassment Threshold (100 dB)*	Behavioral Harassment Threshold (90 dB)*	
Steller sea lion	0	N/A	270 – 350[2]	0	N/A	270 – 350[2]
California sea lion	0	N/A	3,510 – 4,550	0	N/A	3,510 – 4,550
Harbor seal	0	N/A	7,290 – 9,450	N/A	0	7,290 – 9,450
Transient killer whale	N/A	0	270 – 350	N/A	N/A	270 – 350
Dall's porpoise	N/A	0	135 – 175[3]	N/A	N/A	135 – 175[3]
Harbor porpoise	N/A	0	1,350 – 1,750	N/A	N/A	1,350 – 1,750
Total	**0**	**0**	**12,825 – 16,625**	**0**	**0**	**12,825 – 16,625**
*** Airborne harassment thresholds do not specify pile driver type.**						

1. Distance to the 160 dBRMS behavioral disturbance zone for impulsive noise is combined with distance to the 120 dBRMS behavioral disturbance zone for continuous noise.
2. Steller sea lion distribution within the project area is patchy, with their occurrence concentrated near Delta Pier. Although only 1 exposure per day was calculated, it is more likely that more than one exposure would occur in a day. To ensure the Navy has adequate MMPA/ESA coverage during EHW-2 construction, the Navy increased the number of takes requested to 2 exposures per day of pile driving.
3 The number of behavioral harassment exposures calculated for Dall's porpoise was zero. Dall's porpoises are rarely present in Hood Canal and only one was observed in 18 surveys of the waters off NBK at Bangor. Since this individual was observed in deeper offshore waters encompassed by the continuous noise behavioral harassment zone (120 dB threshold), it is possible that an animal may be exposed to behavioral harassment due to pile driving with one impact hammer and three vibratory drivers operating concurrently. Therefore, the Navy believes that harassment exposures may occur due to multiple-rig pile driving based on possible exposure of 1 Dall's porpoise per day during pile driving, for a total of 135–175 behavioral harassment exposures due to vibratory pile driving over the course of the project.

Alternative 5 would expose marine mammals to noise disturbance, construction vessel traffic, water quality impacts, prey availability impacts, and human activity for a shorter period of time. The extent of construction-period impacts to benthic habitats would be larger: 29.5 acres for Alternative 5 compared to 25.7 acres for Alternative 1, of which 2.4 acres and 0.9 acre of marine vegetation would be affected, respectively.

These differences would neither increase nor decrease noise harassment threshold distances; therefore, the effect determination for ESA-listed species (Steller sea lion) would be the same as described for Alternative 1. Because the number of pile driving days would be fewer for Alternative 5, the number of potential exposures of marine mammals under the ESA and MMPA would be less than for Alternative 1.

3.9.2.5.2 OPERATION/LONG-TERM IMPACTS

Alternatives 1 and 5 would have the same operations but Alternative 5 would be larger (8.5 acres compared to 6.3 acres) and closer to the shoreline. Within the affected benthic habitats, Alternative 5 would impact 0.20 acre of marine vegetation compared to 0.13 acre with Alternative 1. Nearshore impacts on potential prey species would be greater with Alternative 5 because of the larger overwater footprint but the effects on deeper water prey species would be less than with Alternative 1. In the context of the wide ranges covered by marine mammals in Hood Canal, differences in operational impacts to marine mammals of the two alternatives would be minor. Maintenance of the EHW-2 under Alternative 5 would have similar impacts to marine mammals as Alternative 1.

3.9.2.6 No-Action Alternative

There would be no construction- or operations-related activities that would disturb marine mammals in the project area under the No-Action Alternative. Therefore, this alternative would have no impacts to marine mammals.

3.9.2.7 Mitigation Measures and Regulatory Compliance

3.9.2.7.1 MITIGATION MEASURES

Appropriate and effective mitigation measures that would be in compliance with the MMPA and ESA are described in detail in the Mitigation Action Plan (Appendix F). Mitigation measures and current practices to reduce direct impacts to marine mammals would include the following:

- The primary pile driving method would be a vibratory driver. This equipment generates less intense noise than an impact hammer.
- A bubble curtain other noise attenuating device would reduce underwater impact pile driving noise levels by approximately 10 dB, as described in Section 3.4.2.
- Using a soft-start approach at the beginning of each pile driving session may provide additional protection to marine mammals by providing a warning and/or giving marine mammals a chance to leave the area prior to the hammer operating at full capacity.
- A monitoring program using trained marine mammal observers would be implemented during construction of the EHW-2 that would include acoustic measurements, visual monitoring of marine mammals, and procedures for responding to the presence of marine mammals within the shutdown zone and the buffer zone. The shutdown zone would correspond to the area within which marine mammal injury could potentially occur

(based on the 180 dB injury criterion for cetaceans and the 190 dB injury criterion for pinnipeds for impact pile driving or a zone no smaller than 10 meters), and will monitor additional area with a buffer zone to document behavioral responses of marine mammals to construction activities. Prior to the start of pile driving activity, the shutdown and buffer zones would be monitored to ensure that they are clear of marine mammals, and pile driving would only commence once observers have declared the shutdown zone clear of marine mammals. If a marine mammal approaches or enters the shutdown zone during the course of pile driving operations, pile driving would be halted or delayed until either the animal has voluntarily left or 15 minutes have passed without detection of the animal.

- An absorbent oil containment boom would be placed around the construction area to contain accidental gas or oil spills to ensure that marine mammals are not impacted by oil spills.
- A floating debris barrier would be placed around the construction site to contain construction debris to avoid injury to marine mammals. Details of the debris barrier would be provided by the construction contractor in an approved Debris Management Plan (see Section 3.2.2).

3.9.2.7.2 MMPA COMPLIANCE

Steller sea lions, California sea lions, harbor seals, transient killer whales, Dall's porpoises, and harbor porpoises would be exposed at sound levels that would constitute Level B harassment under the MMPA. Any exposure to behavioral disturbance would likely have a minor effect on the individual and any effect at the population, stock, or species level would be negligible. In accordance with the MMPA, the Navy is applying to NMFS for the incidental, but not intentional, taking of marine mammals. Two types of authorizations are available from NMFS for incidental take (16 USC 1371 § 101(a)(5)). An LOA would be issued if the potential for serious injury and/or mortalities exists and no mitigating measures could be taken to prevent this from occurring. An IHA would be issued for incidental take of marine mammals by harassment, where it may be shown that:

1. There is no potential for serious injury or mortality, or
2. The potential for serious injury or mortality can be negated through mitigation requirements that could be required under the authorization.

The Navy applied for an IHA for the first year of construction of the EHW-2 in May 2011 and subsequently submitted addenda to the application, the last of which was in December 2011 (NAVFAC 2011c). The proposed rule on the IHA application was published in the FR in late December 2011 for public comment. The Navy is in consultation with NMFS over conditions of the authorization, which would include mitigation measures, monitoring, and reporting requirements. In the MMPA permit applications, the Navy requested the maximum expected number of takes. As a conservative measure and based on past consultation history, the Navy requested takes for underwater behavioral disturbance for one species (Dall's porpoise) where the calculations determined no exposures would occur. The Navy will prepare and submit additional MMPA authorization applications to cover subsequent years of the project. The Navy will comply with requirements included in all future NMFS authorizations under the MMPA.

3.9.2.7.3 ESA COMPLIANCE

Steller sea lion (Eumetopias jubatus), an ESA-listed species, occurs at the Bangor waterfront during the proposed in-water construction season and would be exposed to project-related effects. Southern resident killer whales (Orcinus orca) do not occur at the Bangor waterfront but may be indirectly affected by project effects on their preferred prey, Chinook salmon. The Navy submitted a biological assessment of Alternative 1 for Steller sea lion and southern resident killer whale to NMFS as part of ESA Section 7 consultation (NAVFAC 2011b). The effect determination for the proposed project is "may affect, likely to adversely affect" for Steller sea lions due to the potential for exposures to underwater SPLs that could cause behavioral disturbance. The effect determination for the proposed project was "may affect, not likely to adversely affect" for southern resident killer whales due to indirect effects on their prey base.

NMFS issued a Biological Opinion of Alternative 1 for ESA-listed marine mammal species on September 29, 2011 (NMFS 2011). NMFS concluded that the proposed action (Alternative 1) has the potential to expose Steller sea lions to sound generated by pile driving activities, but will not affect population viability or jeopardize the continued existence of the Steller sea lion. Critical habitat has not been designated or proposed for Steller sea lion in the action area; therefore, the proposed action would not affect critical habitat. NMFS did not include an ITS for Steller sea lion because incidental take of marine mammals has not yet been authorized under the MMPA. The ITS must wait until the MMPA rule making process is complete. At that time, the IHA provided by NMFS in their final rule will authorize the Navy to "take" marine mammals pursuant to the MMPA. NMFS will then complete Section 7 consultations on the issuance of the IHA, and may issue an amended Biological Opinion at the conclusion of those consultations that would include ITS for listed marine mammals. No reasonable and prudent measures or terms and conditions specific to Steller sea lion were provided in the current Biological Opinion. If NMFS issues an amended Biological Opinion, the Navy will comply with all reasonable and prudent measures and the required terms and conditions.

With regard to southern resident killer whales, NMFS (2011) also found that potential adverse effects on the prey base (salmonids) of southern resident killer whales would result in an insignificant reduction in prey resources for southern resident killer whales that may intercept these species within their range. NMFS (2011) concluded that the potential effects of the proposed action are insignificant and concurred that the proposed action may affect, but is not likely to adversely affect southern resident killer whales. Therefore, no reasonable and prudent measures or terms and conditions specific to southern resident killer whale were provided. There is no designated critical habitat in the action area for southern resident killer whale. NMFS found that potential adverse effects on southern resident killer whale critical habitat are discountable or insignificant and provided a determination of "may affect, not likely to adversely affect" southern resident killer whale critical habitat.

3.9.3 Summary of Impacts

Impacts to marine mammals during the construction and operations phase of each of the project alternatives, and mitigation measures, are summarized in Table 3.9–20. Table 3.9–21 is a comparison of behavioral exposures of marine mammals by species and alternative.

Table 3.9–20. Summary of Impacts to Marine Mammals

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE MAMMALS
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Increased underwater noise during pile driving sufficient to exceed NMFS disturbance thresholds for marine mammals. There would be 200 to 400 pile driving days and 2 to 3 in-water work seasons. Non-take impacts due to increased vessel traffic, human activity, and airborne construction noise. Indirect effects on prey species due to temporary degradation of habitat. *Operations/Long-term Impacts:* Indirect effects on prey species due to changes in benthic habitat and barriers to migratory fish. *MMPA:* The proposed action would expose all marine mammal species to sound levels that would constitute Level B harassment. 19,000 – 38,000 behavioral disturbance exposures due to impact and vibratory pile driving. *ESA:* The Navy concludes the appropriate effect determination for construction and operation is “may affect, likely to adversely affect” for listed Steller sea lion. The Navy requested 400–800 behavioral disturbance exposures due to impact and vibratory pile driving. The Navy concludes the appropriate effect determination for southern resident killer whale is “may affect, not likely to adversely affect”. In its Biological Opinion, NMFS (2011) found that it is likely that Steller sea lions would be exposed to and disturbed by sound generated by pile driving activities, but the proposed action (Alternative 1) will not affect population viability or jeopardize the continued existence of the Steller sea lion. NMFS (2011) also found that potential adverse effects on the prey base (salmonids) of southern resident killer whales would result in an insignificant reduction in prey resources for southern resident killer whales that may intercept these species within their range. NMFS (2011) concluded that the potential effects of the proposed action are insignificant and concurred that the proposed action may affect, but is not likely to adversely affect southern resident killer whales. There is no designated critical habitat in the action area for Steller sea lion or southern resident killer whale. In its Biological Opinion, NMFS (2011) found that potential adverse effects on southern resident killer whale critical habitat are discountable or insignificant and determined that the effect determination for the proposed action is “may affect, not likely to adversely affect” for southern resident killer whale critical habitat.

Table 3.9–20. Summary of Impacts to Marine Mammals (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE MAMMALS
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Increased underwater noise during pile driving sufficient to exceed NMFS disturbance thresholds for marine mammals. Non-take impacts due to increased vessel traffic, human activity, and airborne construction noise. Indirect effects on prey species due to temporary degradation of habitat. Greater potential for impacts than Alternative 1 due to more pile driving days (275–550 vs. 200–400) and an additional in-water work season (3 to 4 vs. 2 to 3). *Operation/Long-term Impacts:* Same indirect effects on prey species due to changes in benthic habitat and barriers to migratory fish compared to Alternative 1. *MMPA:* The proposed action would expose marine mammal species to sound levels that would constitute Level B harassment. Increased exposures of marine mammals compared to Alternative 1 due to more pile driving days. 26,125 – 52,250 behavioral disturbance exposures due to impact and vibratory pile driving. *ESA:* The Navy concludes the appropriate effect determination for construction and operation is "may affect, likely to adversely affect" for listed Steller sea lion. The Navy concludes the appropriate effect determination for southern resident killer whale is "may affect, not likely to adversely affect." This alternative would have increased exposures to sound levels compared to Alternative 1 due to more pile driving days. The Navy requested 550–1,100 behavioral disturbance exposures for Steller sea lion due to impact and vibratory pile driving. The Biological Opinion (NMFS 2011) determinations for Steller sea lion and southern resident killer whale are provided above in the summary for Alternative 1.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Increased underwater noise during pile driving sufficient to exceed NMFS disturbance thresholds for marine mammals. Non-take impacts due to increased vessel traffic, human activity, and airborne construction noise. Slightly increased indirect effects on prey species due to temporary degradation of habitat compared to Alternative 1. Slightly greater potential for impacts than Alternative 1 due to more pile driving days (210–420 vs. 200–400). *Operation/Long-term Impacts:* Slightly increased indirect effects on prey species due to changes in benthic habitat and barriers to migratory fish compared to Alternative 1. *MMPA*: The proposed action would expose marine mammal species to sound levels that would constitute Level B harassment. Slightly increased exposures of marine mammals compared to Alternative 1 due to more pile driving days. 19,950 – 39,900 behavioral disturbance exposures due to impact and vibratory pile driving. *ESA:* The Navy concludes the appropriate effect determination for construction and operation is "may affect, likely to adversely affect" for listed Steller sea lion. The Navy concludes the appropriate effect determination for southern resident killer whale is "may affect, not likely to adversely affect." This alternative would have slightly increased exposures to sound levels compared to Alternative 1 due to more pile driving days. The Navy requested 420–840 behavioral disturbance exposures for Steller sea lion due to impact and vibratory pile driving. The Biological Opinion (NMFS 2011) determinations for Steller sea lion and southern resident killer whale are provided above in the summary for Alternative 1.

Table 3.9–20. Summary of Impacts to Marine Mammals (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE MAMMALS
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Increased underwater noise during pile driving sufficient to exceed NMFS disturbance thresholds for marine mammals. Non-take impacts due to increased vessel traffic, human activity, and airborne construction noise. Slightly increased indirect effects on prey species due to temporary degradation of habitat compared to Alternative 1. Longer duration (290–570 vs. 200–400 days) of pile driving impacts compared to Alternative 1. 3 to 4 in-water work seasons would be 1 season more than Alternative 1. *Operation/Long-term Impacts:* Slightly increased indirect effects on prey species due to changes in benthic habitat and barriers to migratory fish compared to Alternative 1. *MMPA:* The proposed action would expose marine mammal species to sound levels that would constitute Level B harassment. Increased exposures of marine mammals compared to Alternative 1 due to more pile driving days. 27,550 – 54,150 behavioral disturbance exposures due to impact and vibratory pile driving. *ESA:* The Navy concludes the appropriate effect determination for construction and noise is "may affect, likely to adversely affect" for listed Steller sea lion. The Navy concludes the appropriate effect determination for southern resident killer whale is "may affect, not likely to adversely affect." This alternative would have increased exposures to sound levels compared to Alternative 1 due to more pile driving days. The Navy requested 580–1,140 behavioral disturbance exposures for Steller sea lion due to impact and vibratory pile driving. The Biological Opinion (NMFS 2011) determinations for Steller sea lion and southern resident killer whale are provided above in the summary for Alternative 1.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Increased underwater noise during pile driving sufficient to exceed NMFS disturbance thresholds for marine mammals. Non-take impacts due to increased vessel traffic, human activity, and airborne construction noise. Increased indirect effects on prey species due to temporary degradation of habitat compared to Alternative 1. Less potential for noise impacts due to fewer pile driving days (135–175 vs. 200–400) compared to Alternative 1 and only 2 in-water work seasons. *Operation/Long-term Impacts:* Increased indirect effects on prey species due to changes in benthic habitat and barriers to migratory fish compared to Alternative 1. *MMPA:* The proposed action would expose marine mammal species to sound levels that would constitute Level B harassment. Fewer exposures of marine mammals compared to Alternative 1 due to fewer pile driving days. 12,825 – 16,625 behavioral disturbance exposures due to impact and vibratory pile driving. *ESA:* The Navy concludes the appropriate effect determination for construction and operation is "may affect, likely to adversely affect" for listed Steller sea lion. The Navy concludes the appropriate effect determination for southern resident killer whale is "may affect, not likely to adversely affect." This alternative would have fewer exposures to sound levels compared to Alternative 1 due to fewer pile driving days. The Navy requested 270–350 behavioral disturbance exposures for Steller sea lion due to impact and vibratory pile driving. The Biological Opinion (NMFS 2011) determinations for Steller sea lion and southern resident killer whale are provided above in the summary for Alternative 1.

Table 3.9–20. Summary of Impacts to Marine Mammals (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE MAMMALS
No-Action Alternative	No impact.
Mitigation: Under all alternatives, the Mitigation Action Plan (see Appendix F) would compensate for the impacts to aquatic resources. The following mitigation measures would reduce direct impacts to marine mammals. • Use of a bubble curtain or other noise attenuating device during impact pile driving. • Use of a mechanical soft-start approach at the beginning of each impact and vibratory pile driving session to induce marine mammals to leave the immediate pile driving area. • Marine mammal monitoring program that includes designation of pile driving shutdown zone and buffer zone, and procedures for responding to presence of marine mammals within these zones.	
Consultation and Permit Status • The Navy applied to NMFS for an IHA for the first year of construction of the EHW-2 in May 2011 and subsequently submitted several addenda to the application, the last of which was in December 2011 (NAVFAC 2011c). The proposed rule on the IHA application was published in the FR in late December 2011 for public comment and the Navy is in consultation with NMFS over conditions of the authorization. The Navy will comply with measures contained in NMFS' authorization. The Navy will prepare and submit additional MMPA authorization applications to cover subsequent years of the project. • The Navy submitted a biological assessment for Steller sea lion and southern resident killer whale for Alternative 1 to NMFS as part of ESA Section 7 consultation (NAVFAC 2011b). NMFS issued a Biological Opinion (NMFS 2011) on September 29, 2011, on the Steller sea lion and southern resident killer whale under the ESA and concurred with these effect determinations but did not include an ITS because "take" of marine mammals has not yet been authorized under the MMPA. After NMFS issues an IHA allowing the Navy to "take" marine mammals pursuant to the MMPA, NMFS will complete Section 7 consultations on the issuance of the IHA. NMFS may issue an amended Biological Opinion at the conclusion of those consultations that would include incidental take statements for listed marine mammals. The Navy will comply with any terms and conditions that NMFS may issue in an amended Biological Opinion (as described in Section 3.9.2.7).	

Table 3.9–21. Total Potential Behavioral Exposures for Each Species by Alternative

SPECIES	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5
Steller sea lion	400–800	550–1,100	420–840	580–1,140	270–350
California sea lion	5,200–10,400	7,150–14,300	5,460–10,920	7,540–14,820	3,510–4,550
Harbor seal	10,800–21,600	14,850–29,700	11,340–22,680	15,660–30,780	7,290–9,450
Transient killer whale	400–800	550–1,100	420–840	580–1,140	270–350
Dall's porpoise	200–400	275–550	210–420	290–570	135–175
Harbor porpoise	2,000–4,000	2,750–5,500	2,100–4,200	2,900–5,700	1,350–1,750
Total	**19,000–38,000**	**26,125–52,250**	**19,950–39,900**	**27,550–54,150**	**12,825–16,625**

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3.10 MARINE BIRDS

Major groupings of marine birds that occur on NBK at Bangor include shorebirds, wading birds, marine waterfowl, raptors, and seabirds (Table 3.10–1), which use the waters in and around the EHW-2 project site. Marine birds use manmade structures on the marine waterfront and trees along the shoreline for perching, resting, and (for a few species) nesting, but in general they focus on marine habitats and food resources to meet their needs. Marine bird species may also use upland areas; however, the upland environment for wildlife is discussed in Section 3.15, Wildlife. Marbled murrelets, an ESA-listed species, are present in the marine environment on NBK at Bangor.

The ESA (7 USC §36 and 16 USC §1531) protects fish, wildlife, and plant species that are listed as threatened or endangered in the United States or elsewhere. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking or approving actions that may jeopardize listed species. The ESA also protects the designated critical habitat of listed species. The ESA defines "take" to mean harass, harm, kill, or capture, among other actions. "Harm" is defined to include adverse habitat modification. USFWS is authorized to oversee compliance with the ESA (7 USC §36 and 16 USC §1531 et seq.) for federally listed wildlife species. Aside from the ESA-listed marine mammal species discussed in Section 3.9, the only listed wildlife species that has been observed in the vicinity of NBK at Bangor is the marbled murrelet. The Navy submitted a biological assessment and consulted formally with USFWS on potential effects of the proposed action on listed species (NAVFAC 2011b). USFWS issued a Biological Opinion placing terms and conditions on project construction to minimize effects on ESA-protected species. These include hydroacoustic monitoring and marbled murrelet monitoring during pile driving, and the shutdown of pile driving when marbled murrelets are present within areas where injury could occur due to pile driving noise.

The Migratory Bird Treaty Act (MBTA) (16 USC 703 et seq.) and EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, protect migratory birds from harm, except as permitted by USFWS for purposes such as banding, scientific collecting, taxidermy, falconry, depredation control, and other regulated activities such as game bird hunting. Harm includes actions that "result in pursuit, hunting, taking, capture, killing, possession, or transportation of any migratory bird, bird part, nest, or egg thereof." Bald eagles are protected under both the MBTA and the Bald and Golden Eagle Protection Act (16 USC § 668), which prohibits the taking of bald eagles through pursuit, shooting, poison, killing, trapping, collecting, disturbance, or transportation.

Consultation and Permit Compliance Status. USFWS issued a Biological Opinion in November 2011 placing terms and conditions on project construction to minimize effects on this ESA-protected species. The Navy consulted with USFWS regarding the MBTA and Bald and Golden Eagle Protection Act.

3.10.1 Existing Environment

Shorebirds and marine waterfowl are mostly present near the EHW-2 project site during the winter months and during migration periods (Table 3.10–1). However, several species such as killdeer, spotted sandpiper (shorebirds), Canada geese, and dabbling duck species (waterfowl) are present year round. Seabirds (such as gulls and terns) and diving-pursuit birds (such as cormorant, murre, and guillemot) also occur year round. The marine environment on NBK at Bangor (including the EHW-2 project site) provides habitat for nesting, foraging, loafing, social interaction, and brood rearing. Two fish-eating raptor species may be present near the EHW-2 project site. The bald eagle is a year-round resident and the osprey is a summer resident.

Table 3.10–1. Marine Bird Groupings and Families at the Bangor Waterfront

Marine Bird Grouping	Marine Bird Families	Season(s) of Occurrence	Preferred Habitats	Preferred Prey
Shorebirds and Wading Birds	Plovers, sanderlings, dowitchers, sandpipers, yellowlegs, and phalaropes Great blue heron	• Killdeer: year-round • Great blue heron: year-round • Spotted sandpiper: summer • Phalaropes: during migration • All other species: winter and during spring and/or fall migration	• Great blue heron: shoreline, shallow marine and freshwater • Shorebirds: Intertidal zone, mudflats, beaches	• Great blue heron: crustaceans, small fishes • Shorebirds: marine worms, insect larvae, aquatic insects
Marine Waterfowl	Diving ducks (goldeneye, scoters, bufflehead), mergansers, grebes, loons, dabbling ducks (mallard, wigeon), and geese	• Canada goose, red-necked and hooded mergansers, and some dabbling ducks: year-round • Surf and white-winged scoters: winter and in non-breeding flocks during summer • All other species: winter and/or during migration (spring and/or fall migration)	• Canada goose, mergansers, dabbling ducks: marine and freshwater shorelines, eelgrass beds, and shallow water • Scoters, goldeneyes: marine nearshore and deeper water, near pilings • Grebes, loons: marine nearshore and deeper water	• Canada goose: vegetation • Mergansers: small fishes • Dabbling ducks: marine and freshwater vegetation, freshwater and marine larvae, aquatic and terrestrial insects • Scoters, goldeneyes: molluscs, barnacles, crustaceans, other invertebrates, small fishes • Grebes, loons: small fishes
Seabirds	Pursuit divers: auklets, murres, murrelets, guillemots, and cormorants Surface feeders: gulls and terns	• *Gulls:* glaucous-winged gulls: year-round; Ring-billed gull: year-round; mew gull: winter, migrant; Bonaparte's gull: fall and spring migrant; other species: winter • Terns: Caspian terns: summer; common tern: fall migrant • All other species: year-round	• Pursuit divers: marine nearshore and deeper water • Surface feeders (gulls, terns): shoreline, marine nearshore, deeper water	• Pursuit divers: small fishes, invertebrates, zooplankton • Surface feeders: small fishes, molluscs, crustaceans, garbage, carrion
Raptors	Bald eagle Osprey	• Year-round • Summer resident	• Forested shoreline, shoreline, marine nearshore, freshwater	• Bald eagle: fishes, waterfowl, shorebirds, carrion • Osprey: fishes

Sources: Smith et al. 1997; Opperman 2003; Larsen et al. 2004; Wahl et al. 2005; WDFW 2005.

3.10.1.1 Threatened, Endangered, and Protected Marine Birds

The marbled murrelet is an ESA-listed species, and the bald eagle is protected under the Bald and Golden Eagle Protection Act (16 USC § 668-668a). With some exceptions (house sparrow, starling, rock pigeon), migratory birds receive protection under the MBTA.

3.10.1.1.1 MARBLED MURRELET

3.10.1.1.1.1 STATUS

The marbled murrelet was listed in 1992 as threatened in California, Oregon, and Washington under the ESA (57 FR 45328) (Table 3.10–2). Primary causes of the species' decline include direct mortality from oil spills and by-catch in gill-net fisheries, as well as loss of nesting habitat (61 FR 26256). Critical habitat for nesting was designated for the marbled murrelet in 1996 (61 FR 26256) and is currently proposed for revision, but the revised critical habitat will not include military lands (71 FR 53838). NBK at Bangor is not within designated marbled murrelet critical habitat (61 FR 26256; 71 FR 53838). Designated critical habitat closest to Hood Canal includes forest lands west and south from Dabob Bay, which is within flight distance of the EHW-2 project site (less than 52 miles) for breeding murrelets (61 FR 26256).

Table 3.10–2. Federally Listed Threatened Marine Bird Species in Hood Canal

WILDLIFE	FEDERAL LISTING	CRITICAL HABITAT	CRITICAL HABITAT AT BASE
Marbled murrelet	Threatened *57 FR 45328,* *October 1, 1992*	Designated *61 FR 26256* *May 24, 1996* Proposed revision *71 FR 53838* *September 12, 2006*	No, closest critical habitat is forest lands west and south from Dabob Bay

3.10.1.1.1.2 SPECIES RANGE AND POPULATION SIZE

Marbled murrelets occur year-round in Hood Canal with their numbers increasing in late fall/early winter and declining in late winter/early spring. Monitoring of marbled murrelets occurs in Hood Canal as part of the Northwest Forest Plan Murrelet Effectiveness Monitoring Program (Raphael et al. 2007) (summer surveys, sampling between May 15 and July 31 each year) and the Puget Sound Ambient Monitoring Program (PSAMP) (winter surveys, sampling beginning in December and data available for 1993 through 2005), conducted by the WDFW (Nysewander et al. 2005). Hood Canal is within Conservation Zone 1, Stratum 2 of the Northwest forest Plan monitoring area.

USFWS (2010) estimated the murrelet summer density for Floral Point at the northern end of the Bangor waterfront using the historical survey results for stratum 2 (conducted in July and August 2008) in Conservation Zone 1[9] (Falxa et al. 2009). The resulting summer density was 4.1 per square mile (1.61 per sq km). To approximate murrelet winter density at Floral Point, USFWS (2010) developed an index using the results of winter surveys reported by Nysewander et al. (2005) for the PSAMP (1992–1999). This resulted in a multiplication of the summer

[9] Conservation Zone 1 Stratum 2 is the San Juan Islands, selected portions of Puget Sound, and northern Hood Canal.

density by a factor of 1.84. The resulting winter density was 7.7 per square mile (2.96 per sq km). These densities are applied in Section 3.10.2.1.1.7 (Calculation of Exposure of Marbled Murrelets to Noise Impacts).[10]

Marbled murrelet presence in nearshore and deeper waters in the vicinity of NBK at Bangor has been confirmed in recent surveys. Marbled murrelets were observed in shoreline and at-sea surveys conducted during every season from 2007 to 2010 (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b, 2011b). Survey results included one individual near the existing EHW in September 2008 (Tannenbaum et al. 2009b). The Kitsap Audubon Society reported marbled murrelets in three annual Christmas Bird Count surveys conducted along the shoreline south of the Bangor waterfront. The Navy conducted marbled murrelet monitoring in January 2009 during the installation of five steel piles (Carderock Project). During each of the five pile driving days, one to eight marbled murrelets were frequently observed within 1,000 meters (3,280 feet) of pile driving, and intermittent sightings of 12 to 31 murrelets were recorded. No marbled murrelet sightings occurred within the potential injury zone for underwater pile driving noise (see Section 3.10.2.1.1.5 for discussion of noise-related injury). In addition, during the Test Pile Program (late August through late October) the Navy conducted marbled murrelet monitoring during construction and also conducted baseline surveys on non-construction days. Marbled murrelets were not detected within or close to the WRA (including the EHW-2 construction area), although murrelets were detected elsewhere in Hood Canal (preliminary data). The closest marbled murrelet sighting was approximately 1.2 km south of the WRA.

3.10.1.1.1.3 BEHAVIOR AND ECOLOGY

Murrelets use the marine environment in Hood Canal for courtship, loafing, and foraging (USFWS 2010). In this area, nesting is asynchronous between late April and early September (McShane et al. 2004). During the breeding season, this species tends to forage in well-defined areas along the shoreline in relatively shallow marine waters (Strachan et al. 1995). Murrelets typically forage in pairs during the summer, with single birds occurring less often (Strachan et al. 1995). During the pre-basic (post-breeding season) molt (July through November), murrelets are essentially flightless for up to 2 months (Nelson 1997) and must select foraging sites that provide adequate prey resources within swimming distance (Carter 1984; Carter and Stein 1995). During the non-breeding season (September through April), murrelets typically disperse and are found farther from shore (Strachan et al. 1995). Winter flock size averages four birds (USFWS 2010). Murrelets forage at all times of the day, and in some cases at night (Strachan et al. 1995).

Marbled murrelets nest solitarily in trees with features typical of coniferous old-growth (stand age from 200 to 250 years old, trees with multi-layered canopy). Although old-growth forest is the preferred habitat for nesting, this species is known to nest in mature second-growth forest with trees as young as 180 years old (Hamer and Nelson 1995). WDFW Priority Habitat Species maps do not indicate the presence of marbled murrelet nests in the upland areas

[10] Since the publication of the EHW-2 Draft EIS, marbled murrelet density data from the 2010 summer surveys has recently become available. Falxa (2011 data as reported in USFWS 2011) reported a summer density for marbled murrelets in Stratum 2 of 1.8 birds per sq km (4.7 per sq mi) in 2010. In the Biological Opinion for the EHW-2 project, USFWS (2011) incorporated these data with past years of survey effort to take into account annual historic variability in marbled murrelet density. They utilized the 10-year average of marbled murrelet density for the exposure analysis. The 10-year average resulted in a summer density of 1.0 bird per sq km (2.6 birds per sq mi). The winter density index (multiplier of 1.84) was retained in this analysis, resulting in a winter density of 4.8 birds per square mile (1.0 bird per sq km). These densities are lower than those in the Falxa et al. (2009) report, which were used by the Navy in the exposure modeling for the EHW-2 EIS. As a result, the Navy maintained the more conservative analysis for estimating potential exposures of murrelets to pile driving noise from EHW-2 construction.

including and adjacent to NBK at Bangor (WDFW 2007b). Although forest stand inventories on NBK at Bangor indicate that stands are typically less than 110 years old, some relict old growth trees can be found near Devil's Hole and a small "old growth" stand has been located at the northern portion of the base (International Forestry Consultants 2001; Jones 2010a, personal communication). This stand is scheduled for delineation to determine suitability as "potential habitat" for marbled murrelets."

3.10.1.1.1.4 ACOUSTICS

While little is known about the general hearing or underwater hearing capabilities of birds, research suggests a maximum sensitivity for airborne sound between 1 and 5 kHz for bird species that have been tested (none of which were seabirds) (Dooling 1982). No audiograms were found for underwater hearing capabilities of birds.

3.10.1.1.2 RAPTORS

The bald eagle was delisted as threatened under the ESA on August 8, 2007 (72 FR 37346). However, the bald eagle remains protected under both the MBTA and the Bald and Golden Eagle Protection Act (16 USC § 668-668a), which prohibits the taking, possession of, or commerce in bald and golden eagles. Bald eagles in the Pacific Northwest include resident birds and winter migrants that breed farther north. Migration patterns in general are timed to track the availability of spawning salmonids (Buehler 2000). Many resident eagles in the Pacific Northwest migrate in late summer, when juveniles and adults move north up the coast to meet salmon runs in Alaska. At the end of these salmon runs in late fall, Alaskan and Pacific Northwest eagles move south along the coast following salmon runs. Adults reach wintering grounds in Pacific Northwest states in November or December, followed by juveniles in January (Buehler 2000). Eagles that breed in more northern latitudes return to their breeding grounds during spring migration from January to March, depending on food resources and weather conditions.

WDFW identified 1,125 bald eagle territories in Washington in 2005, of which 75 percent were occupied (WDFW 2007c). Near Hood Canal and the Bangor waterfront, bald eagles nest along the shoreline of Dabob Bay on the Bolton Peninsula and along the shoreline of Quilcene Bay, west of Dabob Bay, in Hood Canal. Bald eagles have been observed feeding, perching or roosting, and bathing on NBK at Bangor year round (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b, 2011b). An active bald eagle nest is located south of Devil's Hole near the waterfront (Leicht 2008, personal communication) and bald eagle nesting territories occur within 1 mile of the base (WDFW 2007b). The closest known nesting territory outside the base contains two nests, one of which is approximately 850 feet north of the Bangor property line on NBK (WDFW 2010). A third nest in this territory, which was about 550 feet from the property line, no longer exists (Slater 2008, personal communication). Five known bald eagle territories are located on the Toandos Peninsula of Hood Canal (WDFW 2007b).

The osprey is a summer resident in western Washington that occurs and nests near water, including marine shorelines, rivers, lakes, and streams where fish are available for foraging (Poole et al. 2002). Their nests are usually located in tall trees near large bodies of water. They have been observed flying, perching, and foraging along the Bangor shoreline (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b). No active nest sites have been reported in the vicinity of the project area.

3.10.1.1.3 MIGRATORY BIRDS

Most of the marine bird species occurring near the EHW-2 project site are migratory, including marine waterfowl and seabirds (see Appendix D). Five of the migratory marine birds occurring in the vicinity of the EHW-2 project site are considered birds of conservation concern[11] identified by USFWS: two seabirds (Caspian tern and pelagic cormorant), two marine waterfowl species (yellow-billed loon and western grebe), and two shorebirds (lesser yellowlegs and short-billed dowitcher) (see Appendix D) (USFWS 2008). Of these species, only the pelagic cormorant commonly occurs at the Bangor waterfront.

3.10.1.2 Marine Bird Species Groups on NBK at Bangor

The following discussion provides an overview of the marine bird groupings that occur in the vicinity of the EHW-2 project site, including marine bird families, relative occurrence, habitat requirements, and food resources. Section 3.10.1.1 provides information on endangered, threatened, and protected species that occur near the project site. Appendix D provides a complete listing of all birds known or expected to occur on NBK at Bangor and includes information on seasons of occurrence.

On NBK at Bangor, marine bird density is highest in winter, with large numbers of marine waterfowl occurring at this time. In surveys conducted in the 1990s by Nysewander et al. (2005), the combined density of marine birds during summer months (July) in the vicinity of the Bangor waterfront was 10 to 29 birds per square mile, compared to 29 to 77 birds per square mile during winter (December to February). Many of the marine bird species are migratory or only occur during part of the year.

3.10.1.2.1 SHOREBIRDS AND WADING BIRDS

Shorebirds occurring at or near the EHW-2 project site are mainly present during winter and/or migration, depending on species life history (Table 3.10–1). Exceptions include the killdeer, which is present year round, and the spotted-sandpiper, a summer resident and potential breeder on NBK at Bangor. Shorebirds primarily rely on resources on NBK at Bangor for foraging during the non-breeding season when over-wintering or as a stopover during spring and fall migrations (for species such as phalaropes) (Buchanan 2004). Both the killdeer and spotted sandpiper nest close to water (Opperman 2003) and may nest on the shoreline near the EHW-2 project site. Shorebirds focus on intertidal habitat for all foraging activities (Johnson and O'Neil 2001). Many shorebird species (e.g., plovers, sanderlings, sandpipers, and dowitchers) forage in intertidal mudflats or on beaches near the shoreline for polychaete and oligochaete worms, insect larvae, and aquatic insects (Buchanan 2004). Other food sources of shorebirds include amphipods, copepods, crustaceans, and molluscs. Shorebirds rest or sleep (roost) in a variety of location-dependent habitats. Some roosting habitats used by shorebirds include salt flats adjacent to intertidal foraging areas, higher elevation sand beaches, fields, or grassy areas near intertidal foraging areas; roost sites occasionally include piles, log rafts, floating docks, or other floating structures when natural roost sites are limited (Buchanan 2004).

Great blue herons are wading birds that forage on fish, amphibians, and aquatic invertebrates in wetlands, streams, and marine shorelines in Washington (Quinn and Milner 2004). They are

[11] Birds of conservation concern are defined as "species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act…" (USFWS 2008).

year-round residents in low-elevation areas of western Washington. Great blue herons breed in colonies (rookeries) that are typically located near a body of water. They are observed foraging, resting, and flying along the Bangor shoreline throughout the year (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b, 2011b). In 2008, three new nests were constructed on a lightning tower at the existing EHW, at least two of which had chicks during summer 2008 marine wildlife surveys (Tannenbaum et al. 2009b). Surveys conducted between November 2009 and May 2010 did not find evidence of use of this site during summer 2009 or 2010 (Tannenbaum et al. 2011b).

3.10.1.2.2 MARINE WATERFOWL

Most marine waterfowl species only occur at the Bangor waterfront during the winter (Tannenbaum et al. 2011b) and migrate north for their breeding season. However, common and hooded mergansers, Canada geese, and some dabbling duck species (mallard, gadwall, and northern shoveler) can be found near the EHW-2 project site year round. Of these species, only Canada geese and merganser have been regularly sighted during summer months (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b). Surf and white-winged scoters primarily occur in winter but can occur in summer (Opperman 2003), although sightings of scoters are less common during summer months (Agness and Tannenbaum 2009b). Marine waterfowl primarily forage in the nearshore environment, including near manmade structures (such as the existing EHW), but are also found in inland deeper marine waters (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b, 2011b). The primary forage resources of marine waterfowl include molluscs, crustaceans, and plant material. Other secondary food sources of marine waterfowl in the nearshore area of the EHW-2 project site are aquatic larvae and invertebrates. In the Puget Sound region, eelgrass beds are important foraging zones for dabbling ducks (American wigeon and mallard) (Lovvorn and Baldwin 1996). Mergansers, such as the common merganser, nest close to water in rock crevices, tree cavities, or under tree roots (Opperman 2003) and may nest along the shoreline habitat near the EHW-2 project site during summer. Marine waterfowl also rest on shore and the intertidal zone (Agness and Tannenbaum 2009b). Summer surveys of marine waterfowl on the Bangor shoreline did not reveal any evidence of local breeding, that is, nest sites or chicks (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b).

3.10.1.2.3 SEABIRDS

Two primary guilds of seabirds occur near the EHW-2 project site: surface-feeding and pursuit-diving. In addition, the parasitic jaeger is a predatory seabird that may occur in the vicinity of NBK at Bangor during fall migration (late September to early October) in pursuit of small birds (such as common terns, which are also in migration during this time) (Opperman 2003). Depending on individual species life history, surface-feeding seabirds may be present in the vicinity of NBK at Bangor during different seasons. Whereas glaucous-winged gulls occur year round (Hayward and Verbeek 2008), other gull species only occur during a portion of the year (Table 3.10–1 and Appendix D). Glaucous-winged gulls breed at established colonies, and the closest colony to the EHW-2 project site is located approximately 30 miles to the northwest (Protection Island) (Hayward and Verbeek 2008). Non-breeding Caspian terns and breeders disperse from colonies after the breeding season ends in June or July and may occur in the vicinity of the EHW-2 project site from April to August. Gulls and terns in the vicinity forage on small schooling fish, visible from the water surface in the nearshore marine and inland marine deeper water habitats (e.g., Pacific herring, Pacific sand lance, and juvenile salmonids). Additional forage resources taken opportunistically by gulls include objects gleaned on the water

surface, garbage on shore or inland, scavenged carrion, and small birds and eggs. Gulls can also forage in the intertidal zone; for example, gulls can feed on molluscs by dropping a mollusc from the air to break the shell on the beach or other hard surface, such as the existing EHW.

Pursuit-diving seabirds can occur year round in the vicinity of the EHW-2 project site; however, numbers of some species are greater during winter months (e.g., pelagic cormorant, common murre, and pigeon guillemot). Cormorants, such as the double-crested cormorant, nest in colonies along the outer coast of Washington; however, non-breeding cormorants are found year round on NBK at Bangor. Cormorants roost on buoys and other structures at the waterfront in groups of 10 individuals, the majority of which are juveniles (Agness and Tannenbaum 2009b). Gulls roost in similar sized groups (Agness and Tannenbaum 2009b).

With the exception of the pigeon guillemot, seabirds such as the common murre and rhinoceros auklet do not nest near the EHW-2 project site (Wilson and Manuwal 1986; Ainley et al. 2002; Agness and Tannenbaum 2009b). Non-breeding common murres can occur year round. In general however, common murres are most abundant in inland waters of Washington during the winter (Johnson and O'Neil 2001), whereas rhinoceros auklets are more common in inland waters during the summer (Johnson and O'Neil 2001; Opperman 2003).

Pursuit-diving seabirds are found in nearshore and inland marine deeper waters near the EHW-2 project site, where they dive to capture prey underwater. These seabirds are also found near manmade structures, such as the existing EHW, where algal and invertebrate communities (which provide additional forage resources) have become established on underwater piles. Primary forage resources of these seabirds include small schooling fish and other nearshore fish, such as Pacific sand lance and Pacific herring (Vermeer et al. 1987). The pigeon guillemot forages opportunistically on a more general diet of epibenthic fish and invertebrates than some other pursuit-divers, such as the common murre (Vermeer et al. 1987). Additional forage resources of pursuit-diving marine birds in the marine water habitats include zooplankton and aquatic invertebrates.

3.10.1.3 Marine Bird Habitats

Habitats near the EHW-2 project site used by marine birds include estuarine habitat, intertidal and subtidal zones of the nearshore marine, and inland marine deeper water habitat, as described below. Marine birds also use manmade structures, such as piers and piles associated with overwater structures including the existing EHW.

3.10.1.3.1 ESTUARIES

Three Bangor waterfront locations with year-round freshwater output may be considered estuarine habitat: outflows from Devil's Hole (approximately 1 mile south of the project site), Cattail Lake (approximately 1.5 miles north of the project site), and at the site nearest the project—Hunter's Marsh (Figure 3.11–2). The productive nearshore habitat within estuaries, and associated eelgrass beds commonly present in estuarine habitat, provide foraging opportunities for marine waterfowl and seabirds that frequent the nearshore (Table 3.10–3). Food resources used by marine birds in estuarine habitat ranges from small schooling fish to invertebrates and marine vegetation (Johnson and O'Neil 2001).

Table 3.10–3. Marine Habitats Used by Marine Birds in Hood Canal

HABITAT TYPE		HABITAT VALUES	CHARACTERISTIC SPECIES
Estuaries		Estuarine habitat has value for foraging, loafing, social interaction, and potential brood-rearing activities for a variety of marine waterfowl and seabirds.	Same as Nearshore Marine
Nearshore Marine	**Intertidal Zone**	Intertidal habitat has value for foraging activities of shorebirds and gulls, in addition to nesting habitat for breeding shorebirds (killdeer).	Killdeer, sandpiper species, glaucous-winged gull, other gull species, raptors, great blue heron
	Subtidal Zone	Subtidal habitat has value for foraging, loafing, social interaction, and potential brood-rearing activities for a variety of marine waterfowl and seabirds.	Common merganser, Barrow's goldeneye, common goldeneye, American wigeon, surf scoter, white-winged scoter, bufflehead, various grebes, loons, cormorants, pigeon guillemot, marbled murrelet, Canada goose, glaucous-winged gull, raptors, and mallard
Inland Marine Deeper Water		Inland deeper water habitat has value for foraging, loafing, and social interactions of marine waterfowl and seabirds.	Surf scoter, white-winged scoter, Barrow's goldeneye, common goldeneye, double-crested and pelagic cormorants, pigeon guillemot, marbled murrelet, and glaucous-winged gull
Manmade Structures		Manmade structures have value for roosting activities of select seabirds, and foraging of marine waterfowl and seabirds on the underwater piles of structures.	*Roosting:* Glaucous-winged gull, other gull species, pigeon guillemot, and double-crested and pelagic cormorants, great blue heron *Foraging:* Pigeon guillemot, scoters, goldeneyes, and grebes

Sources: Johnson and O'Neil 2001; Agness and Tannenbaum 2009b.

3.10.1.3.2 NEARSHORE MARINE HABITAT

3.10.1.3.2.1 INTERTIDAL ZONE

The intertidal zone along the waterfront near the EHW-2 project site provides food resources for a variety of marine birds in the shorebird group, as well as gulls (Table 3.10–3). The amount of intertidal habitat available varies throughout the day with tidal fluctuation. Food sources from intertidal mudflats occur in the upper intertidal zone, and food sources from shellfish and invertebrates occur in the intermediate intertidal zone. Forage resources used by shorebirds include molluscs, crustaceans, amphipods, worms, and aquatic insects, among other resources.

3.10.1.3.2.2 SUBTIDAL ZONE

Marine waterfowl and seabird species use the subtidal zone of nearshore marine habitat for foraging, loafing (resting on water), social interaction, and potentially for brood-rearing (Table 3.10–3). Forage resources used by marine birds in the nearshore marine habitat include small fish (i.e., juvenile salmonids, Pacific sand lance, and Pacific herring), crustaceans, molluscs, amphipods, aquatic insects, aquatic invertebrates, and plant material such as eelgrass (Johnson and O'Neil 2001).

3.10.1.3.3 INLAND DEEPER WATER MARINE HABITAT

Inland marine deeper water habitat at and near the EHW-2 project site is used by marine waterfowl and seabirds for foraging, loafing, and social interaction (Table 3.10–3). Forage resources in this habitat primarily include schooling small fish, which are patchily distributed spatially and temporally across deeper water habitat (Hunt 1995).

Marine waterfowl can also occur in deeper waters; however, forage resources for some species of this marine bird group can be more plentiful in the nearshore environment (i.e., plant material and aquatic insects). Fewer marine bird species use inland deeper marine habitat in the summer than in the winter (Johnson and O'Neil 2001).

3.10.1.3.4 MANMADE STRUCTURES

Marine birds use buoys, piers, and piles on NBK at Bangor as day roosts, perching sites, and nesting sites (Agness and Tannenbaum 2009b). Wharves along the waterfront such as the existing EHW provide underwater substrate for an assemblage of invertebrates such as molluscs, worms and crustaceans, and algal communities that attach to the wharf structures. For example, piles create structure for species typically found in shallower waters or benthic environments and, therefore, can attract marine bird species that forage on such prey (Table 3.10–3).

3.10.2 Environmental Consequences

The evaluation of impacts to marine birds considers the importance of the resource (i.e., legal, recreational, ecological, or scientific); the proportion of the resource affected relative to its occurrence in the region; the particular sensitivity of the resource to project activities; and the duration of environmental impacts or disruption. Impacts to resources are critical if:

- Habitats of high concern are adversely affected over relatively large areas;
- Disturbances to small, essential habitats would lead to regional impacts to a protected species; or
- Disturbances harass or impact the ability of species to acquire resources and ultimately impact the abundance or distribution of federally listed threatened or endangered species.

Both permanent habitat loss and temporary disturbance due to construction are concerns, as is continued or progressive habitat degradation.

In particular, underwater pile driving noise during the construction period has the potential to disrupt marine bird nesting, foraging, and resting in the vicinity of the EHW-2. The zone of impact due to construction noise, which extends beyond the construction zone, is described in the following sections. Other impacts to marine birds, such as changes in prey availability, are anticipated to be highly localized to the construction area. The Navy's effect determination for

the proposed project is "may affect, likely to adversely affect" for marbled murrelets due to their likely presence in adjacent marine waters during pile driving.

Impacts from operation of the EHW-2 include human activity over a larger area that is currently undeveloped and changes in prey availability at the site of the EHW-2. Impacts to marine birds are anticipated to be highly localized to the EHW-2 site. Marine birds are wide-ranging and have suitable habitat available along the Bangor waterfront and elsewhere in Hood Canal, relative to the area that might be impacted by operation of the EHW-2. Moreover, species documented in waterfront surveys along the Bangor shoreline appear to be capable of habituating to human activity. Although individuals may be affected by operations at the EHW-2, no significant impacts to marine bird populations in Hood Canal are expected.

3.10.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.10.2.1.1 CONSTRUCTION

The primary impacts to marine birds from construction of Alternative 1 would be associated with water quality changes (turbidity) in nearshore habitats, noise associated with pile driving and other construction equipment, increased construction vessel traffic, changes in prey availability (benthic community and forage fish), and visual disturbance from the presence of construction workers and equipment during the 2 to 3 season in-water construction period.

Construction-related activities are likely to disturb foraging marine birds because the number of vessels, including barges, and workmen in the area would increase. The most significant impact to marine birds would occur when birds are foraging underwater at the same time underwater noise is being generated by impact pile driving, and to a lesser extent, vibratory pile driving (see Section 3.10.2.1.1.5). As described in this section, underwater noise thresholds for behavioral disturbance and hearing-related injury impacts would be exceeded for marbled murrelets, a federally listed ESA species, which are likely to be present during construction and are likely to be adversely affected. Birds resting or foraging on the surface of the water, the shoreline, or manmade structures would also be exposed to pile driving noise. Mitigation measures described below in Section 3.10.2.7 would reduce the likelihood of adverse impacts to these species. Construction would typically occur 6 days per week. Impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). Upland construction would occur between 7:00 AM and 10:00 PM.

Construction in upland areas that would not involve pile driving would not affect marine birds (including marbled murrelets). The proposed pure water facility and water lines, although close to the marine shoreline, would not include in-water construction or operation. This new facility would be located in an existing developed area with considerable human activity, noise, and lighting. The three new buildings and replacement parking spaces would be located in an upland area that is distant from the marine shoreline and would not affect habitats used by marine birds. Noise and lighting from construction and operation of these facilities would not impact marine birds. Therefore, no adverse impacts to marine birds are anticipated.

3.10.2.1.1.1 WATER QUALITY

Impacts to water quality would be similar to those described for marine mammals in Section 3.9.2.1.1. Turbidity caused by pile driving would diminish the ability of pursuit diving birds to search and find prey at the EHW-2 project site. Other bird species that prey on benthic organisms would be impacted if resuspended sediments cover their prey. However, increased turbidity would be limited to the area immediately around driven piles. Current practices and BMPs would be implemented to minimize impacts to water quality, such as, an oil boom would be deployed to contain oil spills and procedures would be implemented to remove contaminants. Marine birds would be unlikely to enter the contained area during periods of construction activity due to the daily pile driving noise, vessel movement, and human presence during the 7-month in-water construction window over the 3 years of construction. Some birds may enter the area during breaks in activity, when turbidity due to pile driving would be low. Containment and treatment of any oil or contaminant spills would reduce the exposure of these birds to contaminants.

3.10.2.1.1.2 VESSEL TRAFFIC

Vessel movements have the potential to affect marine birds by disturbing individual animals, as evidenced by behavioral changes (review in Piatt et al. 2007). Responses to disturbance also vary with environmental factors such as habitat types, tides, time of day, and weather (review in Agness 2006). Responses to vessel disturbance are species-specific, and it is likely that both airborne and underwater noise and visual presence of vessels play a role in prompting reactions from marine birds. The probability and significance of vessel and marine bird interactions is dependent upon several factors including numbers, types, and speeds of vessels; the regularity, duration, and spatial extent of activities; and the presence/absence and density of marine birds. In general, large, loud, or fast boats appear to have greater impacts than smaller, quieter boats (Piatt et al 2007).

Behavioral changes in response to vessel presence include avoidance reactions, alarm/startle responses, temporary abandonment of resting sites, and other behavioral and stress-related changes (such as altered swimming speed, flight, diving, altered direction of travel, and changes in feeding activity, vocalizations, and resting behavior). For example, studies of vessel disturbance and murrelet species (including marbled murrelet) in Alaska, British Columbia, and Washington showed that murrelet counts were negatively correlated with vessel traffic, fewer birds made foraging dives, more birds made avoidance dives, and more birds flew off the water compared to undisturbed focal groups (Kuletz 1996; Speckman et al. 2004; Agness 2006; unpublished data reviewed in Piatt et al. 2007). Boat distance and speed had an effect on reactions by marbled murrelets (review in Piatt et al. 2007). On average, murrelets reacted (by diving or flying) to approaching boats at 40 meters (130 feet)when boat speed was greater than 16 knots, but flushed on average at 28 meters (92 feet) when boat speed was less than 7 knots.

Marine birds at the Bangor waterfront encounter vessel traffic associated with daily operations, maintenance, and security monitoring along the waterfront. During construction of the EHW-2, several additional vessels would operate in the project area, including one derrick barge and one pile barge for pile driving, and one derrick barge and two material barges for deck construction (see Section 2.2.2), tug boats that would move barges into position, and smaller supporting boats. At any given time, there would be no more than two tugs and six smaller boats, plus barges, present in the construction area. The powered vessels would operate at low speeds within the relatively limited construction zone and access routes during the in-water

construction period. Tugs would be employed primarily to bring barges to and from the project area and to position them, which generally involves low speeds. Small boats used to ferry personnel or for monitoring would likewise be operating at slow speeds.

The increased boat traffic associated with in-water construction activities would likely displace some marine birds from foraging and resting in the EHW-2 construction area. As described in Section 3.10.1.2, seabirds and waterfowl are most abundant in the project area during the in-water work period, but the effect on breeding marine birds would be negligible because most species do not breed in the project area. Most marine bird species that occur on the Bangor waterfront appear to have habituated to high levels of vessel traffic, based on surveys of developed areas such as Delta Pier, Marginal Pier, and the Service Pier. Thus, although some individuals are likely to be disturbed by increased construction-period vessel traffic in the project area, they would likely continue to frequent the project area during periods when vessel traffic is low. In the context of marine bird populations in Hood Canal, the affected area is too small to constitute a significant adverse impact.

3.10.2.1.1.3 PREY AVAILABILITY

The prey base for marine waterfowl (which includes molluscs and crustaceans) and seabirds (which includes juvenile salmonids and forage fish) in the vicinity of the EHW-2 project site is described in Section 3.10.1.2.2 and Section 3.10.1.2.3, respectively. Impacts to shellfish, benthic organisms, and finfish from construction activities are described in Sections 3.7.2.1 and Section 3.8.2.1. In general, pile installation and propeller wash from vessels would bury benthic organisms with limited mobility under sediment, and mobile invertebrates and fishes would move from the noise impact zone to avoid pile driving noise. Increased turbidity would make it difficult for marine birds to locate prey. The result would be reduced prey availability in the immediate vicinity of the EHW-2. However, adverse impacts to prey species due to water quality and sediment impacts would be temporary during the 2 to 3 season in-water construction period and confined to the immediate vicinity of the construction site.

Fish potentially would be disturbed by pile driving noise resulting from concurrent operation of vibratory and impact rigs within 11,024 feet of the centroid of pile driving noise (Section 3.8.2.1.1) but may actually avoid a much smaller area, as described in Section 3.8.2.1.1.1. Thus, prey availability within an undetermined portion of the impact zone for fish would be reduced. These impacts would occur over each of the 7 months per year of the 2 to 3 season in-water construction period. In the context of Hood Canal marine bird populations overall, the affected area is too small to constitute an adverse impact.

3.10.2.1.1.4 VISUAL DISTURBANCE

Visual disturbance would also impact use of the construction area by marine bird species, which have variable levels of tolerance for disturbance. Species that are intolerant of visual disturbance while foraging, including bald eagles and great blue herons, would be impacted during construction through increased visual disturbance and noise at shoreline foraging areas in the vicinity (Watson and Pierce 1998; Quinn and Milner 2004; Eissinger 2007). Birds that depart during construction activities may return to the area following a decrease in activity, such as during evening hours or early morning hours before work commences and when activities are completed. Due to the large Bangor waterfront area and the surrounding Hood Canal, alternative foraging areas are present.

3.10.2.1.1.5 UNDERWATER NOISE

Ambient noise conditions along the Bangor waterfront are described in Section 3.9.2.1.1.4. In general, noise levels are elevated over ambient conditions in Hood Canal due to waterfront operations, but are within the minimum and maximum range of measurements taken at similar environments in Puget Sound (see Section 3.4.1.1, Underwater Sound Levels). Underwater noise associated with pile driving activities (up to 1,250 piles in water) is likely to cause the most significant impacts to marine birds present during construction of the EHW-2. Existing underwater noise levels measured along the Bangor waterfront were measured at 114 dB re 1µPa (Slater 2009). Sound from pile driving would be detected above the ambient background noise levels at any location in Hood Canal with a direct acoustic path (i.e., line-of-sight to the driven pile to receiver location). Locations that have an intervening land mass would experience lower noise levels from pile driving.

As described in Section 3.4.2.1, a noise attenuating device such a bubble curtain would be used for impact pile driving that reduces sound levels by 10 dB. Other mitigation measures for pile driving noise, including a soft-start approach[12] to pile driving operations and marbled murrelet monitoring, are described in Section 3.4.2.7 and the Mitigation Action Plan (Appendix F), respectively.

The movements of survey boats engaged in marbled murrelet monitoring during pile driving operations would tend to discourage seabirds from foraging or resting inside the injury and behavioral disturbance zones while noise levels are elevated, as seabirds generally withdraw from moving boats. Thus, the marbled murrelet monitoring protocol would protect MBTA-protected seabird species as well as the marbled murrelet from exposure to construction noise.

INJURIOUS IMPACTS OF NOISE

There are no empirical data specific to impact pile driving and its effects on any seabird, but studies that have evaluated other types of underwater sounds (underwater blasting and seismic testing) on vertebrates provide some basis for evaluating the effects of pile driving on seabirds (Entranco and Hamer Environmental 2005). Exposure to high SPLs can result in barotrauma (Hastings and Popper 2005; USFWS 2006), i.e., internal injuries, including hemorrhage and rupture of internal organs caused by a difference in pressure between an air space inside the body and the surrounding gas or liquid. High underwater SPLs in controlled experiments using underwater explosives were shown to cause internal hemorrhaging of eardrums and other injuries in ducks (Yelverton et al. 1973). Permanent auditory injury (PTS) is another possible outcome of exposure to elevated underwater SPLs, although this has not been documented in the literature.

REVISION OF THE MARBLED MURRELET UNDERWATER INJURY CRITERION

Since the release of the March 2011 DEIS for construction and operation of the EHW-2 on NBK at Bangor, the analytical methodology for assessing the potential for injurious impacts to the marbled murrelet from impact pile driving has undergone several changes. Most notably, USFWS has recently refined the definition for the onset of injurious impacts to the marbled murrelet, and USFWS has revised the criterion level and metric used to assess injurious impacts

[12] Soft starts for vibratory drivers require initial starts of 15 seconds at reduced energy followed by a 30-second waiting period. This measure shall be repeated two additional times. Soft starts for impact hammers shall be one dry fire followed by a 30-second waiting period. This procedure shall be repeated two additional times.

that may occur to the marbled murrelet from impact pile driving. This section describes the resulting modifications to the analytical methodology based on the new underwater noise injury criterion of 202 dBSEL re 1μPa^2-sec cumulative of all impact hammer strikes in a 24-hour period and includes the Navy's revised assessment of the impacts of the construction and operation of the EHW-2 facility on the marbled murrelet. The marbled murrelet noise injury criterion would also apply to other diving seabirds.

A Marbled Murrelet Science Panel for Marbled Murrelet Injury Threshold was held from July 27–29, 2011, at the offices of USFWS in Lacey, Washington. The panelists consisted of technical experts and scientists affiliated with federal agencies, academia, and consulting firms who have expertise in underwater acoustics (including pile driving acoustics); the impacts of sound on fish, marine mammals, and terrestrial and marine birds; and the life history and demography (statistical study of the population and distribution) of the marbled murrelet.

The scope of issues that the panel examined was limited to data relevant for establishing criteria level(s) at which the onset of injurious effects would occur for the marbled murrelet. Other topics such as the sound pressure levels at which sub-injurious or behavioral effects may occur, mitigation or minimization strategies, and marbled murrelet monitoring protocols were beyond the panel's scope. USFWS and the Navy both acknowledged that these issues are also important and could warrant future discussion. However, prior to the convening of the panel, it was jointly decided by the agencies to place priority on establishing a scientifically supported criterion level for assessing injurious impacts.

A technical report documenting the presentations, discussions, and recommendations (SAIC 2011) is available at http://www.fws.gov/wafwo/pdf/MAMU_ConferenceSummaryReport_090711.pdf. The technical report recommended an underwater auditory injury criterion of 202 dBSEL re 1μPa^2-sec cumulative of all impact pile driving strikes within a 24-hour period. The Washington USFWS formally accepted the panel's recommendation as the interim criterion for assessing injurious effects from impact pile driving to the marbled murrelet.

AREA ENCOMPASSED BY UNDERWATER SOUND INJURY CRITERION

Sound attenuation modeling for pile driving for the EHW-2 project is described in detail in Section 3.4.2.1. Up to three vibratory drivers could be operated concurrently with one impact hammer. Underwater noise source levels used for the calculations were 195 dBRMS re 1 μPa at 33 feet for an impact hammer and 180 dBRMS re 1 μPa at 33 feet for each vibratory driver, based on a 60-inch hollow steel pile.

The underwater injury criterion for the marbled murrelet only applies to impact pile driving, as described in Section 3.4.2.1.1.2; therefore, the Navy's noise exposure modeling only used source level data for a single impact pile driving rig to predict the distance to the injury threshold. The distance to the injury criterion is dependent upon the number of strikes of the impact hammer that are carried out within a 24-hour period. Based on the pile-driving scenarios presented in Section 2.2.1, two pile driving scenarios are possible during construction. It is assumed that on most days, a single impact hammer would be used to proof up to five piles, with each pile requiring a maximum of 200 strikes. Therefore, the likely scenario would require up to 1,000 impact strikes per day. A less likely, but possible, scenario assumes driving three piles full length (up to 2,000 strikes per pile) and proofing an additional two piles, at 200 strikes each, with an impact hammer. This worst-case scenario would result in up to 6,400 impact strikes per day. In order to be conservative, the Navy carried out the noise exposure analysis assuming that all pile driving days could require the maximum number of pile driving strikes (e.g., 6,400) per day.

In order to calculate the distance to the underwater injury criterion (202 dBSEL re 1μPa^2-sec), the cumulative SEL value for the Navy's proposed action would need to be derived. The calculation of the SEL cumulative acoustic energy for all strikes completed during a pile driving day was determined using the following formula:

$$\textit{Cumulative SEL} = \textit{Single Strike SEL} + 10 * \textit{Log}_{10}\ (\textit{Number of strikes})$$

Using this approach and the 202 dBSEL re 1μPa^2-sec criterion, construction of the EHW-2 would likely result in noise-related injury to marine birds within 181 feet (55 meters) from the centroid of the impact pile-driving rig, assuming a properly functioning bubble curtain or other noise attenuating device is used. The distance to and the area encompassed by the injury threshold is shown in Table 3.10–4. Since the cumulative SEL formula takes into account all impact pile strikes within a 24-hour period, the area depicted in Table 3.10-4 is the size of the injury zone as it has increased to its maximum extent through the course of the pile driving day. As a result, during the early portion of the construction day, the injury zone would be smaller and would only gradually increase out to a distance of 55 meters after all strikes have been completed.

BEHAVIORAL RESPONSES TO NOISE

Behavioral responses of birds to pile driving are not well known and were extrapolated from the literature on fishes by USFWS for the purpose of developing thresholds for behavioral disturbance due to noise, recognizing that there is considerable uncertainty on the subject (USFWS 2006). In the analysis of impact hammer pile driving effects on marbled murrelets at the Anacortes, Washington, ferry terminal, USFWS stated that they would anticipate that SPLs in excess of 150 dBRMS could cause significant disruption of normal behaviors (USFWS 2006). This value is considered a guideline, not a criterion, for foraging marbled murrelets. No guideline is available yet that is specific to disturbance from vibratory pile installation noise.

Behavior that would indicate disturbance of marbled murrelets and other marine birds includes flushing (startle reaction), aborted feeding attempts, delayed feeding, or avoidance of the area. TTS can also result from exposure to elevated underwater noise, potentially affecting communication and/or ability to detect predators or prey. Responses of marine bird species in general are expected to be similar to those predicted for marbled murrelets.

AREA ENCOMPASSED BY BEHAVIORAL DISTURBANCE CRITERION

The underwater disturbance guidance threshold (150 dBRMS re 1μPa) established by USFWS for behavioral disturbance of the marbled murrelet applies to both impact and vibratory pile driving. As a result, the most conservative approach to predicting potential disturbance that may result from pile driving associated with EHW-2 construction is to consider the cumulative effect of all sources (i.e., one impact rig and three vibratory rigs) operating concurrently. Sound attenuation modeling for the combined effects of multiple pile driving sources for the EHW-2 project is described in detail in Section 3.4.2.1. The noise exposure analysis conducted in the DEIS for predicting the distance to the disturbance guidance threshold has not been altered in the FEIS. However, the change in the injury criterion by USFWS has resulted in a reduction in the potential size of the injury zone from EHW-2 construction. As a result, the area over which disturbance effects may occur has increased slightly from the DEIS analysis. The distance to and the area encompassed by the disturbance guidance threshold is shown in Table 3.10–4.

Table 3.10–4. Calculated[1] Maximum Distance(s) to the Underwater and Airborne Marbled Murrelet Noise Threshold due to Impact Pile Driving and Areas Encompassed by Noise Threshold

	UNDERWATER NOISE		AIRBORNE NOISE
	Injury 202 dBSEL[1]	Behavioral Disturbance 150 dBRMS[1]	Injury 92 dBA[2]
Distance to Threshold[3]	181 feet (55 meters)	11,024 feet (3,360 meters)	256 feet over water (78 meters)
			69 feet over land (21 meters)
Area Encompassed by Threshold	0.0037 sq mi (0.0095 sq km)	5.5 sq mi (14.2 sq km)	0.008 sq mi over water (0.021 sq km)
			0.00027 sq mi over land (0.0007 sq km)

1. A bubble curtain or other sound attenuating device assumed to achieve a 10 dB reduction in sound pressure levels is used during all impact pile driving. Sound pressure levels used for calculations were: 185 dB re 1 μPa at 33 feet for impact hammer with noise attenuator and 180 dB re 1 μPa for vibratory driver for 60-inch hollow steel pile.
2. Over-water airborne sound pressure level used for calculations was 105 dBA re 20 μPa at 50 feet for impact hammer, and 95 dBA re 20 μPa at 50 feet for vibratory drivers. Over vegetated land, airborne sound pressure levels are reduced by 10 dB. Therefore, the values over vegetated land for calculations were 85 dBA re 20μPa at 50 feet for vibratory rig and 95 dBA re 20 μPa at 50 feet for impact rig.

Treating concurrent vibratory driver and impact hammer noise as impulsive sound, the modeled distance to the threshold for behavioral disturbance for marbled murrelets (150 dBRMS) is 11,024 feet from the centroid of the multiple pile driving rigs. Marine birds would likely avoid the immediate pile driving sites but may habituate to pile driving noise well within the disturbance impact area.

A representative depiction of the areas that may be affected by above-threshold noise levels based on the maximum size of the injury zone, and the positioning of the impact rig at different locations within the footprint of the EHW-2 facility, is shown in Figure 3.10–1. Other areas could experience above-threshold noise when the pile driving rig occurs at other locations along the EHW-2 structure. Marbled murrelets (and other diving birds) could be injured if they are diving during impact pile driving and are exposed to underwater impact pile driving noise within these distances/areas.

3.10.2.1.1.6 AIRBORNE NOISE

Marine birds would be potentially disturbed by airborne noise associated with construction. Construction of the EHW-2 would result in increased airborne noise in the vicinity of the construction site, as discussed in Section 3.16.2.1.1. Activities that would generate elevated noise levels could include excavation for the abutment, pile driving, road construction, placement of armor rock, and other uses of heavy equipment. The highest noise levels would be associated with impact pile driving (up to 1,250 piles in water and 55 upland piles), and are estimated to be 105 dBA at 50 feet from the pile for an impact hammer, and 95 dBA at 50 feet from the pile for vibratory pile driving.

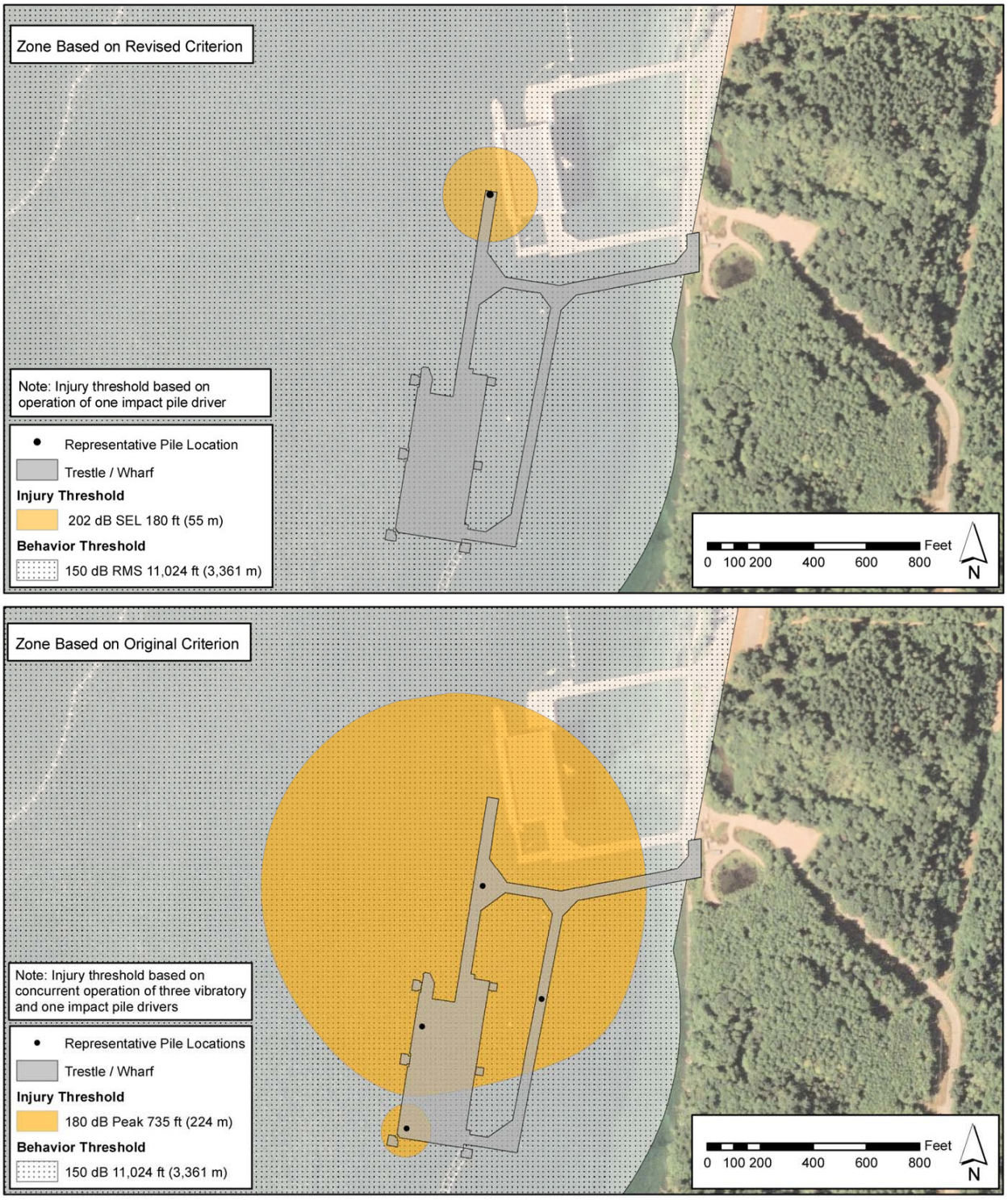

Figure 3.10–1. Representative View of Affected Areas for Marine Birds Due to Underwater Pile Driving Noise Based on Revised Injury Criterion

Operation of other construction equipment would produce noise levels ranging from 78 to 90 dBA at 50 feet from the source (see Section 3.16.2.1). In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet, but this noise level would be occasional. This noise level would attenuate to 75 dBA at approximately 416 feet over water and a much shorter distance over land (see discussion of noise attenuation in Section 3.16.2.1.1).

Mitigation measures for pile driving noise, including a soft-start approach to pile driving operations and marbled murrelet monitoring, are described in Section 3.4.2.7 and the Mitigation Action Plan (Appendix F), respectively. The movements of survey boats engaged in marbled murrelet monitoring during pile driving operations would tend to discourage seabirds from foraging or resting inside the injury and behavioral disturbance zones while noise levels are elevated, as seabirds generally withdraw from moving boats. Thus, the marbled murrelet monitoring protocol would protect MBTA-protected seabird species as well as the marbled murrelet from exposure to construction noise.

AREA ENCOMPASSED BY AIRBORNE SOUND INJURY THRESHOLD

USFWS (2004) identified a sound-only injury threshold of 92 dBA for marbled murrelets at nest sites, where injury is defined as a bird flushing from the nest or the young missing a feeding. This guidance is also applied to murrelets foraging and resting in the marine environment that are exposed to impact pile driving. USFWS (2004) also has provided guidance on noise-only alert and disturbance thresholds for nesting marbled murrelets, where alert behavior refers to the bird showing apparent interest in the noise source and disturbance is indicated by avoidance of the noise. However, the noise levels change depending on the baseline noise level and are applied to nesting birds in generally undeveloped forested areas (USFWS 2004; Teachout 2009, personal communication; WSDOT 2010a).

Noise-related thresholds have not been established for other marine bird species that occur on the waterfront, such as raptors (osprey, bald eagle), scoter species, pigeon guillemots, goldeneye species, cormorants, and grebes, but they are likely to respond similarly to pile strikes and construction noise. Behavioral responses of seabirds, including marbled murrelets, were monitored at sea during construction of the Hood Canal Floating Bridge in Washington (Entranco and Hamer Environmental 2005). At the beginning of pile driving work, the majority of seabirds in the vicinity responded by flushing, but over time some habituation occurred. Most of these species use the Bangor waterfront for foraging and resting (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b). As discussed above for underwater noise impacts, marine bird species are widespread throughout Puget Sound, and some of these appear to concentrate in Hood Canal during winter months (Nysewander et al. 2005; PSAT 2007a).

Airborne sound attenuation modeling for pile driving for the EHW-2 project is described in detail in Section 3.16.2.1. Up to three vibratory drivers could be operated concurrently with one impact hammer in water for construction of the trestle and wharf as well as on the shoreline for construction of the trestle abutment. No additional pile drivers would be required to install the abutment piles and the abutment piles were included in the noise analysis along with in-water piles. Airborne noise source levels used for the calculations were 105 dBA re 20 μPa at 50 feet for an impact driver and 95 dBA re 20 μPa at 50 feet for a vibratory driver.

For the 92 dB injury threshold due to airborne noise, the most conservative approach is to treat combined sounds of the two pile driver types as impulsive noise, as this approach propagates sound farther than the case where both pile driver types are treated as a continuous

noise source. Using this approach, construction of the EHW-2 would likely result in noise-related injury to marbled murrelets (and presumably other seabirds) at a distance of 256 feet over water from the centroid of multiple pile driving rigs. The 92 dBA threshold distance over vegetated land would be 69 feet from each driven pile because noise fields from multiple pile drivers in this situation do not overlap. The areas encompassed by these threshold distances are shown in Table 3.10–4 and a representative scenario of areas affected by above-threshold noise levels for multiple pile driving rigs is shown in Figure 3.10–2. Other areas would be included in the above-threshold noise areas if the analysis were performed for pile driving rigs at other locations on the EHW-2. For example, pile driving on the shoreline for the trestle abutment would produce airborne noise levels above the 92 dBA threshold as far as 69 feet over land (eastward).

SENSITIVE NOISE RECEPTORS

No sensitive marine bird receptors with recent use are known in the area that would be affected by airborne construction noise, including marbled murrelet nesting habitat and nests of marine bird species. Bald eagle nests are described below in Section 3.10.2.1.1.8. EHW-2 construction activities would occur slightly more than 100 feet from the existing EHW lightning tower, where great blue herons nested in 2008 (Tannenbaum et al. 2009b). It is not known if herons used this site for nesting in subsequent years, although no nest material was present during occasional surveys of the waterfront from November 2009 to May 2010 (Tannenbaum et al. 2011b). This species is very sensitive to noise and visual disturbance near nest sites and would be unlikely to use this tower for nesting during the construction period. The nesting season for this species (March through late June) does not coincide with in-water construction work. However, upland construction noise and activity including abutment pile driving activity in the shoreline may occur during the nesting season, and would likely prevent herons from nesting in the lightning tower.

Pigeon guillemots nested in the rafters of the MSF in 2007 (Agness and Tannenbaum 2009b), located over 1 mile from the EHW-2 construction area on the Bangor shoreline, but did not nest there in 2008 or 2010. Their future use of this structure would not be impacted by pile driving or other construction noise at the EHW-2 project site because noise levels would attenuate to existing operational noise levels or below at this distance (see Section 3.10.2.1.1.6) (Figure 3.10–2). In the context of Hood Canal overall, the area affected by airborne construction noise is too small to constitute an adverse impact to other marine bird populations.

3.10.2.1.1.7 CALCULATION OF EXPOSURE OF MARBLED MURRELETS TO NOISE IMPACTS

Underwater and airborne sound levels from impact and vibratory pile driving have the potential to harm (as defined by the ESA) marbled murrelets foraging and resting in the vicinity of the EHW-2 project site. Nearshore waters in the vicinity provide foraging habitat and prey species, and marbled murrelets have been observed in the area during the proposed in-water construction window. Some construction activities may temporarily affect the presence of this species, such as water quality changes (turbidity) in nearshore habitat and dislocation of prey populations (benthic community and forage fish). The presence of construction workers, barges, cranes, other vessels and equipment, and associated activities would create visual disturbances for marbled murrelets attempting to forage or rest in surrounding waters. Although the proposed action may affect prey availability and other habitat features for marbled murrelets in the immediate vicinity of the construction site, none of these effects is expected to rise to the level of take.

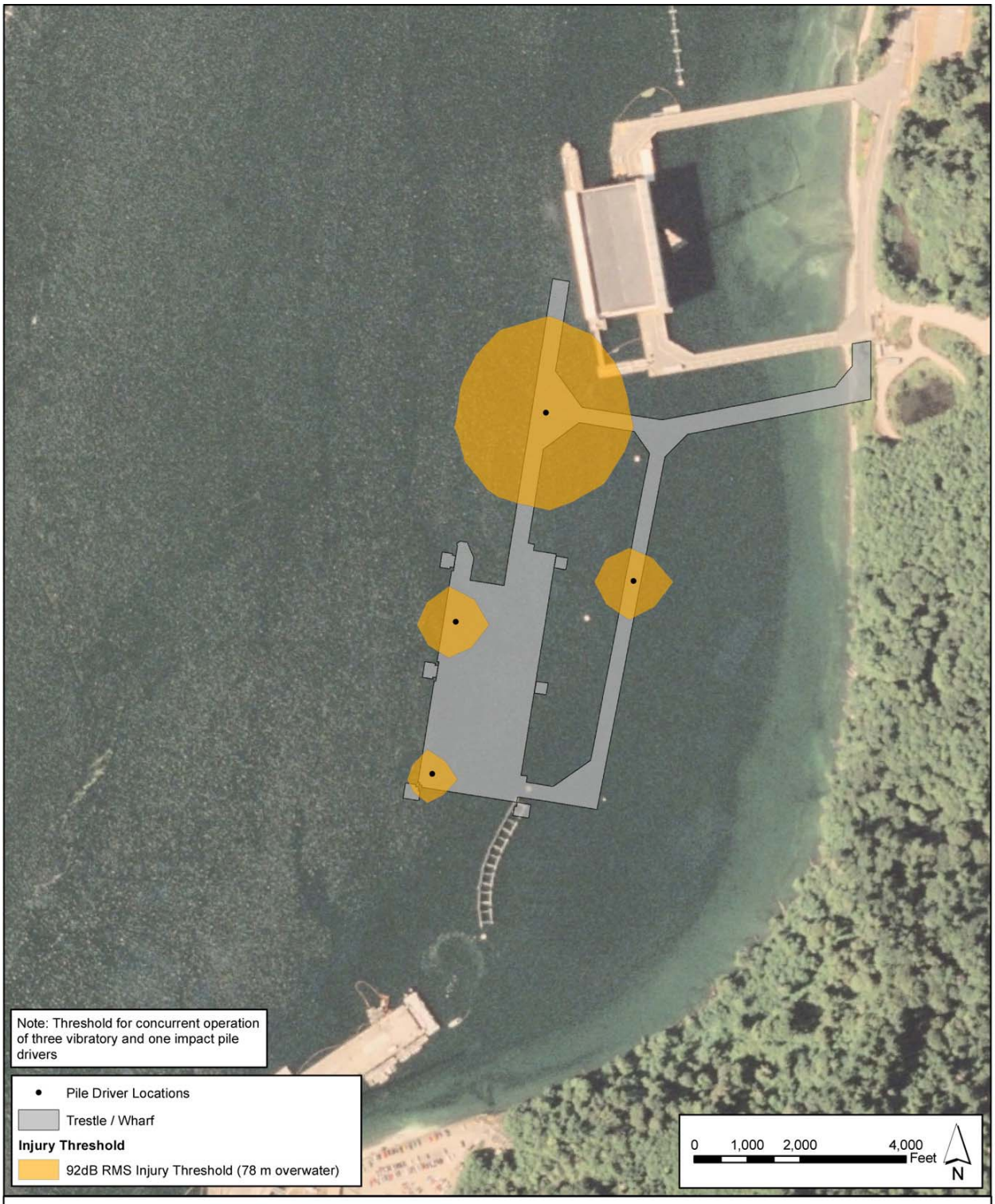

Figure 3.10−2. Representative View of Affected Areas for Marine Birds Due to Airborne Pile Driving Noise

Estimates of potential exposure to elevated construction noise were calculated based on the activity with the greatest potential to injure or disturb marbled murrelets in the project area, i.e., impact and vibratory pile driving. A formula was developed for calculating exposures due to pile driving founded on the following assumptions:

- Daily population density is at least as large as any documented highest population estimate.
- Marbled murrelets would be present in the project area during construction each day.
- Exposure to elevated noise for an individual is counted once per method of installation during a 24-hour period.
- Pile driving could occur every day of the 200 to 400 potential pile driving days (211 to 411 days for airborne noise to include days to drive the abutment piles).
- Up to three vibratory rigs and one impact hammer rig would operate concurrently.
- Some type of mitigation (i.e., bubble curtain or other noise attenuating device) would be used for impact pile driving.
- All pilings to be installed would have a noise disturbance distance equal to the piling that causes the greatest noise disturbance (i.e., the piling farthest from shore).

Exposures to underwater and airborne pile driving noise were estimated as:

Exposure estimate = (n * ZOI)* days of pile driving activity, where n = density estimate
ZOI = the area encompassed by all locations where the SPLs equal or exceed the threshold being evaluated

The product of n*ZOI for the impact thresholds (Table 3.10–4) is rounded to the nearest whole number, using 0.5 as a break point. A product less than 0.5 is rounded to zero.

The density of marbled murrelets was calculated to be 4.2 per square mile (1.61 per sq km) for the summer months (USFWS 2010). This density would apply during the portion of the in-water work window from July 16 through October 31. The density of marbled murrelets (7.7 per square mile, or 2.96 per sq km) is greater in winter months, which would include the period from November 1 through February 15 of the in-water construction season. Behavioral disturbance was estimated by multiplying the density for each season by the area of the underwater behavioral disturbance isopleth (150 dB_{RMS} re 1μPa) (Table 3.10–5) over the number of days of potential pile driving during each season. This assumes that half of the estimated range of pile driving days (out of a total of 200 to 400 [211 to 411 for airborne noise] days over the course of the project) would occur during the summer period July 16 through October 31, and half would occur during the winter period November 1 through February 15. Table 3.10–5 shows estimated exposures of marbled murrelets to behavioral disturbance due to impact and vibratory pile installation during the summer and winter periods. As calculated in this table, airborne and underwater noise exposures can occur on the same day.

Injury exposure is not expected due to underwater impact pile driving (determined by the 202 dB_{SEL} injury isopleth) because the product of density times ZOI is less than 0.5 (Table 3.10–5). Similarly, no airborne injury exposure is expected (Table 3.10–5). In addition, all pile driving would cease prior to marbled murrelets entering the injury zones for either airborne or underwater pile driving, as described in Section 3.10.2.7.

Table 3.10–5. Alternative 1: Summary of Potential Exposures for Marbled Murrelet during the In-Water Pile Driving Season (Mid-July to Mid-February)

Season	Density of Marbled Murrelets (sq mi)	Underwater[1]		Airborne[1]
		Injury Threshold (202 dBsel)	Behavioral[2] Disturbance Threshold (150 dBrms)	Injury Threshold[3] (92 dBA)
July 16 – October 31	4.2	0	2,300 – 4,600	0
November 1 – February 15	7.7	0	4,200 – 8,400	0
Total Exposures		0	6,500 – 13,000	0

Source: USFWS 2010.

1. The airborne exposure calculations assumed that 100 percent of the in-water densities were available at the surface to be exposed to airborne sound.
2. An example of the noise exposure calculation is as follows: During the period July 16 through October 31, density (4.2 murrelets per square mile)*ZOI for behavioral disturbance (5.5 square mile) results in a daily abundance of 23 murrelets in the ZOI. Multiplied by half of the total pile driving days (100–200 days), a range of 2,300–4,600 exposures due to behavioral disturbance is estimated for marbled murrelets during this time period.
3. Airborne exposure calculations were made using a total of 211 – 411 pile driving days, since an additional 11 days of pile driving would occur for abutment construction above the MLLW mark.

Effects on the Marbled Murrelet

USFWS's recent refinement of the definition for the onset of injurious impacts to the marbled murrelet allows for some additional clarification of the effects that may constitute harm versus harassment as defined by the ESA.[13] Based on guidance from USFWS, the Marbled Murrelet Science Panel defined the onset of auditory injury as the loss of auditory hair cells due to impulsive acoustic overexposure. It should be noted that auditory hair cells of birds are capable of regeneration (Niemiec et al. 1994; Ryals et al. 1999; Dooling et al. 2008; Saunders 2010). However, depending on the level of damage, regenerated hair cells may not develop or function identically to the original hair cell, and not all regenerated hair cells take root permanently. As a result, exposures to sound that meet the criterion established for the onset of auditory injury (202 dBsel re 1μPa^2-sec) would qualify as harm under the ESA. As indicated in Table 3.10–5, the Navy does not predict that construction of the EHW-2 would result in any acoustic exposures that would cause injury to or harm the marbled murrelet.

The onset of auditory injury in the marbled murrelet (i.e., auditory hair cell loss) corresponded to a large auditory threshold shift (approximately 40 dB) based upon the literature (Dooling and Saunders 1974; Saunders and Dooling 1974; Dooling 1980; Ryals et al. 1999). Therefore, low levels of auditory threshold shift (if short-term and at levels allowing for full recovery) would not cause injury or harm to the marbled murrelet. Low levels of auditory threshold shift, typically

[13] USFWS regulations (50 CFR§ 17.3) define harm and harassment under the ESA as follows:

- Harm means an act that actually kills or injures wildlife. Such acts may include significant habitat modification or degradation when it actually kills or injures wildlife by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering.
- Harass means an intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns ,which include, but are not limited to, breeding, feeding, or sheltering.

termed temporary threshold shift (TTS), can be described using the analogy of a rock concert. Typically, after the presentation of a loud sound (i.e., rock concert) the auditory system can become fatigued, resulting in a temporary reduction in our sensitivity to hear sounds within certain frequencies. This phenomenon can last from several minutes to up to a few days depending on the intensity and duration of the exposure. Because the effects are temporary, fully recoverable, and do not result in any physiological damage to the auditory system, they are not considered injurious. Empirical data are not available from which an SEL criterion could be established that would correlate to exposures that result in the onset of TTS. However, these types of exposures would likely occur at an SEL level relatively close (within 15 dB) to that established for the onset of injury, based on marine mammal studies (Southall et al. 2007).

A temporary shift in an animal's hearing sensitivities could result in an increased effort for them to discern certain sounds or cues within their surroundings, temporarily mask some aspects of communication, or increase exposure to predation. Depending on the degree of the auditory shift, TTS may not have a perceptible effect on their hearing capabilities (i.e., within the normal range of variability) or negatively impact the animal's typical behavior. Alternatively, exposures that cause TTS could result in increased energy expenditures for foraging or breeding, which could have a temporary negative effect on the animal's fitness or could result in increased risk to other incidental hazards (i.e., predation risk). Such effects have been accounted for in the Navy's modeling, within the exposures predicted within the disturbance zone, defined at the lower limit by the USFWS guidance threshold of 150 dBRMS re 1μPa. Exposures resulting in TTS, depending upon the severity, may qualify as harassment under the ESA.

As discussed previously in Sections 3.10.2.1.1.5 and 3.10.2.1.1.7, exposures within the area defined by the 150 dBRMS isopleth (re 1μPa) may result in behavioral effects on marbled murrelets or other birds. Behavioral responses of birds to pile driving are not well known and were extrapolated from literature on fishes by USFWS for the purpose of developing the guideline threshold for behavioral disturbance (150 dBRMS re 1μPa) due to noise, recognizing that there is considerable uncertainty on the subject (USFWS 2006). Behavior that could indicate disturbance of marbled murrelets and other marine birds may include startle reactions such as taking flight or diving, aborted feeding attempts, delayed feeding, or avoidance of the area. Due to the lack of any empirical data regarding exposures from pile driving that may constitute behavioral disturbance, the Navy has conservatively estimated that all underwater exposures predicted within the 150 dBRMS isopleth (re 1μPa) may cause behavioral effects. However, it is unknown if these exposures within this area would constitute harassment under the ESA.

Marbled murrelets may be present in small numbers in the project area in any month but are not regularly or predictably present on a daily basis. They appear to be most abundant during the winter (USFWS 2010), that is, during the construction window for pile driving. Marbled murrelets would likely avoid the immediate pile driving site but may habituate to underwater pile driving noise well within the disturbance impact area (defined by the 150 dBRMS isopleth for underwater sound), especially if fish that may be stunned or killed by pile driving are present. If fish are killed or injured as a result of pile driving, this may attract foraging marine birds to the noise impact area in spite of the noise levels. Even without this attractant, marbled murrelets and other marine birds may continue to forage close to the construction area and be exposed to noise-related injury. Monitoring work at the Hood Canal Bridge (Entranco and Hamer Environmental 2005) demonstrated that marbled murrelets continued to dive and forage within 984 feet of active pile driving operations, well within the disturbance threshold (11,024 feet) suggested by the

USFWS guideline. This observation suggests that foraging marine birds may habituate to pile driving and may continue to forage within predicted disturbance zones.

Marbled murrelets also would be affected by airborne pile driving noise at the EHW-2 project site. No exposures to injurious airborne sound levels are anticipated, based on sound propagation modeling discussed in Section 3.10.2.1.1.7. Although there is currently no established disturbance threshold, murrelets may respond behaviorally to elevated airborne sound levels. Ambient noise levels at docks on the Bangor waterfront were described in the existing conditions section. However, the project site is located in the area south of the existing EHW, which currently is undeveloped and relatively quiet. Marbled murrelets resting in the waters of the project area would be likely to dive underwater if disturbed or injured by airborne noise from pile driving, potentially exposing them to underwater noise impacts.

A complicating factor is related to the annual molting cycle of marbled murrelets. The late-summer pre-basic molt condition (mid-July to December), during which murrelets are essentially flightless for up to two months, would overlap with the in-water construction season for the EHW-2. During the pre-basic molt period, marbled murrelets would be less able to withdraw quickly from the action area when suddenly exposed to injurious or disturbing sound levels, and would likely dive underwater to avoid the disturbance. Injury effects on marbled murrelets from pile driving would be prevented by implementing a marbled murrelet monitoring plan (see Mitigation Action Plan, Appendix F), which provides for halting pile driving while murrelets are present within the injury effects areas (for underwater and airborne noise shutdown zones). Disturbance effects would be minimized by implementing this Plan, which provides for monitoring marbled murrelets within the injury shutdown zone as well the non-injurious TTS shutdown zone (between cumulative 183 dB SEL and 202 dB SEL up to a distance of 293 meters).

It is very unlikely that marbled murrelets would be present in the project upland area because suitable nesting habitat is not available. Other project-related effects on marbled murrelets, including water quality effects, vessel traffic, visual disturbance, and prey availability are similar to those described above for marine birds in general (Section 3.10.2.1.1).

Because the in-water construction period (7 months per year in each of the 2 to 3 seasons of in-water construction) overlaps the period in which murrelets are most likely to be present in the project area, and pile driving sounds are potentially injurious or disturbing, the Navy's effect determination for construction of the project is "may affect, likely to adversely affect" for this species. USFWS issued a Biological Opinion in November 2011 stating that the project is likely to result in takes of marbled murrelets, as defined by the ESA, but that the project is not likely to jeopardize the continued existence of the marbled murrelet. Marbled murrelets that are adversely affected as defined by the ESA could exhibit behavioral reactions but are unlikely to be injured by pile driving noise. Marbled murrelet observers will monitor the shutdown zones during pile driving activities (see Appendix F, Mitigation Action Plan for a detailed discussion of mitigation measures) and will alert work crews when to begin or stop work if marbled murrelet are present in or near the shutdown zones, reducing the potential for acoustic harassment.

Marbled murrelets are likely to continue foraging and resting in waters adjacent to the Bangor waterfront following construction and therefore may experience operations/long-term effects of the EHW-2. Operations at the EHW-2 would increase noise and human activity in a section of the nearshore that is currently relatively undisturbed. Since marbled murrelets have habituated to existing levels of noise and human activity along the Bangor waterfront, it is likely

that they would habituate to noise and human activity at the EHW-2. Indirect effects would result primarily from reductions in prey populations of forage fish and juvenile salmonids in the vicinity of the EHW-2, which would potentially affect a very small number of marbled murrelets, in part because they are not regularly present on NBK at Bangor (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b). The affected area is negligible in contrast to the available foraging range for this species elsewhere on the Bangor waterfront and other inland marine waters; thus, the likelihood of adverse effects on marbled murrelets is negligible. Therefore, the effect determination for long-term operations at the proposed EHW-2 is "may affect, not likely to adversely affect" for marbled murrelets.

3.10.2.1.1.8 EFFECTS ON OTHER PROTECTED MARINE BIRD SPECIES

Other protected marine bird species that forage along the waterfront and/or nest in the vicinity of the EHW include the bald eagle, and migratory bird species including the seabirds, waterfowl, shorebirds, wading birds, and other raptors described in Section 3.10.1. Construction period impacts to marine bird species were described in Sections 3.10.2.1.1.1 through 3.10.2.1.1.6. Similar to marbled murrelets, other pursuit-diving seabirds and diving ducks in particular would be susceptible to underwater pile driving noise impacts, as depicted in Figure 3.10–1. Marine bird species would also potentially be impacted by airborne noise. Figure 3.10–2 shows areas that would be within the above-injury threshold zone for four representative pile driver locations on the wharf. Affected areas would shift depending on where the four pile drivers were in operation on a given day. The array of pile drivers would include locations on the shoreline when installation of abutment piles is underway.

Protected marine bird species would be subject to water quality and sediment disturbance, accidental gas and oil spills, disturbance from human activity and vessel traffic, and indirect effects such as changes in prey abundance as described in previous sections. Bubble curtains used to reduce underwater pile driving noise levels would affect turbidity, depending on the type of bubble curtain used. An unconfined bubble curtain would increase turbidity in the immediate vicinity and downcurrent of the unit while active. Pursuit-diving seabirds and diving ducks would be less likely to forage in the vicinity of active pile driving operations because of elevated underwater noise levels. A confined unit would contain suspended sediments within the pile containment area until the device is removed, after which suspended sediment would be released in the immediately vicinity and downcurrent. Seabirds would be more likely to encounter turbidity under this condition, but the affected area would be localized to the vicinity of a driven pile.

- *Bald Eagle.* Bald eagles have been observed foraging on the shoreline approximately 3,200 feet (0.6 mile) north of the EHW-2 project site (Tannenbaum et al. 2009b). USFWS (2003) determined that elevated noise levels from impact pile driving at a dock in Port Angeles could disrupt the normal feeding behavior of adult bald eagles within approximately 0.5 mile of the dock site. Watson and Pierce (1998) found that vegetative screening and distance were the two most important factors determining the impact of visual disturbances for bald eagles. There is no effective screening within 0.5 mile north of the existing EHW along the shoreline; thus, bald eagles would avoid foraging within this area during the construction period. Similarly, bald eagles would probably avoid the area of the EHW-2 project site, south of the existing EHW, because of construction-related noise and disturbance. This area does not currently appear to receive as much use by this species as other locations on the Bangor waterfront (one sighting vs. 19 sightings, respectively) (Tannenbaum et al. 2009b, 2011b); thus, no adverse impacts are predicted.

The prey base for bald eagles (primarily pelagic fish) would be impacted by construction, due to increased turbidity and avoidance of the site by prey species, but adverse impacts to prey abundance and availability would be localized and temporary during the 7-month in-water construction season for each of 3 years that construction would take place.

The bald eagles observed during spring and summer marine bird surveys along the Bangor shoreline are probably the resident pair at the nests located in the Vinland neighborhood, and a resident pair nesting near Devil's Hole, since this species is highly territorial during the breeding season. The closest nest is over 6,000 feet from the EHW-2 project site, with screening vegetation present. Pile driving noise levels from the EHW-2 construction site that are received at the closest nest would be lower than or within the range of existing operational noise levels (see Section 3.10.2.1.1.6), and no impacts to nesting bald eagles are expected.

- *Migratory Birds.* Most migratory and winter-resident seabirds, shorebirds, and waterfowl do not breed in the vicinity of the Bangor waterfront. Six species recognized by USFWS as species of concern could occur in the project area, include the Caspian tern, yellow-billed loon, pelagic cormorant, western grebe, lesser yellowlegs, and short-billed dowitcher (Appendix D) (USFWS 2008). Of these species, pelagic cormorants have been observed in Christmas bird counts (Kitsap Audubon Society 2008) and summer surveys (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b). The species does not breed in the vicinity, however. Western grebes have been observed during the spring migration (Agness and Tannenbaum 2009b) and Christmas bird counts (Kitsap Audubon Society 2008). Migratory marine bird species would be subject to water quality impacts, construction noise, vessel traffic, changes in prey availability, and visual disturbance as described in Section 3.10.2.1.1. In particular, diving species such as loons, grebes, and cormorants could be exposed to potentially harassing underwater construction noise as described in Section 3.10.2.1.1.5. Direct and indirect impacts to migratory birds and the effects of implementation of the marbled murrelet monitoring plan (Appendix F, Mitigation Action Plan) would be similar to those described for marbled murrelets.

While it is likely that most marine birds would avoid the immediate vicinity of the construction site, especially while pile driving is taking place, it is possible that some individuals may habituate sufficiently to use the area when there is no pile driving, in particular outside the in-water work period. Mitigation measures for pile driving noise, including a soft-start approach to pile driving operations and marbled murrelet monitoring, are described in Section 3.4.2.7. and the Mitigation Action Plan (Appendix F), respectively. The movements of survey boats engaged in marbled murrelet monitoring during pile driving operations would tend to discourage seabirds from foraging or resting inside the injury and behavioral disturbance zones while noise levels are elevated, as seabirds generally withdraw from moving boats. Thus, the marbled murrelet monitoring protocol would protect MBTA-protected seabird species as well as the marbled murrelet from exposure to construction noise. Migratory marine birds are widespread throughout Puget Sound in winter months, and the area affected by the EHW-2 is too small to constitute an adverse impact to marine bird populations overall.

3.10.2.1.2 OPERATION/LONG-TERM IMPACTS

Under existing conditions, the Bangor waterfront produces an environment of complex and highly variable noise and visual disturbance for marine birds. Although the operation of the EHW-2 would not result in an increase of boat traffic or human activity, it would nonetheless

divert a portion of the existing activity and boat traffic into an area that currently has a much lower human presence than other developed areas of the waterfront (e.g., the existing EHW, Service Pier, or Delta Pier). Activities associated with this alternative would include traffic from submarines and other vessels, as well as increased visual disturbance from human activity, artificial light, and increased ambient noise levels because of vehicle traffic; use of equipment such as forklifts, generators, and cranes. Some marine bird species, such as pigeon guillemots, waterfowl species, and seabirds including gulls and cormorants, forage and loaf in marine waters and manmade structures at working piers and wharves on NBK at Bangor (Agness and Tannenbaum 2009b). Individuals may initially avoid the immediate vicinity of the EHW-2, but it is likely that most would become habituated to the post-construction activity levels, as they have habituated to activity levels at other developed portions of the waterfront. Operation of the EHW-2 would be unlikely to impact future use of the MSF pier by nesting pigeon guillemots because the sites are over 1 mile apart and attenuated noise levels from the EHW-2 would be less than ambient noise at the MSF at this distance.

The lightning towers would be 230 feet above MLLW, or approximately 209 feet above the EHW-2 deck surface. There would be no guide wires but there would be two sets of catenary wires connecting the towers; one set would be near the top of the towers and the other approximately 130 feet above MLLW. The towers and the catenary wires present potential collision hazards for marine birds. The towers would be marked at the tops with blinking red navigation lights, which would help to minimize bird strikes. The catenary wires would be marked with bird flight diverters or other similar devices that would minimize collisions.

Decreased habitat value for forage fish, salmonids, other finfish, and, to a lesser extent, shellfish, would result in long-term impacts to marine bird prey availability. The increased surface area of Alternative 1 overwater structures (6.3 acres) would reduce biological productivity overall through shading and reduction in the size of eelgrass beds, impacting the prey base (benthic organisms, ground fish, and pelagic fish) in the intertidal, subtidal, and nearshore deeper water zones. In addition, the EHW-2 would create a barrier to movement of shoreline-dependent fishes such as juvenile salmonids and forage fishes. Increased lighting at the EHW-2 may affect prey availability, depending on the species, for marine birds. Some fish may be attracted by artificial lighting, which may in turn attract predators, including marine birds, and facilitate their feeding. Thus, a localized change to the prey base for some marine birds is expected. However, several mitigation measures would be implemented to offset these effects, as described in the Mitigation Action Plan (Appendix F). Lighting would be directed downward toward the surface of the trestles and wharf. The intensity of the light along this structure would not differ substantially from the existing overwater structures. The trestle abutment and armor rock would be above MHHW and would not affect prey availability for marine birds. These structures would not provide habitat for marbled murrelets.

Adverse impacts of the EHW-2 would be limited to the small area including and adjacent to the trestle and wharf. In the context of the Hood Canal marine bird populations overall, operational activities would be similar to those encountered elsewhere at the Bangor waterfront, and the affected area is too small to constitute an adverse impact. Thus, no additional MBTA, Bald and Golden Eagle Protection Act, or ESA take is expected with operation of the EHW-2.

Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components as required (no pile replacement). These activities could affect marine birds through noise impacts and increased human activity and vessel traffic. However, noise levels would not be appreciably higher than existing levels at the Bangor industrial waterfront.

Measures would be employed (Section 3.2.2) to avoid discharge of contaminants to the marine environment. Therefore, maintenance would have negligible impacts to marine birds.

3.10.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.10.2.2.1 CONSTRUCTION

As described in Chapter 2 (Table 2–1), Alternative 2 differs from Alternative 1 in that it would use a larger number of smaller piles for construction of the wharf. The trestle alignments and dimensions would be the same. For marine birds, the primary construction-related concerns are impacts resulting from pile driving and other construction noise and activity, which would differ from Alternative 1 as follows:

- Alternative 2 requires more piles (up to 1,460) than Alternative 1 (1,250).
- The in-water construction period for Alternative 2 would be longer than for Alternative 1: 275 to 550 (286 to 561 for airborne noise) days of pile driving over 3 to 4 in-water work seasons compared to 200 to 400 (211 to 411 for airborne noise) days over 2 to 3 in-water work seasons, respectively. As a result, more potential exposures of marbled murrelets are estimated with Alternative 2 (Table 3.10–6) than with Alternative 1.

Therefore, Alternative 2 would expose marine birds to noise disturbance, construction vessel traffic and human activity for a much longer period of time. In particular, Alternative 2 would likely require one additional construction season compared to Alternative 1. These differences would neither increase nor decrease noise disturbance threshold distances; therefore, the effect determination on ESA-listed species (marbled murrelet) would be the same as described for Alternative 1. Because the number of pile driving days would be greater for Alternative 2, the number of potential exposures of marbled murrelets to behavioral disturbance would be greater under Alternative 2 than for Alternative 1.

Table 3.10–6. Alternative 2: Summary of Potential Exposures for Marbled Murrelet during the In-Water Pile Driving Season (Mid-July to Mid-February)

Season	Density of Marbled Murrelets (sq mi)	Underwater		Airborne[1]
		Injury Threshold (202 dBsel)	Behavioral Disturbance Threshold (150 dBrms)	Injury Threshold (92 dBA)
July 16 – October 31[2]	4.2	0	3,174 – 6,325	0
November 1 – February 15	7.7	0	5,754 – 11,550	0
Total Exposures		0	8,928 – 17,875	0

1. The airborne exposure calculations assumed that 100 percent of the in-water densities were available at the surface to be exposed to airborne sound.
2. Because this alternative has an odd number of pile driving days (275), 138 days was used to calculate exposures for the July 16 to October 31 time period and 137 days was used to calculate exposures for the November 1 to February 15 time period.

3.10.2.2.2 OPERATION/LONG-TERM IMPACTS

Both alternatives would have the same operations and overwater footprint (i.e., the area in which potential prey species would be affected by shading and habitat loss); thus, no differences

are expected in terms of disturbance or prey availability for marine birds. Therefore, operational impacts to marine birds would be the same as those described for Alternative 1. Maintenance of the EHW-2 under Alternative 2 would have similar impacts to marine birds as Alternative 1.

3.10.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.10.2.3.1 CONSTRUCTION

As described in Chapter 2 (Table 2–1), Alternative 3 differs from Alternative 1 in that it would use separate trestles to access the wharf rather than a combined trestle. The wharf configuration would be the same for both alternatives. For marine birds, the primary construction-related concerns are impacts resulting from pile driving noise and other construction noise and activity, which would differ from Alternative 1 as follows:

- Alternative 3 requires more piles (up to 1,290) than Alternative 1 (1,250).
- Alternative 3 would require 210 to 420 (226 to 436 for airborne noise) days of pile installation over 2 to 3 in-water work seasons compared to 200 to 400 (211 to 411 for airborne noise) days over 2 to 3 in-water work seasons for Alternative 1. As a result, more exposures of marbled murrelets are estimated with Alternative 3 (Table 3.10–7) than with Alternative 1.

Thus, Alternative 3 would expose marine birds to underwater noise disturbance, construction vessel traffic and activity for a slightly longer period of time than Alternative 1. These differences would neither increase nor decrease noise disturbance threshold distances; therefore, the effect determination on ESA-listed species (marbled murrelet) would be the same as described for Alternative 1. Because the number of pile driving days would be greater for Alternative 3, the number of potential exposures of marbled murrelets to behavioral disturbance would be greater than for Alternative 1 (Table 3.10–7).

Table 3.10–7. Alternative 3: Summary of Potential Exposures for Marbled Murrelet during the In-Water Pile Driving Season (Mid-July to Mid-February)

Season	Density of Marbled Murrelets (sq mi)	Underwater		Airborne[1]
		Injury Threshold (202 dBsel)	Behavioral Disturbance Threshold (150 dBrms)	Injury Threshold (92 dBA)
July 16 – October 31	4.2	0	2,415 – 4,830	0
November 1 – February 15	7.7	0	4,410 – 8,820	0
Total Exposures		0	6,825 – 13,650	0

1. The airborne exposure calculations assumed that 100 percent of the in-water densities were available at the surface to be exposed to airborne sound.

3.10.2.3.2 OPERATION/LONG-TERM IMPACTS

Alternatives 1 and 3 would have the same operations, but the nearshore overwater footprint (i.e., the area in which potential prey species would be affected by shading and habitat loss), would be slightly greater with Alternative 3 (6.6 acres vs. 6.3 acres). In the context of the wide ranges covered by marine birds in general, differences in operational impacts to marine birds

from the two alternatives would be negligible. Maintenance of the EHW-2 under Alternative 3 would have similar impacts to marine birds as Alternative 1.

3.10.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.10.2.4.1 CONSTRUCTION

As described in Chapter 2 (Table 2–1), Alternative 4 differs from Alternative 1 in that it would use a larger number of smaller piles for construction of the wharf and a larger of number for the trestles. The trestle alignments and dimensions would be the same. For marine birds, the primary construction-related concerns are impacts resulting from pile driving, which would differ from Alternative 1 as follows:

- Alternative 4 requires more piles (up to 1,500) than Alternative 1 (1,250).
- The in-water construction period for Alternative 4 would be much longer than for Alternative 1: 290 to 570 (306 to 586 for airborne noise) days of pile driving over 3 to 4 in-water work seasons compared to 200 to 400 (211 to 411 for airborne noise) days over 2 to 3 in-water work seasons, respectively. As a result, more exposures of marbled murrelets are estimated with Alternative 4 (Table 3.10–8) than with Alternative 1.

Therefore, Alternative 4 would expose marine birds to underwater noise disturbance, construction vessel traffic, and human activity for a much longer period of time than Alternative 1. These differences would neither increase nor decrease noise disturbance threshold distances; therefore, the effect determination on ESA-listed species (marbled murrelet) would be the same as described for Alternative 1. Because the number of pile driving days would be greater for Alternative 4, the number of potential exposures of marbled murrelets to behavioral disturbance would be greater than for Alternative 1 (Table 3.10–8).

Table 3.10–8. Alternative 4: Summary of Potential Exposures for Marbled Murrelet during the In-Water Pile Driving Season (Mid-July to Mid-February)

Season	Density of Marbled Murrelets (sq mi)	Underwater		Airborne[1]
		Impact Injury Threshold (202 dBsel)	Vibratory Disturbance Threshold (150 dBrms)	Injury Threshold (92 dBA)
July 16 – October 31	4.2	0	3,335 – 6,555	0
November 1 – February 15	7.7	0	6,090 – 11,970	0
Total Exposures		0	9,425 – 13,525	0

1. The airborne exposure calculations assumed that 100 percent of the in-water densities were available at the surface to be exposed to airborne sound.

3.10.2.4.2 OPERATION/LONG-TERM IMPACTS

Alternatives 1and 4 would have the same operations, but the nearshore overwater footprint (i.e., the area in which potential prey species would be affected by shading and habitat loss) would be slightly greater for Alternative 4 (6.6 acres vs. 6.3 acres). In the context of the wide ranges covered by marine birds in general, differences in operational impacts to marine birds for the two alternatives would be negligible. Maintenance of the EHW-2 under Alternative 4 would have similar impacts to marine birds as Alternative 1.

3.10.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.10.2.5.1 CONSTRUCTION

As described in Chapter 2 (Table 2–1), Alternative 5 differs from Alternative 1 in that it would use a floating wharf supported by pontoons that would be wider than the pile-supported wharf in Alternative 1, but the combined trestles would be the same. The overwater footprint of Alternative 5 (8.5 acres) would be greater than the footprint of Alternative 1 (6.3 acres). For marine birds, the primary construction-related concerns are impacts resulting from pile driving, which would differ from Alternative 1 as follows:

- Significantly fewer piles would be required with Alternative 5 (up to 440 compared to up to 1,250 with Alternative 1).
- The in-water construction period for Alternative 5 would be significantly shorter than for Alternative 1: 135 to 175 days of pile driving over 2 in-water work seasons compared to 200 to 400 days over 2 to 3 in-water work seasons, respectively.

These differences would neither increase nor decrease noise disturbance threshold distances; therefore, the effect determination for ESA-listed species (marbled murrelet) would be the same as described for Alternative 1. Because the number of pile driving days would be fewer for Alternative 5, the number of potential exposures of marbled murrelets to behavioral disturbance would be less than for Alternative 1 (Table 3.10–9).

Table 3.10–9. Alternative 5: Summary of Potential Exposures for Marbled Murrelet during the In-Water Pile Driving Season (Mid-July to Mid-February)

Season	Density of Marbled Murrelets (sq mi)	Underwater		Airborne[1]
		Injury Threshold (202 dBsel)	Behavioral Disturbance Threshold (150 dBrms)	Injury Threshold (92 dBA)
July 16 – October 31[2]	4.2	0	1,564 – 2,024	0
November 1 – February 15	7.7	0	2,814 – 3,654	0
Total Exposures		0	4,378 – 5,678	0

1. The airborne exposure calculations assumed that 100 percent of the in-water densities were available at the surface to be exposed to airborne sound.
2. Because this alternative has odd numbers of pile driving days (135 and 175), 68 and 88 days was used to calculate exposures for the July 16 to October 31 time period and 67 and 87 days was used to calculate exposures for the November 1 to February 15 time period.

3.10.2.5.2 OPERATION/LONG-TERM IMPACTS

Alternatives 1 and 5 would have the same operations and nearshore impacts but the overwater footprint of Alternative 5 (8.5 acres) would be greater than the footprint of Alternative 1 (6.3 acres). Also, the wharf under Alternative 5 would be closer to shore and have a greater effect on nearshore prey availability for marine birds and a smaller effect on deeper water prey than Alternative 1. In the context of the wide ranges covered by marine birds in Hood Canal, differences in operational impacts to marine birds for the two alternatives would negligible. Maintenance of the EHW-2 under Alternative 5 would have similar impacts to marine birds as Alternative 1.

3.10.2.6 No-Action Alternative

There would be no construction- or operations-related activities that would disturb marine birds in the project area under the No-Action Alternative. Therefore, this alternative would have no impacts to marine birds.

3.10.2.7 Mitigation Measures and Regulatory Compliance

3.10.2.7.1 MITIGATION MEASURES

Appropriate and effective mitigation measures that would be in compliance with the ESA are described in detail in the Mitigation Action Plan (Appendix F). Mitigation measures and current practices to reduce direct impacts to marine birds, including marbled murrelets, would include the following:

- The primary pile driving method would be a vibratory driver. Vibratory installation generates less noise (180 dBRMS at 33 feet) underwater than an impact hammer (185 dBRMS at 33 feet) for piles of the size proposed for this project.
- A bubble curtain or other noise attenuating device would reduce underwater pile driving noise levels for impact pile drivers by approximately 10 dB, as described in Section 3.4.2 and would contain turbidity, as described in Section 3.2.
- Using a soft-start approach may be an effective means of discouraging marbled murrelets and marine birds from remaining in the zone of potential injury.
- A monitoring program using trained observers would be implemented during construction of the EHW-2 that would include acoustic measurements, visual monitoring of marine birds, and procedures for responding to the presence of marbled murrelets within the shutdown zone (see Appendix F, Mitigation Action Plan). The shutdown zone would correspond to the area within which marbled murrelet injury could potentially occur (based on the 202 dBSEL injury criterion for impact pile driving).
- Impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). Upland construction would occur between 7:00 AM and 10:00 PM.
- An absorbent oil containment boom would be placed around the construction area to contain accidental gas or oil spills to ensure that marbled murrelets and other marine birds are not impacted by oil spills outside of the contained area.
- A floating debris barrier would be placed around the construction site to contain construction debris to avoid injury to marbled murrelets and other marine birds.

3.10.2.7.2 ESA COMPLIANCE

Underwater noise levels during construction of the EHW-2 are expected to result in disturbance to marbled murrelet. The Navy submitted a biological assessment of Alternative 1 and consulted formally with USFWS on potential effects of the proposed action on listed species

(NAVFAC 2011b). USFWS issued a Biological Opinion of Alternative 1 on November 16, 2011 (USFWS 2011) stating that incidental take of marbled murrelets is anticipated during the in-water construction period in the form of harassment as a result of non-injurious TTS. USFWS also stated that this level of anticipated take is not likely to jeopardize the continued existence of the marbled murrelet or result in destruction or adverse modification of critical habitat as no critical habitat within the marine environment has been designated for marbled murrelets.

3.10.2.7.2.1 REASONABLE AND PRUDENT MEASURES FROM USFWS BIOLOGICAL OPINION

"Reasonable and prudent measures" are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02). "Terms and conditions" implement the reasonable and prudent measures (50 CFR 402.14). These must be carried out for the exemption in Section 7(o)(2) to apply. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. USFWS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of marbled murrelets:

- Reasonable and Prudent Measure 1: Minimize incidental take resulting in non-injurious TTS caused by exposure to underwater sound pressure associated with impact pile driving.
- Reasonable and Prudent Measure 2: Monitor incidental take caused by exposure to underwater sound pressure associated with impact pile driving and by in-air sound pressure associated with vibratory and impact pile driving.

3.10.2.7.2.2 TERMS AND CONDITIONS FROM USFWS BIOLOGICAL OPINION

In order to be exempt from the prohibitions of Section 9 of the Act, the Navy must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

The following terms and conditions are required for the implementation of Reasonable and Prudent Measure 1:

1. The Navy shall implement monitoring of marbled murrelets during impact pile driving to reduce impacts associated with non-injurious TTS. The Navy must monitor marbled murrelets, implementing the Service's marbled murrelet survey protocol, out to a distance of 293 meters. This distance may be adjusted based on the number of pile strikes. If a marbled murrelet is observed, impact pile driving must be stopped until the marbled murrelet leaves the monitoring area under its own volition, but pile driving does not need to be stopped for longer than 1 hour per marbled murrelet encounter. Impact pile driving does not need to be curtailed for more than 2 hours total time per day, regardless of the number of marbled murrelets encountered. The Navy will prepare a marbled murrelet monitoring plan that meets Service protocol and provide this to the Service at least 90 days prior to the proposed in-water work window of July 16, 2012. Impact pile driving shall not occur until the Navy is notified that the Service has approved the monitoring plan.
2. The Navy will document the duration and frequency of shutdowns of impact pile driving due to the presence of marbled murrelets and/or sea-state conditions exceeding a Beaufort Sea

State 2 within the area of non-injurious temporary threshold shift (i.e., between cumulative 183 dB SEL and 202 dB SEL to a distance of up to 293 meters depending on the number of pile strikes). Should shutdowns occur at a frequency that is significantly affecting the project's schedule for completion, then the Navy may convene an adaptive management group consisting of representatives of the Navy and the Service to address the issue. The Navy would work with the Service to develop and implement an adaptive strategy. The adaptive management group would identify and agree to criteria and timelines for implementation of the strategy.

The following terms and conditions are required for the implementation of Reasonable and Prudent Measure 2:

1. The Navy will provide a copy of the marbled murrelet monitoring report to the Service's consulting biologist within 90 days of completion of in-water work during each year of construction.
2. The Navy shall implement hydroacoustic monitoring during impact pile driving. The Navy shall prepare a hydroacoustic monitoring plan and provide this to the Service at least 90 days prior to the proposed in-water work window of July 16, 2012. Impact pile driving shall not occur until the Navy is notified that the Service has approved the monitoring plan.
3. The Navy shall provide a copy of the hydroacoustic monitoring report to the Service's consulting biologist within 90 days of completion of in-water work during each year that hydroacoustic monitoring is performed.

USFWS believes that marbled murrelets occurring within no more than 0.48 sq km cumulative total area of marine habitat within Hood Canal will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Navy must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

USFWS is to be notified within three working days upon locating a dead, injured, or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death, if that occurs. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact the U.S. Fish and Wildlife Service Law Enforcement Office at (425) 883-8122, or the Service's Washington Fish and Wildlife Office at (360) 753-9440.

3.10.2.7.2.3 CONSERVATION RECOMMENDATIONS

Section 7(a)(a) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to

help implement recovery plans, or to develop information. The following discretionary conservation measures proposed by the USFWS (2011) are intended to assist the Navy in avoiding or minimizing the effects on listed species from this action and in fulfilling the Navy's legal obligation to conserve listed species:

1. The Navy should convene, in coordination with USFWS, an expert panel comprising researchers, biologists, and acousticians to review USFWS's current approach and to propose refinements, as appropriate, to the use of USFWS's interim underwater sound pressures of between 183 dB SEL and 202 dB SEL for non-injurious TTS effects on marbled murrelets.
2. The Navy should ensure that mitigation for the proposed action occurs within close proximity of the impacts. Mitigation should be in-kind and result in the full compensation of the functions and values impacted. Loss of nearshore habitat due to shading, temporary and long-term loss of eelgrass and macroalgae, and loss of forage fish due to effects associated with lethal and sublethal sound pressures should be mitigated as these resources are important for providing forage for marbled murrelets and other marine species.
3. The Navy should implement measures to reduce threats to marbled murrelets associated with the marine environment that would assist in the recovery of this species. This may include the removal of derelict gill nets from the marine environment.
4. The Navy should perform marbled murrelet surveys to determine their specific occurrence and timing of their use within the areas affected by Navy actions anticipated in the future. These surveys would provide more site-specific information regarding the abundance and timing of use of these areas.
5. The Navy should survey for all dead and/or distressed fish during the proposed action, especially during impact pile driving. Fish that are found dead should be collected and necropsied to determined the cause of death. USFWS should be notified of any dead and/or distressed fish that are observed due to the proposed action.
6. The Navy should monitor the roof of the wharf to determine if bird strikes are occurring. Monitoring on a monthly basis is recommended. Should dead birds be found, the Navy will notify USFWS.

3.10.2.7.3 NAVY RESPONSE

The Navy will comply with all non-discretionary findings (reasonable and prudent measures and terms and conditions) outlined in the USFWS (2011) Biological Opinion. Per Section 7 of the ESA, conservation recommendations are discretionary and not mandatory. As recommended in the Biological Opinion, the Navy will convene an expert panel to review underwater sound pressure criteria for non-injurious TTS effects on marbled murrelets, and will finalize compensatory mitigation plans at sites in proximity to the impacts subject to availability of suitable sites. The Navy has requested funding to conduct marbled murrelet winter density surveys in the nearshore environment of NBK at Bangor for 2014–2018. These surveys would provide the Navy with winter baseline data in order to better detect changes in population trends.

Although surveys and collection of dead and/or distressed fish are not planned, the Navy will submit annual monitoring reports to the USFWS and NMFS that will describe any observable bird, marine mammal, and fish behavior in the immediate area during monitoring. As part of facility maintenance, the Navy would periodically inspect the wharf roof. If any dead threatened or endangered birds are found, the Navy would notify the USFWS.

3.10.2.7.3.1 OTHER CONSULTATIONS WITH USFWS

The Navy consulted with USFWS regarding the MBTA and Bald and Golden Eagle Protection Act and will avoid knowingly impacting bald eagles and other migratory birds' nest sites during construction and operation of the EHW-2.

3.10.3 Summary of Impacts

Impacts to marine birds during the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.10–10. Table 3.10–11 is a comparison of behavioral exposures of marbled murrelets by alternative.

Table 3.10–10. Summary of Impacts to Marine Birds

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE BIRDS
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Direct impacts to marine birds, including raptors (bald eagle, osprey), seabirds, waterfowl, shorebirds, and wading birds due to pile driving noise, increased vessel traffic, human activity, and airborne construction noise for 200–400 pile driving days, 2 to 3 in-water work seasons. Increased underwater noise during pile driving sufficient to exceed USFWS disturbance threshold for marbled murrelet. Indirect effects on prey species due to temporary degradation of habitat. *Operation/Long-term Impacts:* Indirect effects on prey species due to changes in benthic habitat and barriers to migratory fish. *ESA:* The Navy concludes that the appropriate effect determination for construction and operation is "may affect, likely to adversely affect" for listed marbled murrelet. The Navy estimated 6,500–13,000 behavioral disturbance exposures due to impact and vibratory pile driving. In its Biological Opinion, USFWS (2011) concluded that incidental take of marbled murrelets is anticipated during the in-water construction period in the form of harassment as a result of non-injurious TTS. USFWS also stated that this level of anticipated take is not likely to jeopardize the continued existence of the marbled murrelet or result in destruction or adverse modification of critical habitat as no critical habitat within the marine environment has been designated for marbled murrelets.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Direct impacts to marine birds, including raptors (bald eagle, osprey), seabirds, waterfowl, shorebirds and wading birds due to pile driving noise, increased vessel traffic, human activity, and airborne construction noise. Increased underwater noise during pile driving sufficient to exceed USFWS disturbance threshold for marbled murrelet. Indirect effects on prey species due to temporary degradation of habitat. Greater potential for impacts than Alternative 1 due to more pile driving days (275–550 vs. 200–400) and an additional in-water work season (3 to 4 vs. 2 to 3). *Operation/Long-term Impacts:* Indirect effects on prey species due to changes in benthic habitat and barriers to migratory fish. *ESA:* The Navy concludes the appropriate effect determination for construction and operations is "may affect, likely to adversely affect" for listed marbled murrelet. The Navy estimates increased exposures of marbled murrelets compared to Alternative 1 due to more pile driving days: 8,928–17,875 behavioral disturbance exposures due to impact and vibratory pile driving. The Biological Opinion (USFWS 2011) determinations for the marbled murrelet and its critical habitat are provided above in the summary for Alternative 1.

Table 3.10–10. Summary of Impacts to Marine Birds (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE BIRDS
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Direct impacts to marine birds, including raptors (bald eagle, osprey), seabirds, waterfowl, shorebirds, and wading birds due to pile driving noise, increased vessel traffic, human activity, and airborne construction noise. Increased underwater noise during pile driving sufficient to exceed USFWS disturbance threshold for marbled murrelet. Indirect effects on prey species due to temporary degradation of habitat. Slightly greater potential for impacts than Alternative 1 due to more pile driving days (210–420 vs. 200–400). *Operation/Long-term Impacts:* Indirect effects on prey species due to changes in benthic habitat and barriers to migratory fish. *ESA:* The Navy concludes the appropriate effect determination for construction and operations is "may affect, likely to adversely affect" for listed marbled murrelet. The Navy estimates slightly increased exposures of marbled murrelets compared to Alternative 1 due to more pile driving days: 6,825–13,650 behavioral disturbance exposures due to impact and vibratory pile driving. The Biological Opinion (USFWS 2011) determinations for the marbled murrelet and its critical habitat are provided above in the summary for Alternative 1.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Direct impacts to marine birds, including raptors (bald eagle, osprey), seabirds, waterfowl, shorebirds, and wading birds due to pile driving noise, increased vessel traffic, human activity, and airborne construction noise. Increased underwater noise during pile driving sufficient to exceed USFWS disturbance threshold for marbled murrelet. Indirect effects on prey species due to temporary degradation of habitat. Longer duration (290–570 vs. 200–400 days) of pile driving impacts than Alternative 1. 3 to 4 in-water work seasons would be 1 season more than Alternative 1. *Operation/Long-term Impacts:* Indirect effects on prey species due to changes in benthic habitat and barriers to migratory fish. *ESA:* The Navy concludes the appropriate effect determination for construction and operations is "may affect, likely to adversely affect" for listed marbled murrelet. The Navy estimates increased exposures of marbled murrelets compared to Alternative 1 due to more pile driving days: 9,425–18,525 behavioral disturbance exposures due to impact and vibratory pile driving. The Biological Opinion (USFWS 2011) determinations for the marbled murrelet and its critical habitat are provided above in the summary for Alternative 1.

Table 3.10–10. Summary of Impacts to Marine Birds (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO MARINE BIRDS
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Direct impacts to marine birds, including raptors (bald eagle, osprey), seabirds, waterfowl, shorebirds, and wading birds due to pile driving noise, increased vessel traffic, human activity, and airborne construction noise. Increased underwater noise during pile driving sufficient to exceed USFWS disturbance threshold for marbled murrelet. Indirect effects on prey species due to temporary degradation of habitat. Less potential for impacts due to fewer pile driving days (135–175 vs. 200–400) compared to Alternative 1 and only 2 in-water work seasons. *Operation/Long-term Impacts:* Indirect effects on prey species due to changes in benthic habitat and barriers to migratory fish. *ESA:* The Navy concludes the appropriate effect determination for construction and operations is "may affect, likely to adversely affect" for listed marbled murrelet. The Navy estimates fewer exposures of marbled murrelets compared to Alternative 1 due to fewer pile driving days. 4,378–5,678 behavioral disturbance exposures due to impact and vibratory pile driving. The Biological Opinion (USFWS 2011) determinations for the marbled murrelet and its critical habitat are provided above in the summary for Alternative 1.
No-Action Alternative	No impact.
Mitigation: Under all alternatives, the Mitigation Action Plan (see Appendix F) would compensate for the impacts to aquatic resources. The following mitigation measures would reduce direct impacts to marine birds.	
• Use of a bubble curtain or other noise attenuating device during impact pile driving • Use of a mechanical soft-start approach at the beginning of each impact and vibratory pile driving session to induce marine birds to leave the immediate pile driving area • Marbled murrelet monitoring program that includes designation of pile driving shutdown zones and procedures for responding to presence of marine birds within these zones	
Consultation and Permit Status • The Navy has concluded consultation with USFWS on the marbled murrelet under the ESA. A Biological Opinion has been issued by USFWS placing terms and conditions on project construction to minimize effects on ESA-listed species. A description of reasonable and prudent measures and terms and conditions from this opinion is provided in Section 3.10.2.7.2, Mitigation Measures and Regulatory Compliance. • The Navy consulted with USFWS regarding the MBTA and Bald and Golden Eagle Protection Act.	

Table 3.10–11. Comparison of Behavioral Exposure Numbers by Alternatives

ALTERNATIVE	BEHAVIORAL EXPOSURE OF MARBLED MURRELETS
1	6,500 – 13,000
2	8,928 – 17,875
3	6,825 – 13,650
4	9,425 – 18,525
5	4,378 – 5,678

UPLAND ENVIRONMENT

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UPLAND ENVIRONMENT

For this analysis, the upland environment is defined as areas inland of marine waters and above the MHHW line. The upland environment of NBK at Bangor is a mixture of natural and developed areas. Much of the land area has been retained in a more or less natural state, resulting in high quality natural resources such as wetlands, surface water and groundwater, and vegetation. These high quality habitat conditions support a diverse population of plant, fish, and wildlife species. The following sections describe upland conditions at the entire base, as appropriate, and conditions present at the EHW upland project area where upland elements of the EHW-2 project would be located. There are some areas of minor potential geologic hazards near the EHW upland project area, and some concerns for erosion and sedimentation during construction.

Generally, most impacts to the upland environment for the EHW-2 facility would result from temporary disturbance related to construction of a permanent paved access road from Archerfish Road to the upland area along the shoreline, an extension road, and construction of three new buildings and the pure water facility site (construction details are provided in Chapter 2 and impacts are discussed in sections below). Permanent disturbance would include construction of shoreline abutments for the trestles, access road and extension, new retaining walls, security fence, utilities, new underground storage tank, and three new buildings with replacement parking spaces and the pure water facility (and associated infrastructure) to replace those buildings that would be demolished in compliance with Navy safety requirements (Section 2.2.1). During construction, there would be increased potential for erosion and sedimentation from stormwater runoff, which could entrain sediment that would cause temporary localized degradation of some water quality parameters. Wildlife habitat would be disturbed or lost due to removal of the forest vegetation. However, none of the freshwater bodies potentially affected directly or indirectly by the proposed action support fish populations. Therefore, there is no potential for the proposed action to affect freshwater fish, and freshwater fish are not addressed further in this EIS.

Operations at these project locations would not impact the upland environment. There would be a small increase in impervious surface; however, continued stormwater management would be implemented to control stormwater.

3.11 GEOLOGY AND SOILS

Geologic resources include the soil, rock, and upland sediment that are present at or near the surface of the project area. These materials may be naturally in place or may have been moved and modified by human interaction. Discussion of geologic resources involves determination of lithologic types, compaction, surface slopes, potential stability, moisture, standing or moving water, erosion, contamination, and any previous modification to the land surface. Geologic resources may be affected by water at or near the surface, by vegetation, and by other outside influences such as earthquakes and manmade modifications to the land that cause movement and instability of geologic materials. Because interactions between geologic solids and water are so critical, this section on Geology and Soils contains overlap with Section 3.12, Surface Water and Groundwater.

During construction of the EHW-2 facilities, stormwater runoff would be handled in accordance with an NPDES Construction General Permit. A SWPPP would be developed, following guidance in WDOE's *Stormwater Management Manual for Western Washington* (WDOE 2005a). The SWPPP would specify what BMPs would be implemented during

construction and operation to limit erosion and contaminant discharges, including sedimentation, to upland water bodies and Hood Canal (see Section 3.12, Surface Water and Groundwater).

Project activities on NBK at Bangor involving the disturbance or contamination of soils may be subject to regulatory authority or guidelines at the federal and state levels. Applicable laws and regulations are concerned with the effect of soil erosion and sedimentation, instability, contamination, and the placement of fill into wetlands and other surface water bodies. Laws pertinent to degradation of the soil primarily address contamination of soil by hazardous or toxic materials, associated risk to human health and the environment, and subsequent soil cleanup. Sections 3.12, Surface Water and Groundwater, and 3.14, Wetlands, address regulations pertaining to water and wetlands.

CERCLA, also commonly known as Superfund, was enacted to address abandoned or uncontrolled hazardous waste sites. The law has subsequently been amended by SARA and is implemented by the NCP (see Section 3.3 for further discussion). CERCLA is administered by the USEPA and provides for site identification and listing on the NPL. Sites on NBK at Bangor have been listed on the NPL because of contamination associated with a number of hazardous waste sites on the base. Under EO 12580, the Navy is the lead agency for investigation and cleanup of contaminated sites on NBK at Bangor. CERCLA provides for state participation, and WDOE is the lead regulatory agency for contaminated sites on NBK at Bangor. The Model Toxics Control Act (MTCA) is the state regulation (WAC 173-340) that addresses the identification, investigation, and cleanup of hazardous waste sites in Washington.

In January 1990, the Navy, USEPA, and WDOE entered into a Federal Facilities Agreement for the study and cleanup of possible contamination on NBK at Bangor. Studies conducted at the base identified a number of contaminated waste sites that were subsequently combined into eight operable units (OU) within the Bangor NPL site. None of the contaminated sites is located within the EHW upland project area. The nearest site (OU 4, Site C-West) is approximately 0.5 mile east of the EHW upland project area (Parametrix 1994a; Navy 2005a). None of the outlying locations (the new buildings area or pure water facility) are proximal to contaminated sites.

The Washington State Underground Storage Tank regulation (RCW 90.76) establishes requirements for the following: design, construction, and installation of underground tanks; notification of the presence of tanks; licensing and tagging of tanks; and out-of-service underground storage tank systems and closure. Notification to WDOE is required 30 days before installing a new underground storage tank or removing an existing one, and a certified/licensed professional must perform the action and documentation. The regulation is implemented in WAC 173-360.

Shoreline-related activities on NBK at Bangor, including modification of potentially unstable soils, are considered to meet CZMA consistency through application of the policies and regulations of the Kitsap County Shoreline Management Master Program (SMP) (Kitsap County Code, Title 22). Hood Canal has been designated by the state as a Shoreline of Statewide Significance (Code Chapter 22.24.010). As a result, the SMP seeks to enhance and protect water resources in the Hood Canal Watershed, including all lands and activities that affect drainage of water into the canal or its tributaries. This includes minimizing erosion and sedimentation, and protecting soil resources. Further information on coastal consistency is provided below in Section 3.20, Coastal and Shoreline Management.

The Kitsap County Code for geologically hazardous areas is based on that used by the U.S. Geological Survey (USGS), WDNR, and WDOE (Canning 2001; WDOE 2009d). Although the County Code has no direct applicability to Navy projects in a regulatory context, because of

its basis, it can be used as a guideline for environmental evaluations and for meeting the goals of the SMP. The hazards pertaining to construction that affect the geologic stability and erosion of sloping land are covered by the County Code under Chapter 19.400, *Geologically Hazardous Areas*. The geologically hazardous areas are designated based on percent slope, mapping or determination of stability zones, soil types, and groundwater seepage (Kitsap County Code).

Consultation and Permit Compliance Status. No consultations or permits are required, although a CZMA federal consistency determination is required from WDOE (see Section 3.20). The Navy submitted a Phase I CCD to WDOE (included within Appendix I to the FEIS). WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD in spring 2012.

3.11.1 Existing Environment

The geologic conditions described include topography, geology, geologically hazardous areas, and soils. The geomorphology of the Bangor waterfront is typical of shorelines around Puget Sound and Hood Canal, with steep bluffs rising several hundred feet from the marine waters and merging into uplands with a more gradual slope. The underlying geologic conditions are the result of periodic episodes of glaciation, where the advance and retreat of glaciers have laid down successive layers of sediments alternating between dense till layers and other fine- and coarse-grained layers of sediments. Interglacial deposits tend to consist of fine-grained sediments. These glacial and interglacial deposits are more than 1,200 feet thick, overlying bedrock. Surface soils at the EHW upland project area are highly variable, depending upon the nature of the underlying sediments. A majority of the base consists of a gravelly, sandy loam developed on glacial till, which is a common near-surface geologic material. Potential geologic hazards include areas of slope instability and erosion potential, as well as general seismic hazards.

3.11.1.1 Geologic Overview

The Hood Canal basin is a glacially carved fjord with steep flanks rising abruptly to elevations of more than 200 feet above mean sea level (MSL). Further inland on the Kitsap Peninsula, slopes are moderate and many upland areas are nearly flat. Maximum elevations on NBK at Bangor are nearly 500 feet above MSL (USGS 2002, 2003).

The Kitsap Peninsula is underlain by a thick accumulation of glacial and non-glacial sediments in a sequence of alternating coarse- and fine-grained deposits that partially fill the regional north-south bedrock depression referred to as the Puget Sound Lowland. In the EHW upland project area, the thickness of these sediments is more than 1,200 feet and is underlain by bedrock. The glacial deposits consist principally of outwash sand and gravel, lacustrine silt and clay, and till. The non-glacial sediments consist largely of fine-grained floodplain deposits, but in some areas may also contain sand and gravel characteristic of alluvial fans (Kahle 1998; USGS 2003).

The upland area of NBK at Bangor is largely covered by glacial till referred to as Vashon till (Figure 3.11–1). This glacial till consists of very dense, pebbly, silty sand containing 10 to 20 percent clay. Thickness of the till in this area is typically 10 to 100 feet. The till is underlain by Vashon glacial advance outwash, which is a well-sorted deposit of sand and gravelly sand, with occasional lenses of fine-grained material. This unit occurs widely in the area and typically is 10 to 150 feet thick. The advance outwash is exposed at the surface in areas where the till is absent. These windows through the till to the outwash typically are along streams and nearshore areas.

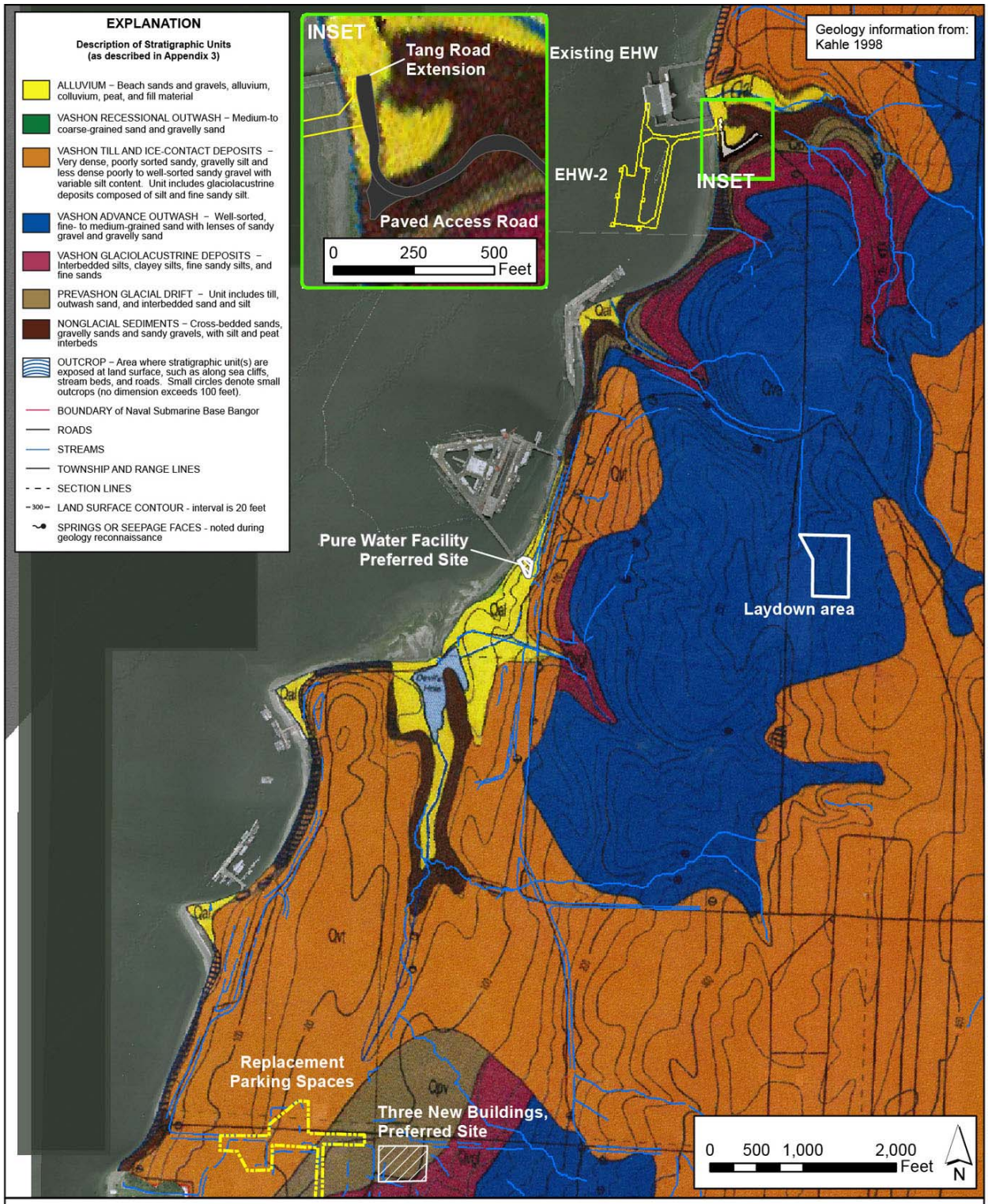

Figure 3.11–1. Surficial Geology of NBK at Bangor

In the EHW upland project area, the outwash is usually less than 100 feet thick and found at elevations of approximately 150 to 300 feet MSL, above the tops of the waterfront bluff. The geologic layer below the outwash consists principally of Vashon glacio-lacustrine silt, clayey silt, and very fine sand.

These glacial lake deposits are exposed in the waterfront bluff at elevations from approximately 75 to 150 feet MSL, and at higher elevations in the valley of Stream G, southeast of Wetland 6 (Figure 3.11–2). In the lower 75 feet of the bluff are pre-Vashon (older) deposits of interbedded sand, gravel, clay, silt, and peat (Kahle 1998; USGS 2003).

The area of the shoreline adjacent to the EHW-2 project site (Figure 3.11–3) is situated largely on the pre-Vashon material, and at higher elevations is Vashon glacio-lacustrine material (Figure 3.11–1). The EHW project construction laydown area on Archerfish Road is located on Vashon advance outwash. The area of the three new buildings is located on pre-Vashon glacial drift. The associated replacement parking spaces are located on both this glacial drift and on Vashon till. The pure water facility site is located on Quaternary alluvium.

3.11.1.2 Soils Overview

Four primary categories of soil types occur within the EHW upland project area:

(1) Upland soils that are developed on Vashon till usually consist of a gravelly, sandy loam (20 to 40 inches thick) overlying a dense hardpan layer. These soils have a variable permeability and may support perched water during winter months. Perched water flows laterally and discharges in depressions and streams and through seeps along hillsides and road cuts. These soils are designated as Alderwood and Poulsbo series soils.

(2) In many of the larger stream cuts and near the tops of bluffs, soils are developed on Vashon advance outwash sediments that consist of loamy sand. These soils are deep and tend to be well drained because of their sand-rich texture. In the EHW upland project area, these coarser-grained soils are designated as Indianola soils.

(3) Soils developed on Vashon glacio-lacustrine sediments consist of silt loam and silty clay loam up to 60 inches thick. This soil has a relatively low permeability, perches water during the winter months, and also supports wetlands. Lateral flows along platy clay layers occur during the wet months, and slopes as low as 8 to 15 percent on this soil type are thus prone to slippage. These fine-grained soils are designated as Kitsap soils.

(4) Soils developed on steeper slopes along bluffs and stream valleys typically overlie Vashon outwash, glacio-lacustrine deposits, and older deposits. These soils have variable characteristics and are prone to instability due to their steepness and local presence of clay. These soils are designated as Indianola-Kitsap complex, with slopes of 45 to 70 percent. In addition to these four listed soil types, other undifferentiated soils include those along streams, in marshes or lakes, and on beaches (Soil Conservation Service 1980).

3.11.1.3 Slope Stability Hazard Areas

Chapter 19.400 of the Kitsap County Code defines areas of high geologic hazard as those with slopes greater than or equal to 30 percent and mapped as unstable, or unstable with landslides. Areas of moderate geologic hazard are defined as those with unstable slopes less than 30 percent, or those with an intermediate stability designation, or slopes of 15 percent or greater with springs or groundwater seepage.

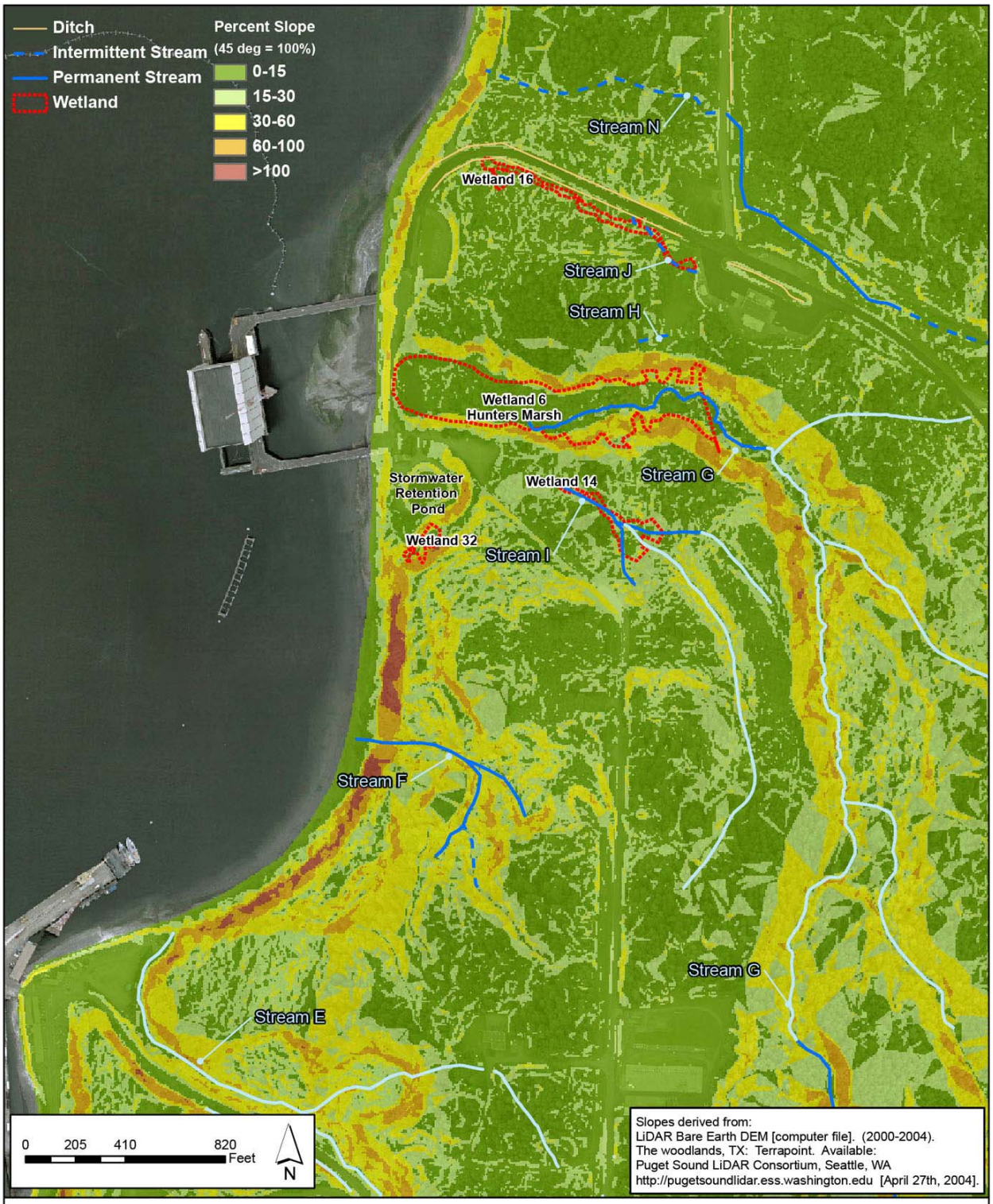

Figure 3.11–2. Topography and Slope Near the EHW-2 Project Site

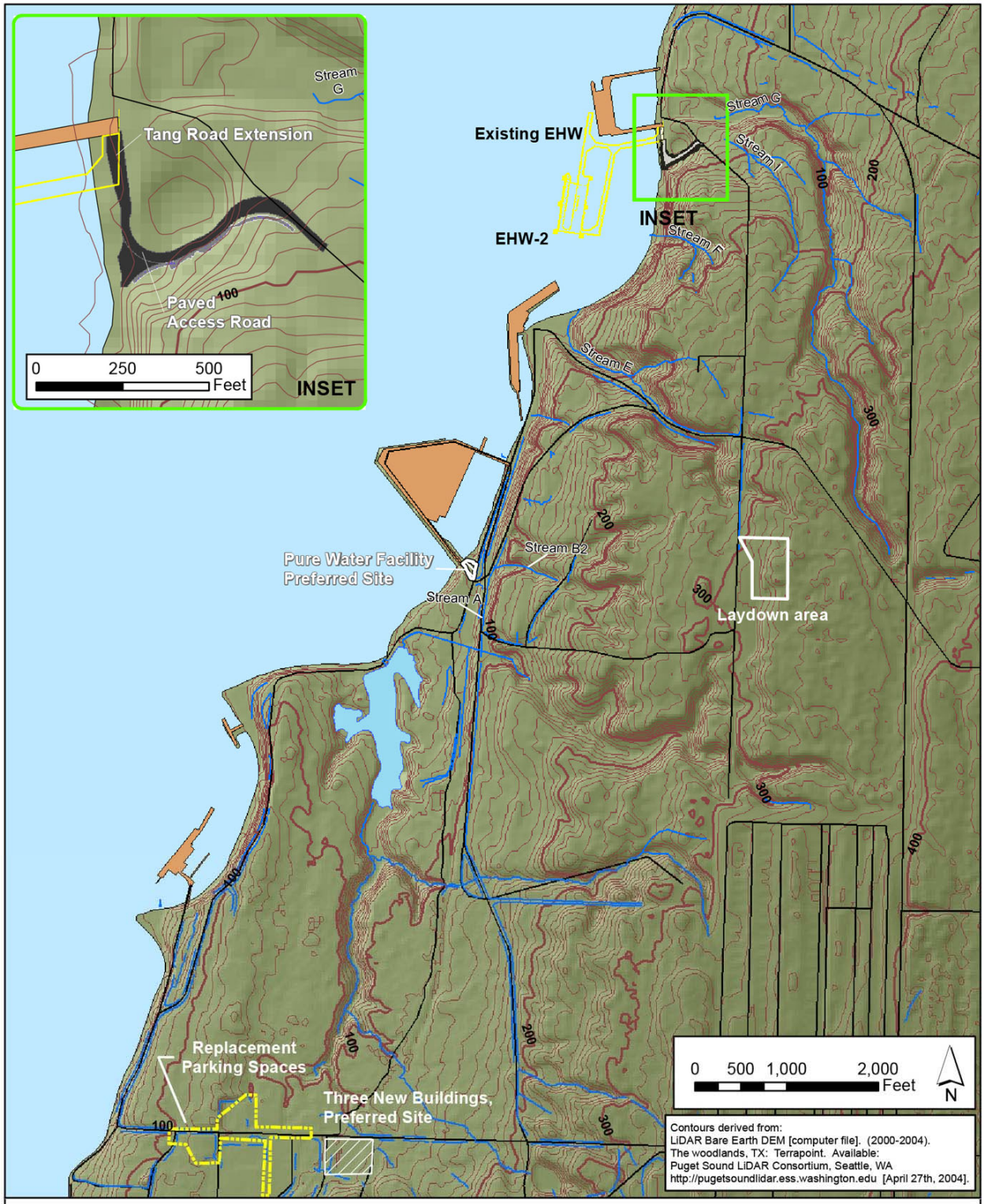

Figure 3.11−3. Location and Topography of EHW Upland Features

Detailed mapping of areas with high potential for slope instability or erosion has not been performed within the boundaries of NBK at Bangor. Mapping conducted as part of the Coastal Zone Atlas of Washington (WDOE 2009d) investigated areas to the north and south of the base, with designations of unstable and intermediate stability, plus local areas of recent landslides.

A recent evaluation of Kitsap County landslides, using light detection and ranging laser survey techniques, identified three noticeable landslides on NBK at Bangor (McKenna et al. 2008). Two of these are located approximately 1,000 feet south of the EHW upland project area, along the north side of Stream E, east of Marginal Wharf (Figure 3.11–2). The other landslide area is located on the southeast side of Cattail Lake, about 6,000 feet northeast of the project area. These three landslides appear to be situated on moderate to steep slopes within Vashon glacio-lacustrine silt-clay deposits (Kahle 1998). Kahle also observed that well-developed slump blocks (rotated soil areas similar to landslides) are present along the shoreline near the existing EHW.

This conclusion is consistent with results of slope stability modeling displayed in a WDNR online map, which predicted that areas on NBK at Bangor lying along the Hood Canal bluffs and along incised stream channels would be expected to exhibit moderate or high slope instability (WDNR 2009). The bluff along the EHW waterfront area and slopes along most reaches of Streams F and G are designated in the model as high slope instability. These areas are prone to landslides and erosion, particularly resulting from seismic or heavy rainfall events. Areas on the steeper slopes containing Vashon glacio-lacustrine sediments are especially susceptible to instability, and seepage zones are present within or above these deposits (Kahle 1998).

The shoreline adjacent to (east and southeast of) the EHW-2 project site is characterized by localized steep slopes ranging between approximately 60 and 175 percent slope (Figure 3.11–2). Slopes adjacent to and immediately south of the existing EHW facility are much lower in elevation and gradient. Some incised stream valleys are also characterized by steep slopes, and moderate to gentle slopes are present in the upland areas above these bluffs and stream valleys.

The steep eastern slope of the EHW stormwater retention pond (Figure 3.11–2) shows signs of possible soil slumping, potentially due to seepage discharge (see Section 3.12.1.3). Water seeping from the soil on the side of this pond may have reduced soil friction, causing soil to slide or rotate downhill. Slopes along a former unpaved road on the hillside south of the pond also suggest gradual slope movement (soil creep) along a wet surface scarp that may have originated as a former roadcut (Navy 2011). This possible slumping and soil creep are not expected to be related to seismic activity, as they are located on the sides of relatively recent manmade slopes with high water content. The upland areas near the onshore components of the EHW-2 project site, along with the new buildings area (including the replacement parking spaces) and pure water facility site, are characterized by low to moderate average slopes, while the construction laydown area exhibits variable slopes (Figure 3.11–3).

Western Washington is recognized as a seismically active region. Faults within the Puget Sound Lowland are capable of producing earthquakes with Richter magnitudes of 7.0 to 7.7. Even larger earthquakes (magnitude 8 to 9) are predicted due to offshore deep subduction faulting. NBK at Bangor lies between two major fault zones that have been active in the recent geological past: the Seattle Fault (active within the last 1,100 years) and the South Whidbey Island Fault (active within the last 2,500 years). These and other regional faults are capable of large-magnitude earthquakes that could affect structures and slope stability in the project area, including production of landslides and other forms of mass wasting (Kitsap County Department of Emergency Management 2004; Bourgeois and Martin 2008).

The USGS has developed a series of seismic hazard maps that describe the likelihood that earthquake shaking of varying degrees will occur in a given area. On NBK at Bangor, predicted peak horizontal ground acceleration (PGA) with a 2 percent probability of exceedance in 50 years is 0.50 to 0.60 g (gravitational acceleration). Predicted ground acceleration with a 10 percent probability of exceedance in 50 years is 0.30 to 0.35 g. For reference, a PGA of 0.10 g is the approximate threshold for damage to older structures or structures not made to resist earthquakes (USGS 2008).

Based on Kitsap County mapping of ground-shaking amplification during an earthquake, the project area is classified as Site Class C and Site Class C to D (on a scale of B to F, where B is neutral and higher letters have increasing amplification of ground shaking). This suggests that seismic ground shaking in the EHW upland project area would be considered to have modest amplification based on near-surface geology. Furthermore, the liquefaction susceptibility for project area soils is considered to be very low to low, indicating that surface soils would have a low probability of liquefying and losing strength during an earthquake (Palmer et al. 2004).

3.11.2 Environmental Consequences

The evaluation of impacts to geologic resources considers whether geologic materials would become unstable under proposed conditions, whether erosion and sedimentation in water bodies would occur, whether excavation and transport of soil would adversely affect water or land environments, and whether soil contamination would increase or spread. In addition, soil stability could be impacted by vibrations through pile driving or earthquakes.

3.11.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.11.2.1.1 CONSTRUCTION

The upland project area at the EHW-2 site includes a permanent paved access road along the south side of the stormwater retention pond, three culverts under this access road, two retention walls, and a permanent gravel bypass road (with one culvert) on the north side of Archerfish Road (Figure 3.11–3 inset). A zone of temporary disturbance for clearing around these roadways and utility work amounts to 1.6 acres. An area located on the east side of the trestle landfall would become a paved roadway where it connects to the existing southern terminus of Tang Road (referred to as Tang Road extension). Total new impervious surface created in this area would be 1.4 acres. A temporary (for approximately 4 years), unpaved construction laydown area (5.0 acres) would be created on the east side of Archerfish Road, south of Seawolf Road (Figure 3.11–3), approximately 4,000 feet south of the project site.

In addition to these project areas, three new buildings would be constructed to replace offices, storage, a rigging shop, and a refit support facility that would be demolished in proximity to EHW-2 (Section 2.2.1.3); the former building areas would be revegetated with native forest and shrub species. These new buildings, associated paved areas, and associated utilities would be located in an existing industrial area of the lower base where maintenance and repair activities occur, approximately 2.2 miles south of the EHW-2 project site. The three buildings (totaling 22,191 square feet) would be situated on an existing parking lot, and the replacement parking spaces would be located almost entirely on previously developed areas (shown in Figure 2–10). The buildings and associated parking, sidewalks, and storage areas will permanently occupy approximately 2.6 acres of impervious surfaces (of which 1.7 acres would be newly impervious [currently vegetated]). Construction of the three new buildings is anticipated to take one year.

The pure water facility site would also house the function of an existing pure water facility to be demolished in proximity to the northern trestle of Delta Pier (Section 2.2.1.4). The preferred location is at the southern trestle of Delta Pier, about a mile south of the EHW-2 facility area. The new facility would consist of a treatment building, several new tanks, paved areas, and a new water line between the facility and Delta Pier. This activity would temporarily disturb 0.5 acre of land and permanently add 0.5 acre of new impervious surface. Construction of the new pure water facility is anticipated to take one year.

Altogether, for the full EHW-2 upland project, 12.6 acres of land would be disturbed by clearing and grading, including 3.6 acres permanently disturbed and 9.0 acres temporarily disturbed. The 3.6 acres of new impervious surface includes 1.4 acres at the EHW-2 site, 1.7 acres for the new buildings area, and 0.5 acre for the pure water facility site. Of the 12.6 acres disturbed, 10.3 acres are currently vegetated; a total of 6.9 acres would be revegetated following construction, while 3.4 acres would be permanently impacted.

At the EHW-2 project site, utilities would be installed (water lines, backflow preventer vaults, sewer line, Ship's Overboard Discharge main, manholes, concrete ducting), a utility building would be replaced, and a security fence would be installed. In addition, a 10,000-gallon aboveground tank for Ship's Overboard Discharge and oily wastewater would be removed and replaced with a new 10,000-gallon underground tank in the same location, immediately east of the Tang Road extension (Section 2.2.1.2; Figure 2–3). The new tank would be constructed of double-walled fiberglass with between-wall leak sensors. These construction activities would involve a small amount of earthmoving, included in the 1.6 acre of temporary disturbance in the general area of the access and extension roadways. Underground tank installation would require excavation of approximately 62 cubic yards of soil. Although petroleum-contaminated soils are not expected during installation of this tank, any that are identified would be characterized and removed according to state MTCA regulations.

Clearing and grading of a total of 3.0 acres for development of the access and bypass roads, Tang Road extension, and stormwater and utility work would disturb soils and create the potential for erosion during storm events. Installation of the latter structures and the new 10,000-gallon underground tank would not appreciably affect the amount of soil movement or erosion during construction. The access road would extend a length of approximately 610 feet, with a typical width between 28 and 32 feet; however, at the southern curve of the roadway would be a widened turn-around area up to approximately 130 feet in width. The eastern half of this proposed roadway would be situated along an existing break in slope that corresponds to the location of a former unpaved road. The overall average grade of the route is 5.8 percent, with a maximum local grade for existing topography of 49 percent. This selected route would minimize the amount of cutting and filling that is needed to develop this paved access road, and the local steeper sloping areas in the middle of the route would be smoothed for a gradual incline. Earthmoving activities to construct this access road would involve soil cutting, including approximately 4,025 cubic yards for roadway excavation, 1,100 cubic yards for clearing and grading, and 2,375 cubic yards of excess and unsuitable soil to be hauled to the laydown area. The haul route would follow the access road eastward, and then southward on Archerfish Road. Some soil filling would also be required in the western half of the access road to create a moderate grade. Fill soils would be imported from a suitable location on base or an approved offsite location (clean fill only).

A small freshwater wetland area (designated Wetland 32) is located in the central length of this access road route (see Figure 3.11–4 and Section 3.14, Wetlands). This 0.2-acre wetland would be filled to accommodate construction of the access road. This portion of the access road route would

be excavated into an older non-glacial deposit, consisting of very compacted sand and gravel with silt and peat (based on the geologic map in Figure 3.11–1). According to the wetland delineation report (Navy 2011), the road route lies on Kitsap silt loam soil, with a relatively high percentage of silt and clay. This wetland report also noted that compaction related to the former road (built prior to 1977) likely has increased the water-holding ability of the wetland. The surface materials identified in the wetland report suggest instability in terms of slope movement along a scarp that may have originated as a former roadcut. Evidence of soil creep or slumping has been noted on the uphill (south) side of the former unpaved roadway that is being utilized for the alignment of the new access road (Navy 2011). This corresponds to the relatively steep slope on the southeastern side of Wetland 32 (Figure 3.11–4). A very small seasonal wet area (Wetland 29) is also present near the top of this slope. Final geotechnical design of the access road will include measures to stabilize this slope. This would include removal of trees (not stumps) along the side and top of this slope in the area near Wetland 29, to reduce weight on the unstable slope in order to minimize soil slumping.

In addition, an area of seepage and potential slumping has been observed on the steep eastern side of the stormwater retention pond, on the slope north of the eastern portion of the access road. This potential slumping may be related to the seepage emanating from this slope, which would be addressed during final geotechnical design of the access road. Regrading and construction would be implemented in the access road area to stabilize this slope in accordance with recommendations in recent and future geotechnical evaluations (Hart Crowser 2010).

Based on the location of areas of potential slumping and design and construction measures to prevent soil movement, the EHW-2 structure would not be affected by soil slumping.

During filling of Wetland 32 for the paved access road, project BMPs would be implemented for surface drainage, as described in Section 2.2.8, including culverts, ditches, retaining walls, weep pipes, and sediment control devices. Drainage from the wetland as well as the access road would flow through three new culverts installed under the access road. These culverts would drain runoff from the vegetated hillside and wetland, and from a ditch along the southeastern side of the roadway. These flows would be treated using low impact development (LID) Water Quality Catch Basins and discharge on the beach across a riprap apron to prevent erosion (Figure 3.11–4). Another culvert under the electrical substation bypass road would be a re-routing of an existing drainage of vegetated areas, with no new drainage, and would not require treatment.

A retaining wall (80 feet long and 7 to 8 feet high) would be constructed near the discharge point to keep the roadway fill slope from covering this discharge headwall as well as the drainage outfall from the retention pond. Another retaining wall would be constructed to minimize the amount of disturbed area and stabilize the proposed cut slope at the southern corner of the new access road (Figure 2–3).

Other BMPs for clearing, grading, and maintenance would include: interceptor ditches on both sides of the roadway; sediment traps outfitted with rock check dams, stand pipes, and straw bale barriers on the southern sides of the road; and silt fences along the northern sides of the road. Water-spraying on soil would be used to control dust generation as needed during earthmoving and hauling activities. Earthmoving work would occur during the initial 10 months prior to the trestle construction phase, during regular construction hours. The trestles would come ashore near where the existing EHW southern trestle reaches shore and merges into the southern extension of Tang Road. At this location, a short length of roadway would connect the trestles with Tang Road. This new road extension would be paved, covering an area of 7,000 square feet (50 by 140 feet, or 0.16 acre) with an impervious surface.

Figure 3.11–4. Topography, Slope, and Features of the EHW Upland Area

The portion of the trestles overlying the intertidal zone would be constructed on piles, similar to the overwater trestles, in order to stabilize this structure. Some regrading and pile driving would occur in this area, where local surface slopes currently range up to 30 or 40 percent. This onshore trestle layout would include a 103-foot long main abutment on the west side of the road extension area, with a 69-foot long wing wall on the north end of the abutment, which in turn would tie into the existing EHW abutment. The new abutment includes a pile-supported, reinforced, cast-in-place concrete cap and wall.

Abutment piling would involve a total of 55 piles, each 24 inches in diameter. Piling for the abutment would be installed similar to in-water piling procedures (Section 2.2.1), using a vibratory driver and impact hammer. The duration of abutment pile driving would last approximately 11 days and would take place before in-water pile driving. On the seaward face of the abutment, armoring would include a buried rock scour blanket with two-man rock (average stone dimensions of 18 by 30 inches, totaling 520 cubic yards) on 6-inch-minus bedding material, and a covering of excavated beach material. To accommodate the abutment, approximately 2,760 cubic yards of sediment/soil would be excavated (some from below MHHW) and used onsite for backfill material. Approximately 300 cubic yards over approximately 1,400 square feet would be excavated and refilled below MHHW.

The impacts to the intertidal environment from earthmoving and hauling activity would include erosion and runoff from the abutment excavation area and the lower part of the paved access road. The abutment area and the western end of the access roadway are adjacent to the shoreline. Temporary and long-term controls of soil erosion and runoff would be in place as BMPs for earthmoving and hauling activities, as listed above, to protect the intertidal environment. Soils typical of this onshore trestle area, Ragnar and/or Indianola Series, underlain by older non-glacial deposits and Quaternary alluvium, are generally considered favorable for construction of transportation-related structures (Soil Conservation Service 1980; Kahle 1998). The pile-driving activities would result in vibrations that could impact the stability of nearby slopes, but the soil type and relatively low slopes would minimize this impact. The steeper slopes to the south of the onshore trestle area would be potentially impacted by vibrations. However, the attenuation of vibratory energy through water and air at the distance from the pile-driving activities to the steep slopes (a minimum of 440 feet to slopes of 100 percent) would minimize this concern. Further information on pile driving is provided in Section 2.2.2 and Table 2–1.

The proposed EHW-2 would be constructed to withstand the maximum expected earthquake magnitude (such as a magnitude 7.5 quake on a local crustal fault). The design of the second EHW incorporates state-of-the-art seismic standards as requirements for construction. The seismic criteria used in the design of the EHW-2 accounts for the low probability worst-case scenario event of 2 percent exceedance in a 50-year period, or an approximate scenario of once in 2,475 years (Hart Crowser 2010). The main wharf facility, wharf, and wharf cover are designed to be structurally stable if this event occurs. The design is in accordance with ASCE 7-05 (American Society of Civil Engineers design guide) and MOTEMS (Marine Oil Terminal Engineering and Maintenance Standards), which are approved standards for such a design and are based on USGS data.

The construction laydown area (Figure 3.11–3) would occupy approximately 5.0 acres that would require clearing of forest and regrading. Dimensions of the laydown area are approximately 605 feet by 360 feet. The laydown area would be developed early in the construction process and would be used for storing construction equipment, tools, and vehicles as well as for stockpiling excess soil. Soil may be segregated at the laydown area depending on

origin. Clearing and grading would disturb soils and create the potential for erosion during storm events. This laydown area would be located in an area with current average slopes of 10 to 12 percent grade, although local slopes in the west-central portion of this area range to more than 50 percent.

The construction laydown area is situated on soils underlain by Vashon advance outwash, consisting of sand with some gravel (Figure 3.11–1). This material is expected to be well-drained and not prone to perching water. Similar to above, this laydown area would not be located in areas of known landsliding, slumping, seepage, streams, or other erosive elements, to the extent practicable. Erosion during development or usage of the construction laydown area would thus be minimal. BMPs would be employed as needed to control erosion and sedimentation, as listed above. Plastic coverings or spraying water on the stockpiled material would be used to minimize windblown dust.

The new buildings area (Figure 3.11–3) includes the three buildings, associated roads, replacement parking spaces, sidewalks, and storage areas. Construction of these structures would permanently occupy a total of 2.6 acres, of which 1.7 acres would be cleared of previously disturbed vegetation. The remaining 0.9 acre is already paved. Similar to the laydown area, clearing and grading would disturb soils and create the potential for erosion during storm events. The new buildings and associated structures are situated in an area with nearly flat slopes and no evidence of soil slumping or seeps.

The three new buildings would be located within an existing parking lot on Vashon till. The area of replacement parking spaces would be situated within disturbed and landscaped areas on pre-Vashon glacial drift and on Vashon till. These units are expected to be poorly to moderately drained and not susceptible to sliding or slumping. After construction, these locations would all be paved or covered with buildings. Therefore, erosion during development or usage of this area would be minimal. BMPs would be employed as needed to control erosion and sedimentation, as listed above.

The pure water facility site (Figure 3.11–3) would require disturbance of a total of 2.0 acres, of which only 0.5 acre would be permanent. Of this 2.0-acre site, 1.4 acres are currently unvegetated (gravel or paved); the 0.6 vegetated acre would be revegetated with native forest and shrub species following construction. This site is situated on Quaternary alluvium and/or Vashon till (Figure 3.11–1), and slopes in this area are nearly flat. Clearing and grading would be minimal, with a small potential for erosion during storm events.

Construction of the pure water facility and the selected water line (option of route 1 or route 2) would be situated within existing developed and disturbed areas (see Figure 2–5). Water line route 1 is located on alluvium and Vashon till. Clearing and grading would be minimal because this water line would be placed above ground; thus, there is little potential for soil disturbance resulting in erosion during storm events. A small portion of water line route 2 would be installed above ground, with the majority mounted on the Delta Pier and trestle. Erosion during development or usage of this area would be minimal. BMPs would be employed as needed to control erosion and sedimentation, as listed above.

No hazardous waste sites or other contaminated soil have been identified in or near the EHW upland project area (Navy 2005a). Therefore, no known impacts exist as a result of handling contaminated soil. If any contaminated soil is identified during construction (e.g., during installation of the new underground Ship's Overboard Discharge/oily waste tank) or created during construction (e.g., vehicle leakage at laydown area), this soil would be removed and

handled in accordance with Navy spill response plans. The current aboveground tank is located onshore, on a concrete pad with containment system. No leaks have been observed or are anticipated.

3.11.2.1.2 OPERATION/LONG-TERM IMPACTS

There would be insignificant adverse impacts to geology or soils due to operation of Alternative 1. Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components, including new utilities, as required. After the EHW-2 construction is complete, the paved access road would permanently remain in use for maintenance purposes. The 1.4 acres of roadways and other facilities at the EHW-2 site would remain as an impervious surface with stormwater being routed and handled. As described in Section 2.2.8, new stormwater structures and utilities would be operated using BMPs to handle soil erosion and any surface water contamination. The area surrounding the roadway would be revegetated and periodically maintained, as described in Section 3.13, Vegetation. Drainage structures along the margins of the access road would remain in place to control runoff. The revegetation of the area surrounding the roadway and the construction of the abutment would protect against erosion or other soil movement in this vicinity.

The laydown area and a portion of the new buildings area, replacement parking and pure water facility site would also be revegetated with native forest species (Section 3.13). Stormwater runoff at these locations would be handled as stated above. Any vehicle leaks or spills would be cleaned up in accordance with the spill response plan prior to revegetation. The new 10,000-gallon underground storage tank would be double-walled and with leak-detection sensors, to minimize impact of contamination to nearby soils. Other activities, including disposal of sewage into existing sewage systems, and transport of oil to and from storage tanks, are expected to continue similar to present operations. Thus, there would be no significant adverse long-term impacts to soils in the laydown area, new buildings area, the pure water facility site, the abutment area, and the area surrounding the access road following construction of Alternative 1.

3.11.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

Impacts to geology and soils resulting from implementation of Alternative 2 would be identical to Alternative 1. This includes a total of 12.6 acres of land that would be disturbed by clearing and grading, amounting to 3.6 acres to be permanently disturbed and 9.0 acres to be temporarily disturbed. The 3.6 acres of new impervious surface includes 1.4 acres for the new roads and other upland features at the EHW-2 site, 1.7 acres for the new buildings area and replacement parking spaces, and 0.5 acre for the pure water facility site. A total of 6.9 acres would be revegetated following construction. The size of the trestle abutment and the amount of soil excavation and pile driving would be identical to Alternative 1, involving the same potential for impacting runoff and soil erosion, and use of the same BMPs (described in Section 3.11.2.1). Further details of construction are included in Section 2.2.3 and Table 2–1.

3.11.2.2.1 CONSTRUCTION

Upland construction components of Alternative 2 would be the same as those of Alternative 1; therefore, impacts to geology and soils due to construction would be the same for both alternatives.

3.11.2.2.2 OPERATION/LONG-TERM IMPACTS

Post-construction, potential impacts for upland components would be the same as those described for Alternative 1. Therefore, impacts to geology and soils due to long-term operation would be the same for both alternatives.

3.11.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

Impacts to geology and soils resulting from implementation of Alternative 3 would be similar to Alternative 1. This includes a total of 12.6 acres of land that would be disturbed by clearing and grading, amounting to 3.6 acres to be permanently disturbed and 9.0 acres to be temporarily disturbed. The 3.6 acres of new impervious surface includes 1.4 acres acre for the new roads and other upland features at the EHW-2 site, 1.7 acres for the new buildings area, and 0.5 acre for the pure water facility site. A total of 6.9 acres would be revegetated following construction. The size of the trestle abutment and the amount of soil excavation and pile driving would be slightly larger than Alternative 1, involving slightly greater potential for impacting runoff and soil erosion, but with the same use of BMPs (described in Section 3.11.2.1). Further details of construction are included in Section 2.2.4 and Table 2–1.

3.11.2.3.1 CONSTRUCTION

The upland construction components of Alternative 3 would be similar to those of Alternative 1, with the following differences. The road extension area covers 8,500 square feet (50 by 170 feet or 0.20 acre) and is slightly longer parallel to the shore because the full trestle width is greater for Alternative 3, compared to Alternative 1 (which covers 7,000 square feet). Consequently, the abutment length is longer, with a 160-foot length and 35-foot long wing walls at both the north and south ends. This would entail installation of 80 abutment piles (instead of 55 piles in Alternative 1). Pile driving activity would take approximately 16 days. Excavation to accommodate the longer abutment structure would involve removal of approximately 3,560 cubic yards of sediment/soil (instead of 2,760), and 700 cubic yards of armor rock (instead of 520). Approximately 550 cubic yards would be excavated and refilled over an area of approximately 1,900 square feet below MHHW. Although this would involve slightly greater amounts of earthmoving, Alternative 3 construction impacts are very similar to those described for Alternative 1.

3.11.2.3.2 OPERATION/LONG-TERM IMPACTS

Post-construction, potential impacts associated with upland components of the project would be the same as those of Alternative 1. Differences in long-term impacts of the slightly larger road extension and abutment would be negligible.

3.11.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

Impacts to geology and soils resulting from implementation of Alternative 4 would be similar to Alternative 1. This includes a total of 12.6 acres of land that would be disturbed by clearing and grading, amounting to 3.6 acres to be permanently disturbed and 9.0 acres to be temporarily disturbed. The 3.6 acres of new impervious surface includes 1.4 acres for new road and other upland features at the EHW-2 site, 1.7 acres for the new buildings area, and 0.5 acre for the pure water facility site. A total of 6.9 acres would be revegetated following construction. The size of the trestle abutment and the amount of soil excavation and pile driving would be slightly larger than Alternative 1, involving slightly greater potential for impact to runoff and soil erosion, but

with the same use of BMPs (described in Section 3.11.2.1). Further details of construction are included in Section 2.2.5 and Table 2–1.

3.11.2.4.1 CONSTRUCTION

The upland construction components of Alternative 4 would be similar to those of Alternative 1. The extension road area covers 8,500 square feet (50 by 170 feet or 0.20 acre) and is slightly longer parallel to the shore because the full trestle width is greater for Alternative 4 compared to Alternative 1 (which covers 7,000 square feet). Consequently, the abutment length is longer 160 feet) and with 35-foot long wing walls at both the north and south ends. This would entail installation of 80 abutment piles (instead of 55 piles for Alternative 1). Pile driving would take approximately 16 days. Excavation to accommodate the longer abutment structure would involve removal of approximately 3,560 cubic yards of sediment/soil (instead of 2,760) and 700 cubic yards of armor rock (instead of 520). Approximately 550 cubic yards would be excavated and refilled over an area of approximately 1,900 square feet below MHHW. Although this would involve slightly greater amounts of earthmoving, Alternative 4 construction impacts are very similar to those described for Alternative 1.

3.11.2.4.2 OPERATION/LONG-TERM IMPACTS

Post-construction, potential impacts associated with upland components of the project would be the same as those described for Alternative 1. Differences in long-term impacts of the slightly larger road extension and abutment would be negligible.

3.11.2.5 Alternative 5: Combined Trestle, Floating Wharf

Impacts to geology and soils resulting from implementation of Alternative 5 would be identical to Alternative 1. This includes a total of 12.6 acres of land that would be disturbed by clearing and grading, amounting to 3.6 acres to be permanently disturbed and 9.0 acres to be temporarily disturbed. The 3.6 acres of new impervious surface includes 1.4 acres for the new roads and other upland features at the EHW-2 site, 1.7 acres for the new buildings area, and 0.5 acre for the pure water facility site. A total of 6.9 acres would be revegetated following construction. The size of the trestle abutment and the amount of soil excavation and pile driving would be identical to Alternative 1, involving the same potential for impacting runoff and soil erosion and use of the same BMPs (described in Section 3.11.2.1). Further details of construction are included in Section 2.2.6 and Table 2–1.

3.11.2.5.1 CONSTRUCTION

Upland construction components of Alternative 5 would be the same as those of Alternative 1. The shoreline abutment length and soil excavation volume would be the same as for Alternative 1; therefore, impacts to geology and soils due to construction would be the same for both alternatives.

3.11.2.5.2 OPERATION/LONG-TERM IMPACTS

Post-construction, potential impacts for upland components would be the same as those described for Alternative 1.

3.11.2.6 No-Action Alternative

Under the No-Action Alternative, there would be no construction or operations-related activities that would directly or indirectly result in ground disturbance or erosion affecting soils near the EHW facility, and thus there would be no geologic impacts.

3.11.2.7 Mitigation Measures and Regulatory Compliance

The proposed action would not directly impact geologically hazardous areas. Design of the paved access road, paved road extension, laydown area, new buildings area, and pure water facility site would minimize impacts by locating or utilizing these features in areas away from unstable steep slopes, streams, and wetlands, to the extent practicable. In the area of potential slumping east of the retention pond and along the southern access road, regrading and other measures would be implemented to stabilize this area. As specified above, measures would be taken to minimize soil erosion and control seepage and other runoff that results from implementation of this alternative, including impacts from all roadways and utilities.

The EHW-2 project would not affect, or be affected by, known or designated contaminated soil sites and therefore would not be affected by CERCLA requirements. The Navy submitted a Phase I CCD to WDOE and WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD in spring 2012.

3.11.3 Summary of Impacts

Impacts to geology and soils associated with the construction and operations phase of each of the project alternatives, along with mitigation measures, are summarized in Table 3.11–1. This includes a total of 12.6 acres of land that would be disturbed by clearing and grading, amounting to 3.6 acres to be permanently disturbed and 9.0 acres to be temporarily disturbed. The 3.6 acres of new impervious surface includes 1.4 acres for new roads and other upland features at the EHW-2 site, 1.7 acres for the new buildings area, and 0.5 acre for the pure water facility site. A total of 6.9 acres would be revegetated following construction.

Table 3.11–1. Summary of Impacts to Geology and Soils

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO GEOLOGY AND SOILS
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Total disturbance area of 12.6 acres; permanent disturbance (new structures/paving) of 3.6 acres. Installation of 172 total feet of abutment length, driving of 55 upland piles, and soil excavation of 2,760 cu yd, with erosion and runoff potential from excavation/filling, armor placement, construction (roads, buildings, parking, utilities, stormwater facilities, construction laydown area), and hauling to laydown area (total project construction duration is 42–48 months). *Operation/Long-term Impacts:* Additional 3.6 acres of impervious surfaces.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Total disturbance area of 12.6 acres; permanent disturbance (new structures/paving) of 3.6 acres. Installation of 172 total feet of abutment length, driving of 55 upland piles, and soil excavation of 2,760 cu yd, with erosion and runoff potential from excavation/filling, armor placement, construction (roads, buildings, parking, utilities, stormwater facilities, construction laydown area), and hauling to laydown area (total project construction duration is 54–64 months). *Operation/Long-term Impacts:* Additional 3.6 acres of impervious surfaces.

Table 3.11–1. Summary of Impacts to Geology and Soils (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO GEOLOGY AND SOILS
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Total disturbance area of 12.6 acres; permanent disturbance (new structures/paving) of 3.6 acres. Installation of 230 total feet of abutment length, driving of 80 upland piles, and soil excavation of 3,560 cu yd, with erosion and runoff potential from excavation/filling, armor placement, construction (roads, buildings, parking, utilities, stormwater facilities, construction laydown area), and hauling to laydown area (total project construction duration is 42–49 months). *Operation/Long-term Impacts:* Additional 3.6 acres of impervious surfaces.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Total disturbance area of 12.6 acres; permanent disturbance (new structures/paving) of 3.6 acres. Installation of 230 total feet of abutment length, driving of 80 upland piles, and soil excavation of 3,560 cu yd, with erosion and runoff potential from excavation/filling, armor placement, construction (roads, buildings, parking, utilities, stormwater facilities, construction laydown area), and hauling to laydown area (total project construction duration is 54–64 months). *Operation/Long-term Impacts:* Additional 3.6 acres of impervious surfaces.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Total disturbance area of 12.6; permanent disturbance (new structures/paving) of 3.6 acres. Installation of 172 total feet of abutment length, driving of 55 upland piles, and soil excavation of 2,760 cu yd, with erosion and runoff potential from excavation/filling, armor placement, construction (roads, buildings, parking, utilities, stormwater facilities, construction laydown area), and hauling to laydown area (total project construction duration is 42–44 months). *Operation/Long-term Impacts:* Additional 3.6 acres of impervious surfaces.
No-Action Alternative	No impact.
Mitigation • No mitigation measures are necessary beyond the proposed BMPs.	
Consultation and Permit Status • The Navy submitted a Phase I CCD to WDOE and WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD in spring 2012.	

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3.12 SURFACE WATER AND GROUNDWATER

Surface water and groundwater resources include standing and moving water at the surface, all shallow subsurface water, and any utilized (pumped) groundwater on NBK at Bangor. Surface water includes streams, ponds, wetlands, retention ponds, stormwater collection structures (e.g., ditches), seepage, and certain interactions with waters of Hood Canal. These surface water bodies may have been naturally located, relocated by humans, or initially constructed by humans. A large number of factors affect surface water and groundwater resources, including precipitation, watershed dynamics, impervious surfaces, stream gradients, vegetation, water quality, recharge and discharge, and pumping of aquifers. Interactions with Hood Canal include runoff and sedimentation, coastal flooding, and tsunami events. Discussion of these resources overlaps with Section 3.11, Geology and Soils. Wetland resources are discussed in more detail in Section 3.14, Wetlands.

Project activities on NBK at Bangor involving groundwater and non-marine surface waters are subject to regulatory authority at the federal and state level.

FEDERAL REGULATIONS

The Federal Water Pollution Control Act Amendments of 1972, as amended in 1977 and 2002, and commonly known as the Clean Water Act (33 USC §1251), established regulations for discharges of pollutants into waters of the United States. The CWA and its implementation are introduced in Section 3.2, Water Quality. The following text highlights CWA sections that are pertinent to upland and shoreline surface waters, followed by other regulatory requirements.

CWA, Section 404. Administered by USACE, Section 404 applies to the discharge of dredged or fill material into navigable waters of the United States, including USACE jurisdictional streams. A Section 404 permit is required for project activities that involve filling, clearing, or grading in USACE Section 404-regulated streams.

CWA, Section 401. Activities that require compliance with Section 404 of the CWA must also obtain a Section 401 water quality certification from WDOE. Issuance of a certification means that WDOE anticipates that the project will comply with state water quality standards and other aquatic resource protection requirements. The water quality certification covers both construction and operation of a project. Conditions of the certification become conditions of the Section 404 permit.

CWA, Section 402. Section 402 regulates wastewater discharges into surface water. Section 402 is implemented by the NPDES program. The USEPA has regulatory authority for NPDES for federal facilities including NBK at Bangor.

An NPDES Construction Stormwater General Permit is required for construction activities that disturb 1 acre or more and may result in a discharge of stormwater to surface waters of the state, including storm drains, ditches, wetlands, creeks, rivers, lakes, and marine waters. The permit requires construction site operators to prepare an SWPPP and to install and maintain erosion and sediment control measures to prevent soil, nutrients, chemicals, and other harmful pollutants from being washed by stormwater runoff into surface water bodies. An NPDES permit is required for the discharge of wastewater into surface waters through a conveyance system (e.g., an outfall). Industrial stormwater discharges on NBK at Bangor are covered under EPA's 2008 MSGP, Authorization to Discharge under NPDES (Navy 2009a). Stormwater runoff discharges from the EHW-2 facility would also be covered under the MSGP. This permit

may include limits on the quantity and quality of discharge, as well as requirements for monitoring the effluent and its receiving water.

CWA, Spill Prevention, Control, and Countermeasures (SPCC) regulation. SPCC regulations (40 CFR 112) are intended to protect water quality from releases of petroleum products. The regulations apply to facilities that store or use more than 1,320 gallons of petroleum products (inclusive of amounts stored in all drums, tanks, and operating equipment containing 55 gallons or more). These regulations are administered by the USEPA and require that an SPCC plan be developed and that secondary containment be provided for containers and tanks. The regulations would apply to project components that use or store petroleum products.

CWA, Section 303(d). Section 303(d) requires the identification of surface water bodies that do not meet applicable CWA quality standards and the development of a cleanup plan, known as a total maximum daily load (TMDL). No freshwater bodies within the EHW upland project area appear on the most recent 303(d) list.

In addition to the CWA, two other federal regulations apply to upland and shoreline surface waters: the Energy Independence and Security Act of 2007 (EISA) and the CZMA.

Energy Independence and Security Act of 2007 (EISA), Section 438. The Energy Independence and Security Act of 2007 (Public Law 110-140) is an Act of Congress concerning the energy policy of the United States. Section 438 of the Act requires federal development projects with a footprint exceeding 5,000 square feet to "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to temperature, rate, volume, and duration of flow." According to the USEPA guidance on implementing Section 438 of the Act (USEPA 2009), the intent of Section 438 is to "require federal agencies to develop and redevelop applicable facilities in a manner that maintains or restores stormwater runoff to the maximum extent technically feasible" and to "replicate the pre-development hydrology to protect and preserve both the water resources onsite and those downstream." Pre-development site hydrology can be maintained by retaining rainfall on-site through infiltration, evaporation/transpiration, and reuse.

Coastal Zone Management Act. As discussed in Section 3.20, Coastal and Shoreline Management, the CZMA requires that federal actions that have reasonably foreseeable effects on coastal users or resources must be consistent to the maximum extent practicable with the enforceable policies of approved state coastal management programs. Activities and development impacting coastal resources that involve the federal government are evaluated through a process called federal consistency, in which the proponent agency is required to prepare a CCD for concurrence from the affected state.

WASHINGTON STATE REGULATIONS

Water Code (RCW 90.03) and Regulation of Public Ground Waters (RCW 90.44) (Water Rights). These laws apply to the appropriation and beneficial use of state surface water and groundwater. Washington requires water rights for withdrawals of more than 5,000 gallons per day. Federal reservations (including military bases) are implied to have reserved water rights that provide sufficient water to carry out the purposes of the facility (including future use). Therefore, no additional water rights would need to be sought from the state to accommodate increased consumption associated with project activities.

Washington State Water Pollution Control Act (RCW 90.48). The state water quality standards are defined in the Washington State Water Pollution Control Act and implemented in

WAC 173-201A. The regulation establishes water quality standards for surface waters of the state of Washington consistent with public health and public enjoyment of the waters and the propagation and protection of fish, shellfish, and wildlife. WDOE's *Stormwater Management Manual for Western Washington* (WDOE 2005a) provides generic and technical guidance on measures to control the quantity and quality of stormwater runoff from development projects for compliance with CWA permit conditions as well as EISA Section 438.

Consultation and Permit Compliance Status. The Navy submitted a JARPA to USACE and WDOE, requesting a permit under CWA Section 404 and a Section 401 water quality certification. The Navy will submit an application to USEPA for coverage under the Construction General Permit in compliance with CWA Section 402. In accordance with the CZMA, the Navy submitted a Phase I CCD to WDOE (included within Appendix I to the FEIS). WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD in spring 2012.

3.12.1 Existing Environment

The EHW upland project area includes three perennial streams that drain toward Hood Canal. Several aquifers have been identified as underlying the upland area of NBK at Bangor. Groundwater from these aquifers provides the water supply for the base. The uppermost aquifer ranges from 10 to 150 feet deep and is situated within glacial outwash deposits (Kahle 1998; USGS 2003). The area along the waterfront has a small potential for tsunami activity.

3.12.1.1 Surface Water

Precipitation and seepage are the sources of surface water for the upland areas on NBK at Bangor. Kitsap County has a temperate maritime climate, with annual precipitation averaging approximately 50 inches per year. The total annual snowfall is approximately 16 inches. Most precipitation falls during late fall and winter (Kitsap County Department of Emergency Management 2004).

3.12.1.1.1 WATERSHEDS

NBK at Bangor includes two main watersheds, defined as major surface water drainages separated by topographic divides. The drainages at the base include five sizable perennial streams that enter Hood Canal (part of the northern Hood Canal watershed), and two tributaries of Clear Creek that flow to the southeast and enter into Dyes Inlet (part of the Clear Creek watershed). By including smaller streams on the base that are usually perennial, a total of 15 streams are enumerated, with drainage basins for these streams varying from 0.03 to 3.7 square miles. Recorded stream flows range from 0.01 to 4.0 cubic feet per second. Three of the perennial streams pass through small lakes or marsh areas before discharging into Hood Canal: Cattail Lake, Wetland 6, and Devil's Hole. Altogether, the base includes four lakes and ponds, and three larger marshes (May 1997).

3.12.1.1.2 STREAMS AND WETLANDS WITHIN THE EHW UPLAND PROJECT AREA

The EHW upland project area lies entirely within the Hood Canal watershed. Three perennial streams are located within the general area designated as the upland project area located near the EHW-2 project site: Stream F, Stream G, and Stream I (Figures 3.11–2 and 3.11–3).

Stream F originates near a wetland area and then flows north and west. Seeps are common within this area, resulting from the presence of low-permeability Vashon glacio-lacustrine deposits (Kahle 1998). The stream eventually flows through a gully in the bluff down to the waterfront. The streambed above the bluff has an average gradient of about 20 percent slope, reaching a maximum along the bluff of about 75 percent slope.

Stream G is the largest stream in the EHW upland project area, and extends for a distance of about 1.5 miles (mostly outside the EHW upland project area). The stream flows north and then west through Wetland 6. Groundwater seepage on the north and south banks of the wetland contribute to stream flows (Brown and Tannenbaum 2009b). Water in Wetland 6 then flows through a weir and a culvert that crosses under Tang Road. The culvert and weir restrict outflow from the marsh before this water discharges to Hood Canal. Sediment from upstream has been captured behind the weir and this has caused much of the downstream portion of the wetland to become filled with sediment. The stream has a gentle gradient, which averages approximately 5 percent slope over the lower one-quarter mile.

Stream I is intermittent in its upper half, and has a total length of approximately 0.5 mile. It flows north and then northwest through Wetland 14. The surface flow then infiltrates into the soil and moves as shallow groundwater, with no evidence of surface water. The actual discharge location is unknown, but the water likely discharges either to Wetland 6 or the stormwater retention pond. The lower reach of the stream has a gradient averaging 7.5 percent slope.

There are no lakes or ponds within the EHW upland project area but a few wetlands are present. A small wetland and seepage area (Wetland 32, Figure 3.11–4) is located south of the retention pond, along and near a former unpaved roadway. The wetland delineation report (Navy 2011) noted that compaction related to the former road (built prior to 1977) likely has increased the water-holding ability of the wetland. Above the slope on the south side of this wetland is a very small seasonal wetland (Wetland 29). The stormwater retention pond is located 250 feet south of Wetland 6 (see Section 3.12.1.3). The pond is intended to collect local runoff from nearby roadways and stormwater from the EHW facility (Navy 2009a).

Stormwater at the upland project areas is transported via the storm drain, drainage ditches, and overland flow. At the area for the three new buildings and associated replacement parking spaces, existing stormwater is collected via catch basins that drain through a storm sewer and is discharged north of Sturgeon Road. Some stormwater is also collected in a drainage ditch on the south and west sides of the existing lot. At the pure water facility site and water line routes, stormwater infiltrates or flows over vegetation into Hood Canal. Adjacent to the pure water facility, Stream A (intermittent) and Stream B2 (perennial) flow through the area of defined construction limits, via culverts under Runner and Escolar Roads, and continue in a roadside ditch that discharges through another culvert into Hood Canal.

3.12.1.1.3 WATER QUALITY

Surface water monitoring in the overall Hood Canal watershed is performed on an ongoing basis by Kitsap County Health District (2005) and WDOE (2008b). In winter 2011, Kitsap County Health District began a 2-year monitoring program sampling for *E. coli* in all water bodies flowing from NBK at Bangor into Hood Canal during both wet and dry seasons. No other monitoring of streams is ongoing at NBK at Bangor.

3.12.1.1.4 FLOODPLAINS / FREQUENTLY FLOODED AREAS

The Hood Canal shoreline below an elevation of 10 feet MSL is identified as a zone of coastal flooding. The waterfront shoreline area is designated by the Federal Emergency Management Agency (FEMA) as an A1-30 zone. This area is subject to flooding during the 100-year flood, which indicates that it has a 1 percent chance of flooding annually and a 26 percent chance of flooding in 30 years (National Flood Insurance Program 1980). The upland portions of the base, including all facilities in the EHW-2 upland area and the pure water facility, are not mapped for flood hazard areas, but are above the 10 feet MSL elevation; these areas are unlikely to contain any flood hazard areas based on their topography and similarity to areas adjacent to the base that are not mapped as flood hazards. The area of Wetland 6, at the lower end of Stream G, could experience flood conditions. Heavy precipitation could cause flooding of the marsh area, which is backed up behind a weir and culvert.

3.12.1.1.5 TSUNAMI HAZARDS

Potential tsunami hazards may exist within Hood Canal along the Bangor waterfront. Historical evidence for possible past tsunami activity is found in sand deposits above sea level along southern Hood Canal. These and other potential tsunami events would be initiated by seismic and/or landslide activity into the canal. The anticipated maximum height of tsunami inundation in Hood Canal is unknown. For comparative purposes, historical landslides in Puget Sound have generated tsunami waves of known heights. An earthquake-induced subaerial landslide in the Tacoma Narrows produced a tsunami that reached 6 to 8 feet in height. And two underwater landslides near Olympia and Tacoma generated tsunami waves of 10 to 15 feet in height (Palmer 2001; Kitsap County Department of Emergency Management 2004; Bourgeois and Martin 2008). A tsunami of this approximate height may have an impact to some EHW-2 structures, similar to an impact to the existing EHW structures. However, the overall potential for a tsunami to occur along the Bangor shoreline is considered very small (Moffatt & Nichol 2011). A large earthquake generated in the offshore tectonic zone would not produce a significant tsunami event in Hood Canal due to the attenuation of wave energy as the wave travels from the Straight of Juan de Fuca and turns into the protected waters of the canal (Gottlieb 2010).

3.12.1.2 Water Supply

None of the surface water bodies described in this section is used as a potable water source. Potable water on NBK at Bangor is provided by four deep groundwater supply wells. Wells for other purposes, including standby wells, are also maintained on the base (Parametrix 1994a) (see Section 3.24.1.1.1, Water Supply).

3.12.1.3 Stormwater Retention

Within the EHW upland project area, a stormwater retention pond is present near the shore, just south of Wetland 6 and Archerfish Road (Figure 3.11–4). This manmade pond is used to collect stormwater runoff from the existing EHW and adjacent parking areas and roadways. An outlet culvert is located between the southwest side of the pond and the beach, and a pumping station is situated to the northwest of the pond. This pond has a normal filled surface area of 0.44 acre, and a maximum possible surface area of 0.7 acre. The pond contains water all or most of the time. This pond is a manmade feature constructed in an upland area for the purpose of stormwater retention (see Section 3.14.1.1, Wetlands). The southern and eastern slopes of the

pond are steep, and some possible slumping of soil was recently noted on the eastern side, potentially due to seepage discharge of subsurface flow from Wetland 14 and Stream I.

3.12.1.4 Groundwater

Groundwater beneath the NBK at Bangor upland area occurs in a series of aquifers composed of permeable sand and gravel layers separated by layers of less permeable deposits of silt, sand, and clay. The uppermost aquifer is situated within Vashon advance outwash (Qva) deposits, and is overlain by low-permeability Vashon till (Qvt) (Figure 3.12–1). The Qva aquifer is typically 10 to 150 feet thick, and the water table occurs at depths of 60 to 80 feet below the land surface in upland areas; however, in lower-elevation areas along Hood Canal, in wetlands, and along some of the deeply incised stream channels, the water table is present at or near the land surface.

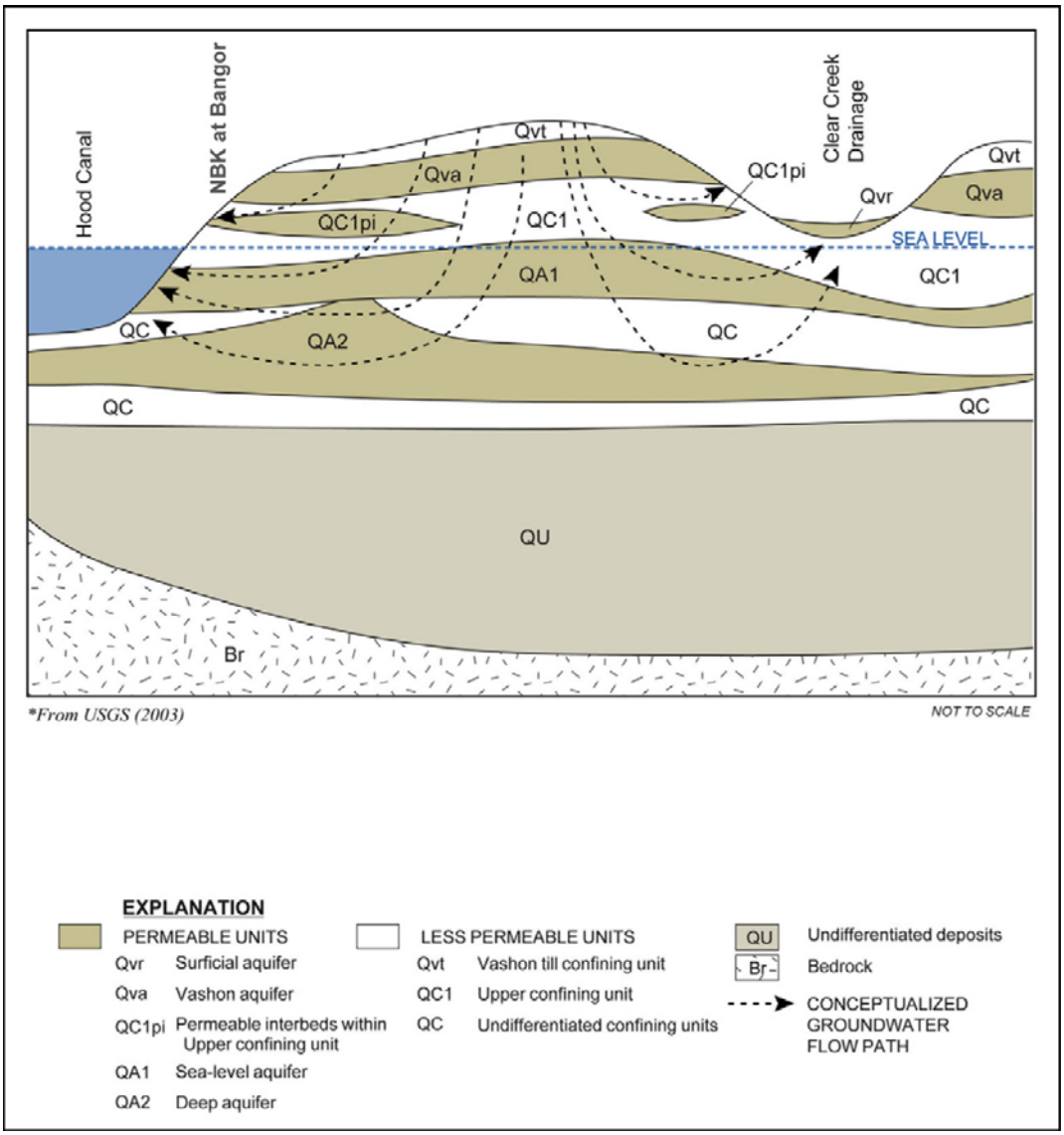

Figure 3.12–1. Conceptual Model of Hydrogeologic Conditions on NBK at Bangor

In addition, perched water may exist at shallow depths on top of low-permeability layers, such as Vashon till and glacio-lacustrine deposits. Some groundwater discharge in the form of springs and seeps is known to occur in the area, most commonly near the base of the Qva unit (Kahle 1998; USGS 2003).

Six groundwater wells, which are not used for drinking water, are present approximately 1,500 feet northeast of the EHW-2 onshore trestle area. These are located near the intersection of Flier Road and Amberjack Avenue. The wells extend to depths between 38 and 92 feet, or elevations of 30 to 85 feet MSL (Kahle 1998).

The EHW upland project area is located in zones of both groundwater recharge and discharge, as schematically depicted by the flow arrows in Figure 3.12–1. Groundwater is recharged by precipitation and infiltration in higher elevation upland areas, on the eastern portion of the EHW upland project area. Groundwater discharge takes place on the western, lower elevation portions of the EHW upland project area and near the pure water facility. Precipitation and surface water are sources of recharge for groundwater. Estimated long-term average recharge to the shallow aquifers on NBK at Bangor typically ranges from 8 to 10 inches per year. The direction of horizontal groundwater flow in the shallower aquifers beneath the EHW upland project area is westward, approximately perpendicular to the shoreline, discharging into Hood Canal or streams that drain to Hood Canal (Parametrix 1994a; Kahle 1998; USGS 2002, 2003).

Groundwater quality data are not available for the specific project area. However, the area is not located near known sources of groundwater contamination or any CERCLA operable units. The nearest groundwater-contaminated site is known as Site A within Operable Unit 1, the Bangor Ordnance Disposal site, which is located 1.2 miles northeast of the EHW-2 project area (USGS 2002; Navy 2005a). None of the outlying locations (laydown area, new buildings area, or pure water facility) are proximal to contaminated groundwater sites.

3.12.2 Environmental Consequences

The evaluation of impacts to surface water and groundwater considers whether surface water bodies would be physically modified, whether the surface water or aquifer quality would be degraded, whether additional stormwater runoff would require handling, whether discharge or recharge between the surface and groundwater would be affected, and whether flooding or tsunami events would affect the area. Surface water degradation includes runoff that causes erosion, turbidity, and sedimentation. Surface water impacts would be gauged by compliance with state water quality standards, including measures of turbidity.

3.12.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

Impacts to upland surface water from construction of Alternative 1 would result from ground-disturbing activities that could cause erosion and increased turbidity and sedimentation in surface water bodies, including removal of a small wetland (Wetland 32, Figure 3.11–3). Other surface water and groundwater resources would not be impacted by this alternative.

3.12.2.1.1 CONSTRUCTION

The EHW upland project activities include construction of a paved access road, a paved road extension, a gravel bypass road, four new culverts, installation or movement of some minor structures (including underground tank) and utilities, a laydown area, a new buildings area and replacement parking spaces, and the pure water facility site. These activities include the clearing

and grading of a total of 12.6 acres of land, amounting to 3.6 acres to be permanently disturbed and 9.0 acres to be temporarily disturbed. The 3.6 acres of new impervious surface includes 1.4 acres for new roads and other upland facilities at the EHW-2 site, 1.7 acres for the new buildings area, and 0.5 acre for the pure water facility site. A total of 10.3 vegetated acres would be cleared for construction; 6.9 acres would be revegetated following construction and 3.4 acres would be permanently impacted (see discussion of construction impacts to geology and soils in Section 3.11.2.1.1). Construction of Alternative 1 is expected to take a total of 42 to 48 months, and construction of the access road and laydown area would occur at the onset of project work. Use of these areas would continue until completion of construction, when regrading and revegetation would occur.

Clearing and grading of this land for construction purposes, and vehicle travel, would disturb soils and create the potential for runoff to cause increased turbidity and sedimentation in nearby drainages and in the intertidal environment. Both the access road and laydown features are located in areas with present average slopes less than 12 percent grade, but local slopes range up to 50 percent. The road extension segment and abutment area have slopes presently ranging up to 30 to 40 percent. The new buildings area and the pure water facility site have slopes that are nearly flat. The gentle slopes of most of these areas minimize erosion potential and impacts to surface water. The exception is the south-central portion of the access road, where slopes are steeper and some areas display heavy seepage and slow soil movement.

Construction of the access road would require filling Wetland 32, a 0.2-acre wetland (Figure 3.11–4). CWA permits will be obtained from USACE for this purpose, and a Section 401 water quality certification will be obtained from WDOE (see Section 3.14, Wetlands). A drainage associated with the wetland would flow through three new culverts installed under the access road east of the turn-around location, with inlet sediment traps, before discharging to the beach west of the access road. These culverts would drain runoff from the vegetated hillside and wetland, and from a ditch along the southeast side of the roadway, and discharge the water through an outfall above the beach (Figure 3.11–4). A retaining wall would be constructed near the discharge point to keep the roadway fill slope from covering this discharge headwall as well as the drainage outfall from the retention pond (Figure 2–3). In the long term, this water would originate from the access road as well as a seep on the south side of the road and would be treated using LID Water Quality Catch Basins (Basic Treatment manhole) prior to discharge. Another culvert under the electrical substation bypass road would be a re-routing of an existing drainage of vegetated areas, with no new drainage, and so would not require treatment or result in impacts to surface water.

In addition, the area surrounding the small seasonal wet area (Wetland 29), including the top and side of the slope south of Wetland 32, would have trees removed (with stumps remaining) to reduce weight on this unstable slope. Final geotechnical design of the access road will include further measures to stabilize this slope.

Some seepage may also be occurring on the slope below the access road on the eastern side of the retention pond. Seepage such as this could potentially cause soil erosion or slumping of the slope. The Navy conducted geotechnical evaluations in this area to address the stability of the access roadway (Hart Crowser 2010). Final geotechnical design of the access road will include measures to stabilize this slope and control movement of water. The nearest identified streams to these upland features are Stream I and Stream G, which are several hundred feet away from the access road (Figures 3.11–2 and 3.11–3). The construction laydown area drains to the northwest to a ditch along the east side of Archerfish Road. Surface water near the new buildings area drains to the north and west, through ditches and the storm drain system. The

pure water facility site drains to the west and north toward the adjacent Hood Canal. Construction of this facility would avoid impacts to Streams A and B2.

During construction, stormwater management and other BMPs would be implemented along the access road, in the laydown area, the new buildings area, and the pure water facility site to control runoff and sedimentation and to minimize impacts to all surface waters, including water quality in the intertidal zone, per the *Stormwater Management Manual for Western Washington* (WDOE 2005a). Construction BMPs for clearing, grading, maintenance, and other activities such as utility work would be employed as needed to control erosion and sedimentation. For the access road, these measures include: interceptor ditches on both sides of the roadway; sediment traps outfitted with rock check dams, stand pipes, and straw bale barriers on the southern sides of the road; and silt fences along the northern sides of the road. These measures would be applied as needed in other areas. Water-spraying on soil would be used to control dust generation during earthmoving and hauling activities. Any potential fluid spills or leakage from vehicles onto soil would be handled in accordance with a spill response plan. Earthmoving work would occur during the initial 10 months prior to the trestle construction phase, during regular construction hours. With implementation of BMPs, impacts to surface water would be minimal.

No hazardous waste sites or other contaminated soil have been identified in or near the EHW upland project area (Navy 2005a). Therefore, no known impacts exist as a result of handling contaminated soil. If any contaminated soil is identified during construction (e.g., during installation of the 10,000-gallon underground tank for Ship's Overboard Discharge/oily waste) or created during construction (e.g., vehicle leakage at laydown area), this soil would be removed and handled in accordance with Navy spill response plans. This current aboveground tank is located on a concrete pad with containment system, and no leaks have been observed or are anticipated. The underground tank would be located at approximately 30 feet above MSL, away from surface water bodies, and installation would not impact groundwater.

The onshore segments of the EHW-2 trestles would come ashore near the existing EHW southern trestle shore landing, before merging into Tang Road. This would involve earthmoving and pile driving for construction of the trestle, road extension segment, and abutment structure. A total of 55 abutment piles (each 24 inches in diameter) are planned, with use of 520 cubic yards of armor rock. These activities may produce erosion and sedimentation that could impact the intertidal environment, and which would be handled by application of BMPs, as listed above. Construction of the abutment on the western end of the road extension would require excavation of approximately 2,760 cubic yards of sediment/soil (some from below MHHW), thus requiring a CWA Section 404 permit from USACE and a Section 401 water quality certification from WDOE. Following construction, the exposed part of the abutment would lie above MHHW. In accordance with the CZMA, the Navy submitted a Phase I CCD to WDOE. WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD.

The stormwater retention pond would not be modified, except for some clearing of brush and regrading of land surface for the paved access road along the western side of the pond's perimeter gravel road (see Figure 2–3). The pond itself would not be impacted by construction of the access road. This pond is a manmade feature constructed in an upland area for the purpose of stormwater retention, and it is considered a water of the U.S. due to its connection to Hood Canal.

Construction and the slight increase in impermeable surface area in the EHW upland project area near the shore (including the pure water facility site) would not impact groundwater recharge, as most of this area lies in a groundwater discharge zone close to the shore. The small

footprint of the paved road extension and abutment would not affect discharge. In areas farther from the shore, including the laydown area and new buildings area, the water table is relatively deep and would not be impacted. Water quality for dissolved constituents in surface water and groundwater would not be impacted by construction activities. No groundwater contaminant plumes have been identified in the EHW upland project area. Therefore, impacts to surface water and groundwater for this alternative during EHW upland construction would be minimal.

3.12.2.1.2 OPERATION/LONG-TERM IMPACTS

There would be insignificant adverse impacts to upland surface water or groundwater due to operation of Alternative 1. Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components, including new utilities, as required. After the EHW-2 construction is complete, the paved access road would remain permanently in use for maintenance purposes. Drainage structures along the margins of the access road would remain in place to control runoff. New stormwater structures and utilities would be operated using BMPs to collect and handle runoff. A total area of 6.9 acres would be revegetated following completion of construction of the EHW-2 facilities, including the laydown area, the area along the paved access road, and a portion of the new buildings area.

The addition of .1.4 acres of new impervious surface for new roads and other features at the eastern end of the trestles would generate an additional amount of stormwater runoff. Runoff from these paved surfaces would be collected and routed to a new stormwater vault located immediately east of the road extension, which would be designed to handle runoff from the EHW-2. Continued stormwater management would be implemented to control the additional stormwater volume. As described for water quality impacts in Section 3.2.2, drainage water from the EHW-2 wharf/ordnance operations area would be collected, treated (by using, for example, an oil/water separator), released to the stormwater retention pond or other stormwater management facility designed to accommodate the EHW-2 and to meet the basic treatment requirements of WDOE's *Stormwater Management Manual for Western Washington*, and then discharged to Hood Canal in accordance with an NPDES MSGP for industrial stormwater discharges (USEPA 2008; Navy 2009a). The new 10,000-gallon underground storage tank would be double-walled and with leak-detection sensors, to minimize impact of contamination to groundwater.

In addition, runoff from the 1.7 acres of new impervious surfaces in the new buildings and replacement parking area, and 0.5 acre in the pure water facility site, would be collected and routed to the existing stormwater collection system, which would be upgraded as needed in accordance with the existing NPDES permit. Stormwater would be treated prior to discharge to Hood Canal. Wastewater from these new facilities would be discharged to the base wastewater (sanitary) system in the same manner as for the existing facilities. Other activities at these locations are expected to continue similar to present operations.

Consequently, there would be only minor long-term impacts from operation of the EHW-2 facilities as a result of implementation of Alternative 1. No other surface water impacts would be expected during operation. Groundwater recharge or quality would not be impacted by operation of the new facilities.

The upland area of the EHW-2 facilities (including the pure water facility) lies above the base flood elevation of 10 feet that is defined for the adjacent Hood Canal shoreline (National Flood Insurance Program 1980) and would not be impacted by coastal flooding. Although tsunami

impact heights are uncertain for Hood Canal, a maximum of 15 feet might be expected, which could impact the EHW-2 facilities depending on tidal levels (see Section 3.12.1.1.5, Tsunami Hazards). A tsunami could potentially cause erosion or damage to some EHW structures, although the armored and piled abutment structure would not be expected to be impacted. However, the overall potential for a tsunami to occur along the Bangor shoreline is considered very small (Gottlieb 2010; Hart Crowser 2010).

3.12.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.12.2.2.1 CONSTRUCTION

Upland construction components of Alternative 2 would be the same as those of Alternative 1; therefore, the impacts to surface water and groundwater would be the same for both alternatives.

3.12.2.2.2 OPERATION/LONG-TERM IMPACTS

Upland components of Alternative 2 would be the same as those of Alternative 1; therefore, the impacts of long-term operation and maintenance to surface water and groundwater would be the same for both alternatives.

3.12.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.12.2.3.1 CONSTRUCTION

The upland construction components of Alternative 3 would be similar to those of Alternative 1, with negligible differences in a slightly larger area of the paved road extension and longer abutment (see discussion of construction impacts to geology and soils in Section 3.11.2.3.1). Although this alternative would involve slightly greater amounts of earthmoving, Alternative 3 construction impacts would be very similar to those for Alternative 1.

3.12.2.3.2 OPERATION/LONG-TERM IMPACTS

Post-construction, potential impacts for upland components would be the same as those of Alternative 1. Differences in the long-term impacts of the slightly larger road extension and abutment would be negligible. The impacts of operation and maintenance of the EHW-2 under Alternative 3 would be the same as under Alternative 1.

3.12.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.12.2.4.1 CONSTRUCTION

The upland construction components of Alternative 4 would be similar to those of Alternative 1 with negligible differences in a slightly larger area of the paved road extension and longer abutment (see discussion of construction impacts to geology and soils in Section 3.11.2.4.1). Although this alternative would involve slightly greater amounts of earthmoving, Alternative 4 construction impacts would be very similar to those for Alternative 1.

3.12.2.4.2 OPERATION/LONG-TERM IMPACTS

Post-construction, potential impacts for upland components would be the same as those of Alternative 1. Differences in the long-term impacts of the slightly larger road extension and

abutment would be negligible. The impacts of operation and maintenance of the EHW-2 under Alternative 4 would be the same as under Alternative 1.

3.12.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.12.2.5.1 CONSTRUCTION

The upland construction components of Alternative 5 would be similar to those of Alternative 1; therefore, the impacts to surface water and groundwater would be the same for both alternatives.

3.12.2.5.2 OPERATION/LONG-TERM IMPACTS

Post-construction, potential impacts for upland components would be the same as those of Alternative 1. Differences in the long-term impacts of the shorter paved road extension and abutment would be negligible. Maintenance impacts would be the same as the other alternatives.

3.12.2.6 No-Action Alternative

There would be no project impacts related to surface water or groundwater under the No-Action Alternative.

3.12.2.7 Mitigation Measures and Regulatory Compliance

The proposed action would have minimal impact to surface waters, with the exception of impacting Wetland 32. To the extent practicable, final design of the laydown areas would minimize impacts by locating these features in areas away from surface water bodies or areas of significant seepage. Other aspects of the proposed action (such as construction of stormwater features and utilities) would have a minor impact or regulatory concern. Regulations or policies that apply to surface water for the proposed action include the following:

- For CWA Section 402 (NPDES) compliance, a permit is required for on-base construction activities that may result in discharge of stormwater to surface waters of the state, including storm drains, ditches, wetlands, creeks, rivers, lakes, and marine waters. For construction projects that disturb 1 acre or more, the Navy would apply to obtain coverage for this specific project under a general permit established by the USEPA. This permit requires the Navy to file a Notice of Intent with the USEPA; prepare a project-specific stormwater pollution prevention plan; and install and maintain erosion and sediment control measures to prevent soil, nutrients, chemicals, and other harmful pollutants from being washed by stormwater runoff into surface water bodies. WDOE's *Stormwater Management Manual for Western Washington* (WDOE 2005a) would be consulted when determining appropriate BMPs for the site.
- Due to the potential for these actions to affect water quality in a wetland and adjacent surface waters, the Navy would also seek a water quality certification from WDOE, under their authority at Section 401 of the Clean Water Act, certifying that the proposed action will not violate state water quality standards.
- Because construction of the shoreline abutment would include removing and filling material below the MHHW tidal level, this would involve discharge of dredged or fill material into waters of the U.S. Construction of the access road would involve partial filling of Wetland 32, and a permit under Section 404 of the CWA will be required;

review and permitting is administered by USACE. The Navy would implement compensatory aquatic mitigation in accordance with the Section 404 permit. In addition, a Section 401 water quality certification will be required by WDOE. The Navy submitted a JARPA to USACE and WDOE to request the permit and water quality certification.

- For compliance with the EISA Act of 2007, the Navy would maintain site hydrology to the maximum extent feasible. Design of upland features (e.g., laydown area) would consider the USEPA guidance for compliance with EISA (USEPA 2009) as well as other relevant technical information regarding methods to improve stormwater retention and quality. Both upland and overwater facilities would be built in accordance with EISA requirements (including water temperature) as well as the water quality and flow control requirements contained in the WDOE *Stormwater Management Manual for Western Washington*.
- In accordance with the CZMA, the Navy submitted a Phase I CCD to WDOE. WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD in spring 2012.

3.12.3 Summary of Impacts

Impacts to surface water and groundwater associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.12–1.

Table 3.12–1. Summary of Impacts to Surface Water and Groundwater

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO SURFACE WATER AND GROUNDWATER
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Permanent disturbance (new structures/paving) of 3.6 acres, plus infilling of 0.2 acre of wetland. Total disturbance area of 12.6 acres, with runoff/erosion potential and resulting potential to affect surface water quality. Installation of 172 total feet of abutment length. *Operation/Long-term Impacts:* Additional 3.6 acres of impervious surface (roads, buildings, parking, sidewalks) and stormwater collection.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Permanent disturbance (new structures/paving) of 3.6 acres, plus infilling of 0.2 acre of wetland. Total disturbance area of 12.6 acres, with runoff/erosion potential. Installation of 172 total feet of abutment length. *Operation/Long-term Impacts:* Additional 3.6 acres of impervious surface (roads, buildings, parking, sidewalks) and stormwater collection.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Permanent disturbance (new structures/paving) of 3.6 acres, plus infilling of 0.2 acre of wetland. Total disturbance area of 12.6 acres, with runoff/erosion potential and resulting potential to affect surface water quality. Installation of 230 total feet of abutment length. *Operation/Long-term Impacts:* Additional 3.6 acres of impervious surface (roads, buildings, parking, sidewalks) and stormwater collection.

Table 3.12–1. Summary of Impacts to Surface Water and Groundwater (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO SURFACE WATER AND GROUNDWATER
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Permanent disturbance (new structures/paving) of 3.6 acres, plus infilling of 0.2 acre of wetland. Total disturbance area of 12.6 acres, with runoff/erosion potential and resulting potential to affect surface water quality. Installation of 230 total feet of abutment length. *Operation/Long-term Impacts:* Additional 3.0 acres of impervious surface (roads, buildings, parking, sidewalks) and stormwater collection.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Permanent disturbance (new structures/paving) of 3.6 acres, plus infilling of 0.2 acre of wetland. Total disturbance area of 12.6 acres, with runoff/erosion potential and resulting potential to affect surface water quality. Installation of 172 total feet of abutment length. *Operation/Long-term Impacts:* Additional 3.6 acres of impervious surface (roads, buildings, parking, sidewalks) and stormwater collection.
No-Action Alternative	No impact.
Mitigation • The Navy would implement compensatory aquatic mitigation in accordance with the Section 404 permit.	
Consultation and Permit Status • The Navy submitted a JARPA to USACE and WDOE, requesting a permit under CWA Section 404 and a Section 401 water quality certification. • The Navy will submit an application to USEPA for coverage under the Construction General Permit in compliance with CWA Section 402. • The Navy submitted a Phase I CCD to WDOE. WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD.	

3.13 VEGETATION

Vegetation resources are the native land cover types of a region (such as forest and shrub communities) and non-native vegetation communities (such as landscaping species and noxious or invasive plant species). Vegetation communities dominated by invasive plants are generally the result of construction-related disturbance.

As federally owned land, NBK at Bangor manages its forest lands and vegetation in compliance with federal law and regulation, Executive Orders, and DoD and Navy guidance. This includes mandated cooperation with other federal agencies such as USFWS, NOAA NMFS, and WDFW. Applicable laws include the Sikes Act Improvement Act (P.L. 86-797 as amended, 16 USC 670(a) et seq.: Conservation Programs on Military Installations); the ESA; the Forest Resources Conservation and Shortage Relief Act (1990); the CWA; the MBTA; and the Noxious Weed Control Act of 1974 [7 USC § 2801-2814, January 3, 1975, as amended 1988 and 1994]). Executive Orders pertaining to Navy lands include EO 11990 (wetlands protections) and EO 13112 (combating the introduction of nonindigenous microbial, animal and plant species). DoD and Navy guidance documents directing forest and land management include the *Memorandum on Implementation of Ecosystem Management in the DOD* (1994); DOD Instruction 4715.03 *Natural Resources Conservation Program* (18 March 2011); *Memorandum on Implementation of Sikes Act Improvement Act: Updated Guidance* (2002); Chief of Naval Operations Instruction 5090.1C *Environmental and Natural Resources Management Manual* (SAIA 2007); Naval Facilities Engineering Command *Real Estate Operations and Natural Resources Management Procedure Manual (P-73)*; and the *Guidelines for Preparing, Revising and Implementing Integrated Natural Resources Management Plans For Navy Installations* (2003).

Consultation and Permit Compliance Status. No consultation is required for upland vegetation impacts. The Navy is in consultation with USACE on jurisdictional determination for wetlands affected by the project and has submitted a Section 404 permit application for work within affected wetlands. The Navy will submit a request for water quality certification from WDOE for wetlands impacts.

3.13.1 Existing Environment

Information on vegetation communities on NBK at Bangor, including the upland project area, was obtained in the course of forest resource surveys (International Forestry 2001), wetland surveys (Johnson Controls 1992; Brown and Tannenbaum 2009b), terrestrial and wetland surveys (Pentec 2003), wildlife habitat surveys (Tannenbaum and Wallin 2009), and cultural resources surveys (HRA 2011). These reports include maps and lists of plant species found at surveyed sites. Based on a review of the USFWS Endangered Species Program list of 2012, no federally listed threatened or endangered plant species have been identified or are likely to occur on NBK at Bangor (USFWS 2012). Natural vegetation communities in the EHW upland project area include forest communities and wetlands (wetlands are described in Section 3.14, Wetlands). Disturbed areas, such as mowed grassland along roadsides and developed areas (including roads and parking lots), are also present, and are described in this section.

3.13.1.1 Land Cover Types

Four primary land cover types occur in the upland environment on NBK at Bangor: (1) forest; (2) brush and shrubland; (3) wetlands, streams, and open water; and (4) developed areas, including lawn, landscaping, and mowed rights-of-way (Table 3.13–1). These cover types, as well as noxious weeds, are described below.

Table 3.13–1. Vegetation Cover Types in the Upland Environment on NBK at Bangor

COVER TYPE	APPROXIMATE ACREAGE	DESCRIPTION
Forest	4,888 (68.4%)	**Conifer Forest** (drier conditions): Trees primarily consist of Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), western redcedar (*Thuja plicata*), western white pine (*Pinus monticola*), shore pine (*Pinus contorta*), Sitka spruce (*Picea sitchensis*), madrone (*Arbutus menziesii*), and grand fir (*Abies grandis*), with an understory of conifer seedlings and salal (*Gaultheria shallon*), sword fern (*Polystichum munitum*), Oregon grape (*Mahonia nervosa*), rhododendron (*Rhododendron macrophyllum*), and huckleberry (*Vaccinium ovatum*). **Deciduous Forest** (moist conditions): Trees primarily consist of red alder (*Alnus rubra*), bigleaf maple (*Acer macrophyllum*), and black cottonwood (*Populus trichocarpa*), with an understory of salmonberry (*Rubus spectabilis*), oceanspray (*Holodiscus discolor*), and herbaceous species that include sword fern, rough horsetail (*Equisetum hyemale*), and giant horsetail (*Equisetum telmateia*). Other species found in second-growth deciduous forest include the non-native Himalayan blackberry (*Rubus discolor*) and native Pacific blackberry (*Rubus ursinus*), holly (*Ilex aquifolium*), and colonial bentgrass (*Agrostis capillaris*). **Mixed Forest:** This includes both coniferous and deciduous trees and understory vegetation. **Wetlands, Streams and Open Waters**, described in Sections 3.14, Wetlands, and 3.12, Surface Water and Groundwater, are present in the Forest cover type.
Brush and Shrubland	314 (4.4%)	Native plants include salmonberry, Oregon grape, salal, and oceanspray, as well as herbaceous species that include sword fern, rough horsetail, and giant horsetail. Other non-native shrub species include Himalayan blackberry, holly, and colonial bentgrass. **Wetlands, Streams and Open Waters**, described in Section 3.14, Wetlands, and 3.12, Surface Water and Groundwater, are present in the Brush and Shrubland cover type.
Developed Areas, including lawn, landscaping, mowed rights-of-way	1,947 (27.2%)	Roads, parking lots, buildings, and other structures. Also includes athletic fields and mowed areas such as road rights-of-way. Native and landscaped grass and shrub areas adjacent to developed facilities.
Total	***7,149***	

Sources: Pacific Northwest Georeadiness Center RSIMS, Navy Region NW Geographic Information System (GIS) data layers.

3.13.1.1.1 FOREST

Approximately 68 percent of the NBK at Bangor upland area, including most of the undeveloped area along the waterfront, is composed of forests. Most forest stands are dominated by coniferous trees, including Douglas-fir, western redcedar, and western hemlock (Table 3.13–1). The forest understory primarily consists of conifer seedlings, evergreen shrubs, and ferns. Canopy closure in coniferous forest stands averages 70 to 100 percent. Most forest stands on NBK at Bangor are second growth, i.e., stands that have regrown following a major disturbance, most frequently timber harvest. About 50 percent of the coniferous forest stands on NBK at Bangor are

approximately 60 to 70 years old, 30 percent of the stands are less than 50 years old, and the remaining 20 percent of the stands are older than 70 years of age. There is an area of about 30 acres with old-growth forest in the northern portion of the base in the watershed east of Wetland 6.

The deciduous forest community on NBK at Bangor, which usually occurs on soils wetter than those of the conifer-dominated forests, includes open to closed canopy stands and is typically composed of red alder, bigleaf maple, and black cottonwood. The understory vegetation in deciduous forest stands consists primarily of deciduous shrubs (Table 3.13–1) (Pentec 2003). About 80 percent of the deciduous forest is 70 years of age or younger, primarily originating from clearcuts occurring in the 1920s to 1940s.

The mixed deciduous and coniferous forest community is characterized by a forest canopy that consists of roughly equal proportions of deciduous and coniferous tree species. Deciduous and mixed deciduous/coniferous forests are the prevalent forest communities closer to the waterfront. An alder-dominated stand is present on the west side of Archerfish Road in the project vicinity, and a mature mixed forest stand is present within 600 feet of the shoreline.

The Navy is the steward of the lands within NBK at Bangor and is responsible for managing the forest resource, including timber harvest, conservation, utilization, and enhancement, while maintaining the environmental conditions consistent with the military mission. Timber harvest is an ongoing activity on NBK at Bangor, although annual harvests over the past 5 years have usually been less than 100 acres. A draft forest management plan is under development for the base (Jones 2010b, personal communication).

3.13.1.1.2 BRUSH AND SHRUBLAND

Brush and shrubland comprise 4 percent of the 7,149 acres of land area on NBK at Bangor (Table 3.13–1). Most of the brush and shrubland areas have developed from areas managed as pasture prior to Navy purchase of the base property. Other shrubland areas include disturbed areas vegetated with opportunistic species. In most cases, disturbed areas that are not maintained are colonized by non-native invasive shrubs, such as Himalayan blackberry and Scotch broom (*Cytisus scoparius*).

3.13.1.1.3 WETLANDS, STREAMS, AND OPEN WATER

Wetlands, streams, and open water comprise 4 percent or 254 acres on NBK at Bangor, and are included in the overall acreages for forested and shrub areas (see Sections 3.14, Wetlands, and 3.12, Surface Water and Groundwater).

3.13.1.1.4 DEVELOPED AREAS

Developed areas comprise 27 percent of the NBK at Bangor land area. These areas are unvegetated and consist of buildings and other structures, roads, other paved areas, and areas cleared of all vegetation (such as dirt roads and parking areas). In addition, native and non-native grassy areas are present on NBK at Bangor in high voltage line rights-of-way. Some of the existing grassy areas are the result of mitigation measures taken in accordance with the Installation Restoration Program, where former hazardous waste sites were cleaned up and planted with native grass and clover species. Non-native grasslands on NBK at Bangor are characterized by such species as reed canary grass (*Phalaris arundinacea*), orchard grass (*Dactylis glomerata*), and tall fescue (*Festuca arundinacea*).

Landscaped areas are dominated by maintained lawns, shrubs and athletic fields. Landscape maintenance on NBK at Bangor includes planting, seeding, mowing, pruning, trimming, clipping, chemical application, and erosion control.

3.13.1.2 Noxious and Invasive Weeds

The most prevalent noxious weeds on NBK at Bangor are Scotch broom, Himalayan blackberry, and tansy ragwort (*Senecio jacobaea*). Tansy ragwort and Scotch broom are designated as Class B noxious weeds by the state of Washington, for which control is decided at the local level (Washington State Noxious Weed Control Board 2010). Control of noxious weeds on NBK at Bangor is described in the *FY 2004 Naval Base Kitsap Bangor Pest Management Plan.* The plan includes mechanical and chemical control methods for vegetation management, including Canada thistle and Scotch broom, around facilities, in lawns and landscaping, and along road rights-of-way. The Navy has recently undertaken efforts to better control Scotch broom on the base, and has been working with Kitsap County for ideas on feasible control methods (Jones 2010b, personal communication).

3.13.1.3 Vegetation Features in the EHW-2 Upland Project Area

3.13.1.3.1 UPLAND VEGETATION NEAR THE SHORELINE OF THE EHW-2

Upland vegetation near the shoreline of the EHW-2 includes wetlands, forest, and some areas dominated by invasive species including Himalayan blackberry and Scotch broom. The forest along the shoreline includes mixed and deciduous forest communities with patches of forested wetlands (see Section 3.14) along a shoreline bluff. North and south of the EHW-2, a narrow shoreline bluff supports a mixed coniferous and deciduous forest community, dominated by Douglas-fir and red alder with a crown closure of 10 percent or less. Oceanspray and salmonberry dominate the understory. The shoreline bluff varies in width and increases in height to the north and south of the EHW-2. The bluff appears to be unstable with many downed trees, which accounts for the low tree canopy cover provided by the remaining standing trees. The upland shoreline areas adjacent to the bluff consist of five separate forest stands that include primarily mixed forest (dominated by Douglas-fir, red alder, and bigleaf maple) with an average stand age of 66 to 76 years old, similar to average conditions across the base (International Forestry Consultants 2001). The range and average size of dominant overstory trees (range 4 to 45 inches diameter at breast height [dbh], and average 19 inches dbh) is larger than average conditions across the base (average range 9 to 29.5 inches dbh, and overall average 14.6 inches dbh). The forest crown closure is approximately 50 percent, which is less than the average crown closure conditions across NBK at Bangor (average 70 to 100 percent). Wetland 6 is adjacent to the parking lot for the existing EHW, and includes forested wetland communities (discussed in Section 3.14, Wetlands).

Other upland plant communities in the vicinity of the shoreline of the EHW-2 include narrow strips of mowed grassland along the roadsides and adjacent to existing parking areas. In addition, Himalayan blackberry, an invasive weed species, is present in the transition between the forested plant communities and the mowed roadsides and existing disturbed areas.

3.13.1.3.2 UPLAND VEGETATION AT LAYDOWN AREA, RELOCATED FACILITIES AREA, AND PURE WATER FACILITY AREA

The construction laydown area and proposed relocated facilities area currently support second-growth conifer forest, including a Douglas-fir and western redcedar canopy and mixed sword fern/bracken fern/shrub understory (HRA 2011). The proposed site for the pure water facility is partially developed and does not support native vegetation (Figure 3.13–1).

Sources: Pacific Northwest Georeadiness Center RSIMS

Figure 3.13–1. Upland Vegetation Near the EHW-2 Project Site

3.13.2 Environmental Consequences

The evaluation of impacts to upland vegetation considers both the direct removal of vegetation and indirect impacts such as the introduction of non-native plants into areas temporarily disturbed by construction. Native vegetation would be removed in developing the following upland project features: the permanent paved access road from Archerfish Road to the upland area along the shoreline, the cut and fill slopes associated with the access road, the nearby area disturbed by construction of stormwater facilities and utilities, the Tang Road extension, and the expanded parking area adjacent to the three new buildings that would house relocated facilities (Figure 3.13–1 and Figure 2–1). A total of 10.3 acres of native vegetation would be disturbed for upland construction, of which 6.9 acres would be revegetated with native plant material following completion of construction.

3.13.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.13.2.1.1 CONSTRUCTION

The EHW-2 project site is primarily in the marine environment (i.e., deeper waters and the zone subject to tidal influence, up to +11.1 feet MLLW), but some construction in the upland project areas would be required, including disturbance of a total of 10.3 acres of vegetation, most of which is forest and shrub vegetation, for the following project elements (Section 2.2.1.2) (Figure 3.13–1):

- A temporary construction laydown area (5.0 acres) that would be in use during the course of construction and revegetated with native plant species after completion of construction (up to 48 months). The laydown area, located east of Archerfish Road approximately 4,000 feet south of the EHW-2 project site, would involve clearing second growth coniferous forest, which may include merchantable timber.
- Vegetation clearing for project utility facilities, a permanent paved road extension connecting the trestle with Tang Road, and a new permanent paved access road that connects Archerfish Road to the shoreline construction area (Figure 2–3). The Tang Road extension would be approximately 170 feet long. This area currently supports shrubby vegetation dominated by Himalayan blackberry, a non-native invasive species. The new access road would be located on a slope to the south of the existing retention pond near the existing EHW and would cover a total distance of approximately 610 feet. This area currently supports a mixture of second growth forest and shrubs and wetland vegetation. Construction in this area would remove up to a total of 3.0 acres of trees, shrub, and wetland vegetation, of which up to 1.6 acres would be revegetated following construction and the remainder (1.4 acres) would become new impervious surface. Following construction of the EHW-2, the area would be prepared for revegetation and planted with an erosion-control seed mix and native plant species.
- The slope adjacent to the southern edge of the new access road would be logged in order to reduce the weight of trees on unstable soils and thus reduce the likelihood of slope failure. Trees within 10 feet of the top of the graded slope would be felled and cut into lengths suitable for removal from the site; no heavy equipment would be used within the tree removal area in order to reduce site disturbance and the potential for slope failure. Stumps would be left in the ground.

- An abutment supporting the trestle/road connection would be installed along the shoreline cliff and would affect approximately 1,700 square feet (0.04 acre) of upland vegetation that is included in the total listed above for paved road extension. Vegetation at the top of the bluff consists of dense Himalayan blackberry thickets, an exotic groundcover, and scattered alders. A portion of the slope below the bluff is vertical and does not support vegetation. The remainder of the slope, while very steep, supports scattered willows and dune grass. Dune grass and scattered willows are also present in a very narrow band (from 0 to 6 feet wide) at the toe of the bluff immediately above the gravel beach. There is a small patch of peafruit rose, Oregon grape, and English ivy near the toe of the slope at the north end of the abutment site.
- Three new buildings would be constructed to house the functions of four existing buildings that would be demolished in the project area. These buildings would be located on an existing parking lot in an industrial area of the Lower Base that is not adjacent to the EHW-2 project site (Figure 2–4, Figure 3.13–1). Associated expanded parking would result in permanent clearing of approximately 1.7 acres of existing vegetation, including shrubs and small trees.
- A pure water facility would be constructed at the landward end of the southern trestle to Delta Pier, about one mile south of the existing EHW (Figure 2–5, Figure 3.13–1). A water pipeline would be installed that extends approximately 1,200 feet north to the pure water facility on a vegetated strip parallel to the existing roadway and railroad bed. The water pipeline would be located on the surface. Development of the pure water facility would result in potential disturbance of up to 0.6 acre that is currently vegetated including a vegetated strip (0.2 acre) along Stream A, a small vegetated area around an existing tank (0.1 acre) and the water pipeline alignment (0.3 acre). Affected vegetation consists of Himalayan blackberry and red alder in the vicinity of Stream A and roadside invasive weed species and grasses adjacent to the existing tank and along the water pipeline alignment. (Although protection of Stream A during construction [Section 3.14.2.1] would probably protect at least part of the adjacent vegetation, this analysis makes the conservative assumption that all adjacent vegetation would be impacted.) The water pipeline alignment would not be revegetated after construction, as the surface would be permanently occupied by the pipeline, but the remaining areas (total 0.3 acre) would be revegetated with native plant species. Stream A and construction period BMPs are discussed in Section 3.14.2.1, Wetlands.

A project total of 3.4 acres of upland vegetation would be permanently displaced by new roads, buildings and associated parking areas, utilities, and stormwater facilities. A total of 6.9 acres disturbed by construction would be revegetated afterward. All clearing and timber sales for construction and laydown area preparation would be done in accordance with an approved NBK at Bangor forest management plan (currently in draft). These areas would be revegetated with native shrub and tree species and managed after completion of the EHW-2 project consistent with the approved forest management plan to avoid establishment of noxious weeds through the construction period and afterward and promote restoration of natural habitat values.

Potential indirect effects of clearing the sites for the construction laydown areas and other temporarily cleared sites include establishment of invasive or noxious plants, such as Scotch broom or Himalayan blackberry. In particular, the laydown areas would be actively managed during construction and post-construction to avoid establishment of invasive or noxious plants which may spread into this area from existing disturbed areas. Regular landscaping and grounds

maintenance, including planting and seeding desirable native plant species, mowing, weeding, and erosion control would help to minimize the establishment or spread of invasive plants to exposed soils on the site.

3.13.2.1.2 OPERATION/LONG-TERM IMPACTS

Long-term, the spread of invasive plants to the revegetated areas (5-acre laydown area, the cut and fill slopes adjacent to the paved access road, and the area disturbed by utility and stormwater construction work), as well as adjacent undisturbed shrub and forest communities would remain a potential problem post-construction. The laydown area would be revegetated following construction, resulting in a shrub/small tree-dominated community, but forest habitat value would not fully recover for 40 or more years. With the implementation of the grounds maintenance activities described above, the spread of invasive plants into adjacent undisturbed natural plant communities would be minimized, and there would be no long-term indirect adverse impacts to vegetation as a result of construction of the EHW-2. Maintenance of the EHW-2 would not affect terrestrial vegetation.

3.13.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.13.2.2.1 CONSTRUCTION

Upland components of Alternative 2 would be the same as those of Alternative 1; therefore, the impacts of construction to vegetation would be the same for both alternatives.

3.13.2.2.2 OPERATION/LONG-TERM IMPACTS

Upland components of Alternative 2 would be the same as those of Alternative 1; therefore, the impacts of long-term operations to vegetation would be the same for both alternatives.

3.13.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.13.2.3.1 CONSTRUCTION

With Alternative 3, the area of new impervious surface (road extension) would be 8,500 sq ft compared to 7,000 sq ft for Alternative 1. There would be minor differences (less than 1,000 sq ft) with regard to vegetation impacts between Alternative 3 and Alternative 1.

3.13.2.3.2 OPERATION/LONG-TERM IMPACTS

Post-construction, potential indirect effects in temporarily-cleared upland components would be the same as those of Alternative 1.

3.13.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.13.2.4.1 CONSTRUCTION

With Alternative 4, the area of new impervious surface (road extension) would be 8,500 sq ft compared to 7,000 sq ft for Alternative 1. There would be minor differences (less than 1,000 sq ft) with regard to vegetation impacts between Alternative 4 and Alternative 1.

3.13.2.4.2 OPERATION/LONG-TERM IMPACTS

Post-construction, potential indirect effects in temporarily cleared upland components would be the same as those of Alternative 1.

3.13.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.13.2.5.1 CONSTRUCTION

Upland components of Alternative 5 would be the same as those of Alternative 1; therefore, the impacts of construction to vegetation would be the same for both alternatives.

3.13.2.5.2 OPERATION/LONG-TERM IMPACTS

Upland components of Alternative 5 would be the same as those of Alternative 1; therefore, the impacts of long-term operations to vegetation would be the same for both alternatives.

3.13.2.6 No-Action Alternative

There would be no construction- or operations-related activities that would directly or indirectly affect native vegetation in the project area under the No-Action Alternative. Therefore, this alternative would have no impacts to vegetation.

3.13.2.7 Mitigation Measures and Regulatory Compliance

The effort to restore the temporarily cleared areas, including the laydown area, to a natural vegetation community and comply with EO 13112 would include the following mitigation measures:

- A revegetation plan would be developed with the objective of restoring a coniferous forest overstory and native shrub understory on restoration sites (laydown area and other temporarily cleared areas). The Navy will monitor restoration sites for 10 years following revegetation activities.
- Seed mixtures may include non-native species compatible with erosion control and restoration objectives (restoring coniferous forest overstory and native shrub understory). Plant material used for site restoration would include only native species.
- The Navy would conduct periodic monitoring for and removal of noxious weeds from within and immediately adjacent to the cleared area, per the NBK Pest Management Plan (Navy 2004). Particular attention would be paid to the interface between disturbed and existing adjacent second-growth forest stand.
- Noxious weeds, such as Scotch broom and Himalayan blackberry, would be removed by hand, mechanical means, or herbicides, per the NBK Pest Management Plan (Navy 2004).
- Dense weed infestations that require more intensive treatments that result in ground disturbance would be reseeded or planted with native forest and shrub species. A more intensive monitoring and maintenance program (such as once a month) would be implemented until the native plants are sufficiently established to minimize invasion by noxious weeds.
- The Mitigation Action Plan (Appendix F) would include compensatory mitigation for loss of wetland habitat (Wetland 32) due to construction of the paved access road.

Based on a review of the USFWS Endangered Species Program list of 2012, no federally listed threatened or endangered plant species have been identified or are likely to occur on NBK at Bangor (USFWS 2012). As federally owned land, the base is exempt from WDNR regulations on tree harvest. Other federal regulations pertaining to upland vegetation on NBK at Bangor address the presence and management of noxious weeds, including the development of programs

that restrict the introduction of exotic organisms into natural communities and control undesirable plants on federal lands (EO 13112, Combating the Introduction of Nonindigenous Microbial, Animal, and Plant Species; Noxious Weed Control Act). No state-listed threatened or endangered plant species are known or expected to occur at the site. No consultation is required for upland vegetation impacts. The Navy is in consultation with USACE on jurisdictional determination for wetlands affected by the project and has submitted a JARPA for a Section 404 permit for work within affected areas.

3.13.3 Summary of Impacts

Impacts to vegetation associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.13–2.

Table 3.13–2. Summary of Impacts to Vegetation

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO VEGETATION
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Permanent displacement of 3.4 acres of forest, shrub, grass, and wetland habitat. Temporary displacement of 6.9 acres of forest and shrub habitat over the course of construction (42–48 months). *Operation/Long-term Impacts:* None.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Permanent displacement of 3.4 acres of forest, shrub, grass, and wetland habitat. Temporary displacement of 6.9 acres of forest and shrub habitat over the course of construction (54–64 months). *Operation/Long-term Impacts:* None.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Permanent displacement of 3.4 acres of forest, shrub, grass, and wetland habitat. Temporary displacement of 6.9 acres of forest and shrub habitat over the course of construction (42–49 months). *Operation/Long-term Impacts:* None.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Permanent displacement of 3.4 acres of forest, shrub, grass, and wetland habitat. Temporary displacement of 6.9 acres of forest and shrub habitat over the course of construction (54–64 months). *Operation/Long-term Impacts:* None.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Permanent displacement of 3.4 acres of forest, shrub, grass, and wetland habitat. Temporary displacement of 6.9 acres of forest and shrub habitat over the course of construction (42–44 months). *Operation/Long-term Impacts:* None.
No-Action Alternative	No impact.

Table 3.13–2. Summary of Impacts to Vegetation (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO VEGETATION
Mitigation Under all alternatives, the following mitigation measures would be implemented: • A revegetation plan would be developed with the objective of restoring a coniferous forest overstory and native shrub understory on restoration sites (laydown area and other temporarily clear areas). • Seed mixtures may include non-native species compatible with erosion control and restoration objectives (restoring coniferous forest overstory and native shrub understory). Plant material used for site restoration would include only native species. • The Navy would conduct periodic monitoring for and removal of noxious weeds from within and immediately adjacent to the cleared area, per the NBK Pest Management Plan. Particular attention would be paid to the interface between disturbed and existing adjacent second-growth forest stand. • Noxious weeds, such as Scotch broom and Himalayan blackberry, would be removed by hand, mechanical means, or herbicides, per the NBK Pest Management Plan. • Impacts to vegetation in Wetland 32 would be mitigated through compensatory mitigation described in the Mitigation Action Plan (Appendix F).	
Consultation and Permit Status • No consultation is required for upland vegetation impacts. • The Navy is in consultation with USACE on jurisdictional determination for wetlands affected by the project and has submitted a JARPA for a Section 404 permit for work within affected areas. A 401 water quality certification has been requested from WDOE as part of the JARPA.	

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3.14 WETLANDS

Wetlands are transitional habitats that occur between upland and aquatic environments where the water table is at or near the surface of the land, or where the land is covered by shallow water that may be up to 6 feet deep. Wetlands are dominated by plants that can tolerate various degrees of flooding or saturated soils. Freshwater habitats with flowing or deep water, such as rivers, streams, lakes, and ponds, are often closely associated with wetlands. In general, wetlands provide several benefits including flood and stormwater control, baseflow support for streams and groundwater, erosion and shoreline protection, water quality improvement, and support for natural biological systems and wildlife habitat (Hruby 2004).

Waters of the U.S., including wetlands, are regulated by USACE under Section 404 of the CWA of 1972. Wetlands under federal jurisdiction are delineated according to the USACE Wetlands Delineation Manual (Environmental Laboratory 1987) and the Western Mountains and Valleys Regional Supplement ("Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0)" (USACE 2010b). USACE's definition of a wetland requires that an area meet criteria for each of three wetland parameters: hydrophytic vegetation, wetland hydrology, and hydric soils (Environmental Laboratory 1987). USACE relies on the WDOE 2004 Wetland Rating System for Western Washington (Hruby 2004) (Table 3.14–1) to assign a functional value to a wetland. This system evaluates wetlands in terms of their hydrologic (flood control), water quality, and habitat functions. Wetlands are classified into four categories, with Category I performing the highest value wetland functions and Category IV providing the lowest value functions (Hruby 2004).

Activities that require compliance with Section 404 of the CWA must also obtain a Section 401 water quality certification from WDOE. Issuance of a certification means that WDOE anticipates the project will comply with state water quality standards and other aquatic resource protection requirements. The water quality certification covers both construction and operation of a project. Conditions of the certification become conditions of the Section 404 permit.

EO 11990 (42 FR 26961), Protection of Wetlands, directs federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid new construction in wetlands wherever there is a practicable alternative. NBK at Bangor complies with requirements of the CWA and EO 11990 in ensuring there would be no net loss of wetlands by construction projects, recommending mitigation of wetland impacts, and requiring that any activity within a jurisdictional wetland area obtain a permit from USACE.

The CZMA requires that federal actions that have reasonably foreseeable effects on coastal users or resources must be consist to the maximum extent practicable with the enforceable policies of approved state coastal management programs. Activities and development impacting coastal resources that involve the federal government are evaluated through a process called federal consistency, in which the proponent agency is required to prepare a CCD for concurrence from the affected state.

Consultation and Permit Compliance Status. The Navy is in consultation with USACE under CWA Section 404 on jurisdictional determination for wetlands affected by the project and has submitted a JARPA for work in affected wetlands. The JARPA also requests water quality certification from WDOE in compliance with CWA Section 401. In accordance with the CZMA, the Navy submitted a Phase I CCD to WDOE (included within Appendix I to the FEIS). WDOE

concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD in spring 2012.

3.14.1 Existing Environment

Wetlands occur within the EHW upland project area (Figures 3.14–1 and 3.14–2), and are characterized in this section by wetland type and size and their functional value. Wetlands survey work on NBK at Bangor, including the upland project area, includes work by Brown and Tannenbaum 2009b (see Appendix L), Johnson Controls 1992, Pentec 2003, and Navy staff (Navy 2011, see Appendix L). The wetlands are either forested, scrub-shrub, or emergent communities and most are less than 1 acre in size. Most of the wetlands have functional values of Category III or IV, except for Wetland 6, which has a Category II classification and is the highest value wetland within the EHW upland project area (per the Hruby 2004 rating system). Based on a review of the USFWS Endangered Species Program list of 2012, no federally listed threatened or endangered plant species have been identified or are likely to occur on NBK at Bangor (USFWS 2012).

3.14.1.1 Wetlands in the EHW Upland Project Area

Most wetlands on NBK at Bangor are naturally occurring, but some are the result of past human activities. The wetlands on base include estuarine, palustrine, and riverine wetland types. Most of the wetlands are palustrine type, emergent, forested, or scrub/shrub wetlands.

Table 3.14–1. WDOE 2004 Wetland Rating System

CATEGORY	DESCRIPTION
I	Category I wetlands are those that (1) represent a unique or rare wetland type; or (2) are more sensitive to disturbance than most wetlands; or (3) are relatively undisturbed and contain ecological attributes that are impossible to replace within a human lifetime; or (4) provide a high level of functions. In western Washington the following types of wetlands are Category I: estuarine wetlands larger than 1 acre, Natural Heritage wetlands, mature and old-growth forested wetlands, wetlands in coastal lagoons, and wetlands that perform many functions very well.
II	Category II wetlands are difficult, though not impossible, to replace, and provide high levels of some functions. These wetlands occur more commonly than Category I wetlands but still need a relatively high level of protection. Category II wetlands in western Washington include: estuarine wetlands, interdunal wetlands, and wetlands that perform functions well.
III	Category III wetlands are (1) wetlands with a moderate level of functions and (2) interdunal wetlands between 0.1 and 1 acre in size. These wetlands have been disturbed in some ways, and are often less diverse or more isolated from other natural resources in the landscape than Category II wetlands.
IV	Category IV wetlands have the lowest levels of functions and are often heavily disturbed. These are wetlands that should be able to be replaced, and in some cases be able to be improved.

Source: Hruby 2004.

Wetlands that have been delineated in the vicinity of the EHW upland project area are described below (Table 3.14–2 and Figure 3.14-1). The wetlands discussed are those that have some potential of being impacted by the proposed action. The wetlands were mapped and described using the Cowardin Classification System (Cowardin et al. 1979), the classification

system used by the National Wetlands Inventory. The wetland rating was determined in the field using the WDOE Wetland Rating System (Hruby 2004).

Table 3.14–2. Wetlands in the Vicinity of the EHW Upland Project Area

WETLAND NAME	ACRES	JURIS-DICTIONAL	WETLAND RATING CATEGORY	DESCRIPTION
Wetland 6	6 (+)* acres	Yes	II	Palustrine, forested/scrub shrub/aquatic bed, algal, permanently and seasonally flooded.
Wetland 14	0.7 acre	Yes	IV	Palustrine, forested, broad-leaved deciduous, emergent marsh, seasonally flooded.
Wetland 16	0.6 acre	Yes	IV	Palustrine, forested, emergent marsh, seasonally flooded.
Wetland 29	0.015	Yes	IV	Palustrine, forested, seasonally flooded.
Wetland 32	0.2 acre	Yes	IV	Palustrine, forested; saturated.

Source: Brown and Tannenbaum 2009a.b; Navy 2011.

*Wetland 6 is larger than the area shown within the project area because wetlands continue upstream of mapped boundary.

Wetland 6 is the only wetland in the vicinity of the EHW upland project area that is included on the National Wetlands Inventory (USFWS 2007). In addition to the wetlands, there is also a manmade stormwater retention pond immediately south of the existing EHW, which supports permanent water and emergent marsh and scrub/shrub vegetation including cattails (*Typha latifolia*) and young willows (*Salix* spp.) (Brown and Tannenbaum 2009b). This pond is a manmade feature constructed in an upland area for the purpose of stormwater retention, and it is considered a water of the U.S. due to its connection to Hood Canal.

Wetland 6 consists of several wetland plant communities, including emergent marsh, scrub/shrub, and broad-leaved deciduous forested wetland plant communities located in a steep-walled valley east of the existing EHW. Six acres of the wetland were delineated, but it extends farther upstream and is larger than the mapped acreage. Stream G provides the primary hydrologic source for the wetland communities of Wetland 6. The flow of water from Stream G is constricted by a control structure on the east side of Tang Road, creating an area of open-water wetland habitat surrounded by emergent and broad-leaved deciduous forested wetland plant communities. Most of the open-water area was filled with sediment transported by runoff from heavy storms during the winter of 2007–2008 (Bhuthimethee et al. 2009b). Upstream there are extensive forested and scrub-shrub wetland communities with an overstory dominated by red alder. The shrub layer is dominated by salmonberry with lady fern (*Athyrium felix-femina*), youth-on-age (*Tolmeia menziesii*), stinging nettle (*Urtica dioica*), and common horsetail (*Equisetum arvense*) in the understory. Devil's club (*Oplopanax horridus*) and skunk cabbage (*Lysichiton americanus*) occur in dense patches adjacent to the stream channel or in groundwater seeps in the steep slopes above the floodplain. The wetland vegetation extends upstream along Stream G as depicted in Figure 3.14–1.

Wetland 6 provides high-quality habitat for wetland-associated wildlife species, and removes stream-borne sediments before discharging into Hood Canal, as evidenced by the amount of fine sediment that collected at the downstream portion of Wetland 6 during the 2007/2008 rain events. Wetland 6 has a Category II wetland rating because it is large, supports a diversity of wetland vegetation types (i.e., open water, emergent marsh, scrub/shrub, and forested) that are capable of providing habitat for a diversity of terrestrial and aquatic wildlife species, and also

provides hydrologic (flood control) and water quality (ability to remove sediments or pollutants) functions because the wetland is at the terminus of the watershed (Stream G) and is constricted at its mouth. In the vicinity of the EHW-2 entry and exit trestles, Wetland 6 has a forested buffer on its north side that is intact. The buffer on the southwestern edge of the wetland is disturbed and occupied by a dirt parking area used for operations of the existing EHW (Figure 3.14–1).

Wetland 14 is 0.7 acre in size, and supports both forested wetland and emergent marsh plant communities. Wetland 14 is crossed by a maintained utility corridor. The forested wetland is dominated by red alder with emergent wetland vegetation in the understory (dominated by soft rush [*Juncus effusus*]) where the trees and shrubs have been removed. Along the utility corridor, Himalayan blackberry is present. The wetland is supported by Stream I. Flow becomes subsurface at the downstream end of the wetland. Wetland 14 is a Category IV wetland because a portion of it is disturbed and, due to its proximity to roads, provides limited habitat for wildlife. In addition, the wetland provides low value for hydrologic and water quality functions. It does not appear to have a surface water connection to Hood Canal, although a subsurface connection to the manmade retention pond west of the parking lot at the end of Archerfish Road is possible. With the exception of the maintained utility corridor, Wetland 14 is surrounded by intact forested buffer.

Wetland 16 is a long, narrow wetland, 0.6 acre in size that parallels the south side of Flier Road. Wetland 16 is associated with a small, narrow drainage (Stream J). A dirt access road cuts across the drainage and water flows into a culvert under this dirt road but also appears to periodically flow over it. The flow in Stream J is primarily runoff from roads and the adjacent building and parking lot. There is no clear stream channel in Wetland 16 downstream of the culvert, and surface water from the wetland eventually joins a roadside drainage, also on the south side of Flier Road but separate from the wetland, which empties into Hood Canal. Wetland 16 appears to be supported by Stream J, groundwater seeps, and roadside runoff. Wetland 16 and Stream J are maintained as a cleared and mowed missile haul route clear zone. The cleared zone consists of a 30-meter (100-foot) zone adjacent to Flier Road, in which all trees and undergrowth were removed, and a 75-meter (250-foot) zone adjacent to the 30-meter (100-foot) zone, in which trees were thinned and undergrowth was removed. The cleared zone would be maintained by mowing in the future, and Wetland 16 will likely support herbaceous wetland vegetation in these areas. The wetland has been expanding in width and farther downhill since vegetation was cleared during the Missile Haul Route project (MacKenzie 2010, personal communication). Wetland 16 is a Category IV wetland because it is disturbed and provides limited habitat for wildlife and low value for hydrologic and water quality functions.

Wetland 29 (0.015 acre) is located on a terrace at the toe of a slope south of the stormwater detention pond, above the scarp supporting Wetland 32 (Figure 3.14–1). The wetland consists of a small, shallow depression seasonally filled with water with saturated soil surrounding it. Hydrology in the wetland is supported by groundwater seepage at the toe of the slope. There is evidence of a small amount of intermittent outflow in a narrow channel on the west edge of the wetland that discharges down the bluff toward Hood Canal, but it is likely that most of the water surfacing on this terrace percolates into the soil and reappears as seepage on the lower bluff. The wetland is predominantly forested with a red alder overstory, scattered salmonberry, and a sedge and horsetail understory. Wetland 29 is a Category IV wetland because it is small, provides limited habitat value for wildlife, and provides low value for hydrologic and water quality functions.

Wetland 32 (0.2 acre) is located on a slope south of the manmade stormwater retention pond south of the existing EHW (Navy 2011). The area is predominantly forested with red alder and

has the appearance of an old road bed. This is further documented by old photos (1977) that show a road cut through the area. The area is skirted by a scarp with evidence of recent soil movement in places (downed trees within the last year, fresh scarp faces with no vegetation re-established). The scarp may have originated as the former roadcut, now located on the uphill side of the wetland, and compaction related to the previous road likely has increased the water-holding ability of the wetland. Hydrology in this wetland originates in seeps that are prevalent along the bottom of the scarp. There was no clear channel to Hood Canal from the wetland, but it is quite likely the water that flows from the seeps to the wetland flow underground and re-emerge in the ditch encircling the stormwater pond, which is hydraulically connected to Hood Canal. Wetland 32 is a Category IV wetland.

3.14.2 Environmental Consequences

The evaluation of impacts to wetlands considers whether the proposed action would involve discharge of dredged or fill material into wetlands, requiring a permit under CWA Section 404. The evaluation also considers whether the proposed action would indirectly affect wetland resources by impacting vegetated wetland buffers or altering wetland hydrology. Wetland 32 would be directly affected by access road construction; direct and indirect effects on other wetlands in the vicinity of upland project construction would be avoided.

3.14.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.14.2.1.1 CONSTRUCTION

Construction in the EHW upland project area adjacent to the EHW-2 area includes a 5.0-acre construction laydown area on Archerfish Road, a paved access road connecting Archerfish Road to the shoreline construction area; a paved extension of Tang Road connecting the EHW-2 trestle to existing Tang Road , and adjacent areas that would be affected by regrading and utility construction. Wetlands in the vicinity of these project features include Wetland 6, Wetland 29, and Wetland 32 (Figure 3.14–1). Wetland 6 is a high-quality forested scrub-shrub community located in the vicinity of the connector road and utilities construction area (see Section 3.14.1.1 above). Wetland 29 and Wetland 32 support deciduous forest and shrub vegetation. The existing stormwater retention pond near the shoreline of the existing southern EHW trestle is a manmade feature that is considered a water of the U.S. due to its connection to Hood Canal.

The USACE Seattle District, USEPA Region 10, and WDOE have developed guidance to outline agency recommendations, requirements, and expectations for wetland protection and mitigation (WDOE et al. 2006). This document recommends wetland buffers to protect wetlands, based on their functional scores as determined by the WDOE Wetland Rating System (Hruby 2004), from disturbance due to construction, among other activities. The recommended buffers include only the vegetated areas adjacent to the wetland; developed areas such as roads and parking lot would not be included because they are existing disturbed areas.

As a Category II (high quality) wetland with high level of function for fish and wildlife habitat, Wetland 6 would be protected by a buffer zone up to 300 feet wide. Construction of the Tang Road extension and utilities/stormwater facilities would be on the other side of Archerfish Road and therefore would be outside the buffer for Wetland 6, and would not directly affect the wetland. Indirect impacts to wetland resources could occur if construction near Wetland 6 degrades wetland buffer vegetation or causes sediment or other pollutants to move into the wetland. Construction BMPs would be implemented to avoid these impacts.

Sources: Pacific Northwest Georeadiness Center RSIMS; Brown and Tannenbaum 2009

Figure 3.14–1. Streams and Wetlands Near the EHW-2 Project Site (North)

Wetland 29 is located above the steep slope to the south of the access road alignment (Figure 3.14–1). The southern edge of the logging limit for road construction is adjacent to and downslope of this wetland (Figure 2–3). No direct impacts to Wetland 29 are anticipated, such as deposition of fill, but some indirect effects are possible. The area within the logging limit would be cleared of trees in order to reduce weight from the unstable slope above the road alignment and prevent future slumping. Trees within 10 feet of the top of the graded slope would be felled and cut into lengths suitable for removal from the site; no heavy equipment would be used within the tree removal area in order to reduce site disturbance and the potential for slope failure. Stumps would be left in the ground. Logging adjacent to the wetland would reduce its habitat value, but given the small size of the wetland as delineated, and its functional rating as Category IV, the impact would be negligible.

Wetland 32 (0.2 acre) is located within the access road alignment (Figure 3.14–1) and would be filled in order to construct the access road. This wetland is a Category IV (low quality) wetland and its recommended buffer would be 50 feet. However, due to topography, the only feasible access route from Archerfish Road to the upland construction area for EHW-2 is south of the retention pond crossing Wetland 32, as described below in Section 3.14.2.7, Mitigation Measures and Regulatory Compliance. Construction of the access road would result in total loss of the wetland and its functions and values. Impacts to this wetland would be mitigated as described in the Mitigation Action Plan (Appendix F) in consultation with USACE and WDOE.

Construction of the access road may accelerate failure of the scarp adjacent to Wetland 32, as described in Section 3.11.2.3.1, Construction, Geology and Soils. Engineering design, control structures (retaining walls), and implementation of BMPs would be used to control water flow and avoid soil movement on the unstable slope. As described above for Wetland 29, trees on the slope above Wetland 32 would be logged in order to reduce weight on the slope and lessen the likelihood of failure. A new culvert would be placed in the wetland to divert drainage toward Hood Canal and away from the paved access road (Figure 3.14–1).

The stormwater retention pond would not be modified or impacted by construction of the paved access road, nor would the new road affect vegetation located between the pond and the existing gravel road that borders the pond. Some clearing of shrubs and regrading of land surface would be required for the new access road along the outer edge of the existing perimeter gravel road on the west side of the pond (see Figure 2–3).

Wetlands 14 and 16 and their buffers are outside the area that could be affected by project construction. No wetlands are present in the vicinity of the temporary laydown area east of Archerfish Road.

Outside of the EHW-2 upland project area, three new buildings and expanded parking would be constructed to house the functions of some of the buildings that would be demolished within the project area (Figure 2–1). These buildings would be located at a site in an existing industrial area of the Lower Base (Figure 3.14–2), a portion of which is already paved. There are no wetlands on the construction site, and no indirect impacts are anticipated beyond the limits of construction. Surface water in the vicinity of the site drains north and west through ditches and the existing storm drain system. During construction, stormwater management and other BMPs (described below) would be implemented on the site to control runoff and sedimentation, minimizing impacts to surface waters.

Sources: Pacific Northwest Georeadiness Center RSIMS; Brown and Tannenbaum 2009

Figure 3.14–2. Streams and Wetlands Near the EHW-2 Project Site (South)

In addition to three new buildings and replacement parking, a pure water facility and aboveground water lines would be constructed at the landward end of the Delta Pier trestle (Figure 2–1; Figure 3.14–2). There are no wetlands on or adjacent to the pure water facility site or proposed water line locations. However, Streams A (intermittent) and B2 (perennial) are present as surface flow in the vicinity of the pure water facility (Figure 3.14–2). These streams pass westerly through culverts under Runner and Escolar Roads and converge in a ditch within a small vegetated area (approximately 0.2 acre) dominated by Himalayan blackberry and red alder located adjacent to the pure water facility site and within the construction limits for this project. The stream would be protected during construction by silt fences or other appropriate BMPs described below.

The abutment support for the EHW-2 trestles described in Section 3.11.2.1.1 involves construction (excavation and fill) in the marine shoreline below MHHW. It is regulated as a water of the U.S. and would also require a CWA Section 404 permit, although it is not a wetland as defined by USACE (Environmental Laboratory 1987). Impacts to the intertidal environment related to abutment construction, which includes pile driving, include erosion and runoff from the excavation area. Excavated material would total approximately 2,760 cubic yards. The area below MHHW affected by excavation and refilling of approximately 300 cubic yards would be approximately 1,400 square feet (0.032 acre).

Construction BMPs would be implemented to prevent indirect impacts to wetlands, surface water drainages, and the marine shoreline. As described in detail in Section 3.11.2.1.1, BMPs for earthmoving and hauling activities would be implemented to reduce impacts in the intertidal and upland environments. BMPs for surface drainage, such as culverts and weep pipes, may be necessary to allow surface water flow and to divert any seepage. BMPs for clearing, grading, and maintenance would be employed as needed to control erosion and sedimentation, including the possible use of benched surfaces, downdrain channels, diversion berms and ditches, erosion control blankets or turf reinforcement mats, plastic coverings, silt fences and check dams, and straw bales. Water-spraying on soil would be used to control dust generation during earthmoving and hauling. Any potential fluid spills or leakage from vehicles onto soil would be handled in accordance with a spill response plan.

3.14.2.1.2 OPERATION/LONG-TERM IMPACTS

Operation of the EHW-2 would not require additional ground disturbance or vegetation clearing adjacent to wetlands or their buffer zones. The new paved access road would traverse Wetland 32, and a new culvert under the road would be designed to convey runoff away from the wetland to the beach. Any remaining soil movement near the wetland, which is currently ongoing, would be stabilized through BMPs during construction of the access road. As described in Section 3.11.2.1.2, there would be no long-term impacts to the intertidal zone associated with the abutment, which would protect against erosion or other soil movement. Maintenance of the EHW-2 would not affect wetlands. Therefore, impacts to wetlands from EHW-2 operations are expected to be negligible.

3.14.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.14.2.2.1 CONSTRUCTION

Construction impacts for wetlands would be the same as those of Alternative 1. The abutment would be the same as for Alternative 1.

3.14.2.2.2 OPERATION/LONG-TERM IMPACTS

Operation/long-term impacts for wetlands would be the same as those of Alternative 1.

3.14.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.14.2.3.1 CONSTRUCTION

Construction impacts for wetlands would be the same as those of Alternative 1. Construction of the abutment would require greater excavation (3,560 cubic yards), but otherwise impacts would be similar to Alternative 1. The area below MHHW affected by excavation and refilling would be approximately 1,900 square feet (0.044 acre).

3.14.2.3.2 OPERATION/LONG-TERM IMPACTS

Operation/long-term impacts for wetlands would be the same as those of Alternative 1.

3.14.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.14.2.4.1 CONSTRUCTION

Construction impacts for wetlands would be the same as those of Alternative 1. Construction of the abutment would entail greater excavated volume (3,560 cubic yards), and the area below MHHW affected by excavation and refilling of approximately 550 cubic yards would be greater (1,900 sq ft, or 0.044 acre).

3.14.2.4.2 OPERATION/LONG-TERM IMPACTS

Operation/long-term impacts for wetlands would be the same as those of Alternative 1.

3.14.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.14.2.5.1 CONSTRUCTION

Construction impacts for wetlands would be the same as those of Alternative 1.

3.14.2.5.2 OPERATION/LONG-TERM IMPACTS

Alternative 5 differs from Alternative 1 in the marine and upland environments. Operation/long-term impacts for wetlands would be the same as those of Alternative 1.

3.14.2.6 No-Action Alternative

There would be no construction- or operations-related activities that would directly or indirectly affect native wetlands in the project area under the No-Action Alternative. Therefore, this alternative would have no impacts to wetlands.

3.14.2.7 Mitigation Measures and Regulatory Compliance

Section 404 of the CWA of 1972 and EO 11990, Protection of Wetlands, directs federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. Section 401 of the CWA requires a water quality certification from WDOE where wetlands impacts are anticipated. NBK at Bangor complies with requirements of the CWA and EO 11990 by ensuring there would be no

net loss of wetlands at the base, implementing mitigation of wetland impacts, and requiring that any activity within a jurisdictional wetland area be permitted by USACE.

During operations at the existing EHW, construction access on the existing road would be restricted. Construction activities therefore warrant a new access road. Due to the topography of the location, the only available access route to the EHW-2 construction site crosses Wetland 32 located south of the retention pond. There are no other feasible routes to the site over land, and a shore access route would have much greater environmental impacts. Construction of the EHW-2 would directly impact Wetland 32, with the loss of 0.2 acre of wetland habitat. Impacts to this wetland would be mitigated through compensatory mitigation measures described in the Mitigation Action Plan (Appendix F).

The pile-supported abutment described in Section 3.11.2.1.1 would require construction below the MHHW line. Construction in the intertidal zone is regulated under the CWA, and USACE permits under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act would be required, in addition to water quality certification from WDOE. Construction in the coastal zone is regulated by the CZMA, which is further discussed in Section 3.20. The Navy is in consultation with USACE on jurisdictional determination for wetlands affected by the project and has submitted a JARPA for a Section 404 permit for work within affected wetlands, and Section 401 water quality certification from WDOE. In accordance with the CZMA, the Navy submitted a Phase I CCD to WDOE. WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD in spring 2012. Following construction, the exposed portions of the abutment would lie above MHHW. The permanent road that is joined to the trestle at this abutment is above MHHW and would not require a USACE permit. Construction-period mitigation measures would consist of the BMPs described in Section 3.14.2.1.1.

3.14.3 Summary of Impacts

Impacts to wetlands associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.14–3.

Table 3.14–3. Summary of Impacts to Wetlands

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO WETLANDS
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Filling of freshwater wetland (0.2 acre). Excavation/filling, pile driving for abutment (0.032 acre). *Operation/Long-term Impacts:* None.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Filling of freshwater wetland (0.2 acre). Excavation/filling, pile driving for abutment (0.032 acre). *Operation/Long-term Impacts:* None.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Filling of freshwater wetland (0.2 acre). Excavation/filling, pile driving for abutment (0.044 acre) greater than Alternative 1. *Operation/Long-term Impacts:* None.

Table 3.14–3. Summary of Impacts to Wetlands (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO WETLANDS
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Filling of freshwater wetland (0.2 acre). Excavation/filling, pile driving for abutment (0.044 acre) greater than Alternative 1. *Operation/Long-term Impacts:* None.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Filling of freshwater wetland (0.2 acre). Excavation/filling, pile driving for abutment (0.032 acre). *Operation/Long-term Impacts:* None.
No-Action Alternative	No impact.
Mitigation Under all alternatives, the following mitigation measures would be implemented: • Impacts to Wetland 32 and other waters of the U.S. (abutment) would be mitigated through compensatory mitigation described in the Mitigation Action Plan (Appendix F). • Construction BMPs to protect surface waters would also protect wetlands and surface water drainages.	
Consultation and Permit Status • The Navy is in consultation with USACE on jurisdictional determination for wetlands affected by the project and has submitted a JARPA for a CWA Section 404 permit for work in affected wetlands, a Rivers and Harbors Act Section 10 permit for construction in navigable waters, and a CWA Section 401 water quality certification from the WDOE. • The Navy submitted a Phase I CCD to WDOE. WDOE concurred with the Phase I CCD on August 26, 2011. The Navy will prepare and submit a Phase II CCD.	

3.15 WILDLIFE

Terrestrial wildlife resources for a specific region include the mammals, birds, amphibians, and reptiles that live in the area and their associated habitats (e.g., forest, brush and shrubland, wetlands, streams, open water, marine shorelines, and developed areas).

NBK at Bangor manages its natural resources in compliance with federal law and regulation, Executive Orders, and DoD and Navy guidance. This includes mandated cooperation with other federal agencies such as USFWS, NOAA NMFS, and WDFW. Applicable laws include the ESA, Bald and Golden Eagle Protection Act, the MBTA (16 USC 703 et seq.), and EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds (see introduction to Section 3.10 for a discussion of the MBTA and EO 13186); and Sikes Act Improvement Act (P.L. 86-797 as amended, 16 USC 670(a) et seq.: Conservation Programs on Military Installations). The MBTA protects migratory birds and their habitats and establishes a permitting process for legal taking. Except as permitted, proponent actions may not result in pursuit, hunting, taking, capture, killing, possession, or transportation of any migratory bird, bird part, nest, or egg thereof. Based on a review of the USFWS Endangered Species Program list of 2012, no federally listed threatened or endangered terrestrial wildlife species have been identified or are likely to occur on NBK at Bangor (USFWS 2012).

None of the freshwater bodies potentially affected by the proposed action contain fish. Therefore, freshwater fish are not addressed in this EIS.

Consultation and Permit Compliance Status. Since no ESA-listed terrestrial wildlife species were identified or likely, no consultation is required under the ESA. The Navy consulted with USFWS regarding the MBTA and Bald and Golden Eagle Protection Act. Additionally, the terms and conditions of the USFWS biological opinion (issued November 2011) provide protection to birds within the project area.

3.15.1 Existing Environment

The terrestrial wildlife in the EHW upland project area is typical of the wildlife that occurs on NBK at Bangor overall. The species described in this section include many mammals, birds (including migratory species), amphibians, reptiles, and nuisance/pest species. The main land cover types on NBK at Bangor provide suitable habitat for a number of different wildlife species and include forest; brush and shrubland; wetlands, streams, and open water; marine shoreline; and developed areas.

3.15.1.1 Wildlife Species

Terrestrial wildlife (game species, non-game mammals, birds, amphibians, and reptiles) in the vicinity of the EHW upland project area are typical of forest-dwelling species that occur on NBK at Bangor as a whole (Table 3.15–1). The occurrence, habitat use, and other natural history information of these species are discussed below. Appendix D provides a complete listing of all wildlife species known or expected to occur on NBK at Bangor.

3.15.1.1.1 GAME SPECIES

The Columbian black-tailed deer is a common, year-round resident on NBK at Bangor that is seen in most habitat types at the base, but is most common in forested areas (SAIC staff observations). Black-tailed deer are herbivores and browse on a variety of grasses, forbs, shrubs, and trees (Raedeke and Taber 1983).

Two cougar sightings were reported at the upper base in 2010, and there have been numerous bear sightings at the lower base (Jones 2010b, personal communication). Cougars prey on black-tailed deer and smaller mammals in forested and adjacent habitats. Black bears are omnivorous foragers eating plants, berries, and small mammals in the understory of forest, grassland, brush, and shrubland habitats.

Five species of game birds are likely to occur on NBK at Bangor (see Appendix D) including native species, such as ruffed and blue grouse. Other game bird species were introduced to the region for the purpose of recreational hunting, including quail species (California and mountain quail) and the ring-necked pheasant (Johnson and O'Neil 2001). Habitats used by game birds include forest and shrubland habitats, and species may opportunistically use grassland habitat as well. These game birds consume primarily plant material, including seeds and berries (Taber and Raedeke 1983).

Table 3.15–1. Wildlife Groupings and Representative Species on NBK at Bangor

WILDLIFE GROUP	REPRESENTATIVE SPECIES	SEASON(S) OF OCCURRENCE
Game Species	Black-tailed deer, black bear, cougar, and game birds (i.e., grouse and quail species)	Year-round
Non-Game Mammals	**Carnivores:** river otter, ermine, coyote, raccoon, red fox, and bobcat **Small mammals:** shrews, moles, mice, squirrels, rats, mountain beavers, beavers, and rabbits **Bats:** *Myotis* species, hoary bat, and big brown bat	Year-round
Non-Game Birds	**Raptors:** osprey, bald eagle, red-tailed hawk, owls, and other birds of prey **Woodpeckers:** pileated woodpecker, downy woodpecker, red-breasted sapsucker **Songbirds:** sparrows, swallows, warblers, kinglets, chickadees, finches, wrens, and others **Other birds:** great blue heron, Canada goose	**Year-round:** great blue heron, woodpeckers, finches, chickadees, red-tailed hawk, crows, jays, sparrows **Summer resident:** osprey and migratory songbirds (e.g. swallows, warblers, Swainson's thrush) **Winter resident:** northern harrier, fox sparrow, golden-crowned sparrow, ruby-crowned kinglet, and others **Spring and/or fall migrant:** sharp-shinned hawk, peregrine falcon, ruby-crowned kinglet, and most summer resident species listed above
Amphibians	Red-legged frog, Pacific tree frog, salamander species Introduced: bullfrog	Year-round
Reptiles	Northwestern and common garter snakes and northern alligator lizard	Year-round

Sources: Storm and Leonard 1995; Adams et al. 1999; Johnson and O'Neil 2001; Opperman 2003; Jones et al. 2005.

3.15.1.1.2 NON-GAME MAMMALS

Carnivores, or predatory mammals, are found in most habitats on NBK at Bangor, where they pursue small mammal and avian prey or other food resources. In addition to the big game species (black bear and cougar), carnivores include raccoons, weasel, bobcat, coyote, and river otter. River otter is considered to be a specialist in aquatic habitats including the marine shoreline, where they forage in shellfish beds and beaches for molluscs, fish, and crustaceans. Coyote and raccoons also frequent the marine shoreline, where they forage on shellfish, crustaceans, and fish (Tannenbaum et al. 2009b; SAIC staff, field observations). Small mammals, including voles, mice, rat, squirrel, and rabbit species, occur in habitats with appropriate food and shelter resources, such as forest understory, grasslands, and brush and shrublands (Johnson and O'Neil 2001). Bat species often forage over open-water habitats with productive insect resources, as well as in forested habitats, forest edges, and open areas (Johnson and O'Neil 2001). Some bat species use forest habitat for maternity colonies and diurnal roosts (e.g., hoary bat and silver-haired bat), whereas other bat species prefer to roost in caves, crevices, or old buildings (*Myotis* spp. and big brown bat) (Johnson and Cassidy 1997).

3.15.1.1.3 NON-GAME BIRDS

A variety of terrestrial birds occur on NBK at Bangor, some of which are year-round residents and some of which are migratory (Table 3.15–1 and Appendix D). Migratory land birds spend only part of the year on NBK at Bangor for nesting, as winter residents, or as short-term, stopover species during migration (Johnson and O'Neil 2001). Songbirds and other small birds are found in most habitats on NBK at Bangor, depending on the species. Summer resident migratory songbirds include insect-eating species such as flycatchers, swallows, and warblers that breed in forested habitat and in shrubby growth. This cover type provides the greatest structure for nesting habitat in proximity to food resources (Larsen et al. 2004; Wahl et al. 2005). Year-round resident species include corvids (crows and jays), wrens, most sparrows, finches, and chickadees.

Woodpecker species are year-round residents that inhabit forested habitat, where they use downed wood, snags, and live trees with decay for foraging on insects, such as ants and other invertebrates, and for cavity nesting (Johnson and O'Neil 2001). Raptor species (birds of prey) occurring on NBK at Bangor include red-tailed hawks, osprey, falcon species (in migration), turkey vulture, and several owl species. Raptor species use all habitats at the base including the marine shoreline. Bald eagles are discussed in Section 3.10.1.1.2. Except for bald eagles, there are no known active raptor nests in the vicinity of the project.

3.15.1.1.4 AMPHIBIANS

Amphibians on NBK at Bangor are likely to include pond/wetland-breeding species (northwestern salamander, rough-skinned newt, Pacific tree frog, red-legged frog (a USFWS species of concern), and long-toed salamander) (Johnson and O'Neil 2001; Jones et al. 2005). Bullfrog, an introduced species, is also likely to be present. A terrestrial-breeding species, the western red-backed salamander, may also be present. Other amphibians that may occur at the base include ensatina, western toad, Olympic torrent salamander, coastal giant salamander, and coastal tailed frog. Pond-breeders require quiet waters and suitable aquatic vegetation to support egg attachment (Johnson and O'Neil 2001). Terrestrial breeders require moist sites, such as seeps, crevices, or large logs, within forested stands for breeding. Outside of the breeding season, amphibians on NBK at Bangor primarily use forest and riparian areas. During winter,

most of the amphibian species in the area enter a state of semi-hibernation in underground terrestrial retreats or in the bottom of ponds.

3.15.1.1.5 REPTILES

Four species of snakes, two lizards, and two turtles potentially occur on NBK at Bangor (Storm and Leonard 1995) (see Appendix D). One of the turtles, the slider, is an introduced species now distributed throughout freshwater habitats of the Pacific Northwest. Whereas some reptile species potentially occurring on NBK at Bangor prefer open areas, such as clearcuts or grassland (western fence lizard), others prefer forest habitat (northern alligator lizard), and many are commonly found near freshwater (garter snake species, rubber boa) or in freshwater (western painted turtle). During winter, most of the reptile species in the area hibernate underground. The primary food sources of lizards include insects and spiders. Snakes also consume insects, as well as other invertebrates (i.e., worms), fish, amphibians, other reptiles, small mammals, and birds. Turtle species are omnivorous, consuming insects, arthropods, crayfish, tadpoles, and aquatic plants.

3.15.1.1.6 MIGRATORY BIRDS

Most of the bird species that occur on NBK at Bangor are considered migratory under the MBTA, although in this region many individuals, especially songbird species, owls, red-tailed hawks, herons, some gull species, and others do not engage in long-distance migrations. Exceptions are introduced or pest species mentioned below in Section 3.15.1.1.7. Migratory birds that are seasonally present on NBK at Bangor include numerous neotropical songbirds occurring as summer residents; migratory raptors occurring as winter residents, summer residents, or during fall and/or spring migration; and numerous waterfowl and shorebird species that are present in various seasons (see Appendix D). Active great blue heron nests were observed on the lightning tower at the existing EHW in the summer of 2008 (Tannenbaum et al. 2009b).

3.15.1.1.7 NUISANCE SPECIES

A number of wildlife species, including European starlings, pigeons, ravens, gulls, mice, bats, raccoon, squirrel, and moles, were identified in the *FY 2004 Naval Base Kitsap Bangor Pest Management Plan* (Navy 2004) as pest species in situations where they occur in structures or interact adversely with humans. This plan describes a variety of methods used to control these species as required primarily for health reasons. Starlings and pigeons are not protected by the MBTA and therefore can be controlled with humane methods, which on NBK at Bangor include routinely destroying starling nests when found, and using netting and other methods to prevent pigeon use of waterfront structures. Mammals are prevented from entering buildings by various exclusion measures, or they may be trapped and relocated.

3.15.1.2 Wildlife Habitats

Wildlife habitats occurring on NBK at Bangor can be categorized based on vegetation cover type as described in Section 3.13, Vegetation. Four wildlife habitat types occur at the base: (1) forest; (2) brush and shrubland; (3) wetlands, streams, and open water; and (4) developed areas, including lawn, landscaping, and mowed rights-of-way (Table 3.15–2).

3.15.1.2.1 FOREST

Forested habitats on NBK at Bangor are characterized as second growth lowland conifer/ hardwood forest, typical of the greater Puget Sound Trough Ecoregion (Johnson and O'Neil 2001; WDFW 2005). Wildlife species that use the forest habitat on NBK at Bangor and its habitat value are described in Table 3.15–2. Wildlife species use forest habitat for a variety of resources, including foraging, shelter from the elements, hiding cover from predators, and breeding habitat (i.e., bird nest sites). Habitat features of forests that are important to wildlife include coarse woody debris (i.e., downed logs), snags (i.e., standing dead trees), and additional components, such as duff, litter, live trees, and surface rocks (Johnson and O'Neil 2001; Lewis and Azerrad 2004). Many wildlife species associated with old-growth habitat can be found in younger forests if habitat features (such as snags, coarse woody debris, or remnant large trees) are present (Johnson and O'Neil 2001).

The forest habitat on NBK at Bangor has been enhanced for wildlife by the creation of artificial nesting structures (such as nesting boxes and brush piles) to encourage bird and small mammal habitation, and perching poles to provide raptors with habitats for nesting and hunting.

Table 3.15–2. Wildlife Habitats and Characteristic Wildlife Species on NBK at Bangor

HABITAT TYPE	DESCRIPTION	HABITAT VALUE	CHARACTERISTIC WILDLIFE
Forest	Comprises 68.4% of the terrestrial habitat.	Forest habitat in the EHW upland project area has value for breeding, foraging, and shelter for a variety of wildlife species.	Amphibians (e.g., salamanders); reptiles (northern alligator lizard); mammals (e.g., small mammals, deer, black bear); and birds (e.g., varied thrush, chestnut-backed chickadee, and pileated woodpecker)
Brush and Shrubland	Comprises 4.4% of the terrestrial habitat	Brush and shrubland habitat in the EHW upland project area has value for cover and forage resources for a variety of mammals and birds.	Small mammals, black-tailed deer, birds (e.g., sparrows) and raptors
Developed Areas, including lawn, landscaping, mowed rights-of-way	Comprises 27.2% of the terrestrial habitat	Grassland and landscaped habitat in the EHW upland project area has some foraging value for a variety of wildlife species, as well as breeding and shelter for small mammals. Buildings and structures are not important habitat for wildlife, with the possible exception of roosting bats and small mammals.	Raccoon, small mammals (e.g., mice and voles); bats, deer; birds (e.g., starling, crows, juncos, gull species, Canada goose); and reptiles (e.g., garter snake spp.)

Sources: Johnson and O'Neil 2001; NBK at Bangor GIS layers 2006.

3.15.1.2.2 BRUSH AND SHRUBLAND

Brush and shrubland habitat provides forage resources and cover for small mammals and browse habitat for black-tailed deer (Johnson and O'Neil 2001). Predatory mammals and raptors may also occur in these habitats in pursuit of prey attracted to the habitat for forage and/or shelter. However, the prominent noxious weeds (e.g., Scotch broom) in shrubland habitat on

NBK at Bangor are less desirable for wildlife habitat and may result in disruption of food webs for wildlife (Johnson and O'Neil 2001). Some shrubland habitat on NBK at Bangor has been enhanced for wildlife species by reclaiming land overgrown with the invasive species Scotch broom and planting native shrubs in their place. There is some brush habitat located around the edges of the waterfront upland area.

3.15.1.2.3 WETLANDS, STREAMS, AND OPEN WATER

Wetlands, streams, and open water on NBK at Bangor provide unique and valuable habitat for a variety of wildlife species (Table 3.15–2). In particular, amphibians, reptiles, and mammals (such as weasel, bats, and river otter) use these freshwater aquatic habitats. Certain bird species, including great blue heron, bald eagle, and osprey, nest close to wetland and open-water habitats (see Section 3.10.1.1.2, Raptors, and Section 3.10.1.2.1, Shorebirds and Wading Birds).

3.15.1.2.4 DEVELOPED AREAS

The diversity of wildlife species occurring on developed lands on NBK at Bangor is relatively low, and some wildlife species that do occur are considered nuisance species, such as European starlings, rock doves (pigeons), rodents, or cosmopolitan species like American crows (Table 3.15–2) (Johnson and O'Neil 2001). These wildlife species use developed habitats on NBK at Bangor for structures to nest on (birds) or in (rodents), food resources (primarily garbage), or resting. In addition, grasslands provide forage habitat for ground-feeding small mammals, songbirds, reptiles, and deer (Table 3.15–2). Small mammals, such as voles, find shelter in grasslands. Additionally, predatory species (e.g., coyote or raptors) can occur in the grassland and open field habitat of NBK at Bangor in pursuit of prey species. This habitat type has limited extent in the EHW upland project area, but it is expected to develop along Flier Road in the 300-foot clear zone. This zone will be maintained in an open grassland condition, limiting the value of this habitat for wildlife species.

3.15.1.2.5 WILDLIFE HABITATS NEAR THE SHORELINE OF THE EHW-2 PROJECT SITE

The marine shoreline in the vicinity of proposed abutment and trestle construction for the EHW-2 includes gravel beaches and shellfish beds separated by bluffs from adjacent upland habitats. Forage resources in this zone attract terrestrial mammalian predators including raccoon, river otter, coyote, bobcat, and weasel. Bald eagles forage along the shoreline. The adjacent upland, where road and utility construction would occur, includes developed areas, second growth forest, and shrub habitats. Developed areas adjacent to the shoreline include existing roads and parking lots, disturbed brush and shrub areas dominated by Scotch broom and Himalayan blackberry. Several wetlands including Wetland 6 and Wetland 32, and mature mixed coniferous/hardwood forest are located in the vicinity of the existing EHW. Wetland 6 and the forest stands are high quality habitats for wildlife species including black-tailed deer, great blue heron, black bear, Douglas squirrel, many song bird species, small mammals, and amphibians. Based on a review of the USFWS Endangered Species Program list of 2012, no federally listed threatened or endangered terrestrial wildlife species have been identified or are likely to occur on NBK at Bangor (USFWS 2012). Marbled murrelets do not use the upland or beach/intertidal zones in the vicinity of the proposed EHW-2 project site. Terrestrial wildlife observations obtained during boat surveys of the shoreline include raccoon, black-tailed deer, otter, coyote, and bird species, none of which is federally listed.

3.15.1.2.6 WILDLIFE HABITATS AT OFF-SITE AREAS

Construction would also take place in several areas that are not immediately adjacent to the EHW-2 facilities, including the site of the three new buildings and associated parking expansion, the construction laydown area, and the pure water facility site located at the landward end of the Delta Pier trestle (Figure 2–1, Figure 3.13–1). Existing second-growth forest habitat at the proposed laydown area is likely to provide value to black-tailed deer, songbirds, and small mammals, and is contiguous with forest habitat. The site of the three new buildings/parking expansion and the pure water facility site are currently developed or previously disturbed by development, and are adjacent to developed areas. These sites have limited value for wildlife due to minimal or previously disturbed vegetation, and current vehicle and pedestrian activity. The sites of the three new buildings, parking expansion areas, and pure water facility site adjacent to Delta Pier are currently lit at night for security purposes.

3.15.2 Environmental Consequences

The evaluation of impacts to upland wildlife considers the importance of the resource (i.e., legal, recreational, ecological, or scientific); the proportion of the resource affected relative to its occurrence in the region; the particular sensitivity of the resource to project activities; and the duration of environmental impacts or disruption.

Impacts to resources are significant if habitats of high concern are adversely affected over relatively large areas; if disturbances to small, essential habitats would lead to regional impacts to a species; or if disturbances harass or impact the ability of species to acquire resources and ultimately impact the abundance or distribution of federally listed threatened or endangered species. Both permanent habitat loss and temporary disturbance due to construction are concerns, as is continued or progressive habitat degradation.

Impacts to upland wildlife species from construction of the EHW-2 are related to human activity, increased noise, habitat loss resulting from the construction laydown area, the paved access road and road extension, the three new buildings, the pure water facility, and disruption of movement corridors. Resources impacted include wildlife habitat, species abundance and distribution, and habitat connectivity and edge effects.

Based on a review of the USFWS Endangered Species Program list of 2012, no federally listed threatened or endangered terrestrial wildlife species have been identified or are likely to occur on NBK at Bangor (USFWS 2012). Therefore, no surveys specific to federally listed terrestrial species were conducted. Migratory birds use and transit the project area, and are protected by the MBTA and EO 13186 (Protection of Migratory Birds).

3.15.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.15.2.1.1 CONSTRUCTION

Construction of the upland laydown area east of Archerfish Road would result in the loss of 5.0 acres of second-growth forest habitat that is contiguous with a band of undisturbed second-growth forest that provides habitat for forest wildlife species (see Section 3.13.2). The site would be revegetated after construction, and a shrub/sapling habitat would develop within a few years but the forest habitat value would not fully recover for 40 years or more.

At the land end of the EHW-2 structure, an additional 1.4 acres of second-growth forest and shrub habitat would be permanently replaced by new upland construction, and 1.6 acres would be cleared and revegetated after construction is completed for road cut-and-fill slopes and utilities, including pipelines, stormwater catchment structures, and utility vaults. Shoreline construction for the abutment and trestles would displace terrestrial wildlife species that forage in the intertidal zone.

An indirect impact of disturbing these areas would be exposing the adjacent undisturbed forest stands to weed species and noise and disturbance resulting from increased human presence and vehicle traffic. Development of the laydown area would reduce connectivity of habitats through the forest zone east of Archerfish Road. However, wildlife species on NBK at Bangor overall would not be significantly impacted by construction of the laydown area because it represents only about 1 percent of the estimated 4,888 acres of available forested habitat at the base.

At the site of the three new buildings and expanded parking, an additional 1.7 acres of previously disturbed shrub and small tree (primarily red alder and Douglas-fir) habitat would be permanently cleared of vegetation. Development of the pure water facility would permanently remove approximately 0.3 acre of weeds, grass, and small trees; an additional 0.3 vegetated acre would be temporarily disturbed and revegetated with native forest and shrub species following construction. Development of these sites would have a negligible impact to wildlife species because they currently are unlikely to have much use by wildlife due to poor habitat value, existing lighting, and high levels of human activity.

Construction noise would increase primarily due to airborne pile driving noise, as described in Section 3.16.2, which would include piles driven in the water as well as piles driven on land. Additional construction noise would result from use of heavy equipment for earth moving and excavation, and vehicle traffic, but these noise levels would be lower than pile driving noise levels (see Section 3.16.2 for noise level details). With the exception of the 92 dBA injury impact for federally listed marbled murrelets (see Section 3.10.2.1.1), there are no established thresholds for airborne noise-related disturbance impacts to terrestrial wildlife species. As described in Section 3.10.2.1.1.6, no sensitive marine bird or upland wildlife receptors with recent use are known in the area that would be affected by airborne construction noise, including marbled murrelet nesting habitat and bald eagle nest sites. However, the marbled murrelet threshold for airborne noise disturbance was used in this analysis to evaluate potential impacts to other upland bird species. This threshold has been used for ESA effects determinations for sound-only injury to nesting marbled murrelets (USFWS 2004a) and foraging murrelets. USFWS (2004a) also has identified noise-only alert and disturbance thresholds for nesting marbled murrelets, where alert behavior refers to the bird showing apparent interest in the noise source and disturbance is indicated by avoidance of the noise. These threshold levels change depending on the baseline noise level (USFWS 2004a; Teachout 2009, personal communication; WSDOT 2010a). Impact pile driving at the EHW-2 project site would attenuate to the 92 dBA injury level over water at approximately 256 feet and over land at approximately 69 feet from the driven pile. Mitigation for in-water and upland (abutment) pile driving would include a soft-start approach[1] at the beginning of pile driving for both impact and vibratory driving to induce wildlife to leave the immediate pile driving area (Section 2.2.1).

[1] Soft starts for vibratory drivers require initial starts of 15 seconds at reduced energy followed by a 1-minute waiting period. This measure shall be repeated two additional times. Soft starts for impact hammers shall be one dry fire followed by a 1-minute waiting period. This procedure shall be repeated two additional times.

Construction noise at the three new buildings/parking expansion, and the pure water facility site could potentially affect wildlife use, but since these sites are existing developed areas with poor habitat value, impacts to wildlife would be minimal. Wildlife use of higher-quality upland construction areas, including the 5-acre laydown area and the area adjacent to the access road could be impacted by construction noise and activity. There are no sensitive wildlife receptors that could be affected by construction noise in the vicinity of these sites. The impacts of construction noise levels to upland wildlife species depend largely upon the habitat uses of these animals within the probable zone of disturbance, especially during their breeding seasons, typically from late February through August, depending on the species. Terrestrial wildlife species would respond to airborne noise disturbance in ways similar to marine wildlife, including habituation and sensitization, as described in Section 3.10.2.1.1.6. Noise might displace some terrestrial wildlife during construction, whereas other species may become habituated to noise and visual disturbances and would remain in the general vicinity. Some wildlife species displaced by noise or increased human activity may return once construction is complete and ultimately re-establish home ranges within the surrounding habitats, especially after revegetation is completed at the disturbed areas (5-acre laydown area plus a total of 1.9 acres disturbed for other upland construction). Although some individual disturbance is likely, population level impacts would be negligible because the affected upland area is small.

Lighting at construction sites can deter use by many nocturnal wildlife species. Construction would occur during normal daytime hours, but some additional lighting may be used on the construction sites at night, which is likely to affect use by wildlife. Given that the construction areas would be cleared of vegetation and occupied by equipment and materials, additional construction lighting at night would not contribute greatly to the overall impacts to wildlife.

3.15.2.1.2 OPERATION/LONG-TERM IMPACTS

Operation of the EHW-2 and upland sites would increase the noise and visual disturbance to wildlife present in adjacent forest habitat due to human activity, such as operations staff walking through the area or driving vehicles. The new roads (750 feet total length) would carry additional vehicle traffic into areas that do not currently contain roads, slightly increasing disturbance and exposure to collisions with vehicles. However, the traffic increase (due to 20 additional personnel at the EHW-2) is not expected to significantly increase the potential for and the likelihood of mortality of upland wildlife species. The abutment (103-foot long with 69-foot wing wall) and trestle would be an impediment to wildlife movement from uplands to the marine shoreline. Temporarily disturbed upland sites (the 5-acre laydown area and areas cleared for construction of various facilities [1.9 acres] described in Section 3.13.2.1.1) would be revegetated with native plant species following construction and available for wildlife use, but shrub habitat value would require several years to recover, and forest habitat value would not fully recover for 40 or more years. The affected upland areas and number of individuals would be very small relative to available forested habitat on NBK at Bangor and therefore the impact to forest-dwelling wildlife species would be minor. Wildlife species that forage on the marine shoreline, such as river otter and raccoon, would be locally adversely affected by reduced connectivity, night lighting (which they tend to avoid), and activity/human presence at the EHW-2. Maintenance of the EHW-2 could result in additional short-term, localized disturbance of wildlife. The three new buildings and pure water facility would include exterior lighting for security, which is likely to deter wildlife use.

3.15.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.15.2.2.1 CONSTRUCTION

Upland components of Alternative 2 would be the same as those of Alternative 1; therefore, the wildlife habitat impacts of construction would be the same for both alternatives. The impact of the duration of noise and visual disturbance to wildlife (54 to 64 months) would be greater than for Alternative 1 (42 to 48 months).

3.15.2.2.2 OPERATION/LONG-TERM IMPACTS

Upland components of Alternative 2 would be the same as those of Alternative 1; therefore, the impacts of long-term operations and maintenance to wildlife would be the same for both alternatives.

3.15.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.15.2.3.1 CONSTRUCTION

Upland components of Alternative 3 would be similar to those of Alternative 1; therefore, the wildlife habitat impacts of construction would be similar for both alternatives. The abutment would be longer (160 feet long with two 35-foot wing walls) than Alternative 1 (103 feet long with 69-foot wing wall on north end), creating a longer impediment to wildlife movement between uplands and the marine shoreline. The impact of the duration of noise and visual disturbance to wildlife (42 to 49 months) would be similar to Alternative 1 (42 to 48 months).

3.15.2.3.2 OPERATION/LONG-TERM IMPACTS

Alternative 3 would have a longer abutment than Alternative 1, but other upland components would be the same. The impacts of long-term operations and maintenance to wildlife would be similar to Alternative 1.

3.15.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.15.2.4.1 CONSTRUCTION

Upland components of Alternative 4 would be similar to those of Alternative 1; therefore, the wildlife habitat impacts of construction would be similar to both alternatives. The abutment would be longer (160 feet long with two 35-foot wing walls) than Alternative 1 (103 feet long with 69-foot wing wall on north end), creating a longer impediment to wildlife movement between uplands and the marine shoreline. The impact of the duration of noise and visual disturbance to wildlife (54 to 64 months) would be greater than for Alternative 1 (42 to 48 months).

3.15.2.4.2 OPERATION/LONG-TERM IMPACTS

Alternative 4 would have a longer abutment than Alternative 1, but other upland components would be the same. The impacts of long-term operations and maintenance to wildlife would be similar to Alternative 1.

3.15.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.15.2.5.1 CONSTRUCTION

Upland components of Alternative 5 would be the same as those of Alternative 1; therefore, the wildlife habitat impacts of construction of Alternative 5 would be the same for both alternatives. The impact of the duration of noise and visual disturbance to wildlife (42 to 44 months) would be similar to Alternative 1 (42 to 48 months).

3.15.2.5.2 OPERATION/LONG-TERM IMPACTS

Upland components of Alternative 5 would be the same as those of Alternative 1; therefore, the impact of long-term operations and maintenance to wildlife would be the same as Alternative 1.

3.15.2.6 No-Action Alternative

There would be no activities related to construction or operations that would affect wildlife or wildlife habitats in the project area under the No-Action Alternative. Therefore, this alternative would have no impact to wildlife.

3.15.2.7 Mitigation Measures and Regulatory Compliance

Mitigation measures during construction would include using a soft-start approach for both impact and vibratory driving to induce wildlife to leave the immediate pile driving area. Following construction, temporarily cleared areas (i.e., a 5-acre laydown area and a total of 1.9 acres for other upland construction) would be revegetated.

The ESA, the MBTA, and the Bald and Golden Eagle Protection Act protect certain wildlife species. Based on a review of the USFWS Endangered Species Program list of 2012, no federally listed threatened or endangered terrestrial wildlife species have been identified or are likely to occur on NBK at Bangor (USFWS 2012). (Consultation on the marbled murrelet, a marine bird species, is discussed in Section 3.10.) The Navy consulted with USFWS regarding the MBTA and Bald and Golden Eagle Protection Act and will avoid knowingly impacting bald eagles and other migratory birds' nest sites during construction and operation of the EHW-2. Additionally, the terms and conditions of the USFWS Biological Opinion (issued November 2011) provide protection to birds within the project area.

3.15.3 Summary of Impacts

Impacts to wildlife associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.15–3.

Table 3.15–3. Summary of Impacts to Wildlife

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO WILDLIFE
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Permanent loss of 3.4 acres of upland habitat. Disturbance of an additional 6.9 acres of upland habitat, followed by revegetation with native plant species following construction period. Construction of abutment and trestles, locally affecting connectivity of uplands to marine shoreline for wildlife. Impacts due to construction noise, human activity, lighting, increased vehicle movement. *Operation/Long-term Impacts:* Increased noise and visual disturbance due to human activity lighting, and vehicle movements in upland project area and marine shoreline.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Permanent loss of 3.4 acres of upland habitat. Disturbance of an additional 6.9 acres of upland habitat, followed by revegetation with native plant species following construction period. Construction of abutment and trestles, locally affecting connectivity of uplands to marine shoreline for wildlife. Impacts due to construction noise, human activity, lighting, increased vehicle movement. Longer duration of pile driving noise and overall construction than Alternative 1. *Operation/Long-term Impacts:* Increased noise and visual disturbance due to human activity, lighting, and vehicle movements in upland project area and marine shoreline.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Permanent loss of 3.4 acres of upland habitat. Disturbance of an additional 6.9 acres of upland habitat, followed by revegetation with native plant species following construction period. Construction of abutment and trestles, locally affecting connectivity of uplands to marine shoreline for wildlife. Impacts due to construction noise, human activity, lighting, increased vehicle movement. Longer abutment would be a larger impediment to wildlife movement between upland and shoreline than Alternative 1. *Operation/Long-term Impacts:* Increased noise and visual disturbance due to human activity, lighting, and vehicle movements in upland project area and marine shoreline.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Permanent loss of 3.4 acres of upland habitat. Disturbance of an additional 6.9 acres of upland habitat, followed by revegetation with native plant species following construction period. Construction of abutment and trestles, locally affecting connectivity of uplands to marine shoreline for wildlife. Impacts due to construction noise, human activity, lighting, increased vehicle movement. Longer abutment would be a larger impediment to wildlife movement between upland and shoreline, plus longer duration of pile driving noise and overall construction than Alternative 1. *Operation/Long-term Impacts:* Increased noise and visual disturbance due to human activity, lighting, and vehicle movements in upland project area and marine shoreline.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Permanent loss of 3.4 acres of upland habitat. Disturbance of an additional 6.9 acres of upland habitat, followed by revegetation with native plant species following construction period. Construction of abutment and trestles, locally affecting connectivity of uplands to marine shoreline for wildlife. Impacts due to construction noise, human activity, lighting, increased vehicle movement. Shorter duration of pile driving noise and overall construction than Alternative 1. *Operation/Long-term Impacts:* Increased noise and visual disturbance due to human activity, lighting, and vehicle movements in upland project area and marine shoreline.

Table 3.15–3. Summary of Impacts to Wildlife (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO WILDLIFE
No-Action Alternative	No impact.
Mitigation Under all alternatives, the following mitigation measures would be implemented: • Temporarily cleared areas (5-acre laydown area and 1.9 acres for construction of various facilities) would be revegetated with native forest species. • A soft-start approach for pile driving would be used for both impact and vibratory driving to induce wildlife to leave the immediate pile driving area.	
Consultation and Permit Status • Since no ESA-listed terrestrial wildlife species were identified or likely, no consultation is required under the ESA. • The Navy consulted with USFWS regarding the MBTA and Bald and Golden Eagle Protection Act.	

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SOCIAL ENVIRONMENT

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SOCIAL ENVIRONMENT

This section describes environmental conditions affecting, or affected by, humans. Noise levels at the EHW-2 project site are typical of an industrialized land use with higher noise levels, but there are few sensitive noise receptors in the vicinity and there are large buffers between noise sources and sensitive receptors. Air quality is rated as good (i.e., the highest rating) and has never exceeded state or federal air quality standards. There are no major point sources of air pollutant emissions on NBK at Bangor. No National Register of Historic Places (NRHP) listed historic/cultural resources are located near the EHW-2 project site or the EHW upland project area. Of over 90 potential resources on NBK at Bangor, only five would be considered eligible for the NRHP: the existing EHW, the Delta Pier (also known as the Refit Pier) and a portion of a World War II railroad (Shelton-Bangor Railroad); the remaining NRHP-eligible resources include an archaeological site and a Cold War building that are located away from the EHW-2 project site and EHW upland project area. There would be no adverse effect on any of the NRHP-eligible properties. The proposed action would not affect access to or use of tribal traditional resource areas. A net loss of tribal resources is not anticipated, but pile driving noise during construction may cause the salmon and steelhead to move to a different location within Hood Canal. This could increase the time allocated to observe the tribes' fishing rights. Tribal divers engaged in resource harvest within this area could experience increased underwater noise levels. The proposed action is compatible with existing land uses, and land use goals and policies including the CZMA and SMA Programs. There is an adequate supply of electricity, and excess capacity in other utilities such as sewer and water, to serve the proposed action, including the four relocated buildings. In addition, the transportation network operates at a reasonable level of service (LOS) and is above established standards (road operations are better than LOS D, which is the minimum standard for road operations). The four relocated buildings and replacement parking would not change these conditions.

Construction of the EHW-2 would impact the social environment through noise, emissions to air, increased traffic, and reductions in visual quality. Construction would benefit the local economy by providing employment and income. There would be no disproportionate adverse effects on low-income or minority (including American Indian) populations, or on children. Operations would increase the demand for energy and utility services. However, capacity exists in the utility and energy systems to meet the EHW-2 requirements, which would have little impact to these systems. Construction would not result in impacts to human health and safety and there would be no increase in danger or change from current safe operations.

3.16 NOISE

Noise is defined as unwanted sound or, more specifically, as any sound that (1) is undesirable because it interferes with communication, (2) is intense enough to damage hearing, or (3) is otherwise annoying. Human response to sound varies according to the type and characteristics of the noise source, distance between the noise source and the receptor, sensitivity of the receptor, and time of day. When discussing noise and humans, noise levels are expressed in terms of dBA, which is a measure adjusted for the sensitivities of human hearing, as discussed below. This section addresses airborne noise, as opposed to underwater noise (Section 3.4).

Navy regulations regarding noise are found in the 2001 Navy Occupational Safety and Health Program Manual (OPNAVINST 5100-23G), which is directed at preventing occupational hearing loss and assuring auditory fitness for all Navy personnel. The Navy's Occupational

Exposure Level over an 8-hour time-weighted average in any 24-hour period is 84 dB (4 dB doubling rate) in the A-weighted scale (dBA) (see Section 3.16.1.1, Sound Environment, for a description of the A-weighting scale). When noise exposures are likely to exceed 84 dBA, hearing-protective devices are required. The Navy Permissible Exposure Limit for impacts or impulse noise is 140 dB peak sound pressure level. Workers will be protected per requirements specified in the U.S. Army Corps of Engineers EM385-1-1 Safety and Health Requirements Manual. EO 12196, Occupational Safety and Health Programs for Federal Employees, directs federal agencies to furnish places and conditions of employment free from recognized hazards causing, or likely to cause, death or serious physical harm, and to ensure prompt abatement of unsafe or unhealthy working conditions.

At the state level, WAC Chapter 173-60 establishes maximum allowable noise levels. Based on land-use characteristics, areas are categorized as Class A, B, or C zones (environmental designations) for the purpose of noise abatement (Table 3.16–1). This regulation applies to noise created on the base that may propagate into adjacent non-Navy properties. Industrial areas, such as the Bangor waterfront, are considered a Class C zone, commercial and recreational areas are considered a Class B zone, and residential areas are considered a Class A zone.

Table 3.16–1. Washington Maximum Permissible Environmental Noise Levels (dBA)

Noise Source	Receiving Property		
	A – Residential (Day/Night)	B – Commercial	C – Industrial
A – Residential	55/45	57	60
B – Commercial	57/47	60	65
C – Industrial	60/50	65	70

Source: WAC 197-60-040.

Title 10, section 10.28.040 of the Kitsap County Code limits the maximum permissible environmental noise levels for residential zones. The hours and maximum permissible noise levels are the same as those in WAC Chapter 173-60. Sounds originating from temporary construction sites as a result of construction activity are exempt from these provisions between the hours of 7:00 AM and 10:00 PM.

Washington noise regulations (WAC 173-60-040) limit the noise levels from a Class C noise source that affect a Class A receiving property to 60 dBA (daytime) and 50 dBA (nighttime) (nighttime hours are considered 10:00 PM to 7:00 AM). However, the state noise rules allow these levels to be exceeded for up to 15 dBA for certain brief periods without violating the limits. In addition, certain activities are exempt from these noise limitations:

- Sounds created by motor vehicles on public roads are exempt at all times, except for individual vehicle noise, which must meet noise performance standards set by WAC 173-60-050.
- Sounds created by motor vehicles off public roads, except when such sounds are received in residential areas.
- Sounds originating from temporary construction activities during all hours when received by industrial or commercial zones and during daytime hours when received in residential zones.
- Sounds caused by natural phenomena and unamplified human voices.

The WAC does not specify the time duration for temporary construction activities.

Consultation and Permit Compliance Status. No consultations or permits are required.

3.16.1 Existing Environment

Noise levels on NBK at Bangor vary based on location but are estimated to average around 65 dBA (A-weighted decibels) in the residential and office park areas, with traffic noise ranging from 60 to 80 dBA during normal working hours (Cavanaugh and Tocci 1998). These noise levels are estimated from the literature. Residential and office park areas are located more than one mile from the main project site, and are acoustically screened from the project site by hills and vegetation. Olympic View, an off-base residential area, is located approximately 0.1 mile from the proposed site of the three new buildings; there is intervening vegetation. The highest levels of noise are produced along the waterfront and at the ordnance handling areas. Airborne noise measurements were taken from October 19–20, 2010, within the waterfront industrial area near the project site. During this period, daytime noise levels ranged from 60 dBA to 104 dBA, with average values of approximately 64 dBA. Evening and nighttime levels ranged from 64 to 96 dBA, with an average level of approximately 64 dBA. Thus, daytime maximum levels were higher than nighttime maximum levels, but average nighttime and daytime levels were similar (Navy 2010c).

These higher noise levels are produced by a combination of sound sources including heavy trucks, forklifts, cranes, marine vessels, mechanized tools and equipment, and other sound-generating industrial/military activities. This section discusses airborne noise only, and noise measurements are not corrected for distance unless specifically indicated. Underwater noise is discussed in Section 3.4.

3.16.1.1 Sound Environment

Due to wide variations in sound levels, measurements are in dB, which is a unit of measure based on a mathematical scale similar in use to a logarithmic scale (e.g., a 6 dB increase corresponds to a 100 percent increase in perceived sound). Sound levels are typically used to assess impacts to humans and thus are weighted (A-weighting) to correspond to the same frequency range that humans hear (approximately 20 Hz to 20 kHz). To make comparisons between sound levels, dB sound levels are always referenced to a standard intensity at a standard distance from the source. According to the USEPA (1974), under most conditions, a 5 dB change is necessary for noise increases to be noticeable to humans. In many cases, sound levels are not corrected for standard distance and reflect levels as measured at the receiver's location. Airborne noise levels are expressed in decibels relative to 20 micropascals (dB re 20μPa).

Ambient noise levels are made up of natural and manmade sounds. Natural sound sources include the wind, rain, thunder, water movement such as surf, and wildlife. The sound levels from these sources are typically low but can be pronounced during violent weather events. Sounds from natural sources are not considered undesirable.

The majority of the daily ambient sound on NBK at Bangor that is considered noise is generated by human activities. These activities include movement of marine vessels and heavy trucks, operation of equipment (such as cranes, forklifts, and other mechanized equipment), various industrial activities occurring at the shoreline and upland facilities, and general traffic.

Ambient background noise in urbanized areas typically varies from 60 to 70 dBA. Cavanaugh and Tocci (1998) measured typical residential noise at 65 dBA. This noise level

likely represents the minimum daytime average levels that occur in the area of the base industrial facilities on NBK at Bangor.

Traffic on the roads is expected to produce levels between 60 and 80 dBA during daytime hours; speeds on NBK at Bangor are limited to 35 to 40 mph on arterials, and 25 mph on secondary streets.

In general, sound pressure levels decrease as the inverse of the change of distance ratio squared; thus, the loudest areas on the base would be near the shoreline where most of the activity is taking place, such as near the existing EHW. Based on recent measurements of aboveground noise taken at the Bangor waterfront, maximum noise in this area is similar to levels observed for common construction equipment.

Maximum noise levels produced by common construction equipment, including trucks, cranes, compressors, generators, pumps, and other equipment that might typically be employed along the Bangor industrial waterfront, are 90 dBA (WSDOT 2010a). Presuming multiple sources of noise may be present at one time, maximum combined levels may be as high as 94 dBA. This assumes that multiple co-located sources combined together increase noise levels as much as 3 to 4 dB over the level of a single piece of equipment by itself. These maximum noise levels are intermittent in nature, and not present at all times. Maximum noise levels at the waterfront during a typical workweek are expected to be approximately 80 to 104 dBA re 20 µPa due to typical truck, forklift, crane, and other industrial activities. Average noise levels are expected to be in the 60 to 68 dBA range, consistent with urbanized or industrial environments where equipment is operating.

A sensitive noise receptor is defined as a location or facility where people involved in indoor or outdoor activities may be subject to stress or considerable interference from noise. Such locations or facilities often include residential dwellings, hospitals, nursing homes, educational facilities, and libraries.

The nearest sensitive noise receptors include schools and residences. Vinland Elementary School is located approximately 3 miles north of the project site, and Breidablik Elementary School is located approximately 4 miles north northeast of the project site. Other sensitive noise receptors include residences in Vinland located just north of the NBK at Bangor northern property boundary, approximately 1.5 miles from the EHW-2 project site, and residences on the west side of Hood Canal, notably in the vicinity of Thorndyke Bay, approximately 4 miles north of the EHW-2 site (Figure 3.21–1). Typical noise levels measured in a small-town residential neighborhood ranged from 43 to 64 dBA, with levels of 52 dBA occurring more than 50 percent of the time (Cavanaugh and Tocci 1998). Vinland and Thorndyke Bay and surrounding areas are predicted to have similar noise characteristics. Sensitive receptors also include recreational users on the eastern side of Toandos Peninsula, as well as boaters or kayakers located on Hood Canal within audible range of the construction site.

3.16.2 Environmental Consequences

The evaluation of impacts due to noise considers noise generated by pile driving, both impact hammer and vibratory methods, as well as noise from vessel and boat traffic and construction equipment. Standard noise transmission models are used to estimate dissipation of noise over distance from the noise source. This section addresses noise impacts to humans such as workers, residents, students, and those engaged in recreation. Noise impacts to recreation are further discussed in Section 3.21; impacts to public safety are addressed in Section 3.26.

Construction activities would generate noise with the greatest levels produced during the pile driving operation. Airborne noise levels from impact pile driving are estimated at 105 dBA re 20µPa at a distance of 50 feet from the pile, and 95 dBA re 20µPa at 50 feet when using a vibratory driver. When pile driving is not occurring, maximum construction noise is predicted to be 94 dBA re 20µPa at a distance of 50 feet. Operations would result in increased localized noise at the EHW-2 project site. However, overall noise at the Bangor waterfront is anticipated to remain similar to existing conditions, because a portion of the operations and boat traffic currently occurring at the existing EHW and other waterfront facilities would be diverted to the EHW-2.

3.16.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.16.2.1.1 CONSTRUCTION

Construction of Alternative 1 would result in increased airborne noise in the vicinity of the construction site. Maximum peak levels would be created during impact pile driving using a single acting diesel impact hammer, estimated to be 105 dBA re 20µPa at a distance of 50 feet from the pile; vibratory driving would create noise levels of 95 dBA re 20µPa at 50 feet. Other construction activities or equipment, such as cranes, heavy trucks, excavators, and jackhammers used for land clearing, delivery of materials, and debris removal, would also cause noise; however, this noise level would be much lower compared to noise produced by the impact hammer (Table 3.16–2). In the absence of pile driving noise, maximum construction noise would be 94 dBA re 20µPa at a distance of 50 feet from the activity, computed as the summation of noise of all equipment operating simultaneously (WSDOT 2010a).

Table 3.16–2. Maximum Noise Levels at 50 feet for Common Construction Equipment

EQUIPMENT TYPE	MAXIMUM NOISE LEVEL
Scraper	90
Backhoe	90
Jackhammer	89
Crane	81
Pumps	81
Generator	81
Front loader	79
Air Compressor	78

Source: WSDOT 2010a.
Maximum Sound Pressure Levels in dBA re 20µPa (A-weighted).

Sensitive receptors, along Hood Canal adjacent to the project site, would be affected by construction noise. Airborne noise due to impact pile driving would be the most noticeable to such sensitive receptors. Noise impacts due to other construction activities would be minimal, and would not exceed normal WAC limits for human receptors located in nearby residential areas. The one exception is the residential area near the proposed site of the three new buildings, but temporary construction noise is exempt from WAC noise limits (Section 3.16.2.1.1.5). Pile driving noise would not be observable above ambient noise levels in the residential areas of NBK at Bangor nor at local schools and residential neighborhoods. Construction would typically occur 6 days per week during daylight hours. Impact pile driving during the first part of the in-water

work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). Upland construction would occur between 7:00 AM and 10:00 PM. There would be between 211 and 411 pile driving days, including the abutment piles, under this alternative.

Airborne noise is commonly reported using A-weighted levels (dBA), which indicates the type of filtering used in the measurement. The purpose for using A-weighting is to assess impacts to human receptors, and thus is filtered or "shaped" to correspond to how humans hear. Construction noise behaves as a point-source, and thus propagates in a spherical manner, with a 6 dB decrease in sound pressure level per doubling of distance (WSDOT 2010a). Two specific noise conditions exist at EHW, namely propagation over water to the west side of Hood Canal, and over heavily vegetated terrain on the east side of Hood Canal. In the first condition, WSDOT (2010a) considers propagation over water as a "hard-site" condition; thus, no additional noise reduction factors apply. However, in the second condition two noise reduction factors apply for the topography of the EHW-2 project site. The first of these is a 7.5 dB loss factor per doubling of distance in "soft-site" conditions, wherein normal, unpacked earth is the predominant soil condition. The second factor is a reduction of 10 dB for interposing dense vegetation, e.g., trees and brush, between the noise source and potential receptors.

Table 3.16–3 tabulates expected A-weighted received noise levels from the maximum daily pile strike scenario (6,400 strikes) for three conditions:

- Noise over soft-site terrain conditions, using a 7.5 dB loss factor per doubling of distance;
- Noise over soft-site terrain conditions, using a 7.5 dB loss factor as described above, with a 10 dB reduction in maximum noise level due to the presence of dense vegetation; and
- Noise over water, using a 6 dB loss factor per doubling of distance.

Figure 3.16–1 shows the same information in a graphical format.

Not all receptors have the same hearing sensitivity as humans, and thus A-weighted analysis is inappropriate for certain species. An unweighted airborne noise analysis is therefore presented to address such species. Table 3.16–4 and Figure 3.16–2 show results of the unweighted airborne noise analysis for impact pile driving.

Table 3.16–3. Attenuation Levels vs. Distance for Impact Pile Driving Peak Airborne Noise, A-weighted

Distance (feet) From Driven Pile	Over Water [1]	Soft Site, No Vegetation [2]	Soft Site, With Vegetation [3]
50	105	105	95
66	103	102	92
134	96	94	84
166	95	92	82
223	92	89	79
561	84	79	69
1,256	77	70	60
1,500	75	68	58
1,991	73	65	55
2,200	72	64	54
8,900	69	49	39
21,500	52	39	29

Maximum Sound Pressure Levels in dBA re 20µPa (A-weighted).

1. 6 dB loss per doubling of distance due to hard-site conditions.
2. 7.5 dB loss per doubling of distance due to soft-site conditions.
3. 7.5 dB loss per doubling of distance due to soft-site conditions, plus 10 dB fixed loss due to the presence of vegetation.

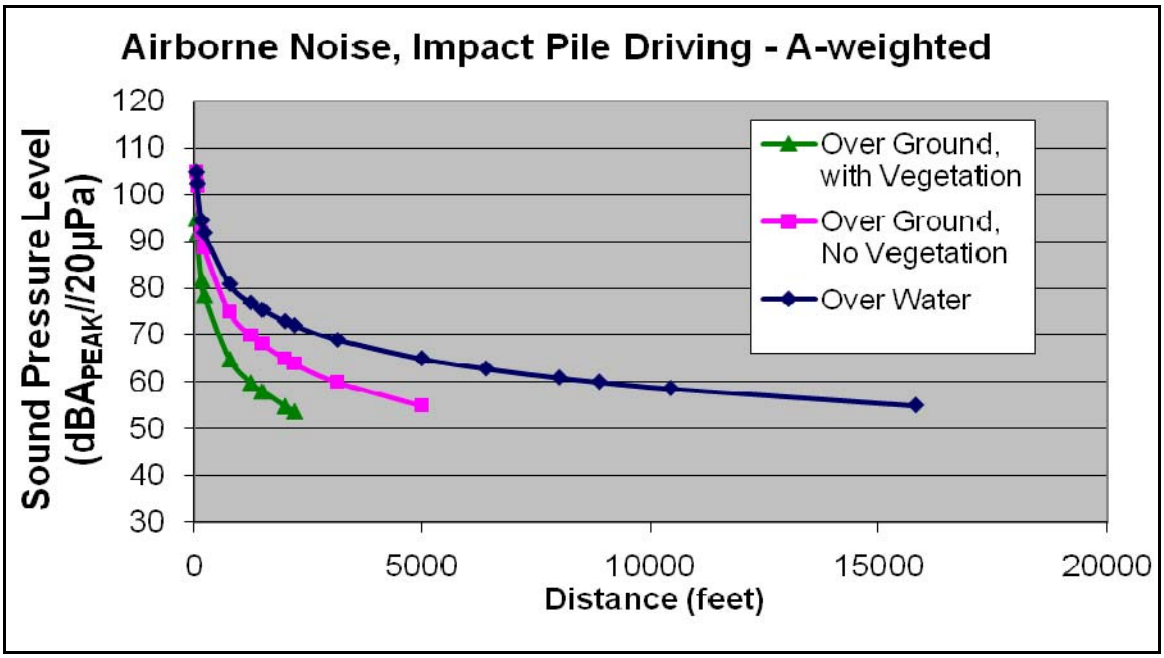

Figure 3.16–1. Airborne Noise Assessment for Impact Pile Driving Showing Expected Noise Levels Over Terrain and Water, A-weighted Sound Pressure Levels

Table 3.16–4. Attenuation Levels vs. Distance for Pile Driving Peak Impact Airborne Noise, Unweighted

Distance (feet) From Driven Pile	Over Water [1]	Soft Site, No Vegetation [2]	Soft Site, With Vegetation [3]
28	122	124	114
32	121	122	112
50	117	117	107
99	111	110	100
249	103	100	90
372	100	96	86
625	95	90	80
1,175	90	83	73

Maximum Sound Pressure Levels in dB re 20µPa (unweighted).

1. 6 dB loss per doubling of distance due to hard-site conditions.
2. 7.5 dB loss per doubling of distance due to soft-site conditions.
3. 7.5 dB loss per doubling of distance due to soft-site conditions, plus 10 dB fixed loss due to the presence of vegetation.

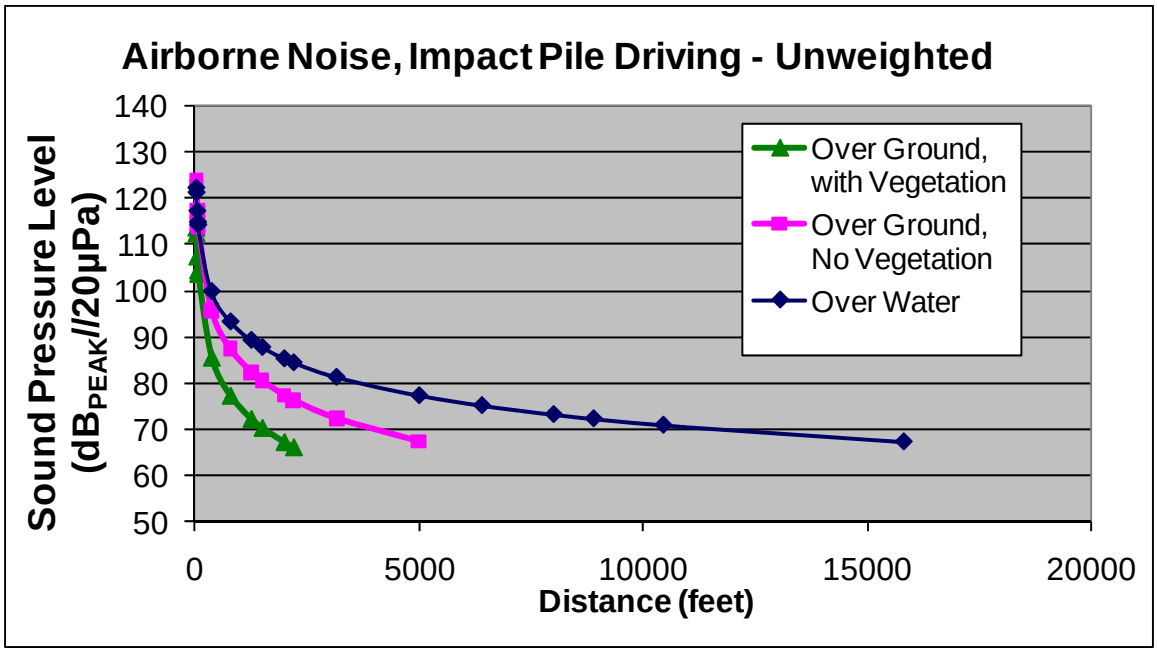

Figure 3.16–2. Airborne Noise Assessment for Impact Pile Driving Showing Expected Noise Levels Over Terrain and Water, Unweighted Sound Pressure Levels

3.16.2.1.1.1 CONSTRUCTION – VIBRATORY PILE DRIVING

A vibratory pile driver would be the preferred method to drive pilings. An impact hammer would be used if a vibratory pile driver was unable to install pilings to the required depth. No more than one impact pile driver would operate at one time. Up to three vibratory pile-driving rigs could be used simultaneously, which would create more airborne noise than a single vibratory driver. Estimated noise conditions are presented for both single-rig and multiple-rig construction. Multiple-rig construction estimates are presented for concurrent operation of three vibratory drivers, and one impact hammer with three vibratory pile drivers.

Several measures would be used to minimize the noise generated by pile driving. A soft-start approach, in which hammer energy levels are increased from low to high, would be used for both pile driving methods to allow time for birds and mammals to move away from the pile driving site before the highest noise levels are produced. Soft starts for vibratory drivers require initial starts of 15 seconds at reduced energy followed by a 1-minute waiting period. This measure shall be repeated two additional times. Soft starts for impact hammers shall be one dry fire followed by a 1-minute waiting period. This procedure shall be repeated two additional times.

3.16.2.1.1.2 CONSTRUCTION – PILE DRIVING, MULTIPLE-RIG OPERATION

Noise from multiple simultaneous sources produces an increase in the overall noise field. A doubling in sound power results in an increase of 3 dB in the environment, which is the result of two sources incoherently adding acoustic pressures in the combined noise environment. The resultant sound pressure level (SPL) from *n*-number of multiple sources is computed with the following relationship using principles of decibel addition:

$$CombinedSPL = 10 \cdot \log_{10}\left(10^{\frac{SPL1}{10}} + 10^{\frac{SPL2}{10}} + \ldots + 10^{\frac{SPLn}{10}}\right)$$

For each multiple-source analysis, a two dimensional grid of closely spaced points was created, and noise levels were computed from individual sources at each grid point, then incoherently summed together to estimate the combined noise field. A-weighted and unweighted values were computed for each multiple-rig scenario analyzed. RMS calculations were made for both equivalent continuous sound and impulsive sound. An equivalent continuous sound pressure level was computed for the impact driver by spreading the impulsive RMS energy over the same time duration as a vibratory driver. Since the impulsive noise only exists for a short duration, a time-weighting factor was calculated to determine the effective continuous sound level to apply to the impulsive source level. With an assumed impact rate of one pile strike per second and an impulsive duration of 125 msec (one eighth of a second) equivalent to a single integration period of an airborne noise meter in the "F" (Fast) mode, the time-weighting factor was computed as 10Log_{10}[125msec/1sec], or -9 dB. This result was summed with continuous RMS noise levels from the vibratory drivers to establish the combined equivalent continuous noise level for both A-weighted and unweighted airborne noise sources. For the impulsive RMS metric of concurrently operating pile drivers, vibratory RMS levels were added directly to the impulsive RMS sound levels of the impact driver. The maximum impulsive noise was computed as the sum of continuous vibratory energy and the impulsive RMS energy over the duration of the impact strike. Since this is only computed over the duration of each pile strike, the impulsive RMS sound pressure level for multiple rigs operating would always be higher than continuous equivalent RMS sound pressure levels.

For this analysis, it was assumed that all rigs were operating simultaneously, and the noise was incoherently summed to produce the expected noise field. Highest levels would be produced immediately adjacent to each pile being driven, and would taper off as the receiver moved away from the work area. Within close proximity of the EHW-2 construction area, the resultant noise field is complex and non-circular due to the geometry of the pile driver rigs. As the receiver moved away from the construction area, the resultant noise field would become somewhat circular. Two multiple-rig scenarios were analyzed: (1) three vibratory rigs operating concurrently and (2) three vibratory rigs and one impact rig operating concurrently. Highest levels would be produced immediately adjacent to each pile being driven and would taper off as the receiver moved away from the work area.

3.16.2.1.1.3 CONSTRUCTION – THREE VIBRATORY PILE DRIVING RIGS

Airborne noise levels during multiple-rig impact and vibratory pile driving would produce noise levels higher than those observed with a single rig operating. Three vibratory rigs would each produce noise levels of approximately 95 dBA re 20µPa at 50 feet and unweighted noise levels of 97 dBRMS re 20 µPa at 40 feet (WSDOT 2010d). Within 50 feet of each pile being driven, the noise from other piles being driven hundreds of feet away would not noticeably contribute to the noise in the vicinity of the initial pile. Thus, within 50 feet from a pile, maximum noise levels for a multiple-rig operating scenario would be approximately the same as that for a single rig operating. Farther away from each pile, the noise contributions from adjacent pile drivers would become more significant, resulting in a more complex attenuation environment, and higher observed noise levels than with a single rig operating. With three vibratory rigs operating, sound pressure levels of 92 dBA RMS would occur at a distance of 69 feet from any of the three driven piles over water. Unweighted levels of 100 dBRMS would occur at a distance of 28 feet or less from each driven pile, and a level of 90 dBRMS would occur within 91 feet of each rig. Table 3.16–5 summarizes estimated distances to specific functional hearing group thresholds from the EHW-2 project site during three-rig vibratory driving.

Table 3.16–5. Estimated Distances to Airborne Noise Thresholds, Three Vibratory Drivers, Continuous RMS Noise

FUNCTIONAL HEARING GROUP	AIRBORNE THRESHOLD	DISTANCE TO THRESHOLD (FEET)[1]
Marbled murrelets		
Injury	92 dBA	69
Pinnipeds (seals, sea lions, walrus)		
Behavior, harbor seals	90 dBRMS, unweighted	91
Behavior, other species	100 dBRMS, unweighted	28
Humans		
Injury	84 dBA[2] (NAVOSH)	308
Behavior, daytime	60 dBA (WAC)	4,869

NAVOSH = Navy Occupational Safety and Health

1. Distance thresholds show worst-case condition, over water.
2. Time weighted average > 8 hours exposure.

3.16.2.1.1.4 CONSTRUCTION – ONE IMPACT AND THREE VIBRATORY PILE DRIVING RIGS

With one impact rig and three vibratory rigs operating, sound pressure levels exceeding 92 dBARMS would occur at a distance of approximately 256 feet from the impact pile being driven, 69 feet from any of the vibratory driven piles. Unweighted levels of 100 dBRMS would occur at a distance of 374 feet or less from the impact driven pile, and within 39 feet of each vibratory driven pile. Unweighted levels exceeding 90 dBRMS would occur within 1,184 feet of the impact driven pile, and levels greater than 100 dBRMS would occur within 374 feet of the impact pile. Table 3.16–6 summarizes estimated distances to specific functional hearing group thresholds from the EHW-2 project site during concurrent impact and three-rig vibratory driving.

Table 3.16–6. Estimated Distances to Airborne Noise Thresholds, One Impact and Three Vibratory Drivers

FUNCTIONAL HEARING GROUP	AIRBORNE THRESHOLD	DISTANCE TO THRESHOLD (FEET)[1]
Marbled murrelets		
Injury	92 dBA	69 (continuous) 256 (impulse)
Pinnipeds (seals, sea lions, walrus)		
Behavior, harbor seals	90 dBRMS, unweighted	417 (continuous) 1,184 (impulse)
Behavior, other species	100 dBRMS, unweighted	131 (continuous) 374 (impulse)
Humans		
Injury	84 dBA[2] (NAVOSH)	240 (continuous) 640 (impulse)
Behavior, daytime	60 dBA (WAC)	5,800 (continuous) 10,138 (impulse)

1. Distance thresholds show worst-case condition, over water.
2. Time weighted average > 8 hours exposure.

Maximum noise levels for Alternative 1 would occur during use of an impact hammer in combination with multiple vibratory rigs. The noise emitted from this equipment could exceed allowable noise limits for the Occupational Safety and Health Administration (90 dBA, 5 dB doubling rate) and Navy Occupational Safety and Health (84 dBA, 4 dB doubling rate) for an 8-hour period, and could potentially cause injury to construction personnel working at the site (Figure 3.16–3). Personal protective equipment would be required for personnel working in these areas. Personal protective equipment must be capable of reducing the noise exposure to less than 84 dBA, 8-hour time weighted average and less than 140 dBPEAK sound pressure level for impact or impulse noise.

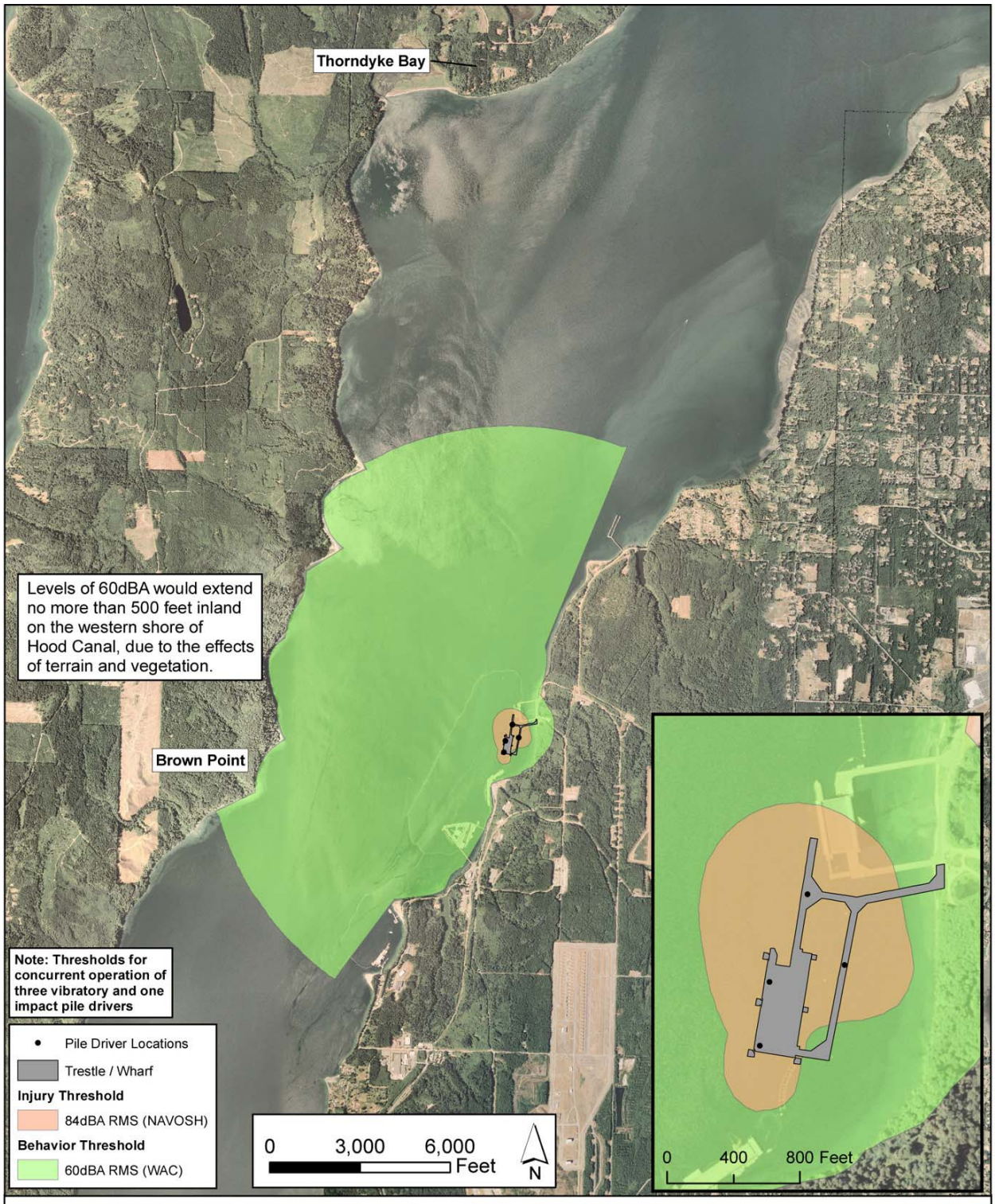

Figure 3.16−3. Representative View of Affected Areas for Human Receptors Due to Airborne Pile Driving Noise

Properties with a direct line-of-site to the impact pile driver would receive noise levels above local background levels. Waterfront residences on the western shore south of Squamish Harbor, including those along Thorndyke Bay greater than 10,138 feet from the EHW-2 site, would receive maximum noise levels less than 60 dBA during concurrent impact and vibratory pile driving and would not exceed maximum daytime noise levels in WAC 173-60-040. Residents at Vinland, just north of the base property line, would be able to audibly hear impact noise during pile driving, but levels received would be below the expected background noise level of a quiet, residential neighborhood of 50 dBA due to trees and interposing vegetation and terrain.

Estimated maximum noise levels at Vinland would be 42 dBA during multiple-rig pile driving; construction noise received at the Vinland Elementary School and Breidablik Elementary School would not exceed these anticipated noise levels. Temporary construction noise during the hours of 7:00 AM to 10:00 PM is exempt from WAC noise requirements; the WAC does not define the allowable duration of temporary construction noise. Impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). Upland construction would occur between 7:00 AM and 10:00 PM. Pile driving (both vibratory and impact) and other construction noise would not exceed WAC allowable noise levels at any time at Thorndyke Bay or Vinland. Affected areas on the eastern shore of the Toandos Peninsula (western shore of Hood Canal), including Thorndyke Bay, are sparsely populated, rural residential areas. Populations in these areas are described further in Section 3.23.2, Socioeconomics.

On-base residential areas would not be affected by pile driving noise due to the intervening distance (4.5 miles), terrain, and vegetation. Impacts to sensitive wildlife receptors are described in Section 3.10.2.1.1.6. Recreational boaters and kayakers in Hood Canal adjacent to the project site could be affected by multiple-rig pile driving noise, although the floating security barrier would prevent recreational users from getting close enough to the pile driver to receive injurious noise levels. Maximum levels of 75 dBA would occur at the floating security barrier at a distance of 1,640 feet from the EHW-2 construction site.

3.16.2.1.1.5 CONSTRUCTION —RELOCATED FACILITIES

Construction of new facilities would temporarily increase airborne noise in the vicinity of the construction sites. Maximum construction noise would be 94 dBA re 20μPa at a distance of 50 feet from the activity, computed as the summation of noise of all equipment operating simultaneously (WSDOT 2010a). Based on the typical noise attenuation rate of approximately 7.5 dBA per doubling of distance (WSDOT 2010a), construction noise would be less than 60 dBA at approximately 1,600 feet (approximately 0.3 mile) from the construction site. Noise impacts due to construction activities could exceed WAC limitations at the nearest sensitive receptor: private residences in Olympic View approximately 0.1 mile southwest of the sites for the three new buildings and replacement parking spaces. However, sounds from temporary construction activities are exempt from these noise limitations. Based on the distance from the EHW-2 project site (over 2 miles) and intervening terrain and vegetation, this residential area would not be affected by pile driving noise. Therefore, construction noise impacts would not be significant.

3.16.2.1.2 OPERATION/LONG-TERM IMPACTS

Operations would result in increased localized noise at the EHW-2 project site. However, overall noise at the Bangor waterfront is anticipated to remain similar to existing conditions, since vessel traffic would remain the same. Once construction of the EHW-2 is completed, noise occurring at the existing EHW and other waterfront facilities would occur at the existing EHW facility and the EHW-2. Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components (not piles) as required. These activities would not generate noise appreciably different from normal operational noise along the Bangor industrial waterfront.

Noise from operation of the three new buildings and pure water facility would be the same as noise produced by the existing facilities. This noise would be audible at times in the nearest residential community to the three new buildings, but would not be louder than noise from existing Navy facilities at the same site. Therefore, no adverse impacts from operational noise are expected.

3.16.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.16.2.2.1 CONSTRUCTION

Potential sound levels produced during construction would be identical to Alternative 1. The only difference would be 54 to 64 months of construction (including 286 to 561 days of pile driving noise) for Alternative 2, compared to 42 to 48 months of construction noise (including 211 to 411 pile driving days) for Alternative 1 This would slightly increase the effects of construction as compared to Alternative 1.

3.16.2.2.2 OPERATION/LONG-TERM IMPACTS

Operations would result in increased localized noise at the EHW-2 project site. However, overall noise at the Bangor waterfront is anticipated to remain similar to existing conditions, since operational conditions would remain the same. Once construction of the EHW-2 is completed, noise occurring at the existing EHW and other waterfront facilities would occur at the existing EHW facility and the EHW-2. Like Alternative 1, maintenance of the EHW-2 under Alternative 2 would not affect noise conditions along the Bangor industrial waterfront.

3.16.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.16.2.3.1 CONSTRUCTION

Potential sound levels produced during construction would be identical to Alternative 1. The only difference would be 42 to 49 months of construction (including 226 to 436 days of pile driving noise) for Alternative 3. This would slightly increase the effects of construction as compared to Alternative 1.

3.16.2.3.2 OPERATION/LONG-TERM IMPACTS

Operations would result in increased localized noise at the EHW-2 project site. However, overall noise at the Bangor waterfront is anticipated to remain similar to existing conditions, since vessel traffic would remain the same. Once construction of the EHW-2 is completed, noise occurring at the existing EHW and other waterfront facilities would occur at the existing EHW

facility and the EHW-2. Like Alternative 1, maintenance of the EHW-2 under Alternative 3 would not affect noise conditions along the Bangor industrial waterfront.

3.16.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.16.2.4.1 CONSTRUCTION

Potential sound levels produced during construction would be identical to Alternative 1. The only difference would be 54 to 64 months of construction (including 306 to 586 days of pile driving noise) for Alternative 4. This would increase the effects of construction as compared to Alternative 1.

3.16.2.4.2 OPERATION/LONG-TERM IMPACTS

Operations would result in increased localized noise at the EHW-2 project site. However, overall noise at the Bangor waterfront is anticipated to remain similar to existing conditions, since vessel traffic would remain the same. Once construction of the EHW-2 is completed, noise occurring at the existing EHW and other waterfront facilities would occur at the existing EHW facility and the EHW-2. Like Alternative 1, maintenance of the EHW-2 under Alternative 4 would not affect noise conditions along the Bangor industrial waterfront.

3.16.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.16.2.5.1 CONSTRUCTION

Potential sound levels produced during construction would be identical to Alternative 1. The only difference would be 42 to 44 months of construction (including 146 to 186 days of pile driving noise) for Alternative 5. This would decrease the effects of construction as compared to Alternative 1.

3.16.2.5.2 OPERATION/LONG-TERM IMPACTS

Operations would result in increased localized noise at the EHW-2 project site. However, overall noise at the Bangor waterfront is anticipated to remain similar to existing conditions, since vessel traffic would remain the same. Once construction of the EHW-2 is completed, noise occurring at the existing EHW and other waterfront facilities would occur at the existing EHW facility and the EHW-2. Like Alternative 1, maintenance of the EHW-2 under Alternative 5 would not affect noise conditions along the Bangor industrial waterfront.

3.16.2.6 No-Action Alternative

Noise levels would not change from existing conditions, because there would be no construction or operational changes from the No-Action Alternative. There would be no changes in the frequency, intensity, or duration of noise and no effects on sensitive receptors.

3.16.2.7 Mitigation Measures and Regulatory Compliance

The Navy will notify the public about upcoming construction activities and noise at the beginning of each construction season. Construction would typically occur 6 days per week. Impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction

activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). Upland construction would occur between 7:00 AM and 10:00 PM in accordance with the Washington Administrative Code noise guidelines.

3.16.3 Summary of Impacts

Impacts to airborne noise associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.16–7.

Table 3.16–7. Summary of Impacts Due to Airborne Noise

ALTERNATIVE	ENVIRONMENTAL IMPACTS DUE TO AIRBORNE NOISE
Impact: Airborne noise levels from pile driving would exceed allowable noise limits for the Occupational Safety and Health Administration. Recreational boaters and kayakers in Hood Canal adjacent to the project site could be affected by impact pile driving noise. Airborne noise would not exceed daytime maximum residential levels imposed by WAC (60 dBA) at Breidablik Elementary School, Thorndyke Bay, Vinland. The WAC limits would be exceeded at the residential area near the construction site of the three new buildings, but temporary construction noise is exempt from WAC noise limits.	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Pile driving (211–411 days) would increase noise levels in residential and recreational areas over a line-of-sight distance of approximately 4 miles. *Operation/Long-term Impacts:* None.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Increased noise levels in residential and recreational areas from pile driving; longer duration for pile driving (286–561 vs. 211–411 days) and construction overall (54 to 64 vs. 42 to 48 months) than under Alternative 1. *Operation/Long-term Impacts:* None.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Increased noise levels in residential and recreational areas from pile driving; slightly longer duration for pile driving (226–436 vs. 211–411 days) than under Alternative 1. *Operation/Long-term Impacts:* None.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Increased noise levels in residential and recreational areas from pile driving; longer duration for pile driving (306–586 vs. 211–411 days) and construction overall (54 to 64 vs. 42 to 48 months) than under Alternative 1. *Operation/Long-term Impacts:* None.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Increased noise levels in residential and recreational areas from pile driving; shorter duration for pile driving (146–186 vs. 211–411 days) than under Alternative 1. *Operation/Long-term Impacts:* None.
No-Action Alternative	No impact.

Table 3.16–7. Summary of Impacts Due to Airborne Noise (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS DUE TO AIRBORNE NOISE
Mitigation and Consultation • Impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). Upland construction would occur between 7:00 AM 10:00 PM. The Navy will notify the public about upcoming construction activities and noise at the beginning of each construction season.	
Consultation and Permit Status: No consultations or permits are required.	

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3.17 AIR QUALITY

Air quality in a given location is defined by the concentration of various pollutants in the atmosphere, generally expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). The air quality of the area is measured in comparison to national and/or state ambient air quality standards. The USEPA has established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), respirable particulate matter (PM) less than or equal to 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), sulfur dioxide (SO_2), and lead. In addition to the NAAQS, greenhouse gases are reportable in certain scenarios to the USEPA when stationary source emissions from a facility exceed 25,000 metric tons carbon dioxide equivalent (CO_2e). The NAAQS represent the maximum allowable atmospheric concentrations that may occur and still protect public health and welfare with a reasonable margin of safety. The standards identify the maximum acceptable ground-level concentrations that may not be exceeded more than once per year, and mean annual concentrations that may never be exceeded. WDOE has also established state standards with concentrations that are at least as restrictive as the NAAQS. The national and Washington State ambient air quality standards are shown in Table 3.17–1. Emissions from sources associated with the proposed action would not be allowed to contribute to a violation of an ambient air quality standard.

The Clean Air Act (CAA) (Title 42, Chapter 85 of the United States Code) and its subsequent amendments form the basis for the national air pollution control effort. The USEPA is responsible for implementing most aspects of the CAA. The USEPA delegates the enforcement of the federal standards to most states. In Washington, WDOE administers the State CAA and its implementing regulations (RCW Chapter 70.94 and WAC 173-400). WDOE has, in turn, delegated to local air agencies the responsibility of regulating stationary emission sources. In Kitsap County, the Puget Sound Clean Air Agency (PSCAA) has this responsibility. In areas that exceed the NAAQS, the CAA requires preparation of a State Implementation Plan, detailing how the state will attain the standards within mandated time frames. Both the federal and state CAA identify emission reduction goals and compliance dates based upon the severity of the ambient air quality standard violation within a region. PSCAA has developed rules to regulate stationary sources of air pollution in Kitsap County (PSCAA 2009a).

Section 162 of the CAA established the goal of prevention of significant deterioration (PSD) of air quality in all international parks; national parks that exceeded 6,000 acres; and national wilderness areas that exceeded 5,000 acres if these areas were in existence on August 7, 1977. These areas were defined as mandatory Class I areas, while all other attainment or unclassifiable areas were defined as Class II areas. Under CAA Section 164, states or tribal nations, in addition to the federal government, have authority to redesignate certain areas as (non-mandatory) PSD Class I areas. Class I areas are areas where any appreciable deterioration of air quality is considered significant. Class II areas are those where moderate, well-controlled growth could be permitted. The PSD requirements affect construction of new major stationary sources in the Class I, II, and III areas and are a pre-construction permitting system.

Table 3.17–1. National and Washington State Ambient Air Quality Standards

Air Pollutant	Averaging Time	Washington/PSCAA AAQS[a,b]	NAAQS[a,b]	
			Primary[c]	Secondary[d]
Carbon Monoxide	8-Hour 1-Hour	9 ppm 35 ppm	9 ppm 35 ppm	-- --
Nitrogen Dioxide	Annual 1-Hour	0.053 ppm	0.053 ppm 0.1 ppm	0.053 ppm --
Sulfur Dioxide	Annual 24-Hour 3-Hour 1-Hour[e] 1-Hour[f]	0.02 ppm 0.10 ppm -- 0.25 ppm 0.40 ppm	0.03 ppm 0.14 ppm -- 0.75 ppm --	-- -- 0.5 ppm -- --
Total Suspended Particulates	Annual 24-Hour	60 µg/m^3 150 µg/m^3	-- --	-- --
Particulate Matter (PM_{10})[g]	Annual 24-Hour	50 µg/m^3 150 µg/m^3	-- 150 µg/m^3	-- 150 µg/m^3
Particulate Matter ($PM_{2.5}$)[h]	Annual 24-Hour	15 µg/m^3 35 µg/m^3	15 µg/m^3 35 µg/m^3	15 µg/m^3 35 µg/m^3
Ozone[i]	8-Hour	0.075 ppm	-- 0.075 ppm	-- 0.075 ppm
Lead and Lead Compounds	Calendar Quarter Rolling 3-month[j]	1.5 µg/m^3 0.15 µg/m^3	1.5 µg/m^3 0.15 µg/m^3	1.5 µg/m^3 0.15 µg/m^3

Sources: USEPA 2010a; WAC 173-470; WAC 173-474; WAC 173-475.

AAQS = Ambient air quality standards.

a. The NAAQS and Washington State standards are based on standard temperature and pressure of 25ºC and 760 millimeters of mercury, respectively. Units of measurement are ppm and micrograms per cubic meter (µg/m^3).

b. National and Washington State standards, other than those based on annual or quarterly arithmetic mean, are not to be exceeded more than once per year.

c. National Primary Standards: The levels of air quality necessary to protect the public health with an adequate margin of safety. Each state must attain the primary standards no later than 3 years after the state implementation plan is approved by the USEPA.

d. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a reasonable time after the state implementation plan is approved by the USEPA.

e. Not to be exceeded more than twice in seven consecutive days.

f. Not to be exceeded more than once per year throughout the state of Washington and never to be exceeded within the PSCAA region.

g. PM_{10} is particulate matter smaller than 10 microns (also called fugitive dust). The 3-year average of the 99th percentile (based on the number of samples taken of the daily concentrations) must not exceed the standard.

h. $PM_{2.5}$ is particulate matter smaller than 2.5 microns. The 3-year annual average of the daily concentrations must not exceed the standard.

i. The 3-year average of the 4th highest daily maximum 8-hour average concentration must not exceed the standard. As of June 15, 2005, USEPA revoked the 1-hour ozone standard in all areas except the 8-hour ozone nonattainment Early Action Compact Areas, none of which occur in the Puget Sound area.

j. Final rule on rolling 3-month average for lead was signed October 15, 2008.

Mandatory PSD Class I areas are listed under 40 CFR Part 81 and WAC 173-400-117. The closest mandatory PSD Class I area in the region that potentially could be affected by the proposed action is Olympic National Park.

CAA Section 169A established the additional goal of prevention of further visibility impairment in the Class I areas. Visibility impairment is defined as a reduction in the visual range and atmospheric discoloration. Determination of the significance of an activity on visibility in a Class I area is typically associated with evaluation of stationary source contributions. The USEPA is implementing a Regional Haze rule for Class I areas that will address contributions from mobile sources and pollution transported from other states or regions.

CAA Section 176(c), General Conformity, established certain statutory requirements for federal agencies with proposed federal activities to demonstrate conformity of the proposed activities with the each state's State Implementation Plan for attainment of the NAAQS. In 1993, EPA issued the final rules for determining air quality conformity. Federal activities must not:

(a) Cause or contribute to any new violation;
(b) Increase the frequency or severity of any existing violation; or
(c) Delay timely attainment of any standard, interim emission reductions, or milestones in conformity to a State Implementation Plan's purpose of eliminating or reducing the severity and number of NAAQS violations or achieving attainment of NAAQS.

General conformity applies only to nonattainment and maintenance areas. If the emissions from a federal action proposed in a nonattainment or maintenance area exceed annual *de minimis* thresholds (typically, 100 tons per year) identified in the rule, a formal conformity determination is required of that action. The *de minimis* thresholds are more restrictive as the severity of the nonattainment status of the region increases. The proposed action is located in an attainment area for all criteria pollutants; therefore, the General Conformity Rule does not apply.

Hazardous air pollutants (HAPs) include air pollutants that can produce serious illnesses or increased mortality, even in low concentrations. HAPs are compounds that have no established federal ambient standards, but they may have significance thresholds established by some states and are typically evaluated for potential chronic inhalation and cancer risks. The effect of HAPs on sensitive members of the population is a special concern. Sensitive receptor groups include children, the elderly, and the acutely and chronically ill. The locations of these groups include residences, schools, playgrounds, and hospitals. The CAA established 188 national air toxic chemicals as HAPs while the WDOE and the PSCAA list about 400 chemicals, which include the 188 from the CAA. HAPs are defined as chemicals that cause serious health and environmental effects released by sources such as chemical plants, dry cleaners, printing plants, and motor vehicles.

Greenhouse gases (GHGs) are gases that trap heat in the atmosphere. These emissions occur from natural processes and human activities. The accumulation of GHGs in the atmosphere regulates the earth's temperature. Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in GHG emissions from human activities.

The most common GHGs emitted from natural processes and human activities include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Examples of GHGs created and emitted primarily through human activities include fluorinated gases (hydro fluorocarbons and per fluorocarbons) and sulfur hexafluoride. Each GHG is assigned a global warming potential (GWP). The GWP is the ability of a gas or aerosol to trap heat in the atmosphere. The GWP

rating system is standardized to CO_2, which has a value of one. For example, CH_4 has a GWP of 21, which means that it has a global warming effect 21 times greater than CO_2 on an equal-mass basis and N_2O has a GWP of 310. Total GHG emissions from a source are often reported as a CO_2 equivalent (CO_2e). The CO_2e is calculated by multiplying the emission of each GHG by its GWP and adding the results together to produce a single, combined emission rate representing all GHGs.

Strengthening Federal Environmental, Energy, and Transportation Management Executive Order (EO 13423) was signed by President Bush on January 24, 2007. The EO instructs federal agencies to conduct their environmental, transportation, and energy-related activities in an environmentally, economically, and fiscally sound, integrated, continuously improving, efficient, and sustainable manner. The EO requires federal agencies to meet specific goals to improve energy efficiency and reduce GHG emissions by annual energy usage reductions of 3 percent through the end of fiscal year (FY) 2015, or by 30 percent by the end of FY 2015, relative to the baseline energy use of the agency in FY 2003. In addition to EO 13423, on October 5, 2009, President Obama signed EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, to establish an integrated strategy towards sustainability in the federal government and to make reduction of GHGs a priority for federal agencies.

The potential effects of proposed GHG emissions are by nature global and cumulative impacts, as individual sources of GHG emissions are not large enough to have an appreciable effect on climate change. Currently, there are no formally adopted or published NEPA thresholds of significance for GHG emissions.

On February 18, 2010, the Council on Environmental Quality (CEQ) issued for public comment draft guidance ‘‘Consideration of the Effects of Climate Change and Greenhouse Gas Emissions,” which is the first time that draft guidance on how federal agencies should evaluate the effects of climate change and GHG emissions for NEPA documentation (CEQ 2010). Specifically, if a proposed action emits 25,000 metric tons or more of CO_2e on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public. CEQ does not propose the 25,000 metric tons per year reference point as an indicator of a level of GHG emissions that may significantly affect the quality of the human environment, but notes that it serves as a minimum standard for reporting emissions under the CAA.

Consultation and Permit Compliance Status. No consultations or permits are required.

3.17.1 Existing Environment

Air quality in the vicinity of the EHW-2 project site, the upland project area, and the greater NBK at Bangor area is generally rated as good, the highest air quality rating, for the majority of the year. There are few point sources of emissions and there has never been a violation of an air quality standard in Kitsap County. Kitsap County is in attainment of all NAAQS in Table 3.17–1.

PSCAA has created regulations requiring that Notice of Construction (NOC) air permits must be obtained for emission sources that may have an impact to air quality. Typically these NOC permits are applied for before operation of an emission source and require stringent operation and maintenance standards. PSCAA also has implemented regulations minimizing smoke emissions from stationary point sources requiring that reasonable precautions be implemented to minimize the emission of fugitive dust and smoke emissions during construction projects. In addition, NBK at Bangor is required by PSCAA to do a twelve-month rolling average of criteria pollutant

emissions and report these emissions to PSCAA per the terms of the NBK at Bangor synthetic minor permit. Table 3.17–2 shows the current 2010 emissions on NBK at Bangor (NAVFAC Environmental 2011).

Table 3.17–2. NBK at Bangor Existing Air Emissions

TOTAL AIR POLLUTANT EMISSIONS (TONS)					
VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$
31.43	18.73	27.90	0.37	9.84	1.84

3.17.1.1 Attainment, Air Emissions, and Air Quality Index

The USEPA designates all areas of the United States as having air quality either better than (attainment) or worse than (nonattainment) the NAAQS. A nonattainment designation means that a primary NAAQS has been exceeded more than once per year in a given area. Areas that were previously designated nonattainment, but now in attainment, are designated as maintenance areas. Kitsap County is presently in attainment for the six criteria pollutants of all NAAQS and has always attained these standards, due to its rural nature and lack of substantial emission sources. All ambient pollutant levels in Kitsap County also are lower than state ambient air quality standards shown in Table 3.17–1. The regulatory requirements for proposed emission sources in attainment areas typically are less rigorous compared to areas that do not attain an ambient air quality standard.

Ozone is a secondary pollutant formed in the atmosphere by photochemical reactions of previously emitted pollutants called precursors. These precursors are mainly oxides of nitrogen and volatile organic compounds (VOCs). The affected area for ozone generally extends much farther downwind than for inert pollutants. In the presence of solar radiation, the maximum impact of precursor emissions on ozone levels usually occurs several hours after their emission and many miles from the source, depending on the wind conditions. One of the main sources of ozone precursors are vehicle emissions (PSCAA 2008).

CO is a byproduct of incomplete combustion. It is produced by transportation sources and other fuel burning sources, such as wood stoves. CO is a pollutant of concern related to transportation sources, because it is emitted in the greatest quantity of any pollutant for which short-term NAAQS exist (1-hour and 8-hour standards). CO concentrations are usually highest at congested intersections, but unlike ozone, diminish rapidly with distance (PSCAA 2008).

Particulate matter (inhalable particles of about 10 microns in size) is generated by industrial activities, fuel burning, vehicle tire wear, combustion engines, and other sources. It is a health concern because these particles can be inhaled deeply into the human lung. Exposure to $PM_{2.5}$ can have serious health effects, especially for sensitive groups such as children and the elderly. In 1999, the PSCAA adopted a local health goal for a daily average never to exceed 25 $\mu g/m^3$. All four counties monitored by the PSCAA exceeded this health goal (but did not violate standards) during the winter of 2008 (PSCAA 2009b).

The USEPA has developed a nationwide reporting index for the criteria pollutants, known as the Air Quality Index (AQI). Based on a 500-point scale for five major pollutants (CO, NO_2, SO_2, O_3, and particulate matter). Concentration monitors record measurements for the five major pollutants, and these measurements are converted into a separate AQI value for each pollutant using standard formulas developed by the USEPA. The highest of these AQI values is reported as the AQI value for that day. For example, if an AQI is 132 for CO and 101 for particle

pollution, the AQI value for that day would be announced as 132 for CO. The index is broken down into quality as follows: (1) 0–50 good, (2) 51–100 moderate, (3) 101–150 unhealthy for sensitive groups, (4) 151–200 unhealthy, (5) 201–300 very unhealthy, and (6) 301–500 hazardous (PSCAA 2008).

For the Bangor waterfront, including the EHW-2 project site and upland project area, as well as Kitsap County, the AQI indicated that air quality was good for most of 2008 (PSCAA 2009b). Approximately 94 percent of the year, air quality was rated as good, and for 6 percent of the year, it was rated as moderate. The highest AQI for Kitsap County in 2008 was 78; thus, there was no occurrence of the AQI within the range of unhealthy for sensitive groups.

PSCAA maintains a network of monitoring stations across Washington, with two stations in Kitsap County. These stations are located in Poulsbo and Bremerton. Monitoring at the Silverdale site (the site closest to NBK at Bangor) has been discontinued. PSCAA only monitors particulate matter in the county because there are so few point sources of air pollutants. This includes $PM_{2.5}$, which is used as a measure of regional visibility. Visibility in Kitsap County in 2008 was highly variable but followed the regional trends. Average visibility for the Puget Sound area has steadily increased over the last decade, with year-to-year variability caused by weather conditions (PSCAA 2009b).

3.17.2 Environmental Consequences

The evaluation of impacts to air quality considers whether conditions resulting from project construction and operation violate federal, state, or local air pollution standards and regulations. Applicable air pollution standards and regulations that are the basis for determinations of environmental consequences are discussed in the introduction to Section 3.17.

PSCAA has not established criteria for assessing the significance of air quality impacts for environmental impact purposes. However, WAC 173-401-200 defines a stationary source as "major" if annual emissions exceed (1) 100 tons per year of a regulated pollutant (VOCs, CO, nitrous oxides [NO_x], SO_2, and PM_{10}), (2) 10 tons per year of a single HAP, or (3) 25 tons per year of combined HAPs. There are currently no PSCAA thresholds for $PM_{2.5}$ emissions. Emissions from a project alternative would be substantial if they exceed one of these PSCAA thresholds. Although these thresholds are designed to assess the potential for stationary sources to impact a localized area, almost all of the project emissions would occur from mobile sources that would operate and spread impacts over a large portion of NBK at Bangor.

Construction duration and activities (such as pile driving, the three new buildings, pure water facility, and replacement parking) in Section 2.0 were used to derive construction equipment usage per activity, using construction schedules of similar projects. In addition, emissions from truck traffic were quantified including 228 roundtrips to the nearest landfill during construction (see Appendix J for more detail). Construction activities would produce minimal fugitive dust (PM_{10} and $PM_{2.5}$) emissions and would not produce substantial air quality impacts with regard to levels of HAPs or criteria pollutants. Future operations would produce a nominal increase in emissions that would not exceed the PSCAA annual emission thresholds.

3.17.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.17.2.1.1 CONSTRUCTION

Impacts to air quality from construction of Alternative 1 would occur from combustive emissions due to the use of fossil fuel-powered construction equipment and support vessels. Emission factors from USEPA NONROAD 2008 were used to quantify the combustive emissions. Minimal fugitive dust (PM_{10} and $PM_{2.5}$) emissions would only occur from onshore construction activities.

Reasonable precautions would be implemented to minimize smoke emissions from pile driving and no temporary construction permit would be required to be obtained from PSCAA. Onshore construction activities would implement BMPs to minimize the generation of fugitive dust, as identified in Section 3.17.2.7 of this EIS. None of the proposed alternatives would require an NOC permit, GHG reporting, or modification of the NBK at Bangor synthetic minor permit. Visible emission limits and work practices would be observed and implemented during operation of all stationary point source emission sources during operation of any cranes or pile hammers. For all alternatives, there would be no required reporting of GHG to EPA.

Table 3.17–3 summarizes the total emissions of criteria pollutants that would occur from construction of Alternative 1 within the project region. These totals are for construction of the entire alternative, which would take 42 to 48 months to complete. Since Alternative 1 is located in an Attainment Area for all criteria pollutants and, therefore, does not exceed the PSCAA threshold, General Conformity would not be applicable. Therefore, construction of Alternative 1 and the relocation of the four new buildings (including the pure water facility) and replacement parking would produce less than significant air quality impacts.

Alternative 1 would emit HAPs that could potentially impact public health. HAPs are subsets of VOC and PM_{10} emissions. Annual construction emissions (based on a 48-month buildout) show that Alternative 1 would generate a combined annual total of 4.67 tons of VOC and PM_{10} emissions, which is lower than the 10 tons per year for a single HAP that defines a stationary source as "major." As a result, construction of Alternative 1 would produce less than significant impacts to public health.

Alternative 1 would produce short-term emissions of GHGs. The GHGs emitted would include CO_2, CH_4, and N_2O. Table 3.17–4 shows the total GHG emissions that would occur from proposed construction and the carbon dioxide equivalent (CO_2e). As indicated in the Regulatory Overview discussion above, CEQ recently issued draft guidance explaining how federal agencies should analyze the environmental impacts of GHG emissions and climate change when they describe the environmental impacts of a proposed action under NEPA. CEQ proposes a GHG emissions level of 25,000 metric tons per year as a useful indicator that a project may meet the foregoing "meaningful" standard for public disclosure. The draft guidance clarifies that the emissions level of 25,000 metric tons per year is neither an absolute standard nor an indicator of a level of emissions that may "significantly" affect the quality of the human environment, as that term is defined in CEQ's NEPA regulations.

In the absence of an adopted or science-based NEPA significance threshold or conformity *de minimis* levels for GHGs, this EIS compares GHG emissions that would occur from construction activity to the U.S. GHG baseline inventory of 2009 to determine the relative contribution due to GHG emissions from proposed project alternatives. These data show that the ratio of annual CO_2e emissions from construction of Alternative 1 to the CO_2e emissions associated with the net

U.S. sources in 2009 is approximately 0.004/6,633 million metric tons (USEPA 2011), or about 0.00006 percent of the U.S. CO_2e emissions inventory. Since GHG emissions from Alternative 1 would equate to minimal amounts of the U.S inventory, they would not substantially contribute to global climate change. Therefore, GHG emissions from Alternative 1 would produce less than significant impacts to global climate change.

3.17.2.1.2 OPERATION/LONG-TERM IMPACTS

Operation of Alternative 1 would have a less than significant impact to air quality. There would be no significant changes in the existing long-term operational sources but there would be a small emissions increase of less than 1 ton of all criteria pollutants (see Appendix J) from Alternative 1 such as small heating and cooling equipment, generators, or electricity usage. A small increase in vehicle use on the permanent roads is anticipated if the EHW-2 and existing EHW conduct operations at the same time. These increases would be less than significant because of the small number of vehicles (Section 3.25.2). Maintenance of the EHW-2 would include routine inspections, repair, and replacement of facility components as required. These activities would not result in significant emissions of air pollutants.

Table 3.17–3. Total Air Emissions from Construction of Alternative 1

ACTIVITY	TOTAL AIR POLLUTANT EMISSIONS (TONS)					
	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Pile Driving	1.39	3.82	30.96	1.79	1.81	1.71
Wharf Construction	1.34	6.76	14.64	0.47	1.26	1.24
Onshore Trestle Construction	0.12	0.52	1.60	0.08	1.29	0.18
Relocated Facilities	0.05	0.36	0.48	0.01	7.42	0.79
Commuters	1.60	21.29	2.91	0.04	0.10	0.06
Total Emissions	**4.5**	**32.75**	**50.59**	**2.39**	**11.88**	**3.98**
PSCAA Thresholds	**100**	**100**	**100**	**100**	**100**	**N/A**

Table 3.17–4. Total GHG Emissions from Construction of Alternative 1

ACTIVITY	TOTAL GHG EMISSIONS (METRIC TONS)			
	N_2O	CH_4	CO_2	CO_2e
Pile Driving	0.27	0.14	904	991
Wharf Construction	0.35	0.02	2,439	2,547
Onshore Trestle Construction	0.00	0.00	15	16
Relocated Facilities	0.00	0.00	63	65
Commuters	0.02	0.04	36.66	44.82
Total Emissions	**0.64**	**0.2**	**3,458**	**3,664**
U.S. 2009 Annual GHG Emissions (10^6 metric tons)				**6,633**
Proposed Emissions as a % of U.S. GHG Emissions				**0.00006**

3.17.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.17.2.2.1 CONSTRUCTION

Impacts to air quality from construction of Alternative 2 would be similar to those for Alternative 1 except that additional piles to support the conventional pile wharf would require a longer construction duration.

Table 3.17–5 summarizes the total emissions of criteria pollutants that would occur from construction of Alternative 2 within the project region. These totals are for construction of the entire alternative, which would take 54 to 64 months to complete. The General Conformity is not applicable since Alternative 2 is located in an Attainment Area for all criteria pollutants and, therefore, does not exceed the PSCAA threshold. Therefore, construction of Alternative 2 and the relocation of the four new buildings (including the pure water facility) would produce less than significant air quality impacts.

Alternative 2 would emit HAPs that could potentially impact public health. Annual construction emissions (based on a 64-month buildout) show that Alternative 2 would generate a combined annual total of 5.04 tons of VOC and PM_{10} emissions, lower than the 10 tons per year for a single HAP. As a result, construction of Alternative 2 would produce less than significant impacts to public health.

Similar to Alternative 1 above, Alternative 2 would produce short-term emissions of GHGs, as shown in Table 3.17–6. Since GHG emissions from Alternative 2 would equate to minimal amounts of the U.S inventory, they would not substantially contribute to global climate change. Therefore, GHG emissions from Alternative 2 would produce less than significant impacts to global climate change.

3.17.2.2.2 OPERATION/LONG-TERM IMPACTS

Operation of Alternative 2 would have a less than significant impact to air quality. There would be no significant changes in the existing long-term operational sources, but there would be a small emissions increase of less than 1 ton of all criteria pollutants (see Appendix J) from Alternative 2 such as small heating and cooling equipment, generators, or electricity usage. A small increase in vehicle use on the permanent roads is anticipated if the EHW-2 and existing EHW conduct operations at the same time. This increase would be less than significant because of the small number of vehicles. Maintenance would not result in significant emissions of air pollutants.

Table 3.17–5. Total Air Emissions from Construction of Alternative 2

ACTIVITY	TOTAL AIR POLLUTANT EMISSIONS (TONS)					
	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Pile Driving	1.50	4.31	32.65	1.86	1.93	1.83
Wharf Construction	1.33	6.76	14.64	0.47	1.26	1.24
Onshore Trestle Construction	0.12	0.53	1.60	0.08	1.29	0.18
Relocated Facilities	0.05	0.36	0.48	0.01	7.42	0.79
Commuters	2.60	39.83	4.54	0.05	0.15	0.09
Total Emissions	**5.6**	**51.79**	**53.91**	**2.47**	**12.05**	**4.13**
PSCAA Thresholds	**100**	**100**	**100**	**100**	**100**	**N/A**

Table 3.17–6. Total GHG Emissions from Construction of Alternative 2

ACTIVITY	TOTAL GHG EMISSIONS (METRIC TONS)			
	N_2O	CH_4	CO_2	CO_2e
Pile Driving	0.30	0.14	1,077	1,173
Wharf Construction	0.35	0.02	2,439	2,548
Onshore Trestle Construction	0.00	0.00	15	15
Relocated Facilities	0.00	0.00	62	65
Commuters	0.04	0.07	59.39	72.70
Total GHG Emissions	**0.69**	**0.23**	**3,652**	**3,874**
U.S. 2009 Annual GHG Emissions (10^6 metric tons)				**6,633**
Proposed Emissions as a % of U.S. GHG Emissions				**0.00006**

3.17.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.17.2.3.1 CONSTRUCTION

Impacts to air quality from construction of Alternative 3 would be similar to those for Alternative 1 and would occur from combustive emissions due to the use of fossil fuel-powered construction equipment and support vessels. As most of the construction would occur over water, the construction activities would produce minimal fugitive dust (PM_{10} and $PM_{2.5}$) emissions. However, as identified above for Alternative 1, the project contractor would use standard BMPs to control dust during construction.

Table 3.17–7 summarizes the total emissions of criteria pollutants that would occur from construction of Alternative 3 within the project region. These totals are for construction of the entire alternative, which would take 42 to 49 months to complete. These data show that even if all construction activities occurred within one year, emissions would remain well below the PSCAA annual thresholds. The General Conformity is not applicable since Alternative 3 is located in an Attainment Area for all criteria pollutants and, therefore, does not exceed the PSCAA threshold. Therefore, construction of Alternative 3 and the relocation of the four new buildings (including the pure water facility) and replacement parking would produce less than significant air quality impacts.

Alternative 3 would emit HAPs that could potentially impact public health. Annual construction emissions (based on a 49-month buildout) show that Alternative 3 would generate a combined annual total of 3.84 tons of VOC and PM_{10} emissions, lower than the 10 tons per year for a single HAP. As a result, construction of Alternative 3 would produce less than significant impacts to public health.

Similar to Alternative 1 above, Alternative 3 would produce short-term emissions of GHGs, as shown in Table 3.17–8. Since GHG emissions from Alternative 3 would equate to minimal amounts of the U.S inventory, they would not substantially contribute to global climate change. Therefore, GHG emissions from Alternative 3 would produce less than significant impacts to global climate change.

3.17.2.3.2 OPERATION/LONG-TERM IMPACTS

Operation of Alternative 3 would have a less than adverse impact to air quality. There would be no significant changes in the existing long-term operational sources but there would be a small emissions increase of less than 1 ton of all criteria pollutants (see Appendix J) from Alternative 3 such as small heating and cooling equipment, generators, or electricity usage. A small increase in vehicle use on the permanent roads is anticipated if the EHW-2 and existing EHW conduct operations at the same time. This increase would be less than significant because of the small number of vehicles. Maintenance would not result in significant emissions of air pollutants.

Table 3.17–7. Total Air Emissions from Construction of Alternative 3

ACTIVITY	TOTAL AIR POLLUTANT EMISSIONS (TONS)					
	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Pile Driving	1.40	3.89	31.19	1.80	1.82	1.72
Wharf Construction	1.65	8.33	18.05	0.57	1.56	1.52
Onshore Trestle Construction	0.12	0.52	1.60	0.08	1.31	0.18
Relocated Facilities	0.05	0.36	0.48	0.01	7.42	0.79
Commuters	1.85	24.75	3.33	0.04	0.11	0.07
Total Emissions	**5.07**	**37.85**	**54.65**	**2.5**	**12.22**	**4.28**
PSCAA Thresholds	**100**	**100**	**100**	**100**	**100**	**N/A**

Table 3.17–8. Total GHG Emissions from Construction of Alternative 3

ACTIVITY	TOTAL GHG EMISSIONS (METRIC TONS)			
	N_2O	CH_4	CO_2	CO_2e
Pile Driving	0.28	0.14	927	1,023
Wharf Construction	0.43	0.03	3,008	3,141
Onshore Trestle Construction	0.00	0.00	15	15
Relocated Facilities	0.00	0.00	62	65
Commuters	0.03	0.05	42.47	52
Total GHG Emissions	**0.74**	**0.22**	**4,054**	**4,296**
U.S. 2009 Annual GHG Emissions (10^6 metric tons)				**6,633**
Proposed Emissions as a % of U.S. GHG Emissions				**0.00006**

3.17.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.17.2.4.1 CONSTRUCTION

Impacts to air quality from construction of Alternative 4 would be similar to those for Alternative 1, except for the impacts of the additional piles to support the wharf.

Table 3.17–9 summarizes the total emissions of criteria pollutants that would occur from construction of Alternative 4 within the project region. These totals are for construction of the entire alternative, which would take 54 to 64 months to complete. The General Conformity is

not applicable since Alternative 4 is located in an Attainment Area for all criteria pollutants and, therefore, does not exceed the PSCAA threshold. Therefore, construction of Alternative 4 and the relocation of the four new buildings (including the pure water facility) and replacement parking would produce less than significant air quality impacts.

Alternative 4 would emit HAPs that could potentially impact public health. Annual construction emissions (based on a 64-month buildout) show that Alternative 4 would generate a combined annual total of 3.89 tons of VOC and PM_{10} emissions, lower than the 10 tons per year for a single HAP. As a result, construction of Alternative 4 would produce less than significant impacts to public health.

Similar to Alternative 1 above, Alternative 4 would produce short-term emissions of GHGs, as shown in Table 3.17–10. Since GHG emissions from Alternative 4 would equate to minimal amounts of the U.S inventory, they would not substantially contribute to global climate change. Therefore, GHG emissions from Alternative 4 would produce less than significant impacts to global climate change.

3.17.2.4.2 OPERATION/LONG-TERM IMPACTS

Operation of Alternative 4 would have a less than adverse impact to air quality. There would be no significant changes in the existing long-term operational sources but there would be a small emissions increase of less than 1 ton of all criteria pollutants (see Appendix J) from Alternative 4 such as small heating and cooling equipment, generators, or electricity usage. A small increase in vehicle use on the permanent roads is anticipated if the EHW-2 and existing EHW conduct operations at the same time. This increase would be less than significant because of the small number of vehicles. Maintenance would not result in significant emissions of air pollutants.

Table 3.17–9. Total Air Emissions from Construction of Alternative 4

ACTIVITY	TOTAL AIR POLLUTANT EMISSIONS (TONS)					
	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Pile Driving	1.52	4.37	32.87	1.87	1.95	1.84
Wharf Construction	1.65	8.33	18.05	0.57	1.56	1.52
Onshore Trestle Construction	0.12	0.52	1.60	0.08	0.37	0.09
Relocated Facilities	0.05	0.36	0.48	0.01	7.42	0.79
Commuters	1.85	24.75	3.33	0.04	0.11	0.07
Total Emissions	**5.19**	**38.33**	**56.33**	**2.57**	**11.41**	**4.31**
PSCAA Thresholds	**100**	**100**	**100**	**100**	**100**	**N/A**

Table 3.17–10. Total GHG Emissions from Construction of Alternative 4

ACTIVITY	TOTAL GHG EMISSIONS (METRIC TONS)			
	N_2O	CH_4	CO_2	CO_2e
Pile Driving	0.30	0.14	1,100	1,196
Wharf Construction	0.43	0.03	3,008	3,142
Onshore Trestle Construction	0.00	0.00	15	15
Relocated Facilities	0.00	0.00	62	65
Commuters	0.03	0.05	42.47	52
Total GHG Emissions	**0.76**	**0.22**	**4,227**	**4,470**
U.S. 2009 Annual GHG Emissions (10^6 metric tons)				**6,633**
Proposed Emissions as a % of U.S. GHG Emissions				**0.00006**

3.17.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.17.2.5.1 CONSTRUCTION

Alternative 5 would include a larger wharf but fewer piles than other project alternatives. Table 3.17–11 summarizes the total emissions of criteria pollutants that would occur from construction of Alternative 5 within the project region. These totals are for construction of the entire alternative, which would take 42 to 44 months to complete. The General Conformity is not applicable since Alternative 5 is located in an Attainment Area for all criteria pollutants and, therefore, does not exceed the PSCAA threshold. Therefore, construction of Alternative 5 and the relocation of the four new buildings (including the pure water facility) and replacement parking would produce less than significant air quality impacts.

Alternative 5 would emit HAPs that could potentially impact public health. Annual construction emissions (based on a 44-month buildout) show that Alternative 5 would generate a combined annual total of 4.39 tons of VOC and PM_{10} emissions, lower than the 10 tons per year for a single HAP. As a result, construction of Alternative 5 would produce less than significant impacts to public health.

Similar to Alternative 1 above, Alternative 5 would produce short-term emissions of GHGs (Table 3.17–12). Since GHG emissions from Alternative 5 would equate to minimal amounts of the U.S. inventory, they would not substantially contribute to global climate change. Therefore, GHG emissions from Alternative 5 would produce less than significant impacts to global climate change.

3.17.2.5.2 OPERATION/LONG-TERM IMPACTS

Operation of Alternative 5 would have a less than adverse impact to air quality. There would be no significant changes in the existing long-term operational sources but there would be a small emissions increase of less than 1 ton of all criteria pollutants (see Appendix J) from Alternative 5 such as small heating and cooling equipment, generators, or electricity usage. A small increase in vehicle use on the permanent roads is anticipated if the EHW-2 and existing EHW conduct operations at the same time. This increase would be less than significant because of the small number of vehicles. Maintenance would not result in significant emissions of air pollutants.

Table 3.17–11. Total Air Emissions from Construction of Alternative 5

ACTIVITY	TOTAL AIR POLLUTANT EMISSIONS (TONS)					
	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Pile Driving	1.22	3.10	28.43	1.68	1.62	1.53
Wharf Construction	0.48	2.43	5.26	0.17	0.45	0.44
Onshore Trestle Construction	0.12	0.52	1.60	0.08	1.31	0.18
Relocated Facilities	0.05	0.36	0.48	0.01	7.42	0.79
Commuters	2.58	34.55	4.51	0.05	0.15	0.09
Total Emissions	**4.45**	**40.96**	**40.28**	**1.99**	**10.95**	**3.03**
PSCAA Thresholds	**100**	**100**	**100**	**100**	**100**	**N/A**

Table 3.17–12. Total GHG Emissions from Construction of Alternative 5

ACTIVITY	TOTAL GHG EMISSIONS (METRIC TONS)			
	N_2O	CH_4	CO_2	CO_2e
Pile Driving	0.23	0.13	643	717
Wharf Construction	0.12	0.01	876	913
Onshore Trestle Construction	0.00	0.00	15	15
Relocated Facilities	0.00	0.00	62	65
Commuters	0.04	0.07	58.92	72
Total GHG Emissions	**0.39**	**0.21**	**1,654**	**1,782**
U.S. 2009 Annual GHG Emissions (10^6 metric tons)				**6,633**
Proposed Emissions as a % of U.S. GHG Emissions				**0.00002**

3.17.2.6 No-Action Alternative

Under the No-Action Alternative, none of the proposed construction activities would occur at the project site. Therefore, the No-Action Alternative would not produce any impacts to air quality.

3.17.2.7 Mitigation Measures and Regulatory Compliance

The proposed action would not have an adverse impact to air quality or adversely impact the Class I area. The EHW-2 project would comply with the national and state ambient air quality standards. No consultations or mitigation measures are necessary; however, the project contractor would use standard BMPs to control fugitive dust during construction according to PSCAA Reg. I Section 9.15 and 70.94 RCW of the Washington Clean Air Act. These BMPs would include measures such as:

- Minimizing the amount of land disturbance at a given time,
- Using water sprays on disturbed earth areas,
- Installing gravel at construction area access points to prevent tracking of soil onto paved roads, and
- Revegetating disturbed areas as soon as practical.

3.17.3 Summary of Impacts

Impacts to air quality associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.17–13.

Table 3.17–13. Summary of Impacts to Air Quality

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO AIR QUALITY
Impact	
Alternative 1: Combined Trestle, Large-Pile Wharf (Preferred)	*Construction:* Emissions would not exceed threshold for major source. *Operation/Long-term Impacts:* None.
Alternative 2: Combined Trestle, Conventional Pile-Supported Wharf	*Construction:* Emissions would not exceed threshold for major source. Compared to Alternative 1, increases of equipment and mobile exhaust emissions from the increase in construction from Alternative 1. *Operation/Long-term Impacts:* None.
Alternative 3: Separate Trestles, Large -Pile Wharf	*Construction:* Emissions would not exceed threshold for major source. Compared to Alternative 1, slight increases of equipment exhaust emissions from the increase in construction. *Operation/Long-term Impacts:* None.
Alternative 4: Separate Trestles, Congenital Pile-Supported Wharf	*Construction:* Emissions would not exceed threshold for major source. Compared to Alternative 1, increases of equipment exhaust emissions from the increase in construction. *Operation/Long-term Impacts:* None.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Emissions would not exceed threshold for major source. Compared to Alternative 1, a slight decrease in construction equipment exhaust. *Operation/Long-term Impacts:* None.
No-Action Alternative	No Impact
Mitigation • No mitigation measures are necessary beyond the proposed BMPs.	
Consultation and Permit Status: No consultations or permits are required.	

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3.18 CULTURAL RESOURCES

A cultural resource is any definite location or object of past human activity, occupation, or use, identifiable through inventory, historical documentation, or oral evidence. Cultural resources may include archaeological, building and structural, and traditional resources, as well as historic districts, sites, or objects. Cultural resources that are eligible for listing in the NRHP are called historic properties. Some cultural resources that are important to American Indians, such as resource-gathering areas, may not be eligible for the NRHP but are still protected under the Native American Graves Protection and Repatriation Act (NAGPRA), the American Indian Religious Freedom Act (AIRFA), or other federal laws. American Indian concerns are addressed in Section 3.19.

Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (16 USC 470) requires federal agencies to identify historic properties within the proposed project's area of potential effects (APE), determine potential effects the proposed project may have on identified historic properties, and consult with the State Historic Preservation Officer (SHPO) on determinations of eligibility and findings of effects. If the proposed project adversely affects an identified historic property, further consultation with the SHPO is required to avoid or minimize the adverse effect. Federal regulations define historic properties to include prehistoric and historic sites, buildings, structures, districts, or objects in or eligible for inclusion on the National Register of Historic Places (NRHP), as well as artifacts, records, and remains related to such properties (NHPA, as amended [16 USC 470 et seq.]). To be considered eligible for inclusion in the NRHP, cultural resources must be determined to be significant by meeting one or more of the criteria outlined in 36 CFR 60.4 (NRHP, Criteria for Evaluation). A historic property must also possess integrity of location, design, setting, materials, workmanship, feeling, or association. A property must be 50 years old or older to be considered for eligibility to the NRHP or must have achieved exceptional importance within the last 50 years. For example, more recent historic resources on a military installation may be considered significant if they are of exceptional importance in understanding the Cold War.

Secretary of the Navy Instruction (SECNAVINST) 5090.8a, Policy for Environmental Protection, Natural Resources and Cultural Resources Programs, and Chief of Naval Operations Instruction (OPNAVINST) 5090.1c, Chapter 27, Cultural Resources Management require the Navy to consider the effects of its undertakings on cultural resources in its planning and program efforts. SECNAVINST 4000.35a, Department of the Navy Cultural Resources Program, establishes policy and assigns responsibilities within the Department of the Navy for fulfilling the requirements of cultural resources laws such as the NHPA.

Consultation and Permit Compliance Status. The Navy has consulted with the SHPO regarding the potential effect of the EHW-2 project on the visual context and aesthetic environment of the NRHP-eligible properties within the APE. The SHPO has concurred with the Navy's evaluation of the Delta Pier and EHW as eligible for the NRHP and with the finding of no adverse effect on NRHP-eligible historic properties. Section 106 consultation is complete for historic resources. The Navy consulted with the Skokomish, Port Gamble S'Klallam, Lower Elwha Klallam, Jamestown S'Klallam, and Suquamish Tribes as required by the implementing regulations of Section 106 of the NHPA (36 CFR 800.4(a)(4)).

3.18.1 Existing Environment

Approximately 125 cultural resources have been identified and inventoried within the boundaries of NBK at Bangor, including historic, archaeological, architectural, and traditional resources. Though most have not been formally evaluated, one archaeological site and nine architectural resources are considered to be eligible for inclusion in the NRHP; none of the eligible resources are listed in the NRHP. Three of the NRHP-eligible architectural resources are within the project APE: the existing EHW, the Delta Pier (also known as the Refit Pier), and a portion of a World War II railroad known as the Shelton-Bangor Railroad mainline. The remaining NRHP-eligible resources include the Carlson Spit shell midden (an archaeological site located a mile south of Delta Pier), four Sorting Complex buildings (numbers 6034, 6035, 6036, and 6037), the Railroad Scale House (number 3033), and the Trident Training Facility (number 2000), a Cold War building; these seven historic properties are located away from the EHW-2 project site and the locations of other project-related construction. No historic properties on or within approximately 5 miles of the EHW upland project area are listed in the NRHP. The portion of the EHW-2 project site on NBK at Bangor with the highest probability for undiscovered archaeological resources is the shoreline (refer to Section 3.18.1.2.6, Potential for Previously Unidentified Resources).

3.18.1.1 Historical Setting

The area near NBK at Bangor was likely first inhabited 14,000 to 12,000 years ago. This time marks the end of nearly two million years of a predominantly glacial and periglacial environment in North America. Glaciers between 2,000 to 5,000 feet thick carved the features of today's Hood Canal and Puget Sound. As the ice melted and retreated northward, it left behind a landscape that was colonized by plants and animals alike. In addition to the fauna of today, also present were mammoth, musk ox, giant beaver, mastodon, and sloth. It was an environment that could easily support human occupation (Navy 2007).

The first human inhabitants were probably big game hunters and are known as Paleoindians (14,000 to 8,000 years before present). Although they probably supplemented their diet by gathering various plant species, such organic items are not often well preserved by the archaeological record. Instead, they are best known through the artifacts they left behind, principally projectile points. Additionally, technological distinctions among the projectile points (Clovis, Folsom) may be indicative of cultural divisions and possibly the specialization toward hunting, particularly game animals. The remains of these cultures, although sparse, are found throughout North and South America (Matson and Coupland 1995).

As the climate became warmer and drier after 8,000 years before present, the large mammals on which the Paleoindian populations relied became extinct. Native groups along the coastline of the Pacific Northwest adapted to a maritime subsistence, focusing on the harvest of marine fish and mammals. The environment was so rich in natural resources that the inhabitants of the Northwest coast may have had no need to develop the agricultural practices pursued in regions with less abundant natural resources. The ocean offered whales, porpoises, sea lions, seals, and shellfish, as well as dozens of fish species. At various times of the year, the rivers were full of spawning salmon. The adjoining uplands were home to deer, elk, and other game. This wealth of plant and animal resources allowed for the development of large, permanent settlements and their accompanying social systems, and leaders (Carlson 1990; Matson and Coupland 1995).

Although distinctive regional cultures, as reflected in the archaeological record, appeared around 3,000 years ago among the Northwest Coast groups, including those living in the area that encompasses Puget Sound, subsistence commonalities also emerged. These included a reliance on fishing, hunting, and gathering, with an emphasis on aquatic resources, and utilization of preservation and storage technologies (Matson and Coupland 1995). Material culture included "an emphasis on bone and antler working, woodworking, and pecked and ground stone technology" (Matson and Coupland 1995). Settlements typically included permanent winter villages, composed of plank houses, with residents numbering from one hundred to several hundred.

The subsequent differentiation among groups continued the trend towards a pattern that "is easily seen as the equivalent of ethnographic Northwest Coast people" (Matson and Coupland 1995). These cultures are epitomized by the Locarno Beach phase in northwestern Washington, followed by the Marpole and Marpole-equivalent phases in similar geographic areas. Sites from the more recent archaeological record show affiliations with the cultures in the Gulf of Georgia to the north, but are distinctive enough to indicate that the Puget Sound region continued to become even more differentiated from the rest of the Northwest Coast. The Old Man House, located east of NBK at Bangor on the same peninsula, represents a site that bridges the period from the Late Prehistoric (from 1,500 years ago to Euroamerican contact) to the early Historic period, when Southern Coast Salish peoples lived in the Puget Sound region. During the latter period, Old Man House was within the territory that was part of Suquamish land identified in the 1855 Point Elliott Treaty that became the Port Madison Indian Reservation, and was also the home of Chief Seattle. The reservation was broken into allotments and much of it eventually sold, but a portion of the parcel with Old Man House was returned to the Suquamish in 2004 (Long 2004).

Tribal names from the Puget Sound region that were codified in the 19th century by treaty-makers, settlers, and missionaries often reflected a misunderstanding of affiliation or territory. However, names associated with NBK at Bangor include the Southern Coast Salish Suquamish (speakers of the Southern Lushootseed Salish language) and Skokomish (speakers of the Twana Salish language and signatory to the Point No Point Treaty of 1855); both tribes lived along Hood Canal (Suttles and Lane 1990). The Central Coast Salish tribes known collectively as S'Klallam (also, Klallam and Clallam) (Suttles 1990) were also signatory to the Point No Point Treaty, although their territory was to the north of Hood Canal, along the Straits of Juan de Fuca. The Chemakum were signatories to the Point No Point Treaty; their traditional territory included the eastern side of the Quimper Peninsula, encompassing the western shore of Admiralty Inlet and extreme northern Hood Canal. This tribe was apparently absorbed by the Clallam to their north and the Skokomish (Twana speakers) to the west and south (Elmendorf 1990).

Spaniards were the first Europeans to visit the Washington coast in the 18th century. In 1774, Juan Pérez explored the Northwest coastline. A year later, an expedition led by Bruno Heceta made the first recorded landing in what would become Washington State near the mouth of the Hoh River (Advameg 2010). In 1792 Captain George Vancouver made first contact with the tribes that would come to be known as the Skokomish, Sklalam (Clallam, S'Klallam), and the Suquamish. They were living in permanent villages along the west side of Hood Canal, including the Toandos Peninsula across Hood Canal from NBK at Bangor, and occupying seasonal hunting and fishing camps along the eastern shore of Hood Canal where NBK at Bangor is now located (Navy 2007).

At the time of contact, the primary interest of European and American traders and explorers was the booming fur market. The Hudson's Bay Company established Fort Nisqually, 50 miles south of NBK at Bangor in 1833. A census of the indigenous population along Hood Canal totaled 500 individuals in 1844.

As interest in the fur trade dwindled in the mid 1800s, western Washington began its long history with the lumber industry. Ten miles south of NBK at Bangor, the Puget Mill Company built a mill that remained in operation for nearly 150 years. As more mills were built, the industry grew, with lumber being shipped as far away as San Francisco (Navy 2007).

An American provisional government was established in 1843, encompassing an area that was refined three years later when the boundary between the United States and Canada was established along the 49th parallel (Advameg 2010). With U.S. sovereignty secured north of the Columbia River, the government authorized settlers to claim land in the area (Marino 1990). Also, the U.S. superintendent of Indian Affairs, Territorial Governor Isaac Stevens, began the process of gaining treaty cessions from all the local tribes on Christmas Eve, 1854. Dealing primarily with head chiefs (including Chief Seattle), he managed to establish three treaties that covered the lands surrounding Puget Sound (Marino 1990; Governor's Office of Indian Affairs 2010). These treaties reserved a number of resource harvesting rights to the signatory tribes, particularly related to salmon and shellfish harvesting (Marino 1990; Governor's Office of Indian Affairs 2010).

Shortly after the treaties were signed, small towns were established in the surrounding area. Many of the towns were located near the water for efficiencies in loading and transporting their timber and fishing harvests (Lewarch et al. 1993). Named for the town in Maine, Bangor, Washington was founded in 1890 (Navy 2007).

The Navy facility at Bangor was built along Hood Canal on the west side of the Kitsap Peninsula between 1944 and 1945 and was used as a site for shipping ammunition to locations in the Pacific during World War II. Throughout World War II, and the subsequent Korean and Vietnam conflicts, Bangor continued to operate as a munitions depot. In 1973, the Navy selected Bangor as the homeport for the first squadron of TRIDENT submarines. The new submarine base was officially activated in 1977 as Naval Submarine Base (SUBASE) Bangor. SUBASE Bangor merged with Naval Station Bremerton and Naval Undersea Warfare Center Keyport in 2004 to form the new command known as Naval Base Kitsap (Navy 2007).

3.18.1.2 Area of Potential Effects

The APE comprises an archaeological APE and an architectural APE addressing both direct and indirect effects on historic properties. The APE is "influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking" (36CFR800.16(d)).

3.18.1.2.1 NRHP-ELIGIBLE PROPERTIES

Although NBK at Bangor has no properties listed in the NRHP, there are NRHP-eligible properties within the installation boundaries. The Navy conducted archaeological and architectural surveys and inventories on NBK at Bangor in 1992, 2009, 2010, and 2011, which are shown in Table 3.18–1 (Lewarch et al. 1993; Grant et al. 2010; Hardlines 2010; HRA 2011, see Appendix L; Sackett 2010, 2011). The 1992 investigations surveyed NBK at Bangor for archaeological resources (Lewarch et al. 1993); in addition to recording numerous sites, this project developed a sensitivity model for the presence of archaeological sites associated with

American Indians and Euro-American settlers. In 2009, the Navy recorded three sites outside the current project's archaeological APE (Grant et al. 2010). A 2010 survey of the majority of the EHW-2 project APE located a historic berm that is ineligible for the NRHP; the SHPO has concurred with this finding (HRA 2011; Appendix I). An archaeological survey of the remaining EHW-2 project area in 2011 did not locate any cultural resources eligible for listing in the NRHP (Grant 2011).

Architectural surveys evaluated the NRHP eligibility of buildings and structures within the APE (Sackett 2010, 2011). Delta Pier and the existing EHW are considered eligible based on their Cold War context (Sackett 2010); the segments of the Shelton-Bangor Railroad mainline within the APE are eligible based on their association with World War II (Sackett 2011).

The Navy has determined NRHP eligibility of the recorded sites listed in Table 3.18–1, and the SHPO has concurred where noted as such; the Navy will seek SHPO concurrence with the remaining determinations. Of the 10 NRHP-eligible resources identified on the NBK at Bangor installation, the Carlson Spit shell midden is located approximately one mile south of Delta Pier, outside of the APE, as is the Trident Training Facility; the four Sorting Complex buildings are more than 2 miles to the southeast, and the Railroad Scale House is almost 4 miles away. The EHW, Delta Pier and a portion of Shelton-Bangor Railroad mainline are within the APE. In addition, any resource that might be encountered during future investigations would be treated as eligible for the NRHP until such time as it could be evaluated for NRHP eligibility, in accordance with Section 106 of the NHPA (36 CFR 800.13.2(c)).

Table 3.18–1. Identified Archaeological and Architectural Sites on NBK at Bangor

PREHISTORIC PERIOD SITES [1]	SITE NUMBER	NRHP ELIGIBILITY
Carlson Spit Shell midden	45KP108	Eligible w/SHPO concurrence
Floral Point Shell midden on north side of Floral Point	45KP106	Not Eligible
Amberjack Road Shell midden on south side of Floral Point	45KP107	Not Eligible
HISTORIC PERIOD SITES (SUMMARY) [1]	**NUMBER OF SITES**	**NRHP ELIGIBILITY**
Historic Land Use Complexes (HLUC)	30	Not Eligible
Historic grave	1	Not Eligible
Ornamental plants	10	Not Eligible
Fruit trees (not part of an orchard)	5	Not Eligible
Orchards	7	Not Eligible
Historic debris, foundations, depression, fencelines	14	Not Eligible
Collapsed structures (four are in HLUCs not counted above)	5	Not Eligible
HISTORIC PERIOD SITES [2,3,5]	**SITE NUMBER**	**NRHP ELIGIBILITY**
World War II-era railroad and emergency derail run-out	45KP209	Not Eligible w/SHPO Concurrence
Berm, likely associated with no longer extant K.C. Magazines 307-332	45KP214	Not Eligible
Cabin, wire fence, debris	45KP211	Not Eligible w/SHPO Concurrence

Table 3.18–1. Identified Archaeological and Architectural Sites on NBK at Bangor (continued)

MULTI-COMPONENT SITE [2]	SITE NUMBER	NRHP ELIGIBILITY
Foundations, debris, ornamental plants, piers, pedestrian footbridge. Two cobble tools and disturbed midden deposit.	45KP212	Not Eligible w/SHPO Concurrence
ARCHITECTURAL RESOURCE NAME AND DESCRIPTION [1,4]	**CONSTRUCTION DATE**	**NRHP ELIGIBILITY**
Well house with fruit tree and periwinkle	Pre-1942	Not Eligible
Cabin, outbuilding, foundation, and chicken coop (includes collapsed cabin) (HLUC 27)	Pre-1942	Not Eligible
Wooden structure	Pre-1942	Not Eligible
Cabin with outbuilding (HLUC 29)	Pre-1942	Not Eligible
Storage building	Pre-1942	Not Eligible
Concrete building with apple orchard and historic debris	Pre-1942	Not Eligible
Wooden shack with sloping roof and concrete slab interior (HLUC 35)	Pre-1942	Not Eligible
Log structure with fruit trees (includes collapsed building) (HLUC 38)	Pre-1942	Not Eligible
Administration Area: Buildings 1, 3, and 4	World War II	Not Eligible
Industrial Area District	World War II	Not Eligible
Marginal Wharf	World War II	Not Eligible
Delta Pier	Cold War	Eligible w/SHPO concurrence
Explosives Handling Wharf	Cold War	Eligible w/ SHPO concurrence
Shelton-Bangor Railroad mainline segments (adjacent to Delta Pier and adjacent to construction location)	World War II; Cold War	Eligible w/ SHPO concurrence
NBK AT BANGOR FACILITIES [6]	**CONSTRUCTION DATE**	**NRHP ELIGIBILITY**
1001/Admin Bldg	1944	Not Eligible
1003/BOQ/NCIS Field Office	1944	Not Eligible
1004/Gatehouse/Veterinary Clinic	1944	Not Eligible
1006/Recreation Building/SWFPAC Security Force Facility	1944	Not Eligible
1014/Locomotive Shed/Railroad Equipment Maintenance	1944	Not Eligible
1016/General Storehouse/DRMO	1944	Not Eligible w/SHPO concurrence
1021/Garage Public Works	1944	Not Eligible
1026/Sawmill/Public Works	1944	Not Eligible
1039/Storage	1962	Not Eligible
1181/Water Pumping Station	1945	Not Eligible
1247/Smokeless Powder Surveillance Lab	1953	Not Eligible
1268/Storage Building	1953	Not Eligible

Table 3.18–1. Identified Archaeological and Architectural Sites on NBK at Bangor (continued)

NBK AT BANGOR FACILITIES [6]	CONSTRUCTION DATE	NRHP ELIGIBILITY
1276/Scale House	1953	Not Eligible
1400/Garage	1949	Not Eligible
1429/Telephone Exchange	1959	Not Eligible
1459/Storage Shed	1959	Not Eligible
1461/Railroad Sandblast Shop	1959	Not Eligible
1469/Air Generation and Distribution Facility	1963	Not Eligible
1659/Gate Posts	1945	Not Eligible
2000/Trident Training Facility	1976	Eligible
2150/COMSUBGRY 9 Facility	1980	Not Eligible
3033/Railroad Scale House	1944	Eligible
4183/Radio Transmitter Bldg	1945	Not Eligible
4189/Guest Cottage	1948	Not Eligible
4282/Fire Water Reservoir	1953	Not Eligible
4620/Officers' Club/Training Center	1964	Not Eligible
6034/Sorting Warehouse	1944	Eligible
6035/Sorting Warehouse	1944	Eligible
6036/Sorting Warehouse	1944	Eligible
6037/Utility Building	1944	Eligible
6409/Flammable Storage Bldg	1945	Not Eligible
6473/Air Compressor Building	1963	Not Eligible

Sources: 1. Lewarch et al. 1993; 2. Grant et al. 2010; 3. HRA 2011; 4. Sackett 2010; 5. Sackett 2011; 6. Hardlines 2010.

Note: The SHPO has not concurred with these determinations except as noted.

3.18.1.2.2 ARCHAEOLOGICAL RESOURCES

Four archaeological sites associated with the activities of indigenous populations are located in the vicinity of the Bangor waterfront. American Indian site 45KP108 is a shell midden (locations where shells and other food debris have accumulated over time, often representing locations of past aboriginal use); known as the Carlson Spit Shell Midden, this shell midden is located along the shoreline, approximately one mile south of Delta Pier and is eligible for the NRHP (Lewarch et al. 1997). Because of its distance from the project APE, this site is not discussed further. Sites 45KP106 and 45KP107 are also shell middens and are located just to the north of Floral Point; neither is considered eligible for listing in the NRHP (Lewarch et al. 1997). Site 45KP212 is a multi-component site; the American Indian component consists of two cobble tools and a disturbed midden deposit.

The historic period is represented by a number of archaeological sites, primarily associated with logging and subsistence farming activities in the area of NBK at Bangor. These sites include collapsed historic structures, foundations of buildings relocated or razed during World

War II, historic land use complexes (HLUC), orchard complexes, scattered fruit trees and ornamental plants, debris scatters, a marked historic grave (Lewarch et al. 1993) and a small collapsing cabin with wire fence and low density historic debris scatter (45KP211) (Grant et al. 2010). Historic Navy activity is also represented by the historic component of a multi-component site. Site 45KP212 consists of two cobble tools, a damaged residential concrete foundation remaining from when the house was barged away after the Navy condemned the property, debris and ornamental plants associated with the former residence, concrete foundation fragment and associated piers of unknown origin, a pedestrian footbridge, and a bulkhead/pier associated with a former picnic area (Grant et al. 2010).

Recent surveys of the EHW project areas (proposed action and alternatives) covered all areas above the water line, including the beach and an equipment laydown area (Grant 2011; HRA 2011). There was no in-water historic properties survey of the underwater portion of the APE, but examination of NOAA charts, side-scan sonar images, detailed bathymetric data, and diver surveys of the nearshore identified no shipwrecks, submerged aircraft, or features that would be visible above the seabed. The probability for intact Paleo-Indian or Archaic archaeological deposits under the seabed is low owing to the destructive effects of sea level rise on the readily erodible local glacial deposits (see Section 3.18.1.2.5). Investigations revealed no prehistoric or ethnohistoric cultural materials or sites within the upland portions of the APE. A berm (site 45KP214) was recorded in the southern staging area portion of the APE. The berm extends over 265 feet and is almost 24 feet high at its apex. The berm is associated with the demolished K.C. Magazine bunker complex that is no longer extant. The berm is not eligible for the NRHP (HRA 2011; Appendix I).

3.18.1.2.3 ARCHITECTURAL RESOURCES

Architectural resources representing three eras are located on NBK at Bangor. The first set of resources includes the period of logging, subsistence farming, and recreation that preceded Navy ownership of the study area in 1942. These resources include cabins, concrete structures, and a well house (Table 3.18–1) that were recorded during the 1992 archaeological survey (Lewarch et al. 1993). Those resources that are not intact buildings or structures are treated as historic archaeological sites rather than as architecture; none are considered eligible for listing in the NRHP.

The second and third sets of architectural resources relate to the Navy's use of the installation during World War II and the Cold War era. They include: Administration Area Buildings 1, 3, and 4; the Industrial Area District; and the original Marginal Wharf. Marginal Wharf, Delta Pier, and the existing EHW are within the vicinity of the Bangor waterfront and are within the APE. Marginal Wharf was built in 1944 and later was used to load munitions bound for the Vietnam conflict. It is not considered eligible for the NRHP (HRA 2011). Delta Pier and the existing EHW had prominent roles during the Cold War, providing support for the Trident Nuclear Submarine fleet; both are considered eligible for the NRHP based on their Cold War association (Sackett 2010). Delta Pier and EHW are eligible for listing in the NRHP under Criteria A and C for their association with the United States Triad Strategic Nuclear Deterrent System during the Cold War era and their unique engineering, each representing a specific element that defines Strategic Weapons Facility, Pacific (Sackett 2010). The Shelton-Bangor Railroad, a World War II-era railroad, is represented by an emergency derail run-out, and remaining section of the mainline that has direct association with Hood Canal, where the mainline terminated on the Marginal Wharf. A portion of this railroad has been determined not eligible for the NRHP

(Grant et al. 2010) and many other elements are outside the APE (Sackett 2011). However, the intact section adjacent to Delta Pier and water line route 1 is eligible for inclusion in the NRHP under Criterion A for its association with significant events in World War II as part of a trans-shipment facility to support the offensive drive against Japan, and under Criterion C for the engineering feat of its rapid construction and environmental design elements (Sackett 2011).

3.18.1.2.4 TRADITIONAL CULTURAL PROPERTIES

Cultural resources may also include Traditional Cultural Properties (TCPs) (National Park Service 1998) and Properties of Traditional Religious and Cultural Importance to an Indian Tribe (PTRCIT) (NHPA Section 101(d)(6)(A) and 36 CFR 800.2(c)(2)). TCPs are eligible for listing in the NRHP owing to their "association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining and continuing cultural identity of the community." TCPs may be identified by American Indians or other living communities. PTRCITs may be eligible for the NRHP if they meet NRHP criteria (36 CFR 800.16(l); even if not eligible for the NRHP, this resource type may be afforded protection by other laws, regulations, or executive orders. For any cultural resource to be NRHP eligible, it must be a property (i.e., a physical place) in addition to meeting other eligibility criteria. To date no TCPs or PTRCITs have been identified in the proposed project's APE. American Indian traditional resources, including shellfish, are discussed in Section 3.19.

3.18.1.2.5 SUBMERGED CULTURAL RESOURCES

The NHPA also applies to submerged or marine resources, and the Navy is responsible for identifying cultural resources and impacts on those resources within its jurisdiction. Consultation procedures parallel the NHPA Section 106 procedures with added emphasis on the protection of submerged resources through avoidance.

NOAA nautical charts show no submerged ships or shipwrecks in the vicinity of NBK at Bangor (NOAA 2007). Because of the extent of modern marine activity and its nature, it is unlikely that unrecorded submerged historic resources exist along the Bangor shoreline. With the history of sea level changes in Puget Sound and Hood Canal, it is unlikely that submerged prehistoric sites exist within the submerged portion of the APE. No visible historic properties such as shipwrecks, submerged aircraft, or prehistoric or historic-period features extending above the seafloor have been located by diver or remote sensing surveys of the EHW-2 location.

3.18.1.2.6 POTENTIAL FOR PREVIOUSLY UNIDENTIFIED RESOURCES

Analysis of the data collected in the 1992 survey and inventory (Lewarch et al. 1993) and regional literature resulted in the development of a probability model identifying areas of high, medium, and low sensitivity for the presence of cultural resources on NBK at Bangor (Table 3.18–2). The model predicts that areas along saltwater shores have the highest probability for both pre- and post-contact cultural resources. Extensive disturbance of the shoreline from historic and recent activity has probably removed, covered, or destroyed any prehistoric or historic-period shoreline sites that may have been within the area of the Bangor waterfront. Upland flat areas including meadows have a medium probability, and areas with a closed canopy forest are considered to have a low probability for the presence of surviving cultural resources (Lewarch et al. 1993). A survey in 2009 (Grant et al. 2010) tested the sensitivity assessments and found them still valid, within the limits of the investigation.

Table 3.18–2. Probability Model for the Presence of Archaeological Resources on NBK at Bangor

PROBABILITY	ENVIRONMENTAL CHARACTERISTICS
Prehistoric Period Sites	
High	Saltwater shores; near mouths of drainage; relatively flat areas inland from shorelines and blufflines; marshes, other unique habitats such as marshes
Medium	Upland flat areas overlooking drainages, meadows
Low	Closed canopy, climax forest; offshore
Historic Period Sites	
High	Saltwater shores; drainage mouths; relatively flat areas inland from shorelines and blufflines
Medium	Upland flat areas, meadows; marshes, other unique habitats
Low	Closed canopy, climax forest; offshore

Source: Lewarch et al. 1993.

The EHW-2 project site was originally surveyed for archaeological resources in 1992 (Lewarch et al. 1993). Two HLUCs located inland from the existing EHW illustrate the historic use of the project vicinity. HLUC 20 consists of historic resources at two locations (7.19 and 7.24). Location 7.19 is a foundation and metal debris, and location 7.24 is foundation rubble with fruit trees and a large laurel shrub. HLUC 21 is a concrete foundation, a cellar depression, and fruit trees. None of these are eligible for listing in the NRHP. Although the EHW-2 project site could be considered sensitive for the presence of cultural resources based on its location on the shoreline and near a marsh, extensive disturbance associated with the construction of the existing EHW has probably reduced the likelihood for the presence of archaeological resources. A recent survey of the EHW project area also found evidence of extensive disturbance in the northern APE during subsurface sampling (HRA 2011). The survey identified areas of fill and bulldozed cuts (HRA 2011). Examination of the areas proposed for the new pure water facility and the three new buildings has shown that these areas have also been extensively disturbed (Grant 2011).

The existing parking lot where the three new buildings would be constructed is located in an area considered to have low probability for prehistoric or historic-period archaeological resources (Lewarch et al. 1993). This area was previously disturbed to build the parking lot. A portion of the Shelton-Bangor Railroad mainline runs adjacent to the west side of the existing parking lot. Replacement parking spaces would be placed within disturbed and landscaped areas adjacent to existing parking spaces. No historic buildings or structures, and no archaeological properties eligible for listing in the NRHP are in the area of potential effects for proposed parking. The likelihood of encountering subsurface archaeological resources during construction would be low due to low probability and previous site disturbance. Detailed examination of this area and limited subsurface testing are consistent with this conclusion (Grant 2011).

At the proposed pure water facility site, the shoreline is considered to have high potential for the presence of prehistoric and historic-period archaeological resources (Lewarch et al. 1993). However, the location has been affected by previous disturbance and placement of fill to construct Delta Pier, existing roadways, and the railroad bed (Grant 2011).

3.18.2 Environmental Consequences

Under federal law, impacts to cultural resources (whether the resources are archaeological, architectural, or traditional) may be considered adverse if the resources are listed in, or are eligible for listing in, the NRHP, or are important to traditional cultural groups, such as American Indians. An NRHP-listed or eligible resource is known as a historic property. An action results in adverse impacts to a historic property when it alters the resource's characteristics that make the historic property eligible for the NRHP, including relevant features of its environment or use.

Analysis of impacts to cultural resources considers both direct and indirect impacts. Direct impacts may occur by physically altering, damaging, or destroying all or part of a resource; altering characteristics of the surrounding environment that contribute to the resource's importance; introducing visual or audible elements that are out of character with the property or alter its setting; or neglecting the resource to the extent that it deteriorates or is destroyed. Direct impacts can be assessed by identifying the types and locations of activities and determining the exact location of cultural resources that could be impacted. For example, introducing traffic to a previously quiet location could be considered an impact. Indirect impacts could result from project-related features that lead to effects. For example, project-induced population increases could result in inadvertent impacts to cultural resources, including trampling and erosion, or an increase in the potential for vandalism.

The Skokomish agreed (refer to Appendix H) with the finding of the archaeological survey report (HRA 2011) that no historic properties were affected, referring to archaeological resources. In a November 2011 letter (Appendix N), the Port Gamble S'Klallam Tribe disagreed with the Navy's definition of the APE. The Lower Elwha Klallam and Jamestown S'Klallam Tribes have deferred to the Port Gamble S'Klallam Tribe regarding the EHW-2 APE. Based on further discussion with the Port Gamble S'Klallam Tribe and consideration of tribal views, the Navy has determined that the APE as defined adequately addresses areas where the undertaking may directly or indirectly cause alterations in the character or use of historic properties. The Skokomish and Suquamish Tribes have no further Section 106 concerns within the EHW-2 APE. The Washington SHPO has concurred with the Navy's evaluation of the Delta Pier and EHW as eligible for the NRHP, with the finding of no adverse effect on NRHP-eligible historic properties, and with the Navy's APE (Appendix I). This concludes Section 106 consultation with the SHPO for historic resources.

3.18.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.18.2.1.1 CONSTRUCTION

Archaeological Resources. The Navy has found, and the SHPO and the Skokomish have concurred, that there are no archaeological historic properties affected (refer to Appendix H and Appendix I).

There are no NRHP-eligible archaeological resources within the project footprint or APE, including the marine, shoreline, and upland project areas. Although the saltwater shoreline is sensitive for cultural resources, this shoreline is considered to have a low probability for the presence of significant archaeological resources due to the extent of disturbance (HRA 2011).

No shipwrecks or submerged aircraft have been located in the APE. Although isolated artifacts associated with fishing or marine mammal hunting may exist in the submerged portion

of the APE, there is low probability for the presence of intact inundated Paleo-Indian or early Holocene archaeological sites or features owing to destructive processes associated with sea level rise. Evidence of pre-contact and early historic-period occupation and resource harvesting activities has likely succumbed to heavy disturbance of the shoreline caused by development of the shoreline for NBK at Bangor facilities such as the existing EHW (HRA 2011).

Clearing land for various project components including the relocated pure water facility, three new buildings and replacement parking spaces, and the associated equipment laydown area would disturb approximately 13 acres, with the potential to impact unknown cultural resources. Although most of this acreage would be revegetated, disturbance to any archaeological resources that could be present cannot be reversed. A portion of this area includes land adjacent to Hunter's Marsh, which is considered to have medium to high probability for the presence of archaeological resources due to the likelihood of use by American Indians in the past (Lewarch et al. 1993; Grant et al. 2010). However, the surveys that included all of this area recorded no cultural resources (Lewarch 1993; HRA 2011; Grant 2011). Surface survey and subsurface testing of the area along the Archerfish Road extension revealed extensive disturbance, further reducing the likelihood of locating a historic property (HRA 2011). Construction of the new pure water facility and water line is not expected to encounter intact subsurface archaeological resources because of the extensive disturbance found in this location (Grant 2011). Since water line route 1 would be placed above ground, and water line route 2 would be installed in a previously disturbed area, there is a low likelihood for encountering subsurface deposits during construction.

The location for equipment laydown just east of an existing supplies, equipment, and vehicle outdoor storage area along Archerfish Road, and consisting of 5.0 acres, was also surveyed. The survey identified a berm (45KP214, Table 3.18–1) associated with the demolished K.C. Magazine bunker complex; the berm is not eligible for the NRHP (HRA 2011; Appendix I).

The proposed location of three new buildings in the existing industrial area of the Lower Base was surveyed (Lewarch et al. 1993); no cultural resources were located and there would be no adverse effects on historic archaeological properties. Subsurface archaeological material would be unlikely due to low probability and previous site disturbance (Grant 2011). Replacement parking spaces are to be located on existing paved areas or highly disturbed locations (Grant 2011).

Architectural Resources. The SHPO has concurred that there would be no adverse effect on historic properties from construction of Alternative 1.

More than 25 architectural resources are located within the APE. Approximately nine of these existing facilities and/or structures listed in Table 3.18–3 would be modified or demolished to comply with Department of Defense Explosives Safety Board (DDESB) and Naval Ordnance Safety and Security Activity (NOSSA) requirements to protect buildings located in the vicinity of explosives handling operations. None of those planned for hardening or demolition are considered eligible for the NRHP (Table 3.18–3).

Three of the architectural resources within the APE have been determined eligible for inclusion in the NRHP: the existing EHW, the Delta (or Refit) Pier, and the two segments of the Shelton-Bangor Railroad mainline that run adjacent to the proposed new buildings at the intersection of Trigger and Scorpion and adjacent to Delta Pier (Table 3.18–1). The Washington SHPO has concurred with the evaluations of EHW-1 and Delta Pier and the segments of the Shelton-Bangor Railroad mainline as eligible for listing in the NRHP.

Although construction of the EHW-2 would affect the integrity of the setting of the existing EHW by changing how it looked during its period of significance, SHPO has concurred with the Navy's finding that this would be "no adverse effect" (Appendix I). Similarly, construction of the pure water facility and water line route 1 or 2 would not adversely affect the characteristics that make these historic properties eligible for inclusion in the NRHP. SHPO has concurred with the Navy's finding of no adverse effect (Appendix I).

Construction-related noise and traffic associated with the proposed action would not affect historic properties, as it would be consistent with ongoing operation and maintenance of the existing facilities. Modern construction methods used for the two NRHP-eligible buildings preclude effects from the vibrations associated with the construction. Additional personnel associated with construction of this alternative would not constitute a significant source of indirect impacts. In compliance with SECNAVINST 5090.8A and 4000.35A, the Navy would ensure that construction crews are aware that any cultural resources discovered during land clearing for the new road should not be disturbed, and crews would be instructed in procedures for reporting any such finds.

In the unlikely event that project actions encounter unanticipated archaeological resources, work would stop until the NBK at Bangor cultural resources manager is notified. If appropriate, and in compliance with Section 106 of the NHPA, the Navy would consult with the Washington SHPO to determine a course of action. If the discovery consists of human remains, or other objects addressed by the NAGPRA, then consultation with the appropriate American Indian tribes would also be necessary. Excavation of an archaeological site would require additional site survey and documentation. NBK at Bangor has initiated consultation concerning this project with the Washington SHPO and the Skokomish, Port Gamble S'Klallam, Lower Elwha Klallam, Jamestown S'Klallam, and Suquamish Tribes. Consultation correspondence was not sent to the Lower Elwha because, for this project, they deferred to the Suquamish Tribe for NHPA Section 106 matters (refer to Appendix I).

Construction and operation of the three buildings and replacement parking, the pure water facility and water line, underground storage tank, and EHW-2 with its associated infrastructure, would not affect access to tribal fishing areas or other traditional use areas because these projects are located away from the traditional use areas.

Table 3.18–3. Buildings/Structures Located in the Area of Potential Effect

Facility	NOSSA Require-ment	Facility Number	Date Built	Area of Potential Effect		NRHP Status	Effect
				Visual	Safety Zone [1]		
Ballast Can Storage Shed	None	6071	1982	No	Yes	Not Eligible (SHPO concurs)	No Effect
Ballast Can Main. Facility	None	6310	2010	No	Yes	Not Eligible (SHPO concurs)	No Effect
Emergency Gen for Sewer Lift	None	7006	1978	Yes	No	Not Eligible (SHPO concurs)	No Effect
Transf. Switch Bldg	None	7036	1979	Yes	No	Not Eligible (SHPO concurs)	No Effect

Table 3.18–3. Buildings/Structures Located in the Area of Potential Effect (continued)

FACILITY	NOSSA REQUIRE-MENT	FACILITY NUMBER	DATE BUILT	AREA OF POTENTIAL EFFECT		NRHP STATUS	EFFECT
				VISUAL	SAFETY ZONE [1]		
Administrative/ Construction Field Office	Demolish/ Relocate	7053	1975	No	Yes	Not Eligible (SHPO concurs)	No Effect
Inert Storage	Demolish/ Relocate	7064	1984	No	Yes	Not Eligible (SHPO concurs)	No Effect
Ebb Regulator/ Capacitor	None	7067	1981	No	Yes	Not Eligible (SHPO concurs)	No Effect
Rigging Shop	Demolish/ Relocate	7068	1984	No	Yes	Not Eligible (SHPO concurs)	No Effect
Guard Shelter	None	7075	1984	No	Yes	Not Eligible (SHPO concurs)	No Effect
General Purpose Berthing/Service Pier	None	7100	1981	No	Yes	Not Eligible (SHPO concurs)	No Effect
Port Operations	None	7101	2003	No	Yes	Not eligible (SHPO concurs)	No effect
Bus Shelter	None	7104	1978	Yes	No	Not Eligible (SHPO concurs)	No Effect
Waterfront Support Bldg	Harden	7125	2004	No	Yes	Not Eligible (SHPO concurs)	No Effect
Marginal Wharf	None	7176	1945	Yes	No	Not Eligible (SHPO concurs)	No Effect
Paint /Blast Shop Storage	None	7191	1950	Yes	No	Not Eligible (SHPO concurs)	No Effect
Submarine Crew Mess	None	7204		No	Yes	Not Eligible (SHPO concurs)	No Effect
Advanced Undersea Weapons Bldg	Harden	7246	1953	No	Yes	Not Eligible (SHPO concurs)	No Effect
Waterfront Operations Bldg	Harden	7247	2004	No	Yes	Not Eligible (SHPO concurs)	No Effect
K/B Dock	None	7273	1949	No	Yes	Not Eligible (SHPO concurs)	No Effect
Delta/Refit Pier	None	7400	1978	Yes	No	Eligible (SHPO concurs)	No Adv. Effect
Refit Support Facility	Demolish/ Relocate	7408	1978	No	Yes	Not Eligible (SHPO concurs)	No Effect
Waterfront Sec Fac #1	None	7445	2006	Yes	No	Not Eligible (SHPO concurs)	No Effect

Table 3.18–3. Buildings/Structures Located in the Area of Potential Effect (continued)

FACILITY	NOSSA REQUIRE-MENT	FACILITY NUMBER	DATE BUILT	AREA OF POTENTIAL EFFECT		NRHP STATUS	EFFECT
				VISUAL	SAFETY ZONE [1]		
Explosives Handling Wharf 1	None	7501	1978	Yes	No	Eligible (SHPO concurs)	No Adv. Effect (SHPO concurs)
Oil/Water Separator	None	7512	1978	Yes	No	Not Eligible (SHPO concurs)	No Effect
Pure Water Facility	Demolish/ Relocate	7604	1964	No	Yes	Not Eligible (SHPO concurs)	No Effect
Guard Shelter	None	7611	1964	Yes	No	Not Eligible (SHPO concurs)	No Effect
Emergency Gen. Bldg	None	7702	1978	No	Yes	Not Eligible (SHPO concurs)	No Effect
Shelton-Bangor Railroad mainline segments	None	None	1944	Yes	No	Eligible (SHPO concurs)	No Adv. Effect (SHPO concurs)
Offices in five modular Conex boxes on shore	Harden	None	2005 (approx)	No	Yes	Not Eligible	No Effect

Source: Sackett 2010

1. Buildings located in the Safety Zone will be modified to comply with DDESB and NOSSA requirements.

Note: The SHPO has not concurred with these determinations except as noted.

3.18.2.1.2 OPERATION/LONG-TERM IMPACTS

The SHPO has concurred with the Navy's finding of no adverse effect on historic properties for the EHW-2 project elements (Appendix I). Operation of the EHW-2 would not constitute an adverse effect on the existing EHW. The Delta (or Refit) Pier and Shelton-Bangor Railroad mainline also would not be adversely affected by the operation of the new EHW facility, the pure water facility and water line, or the relocated facilities area (three buildings). Use of the staging area to store vehicles, equipment, and materials, and use of the new road would have no effect as these uses are similar to current activities that occur at the adjacent facility. Since additional ground disturbance would occur in previously disturbed areas, it is extremely unlikely that any previously undiscovered archaeological resources that might be present would be impacted through operations. Because no traditional resources have been identified within the area of potential effect, there would be no impacts to this resource type. Maintenance, as distinct from operation, associated with this alternative would have no impact on any historic property, since routine inspections, repair, and replacement of facility components as required would occur within the footprint of the existing and new facilities and the EHW-2 project area.

3.18.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.18.2.2.1 CONSTRUCTION

The differences between Alternative 2 and 1 lie solely in the configuration of piles. For cultural resources, these project components would impact the existing EHW in the same manner as for Alternative 1, and effects on the Shelton-Bangor Railroad mainline from water line route 1 would also be the same. The SHPO has concurred with the Navy's finding of no adverse effect. No other impacts to historic properties would be anticipated.

3.18.2.2.2 OPERATION/LONG-TERM IMPACTS

Operation/long-term impacts would be the same as Alternative 1.

3.18.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.18.2.3.1 CONSTRUCTION

From the viewpoint of the cultural resources, Alternative 3 is similar to Alternative 1. The onshore road would be a little longer, but still crosses an area that has been surveyed for cultural resources, where no historic properties were located. The settings of the existing NRHP-eligible EHW and Shelton-Bangor Railroad mainline would be impacted by construction, but the SHPO has concurred that there would be no adverse effect.

3.18.2.3.2 OPERATION/LONG-TERM IMPACTS

Operation/long-term impacts would be the same as Alternative 1.

3.18.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.18.2.4.1 CONSTRUCTION

Alternative 4 differs from Alternative 1 in the construction of the wharf component, but the impact to the existing EHW and the Shelton-Bangor Railroad mainline segments would be the same. The SHPO has concurred that there would be no adverse effect.

3.18.2.4.2 OPERATION/LONG-TERM IMPACTS

Operation/long-term impacts would be the same as Alternative 1.

3.18.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.18.2.5.1 CONSTRUCTION

Under this alternative, the differences from the other alternatives lie in the design of the trestles, and the lack of pilings for the wharf. These project elements would impact the integrity of the existing EHW and water line route 1 would impact the Shelton-Bangor Railroad mainline, but the SHPO has concurred that this would not be an adverse effect. The onshore project elements are the same as Alternative 1.

3.18.2.5.2 OPERATION/LONG-TERM IMPACTS

Operation/long-term impacts would be the same as Alternative 1.

3.18.2.6 No-Action Alternative

With the No-Action Alternative, the EHW-2 would not be constructed. The Navy would continue to manage its cultural resources in accordance with Navy regulations and the NHPA.

3.18.2.7 Mitigation Measures and Regulatory Compliance

No mitigation measures would be required as there are no adverse effects.

Pursuant to the implementing regulations of the NHPA, 36 CFR Part 800.13, other applicable federal laws, and DoD and Navy regulations, the "inadvertent discovery" of potentially significant archaeological resources would compel the Navy to evaluate the effects to such resources through consultation with the SHPO, affected American Indian tribes, USACE, and other interested parties. Similarly, if American Indian human remains, funerary items, sacred objects, or items of cultural patrimony are encountered, the Navy must comply with the NAGPRA and other pertinent authorities.

3.18.3 Summary of Impacts

Impacts to cultural resources associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.18–4.

Table 3.18–4. Summary of Impacts to Cultural Resources

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO CULTURAL RESOURCES
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* No adverse effect on historic properties. Some potential for disturbing unknown archaeological resources during construction. *Operation/Long-term Impacts:* No adverse effect on historic properties.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* No adverse effect on historic properties. Some potential for disturbing unknown archaeological resources during construction. *Operation/Long-term Impacts:* No adverse effect on historic properties.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* No adverse effect on historic properties. Compared to Alternative 1, slightly greater potential for disturbing unknown archaeological resources because of the additional area disturbed for road construction. *Operation/Long-term Impacts:* No adverse effect on historic properties.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* No adverse effect on historic properties. Compared to Alternative 1, slightly greater potential for disturbing unknown archaeological resources because of the additional area disturbed for road construction. *Operation/Long-term Impacts:* No adverse effect on historic properties.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* No adverse effect on historic properties. Some potential for disturbing unknown archaeological resources during construction. *Operation/Long-term Impacts:* No adverse effect on historic properties.
No-Action Alternative	No impact.

Table 3.18–4. Summary of Impacts to Cultural Resources (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO CULTURAL RESOURCES
Mitigation • The SHPO has concurred with the Navy's finding of no adverse effect on historic properties. Therefore, no mitigation is required for effects on historic properties.	
Consultation and Permit Status • The Navy concluded Section 106 consultation with the SHPO for historic resources. The Navy would consult with the SHPO and affected American Indian tribes in the event of inadvertent discovery of unknown archaeological resources, or American Indian human remains, funerary items, sacred objects, or items of cultural patrimony. • No permits are required.	

3.19 AMERICAN INDIAN TRADITIONAL RESOURCES

American Indian traditional resources are those resources that embody the beliefs, customs, and practices of a living community of people, in this case American Indians. The place of these resources in the culture has been passed down through the generations, usually orally or through practice. The traditional cultural significance of a resource arises from the role the property plays in a community's historically rooted beliefs, customs, and practices (National Park Service 1998). Not all traditional resources are eligible for listing in the NRHP, but they may be identified and afforded protection under other laws and regulations.

DOD POLICY AND SECNAVINST

On 21 October 1998, the DoD promulgated its Native American and Alaska Native Policy emphasizing the importance of respecting and consulting with tribal governments on a government-to-government basis (explanatory text was added on 21 November 1999). The Policy requires an assessment, through consultation, of the effects of proposed DoD actions that may have the potential to significantly affect protected tribal resources (including traditional subsistence resources such as shellfish and cedar bark), tribal rights (such as fisheries), and American Indian lands before decisions are made by the services.

In 2005, the Navy updated its policy for consultation with federally recognized Indian tribes. SECNAVINST 11010, Department of the Navy Policy for Consultation with Federally Recognized Indian Tribes implements DoD policy within the Department of the Navy and encourages ongoing consultation. Subsequent updates to SECNAVINST 5090.8a (Policy for Environmental Protection, Natural Resources, and Cultural Resources Programs 2006) also mandate American Indian consultation.

LAWS, EXECUTIVE ORDERS, AND MEMORANDA MANDATING CONSULTATION

In addition to the specific policy and SECNAVINST cited above, other federal laws, executive orders, and memoranda include policies requiring consultation with American Indians regarding concerns specific to native interests. These include: NHPA, AIRFA, the Archaeological Resources Protection Act, and NAGPRA; EO 12898 Environmental Justice, EO 13007 Indian Sacred Sites, EO 13175 Consultation and Coordination with Indian Tribal Governments, Presidential Memorandum dated 5 November 2009 emphasizing agencies' need to comply with EO 13175, and the Presidential Memorandum dated 29 April 1994 Government-to-Government Relations with Native American Governments.

GOVERNMENT-TO-GOVERNMENT CONSULTATION

In accordance with DoD policy and Navy instructions, the Navy conducts consultation with American Indian tribes when proposed actions have the potential to significantly affect tribal resources, tribal rights, or Indian lands. Consultation is ongoing regarding the proposed action. The Navy has invited, and is in, government-to-government consultations with federally recognized American Indian tribes that use resources in the vicinity of the project area, including the Skokomish, Port Gamble S'Klallam, Lower Elwha Klallam, Jamestown S'Klallam, and Suquamish Tribes. Consultation with the affected tribes will continue. Appendix H includes tribal consultation correspondence to date.

3.19.1 Existing Environment

3.19.1.1 Tribal Treaty Rights and Trust Responsibilities; Reservation of Rights by American Indians

Treaties with American Indian tribes are government-to-government agreements, similar to international treaties, and preempt contrary state laws. Tribal treaty rights are not affected by later federal laws (unless Congress clearly abrogates treaty rights). Treaty language securing fishing and hunting rights is not a "grant of rights (from the federal government to the Indians), but a grant of rights from them - a reservation of those not granted" (*United States v. Winans,* 25 S. Ct. 662, (1905)). This means that the tribes retain rights not specifically surrendered to the United States. Furthermore, the United States has a trust or special relationship with American Indian tribes.

This unique relationship provides the basis for legislation, treaties, and EOs that grant unique rights or privileges to American Indians. The trust responsibility has been interpreted to require federal agencies to carry out their activities in a manner that is protective of American Indian treaty rights. EO 13175 (Consultation and Coordination with Indian Tribal Governments) affirms the trust responsibility of the United States and directs agencies to consult with American Indian tribes and respect tribal sovereignty when taking actions affecting such rights.

The Treaty of Point No Point signed by the federal government and the S'Klallam and Skokomish Tribes on January 26, 1855, secured these tribes the following:

> The right of taking fish at usual and accustomed grounds and stations is further secured to said Indians in common with all citizens of the Territory, and of erecting temporary houses for the purposes of curing, together with the privilege of hunting and gathering roots and berries on open and unclaimed lands. Provided, however, that they shall not take shell-fish from any beds staked or cultivated by citizens.

The Suquamish also secured the "right of taking fish at usual and accustomed grounds" in the Treaty of Point Elliot, signed on January 22, 1855. Usual and Accustomed (U&A) fishing grounds for the Point No Point signatories encompass the waters and shorelines of Hood Canal and its tributaries, which include NBK at Bangor. Rights to resources in these areas were reaffirmed in the 1974 Boldt Decision (see Section 3.19.1.1.1) (Point No Point Treaty Council [PNPTC] 2010). The Supreme Court of the United States has recognized that the treaty right includes a right of access within all of the tribes' U&A fishing areas (*United States v. Winans,* 198 U.S. 371 (1905)).

The Boldt Decision also includes Hood Canal within the Suquamish U&A (*United States v. Washington,* 459 F.Supp. 1020, 1049 [W.D. Wash. 1975]):

> The usual and accustomed fishing places of the Suquamish Tribe include the marine waters of Puget Sound from the northern tip of Vashon Island to the Fraser River including Haro and Rosario Straits, the streams draining into the western side of this portion of Puget Sound and also Hood Canal.

The primacy of Skokomish fishing rights in the waters of Hood Canal, over those of other tribes granted rights under this treaty, particularly the Suquamish, was affirmed under a 1985 ruling by the Ninth Circuit Court of Appeals (United States v. Skokomish Indian Tribe, 764 F.2d 670 [9th Cir. 1985]). As a result of the ruling, the secondary rights of the Suquamish were also established. Since the 1985 court decision, the Suquamish Tribe must receive permission from the Skokomish Tribe to fish south of the Hood Canal Bridge; this permission has not been granted.

Through the PNPTC, four local tribes developed agreements with NBK at Bangor regarding access to traditional resource areas within the base: the Skokomish, Lower Elwha Klallam, Port Gamble S'Klallam, and Jamestown S'Klallam Tribes. Today, the PNPTC includes only the Jamestown S'Klallam Tribe and the Port Gamble S'Klallam Tribe.

3.19.1.1.1 UNITED STATES V. WASHINGTON STATE

Known as the Boldt Decision, after the presiding United States District Court judge George Boldt, United States v. Washington (384 F. Supp. 312 [W.D. Wash. 1974], aff'd, 520 F.2d 676 [9th Cir. 1975]) affirmed the rights of Washington tribes who were party to the various treaties to harvest fish in their usual and accustomed places, identified the U&A locations of various tribes, and also allocated 50 percent of the salmon and steelhead fishery to treaty tribes. The decision established that the Skokomish, Port Gamble S'Klallam, Lower Elwha Klallam, Jamestown S'Klallam, and Suquamish Tribes have U&A that includes the project location.

A key part of the decision was this interpretation of the treaty language from the Point No Point and Point Elliott treaties:

> By dictionary definition and as intended and used in the Indian treaties and in this decision, 'in common with' means sharing equally the opportunity to take fish ... therefore, non-treaty fishermen shall have the opportunity to take up to 50% of the harvestable number of fish ... and treaty right fishermen shall have the opportunity to take up to the same percentage (U.S. District Judge George Boldt, U.S. v. Washington, 384 F. Supp. 312 [W.D. Wash. Feb 12 1974], aff'd, 520 F.2d 676 [9th Cir. 1975]).

3.19.1.2 American Indian Use of NBK at Bangor

American Indian history in Puget Sound and their use of the project area is summarized in Section 3.18.1.1.

3.19.1.3 Traditional Resources

The Skokomish, Suquamish, Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes have identified shellfish and cedar bark as resources located on NBK at Bangor that are of particular traditional importance. In the cooperative agreement of 1997, signed between the Navy and the PNPTC (Skokomish, Port Gamble S'Klallam, Lower Elwha Klallam, and Jamestown S'Klallam Tribes), the parties agreed during the term of the agreement to harvest intertidal shellfish at one of five beaches at NBK at Bangor. Prior to increased waterfront security measures on NBK at Bangor, five beaches were designated for shellfish harvesting. Four of these beaches were used for recreational shellfish harvesting by NBK at Bangor residents. The fifth beach was identified in the 1997 agreement with the PNPTC to be used for tribal shellfish harvesting. Currently, all beaches are closed to NBK at Bangor residents. Tribes continue to harvest shellfish at the beach south of Delta Pier, and this beach has been identified as an area of

traditional tribal resource use. The species composition and timing of the tribal shellfish harvest is governed by the PNPTC, which develops "annual shellfish management plans for each species and geographic region within the usual and accustomed fishing area of the PNPTC tribes. These plans are developed jointly with the state of Washington" (PNPTC 2010).

3.19.2 Environmental Consequences

The evaluation of impacts to a traditional resource considers whether the resource itself is affected or if there is a change in access to the resource. Impacts may be clearly identified, as when a known traditional resource is directly affected or access is changed. However, consultation with interested and affected American Indians is necessary to identify and evaluate the extent of any adverse effects, and to develop appropriate mitigations.

3.19.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.19.2.1.1 CONSTRUCTION

Construction of the EHW-2 would result in the direct loss of benthic organisms such as clams and oysters in the footprints of the pilings, and the loss of benthic organisms in the construction zone where sediments are disturbed. There are no changes to the status quo regarding tribal access to traditional resources at the NBK at Bangor facility as a result of Alternative 1, including designated shellfish harvesting locales and cedar bark gathering areas; both are located outside of the project area, with the shellfish beach approximately 5,000 feet south of the EHW-2 project area and 1,000 feet south of Delta Pier; cedar bark gathering areas are located outside of the upland project locations. The new pure water facility proposed for the foot of the south Delta Pier trestle is approximately 1,000 feet north of the shellfish beach and would not affect access to the beach, which is from the south. Significant construction noise impacts to these traditional harvest areas are not expected due to their distance from the project area. In addition, construction would not result in any discharge to these shellfish beds or their environs, so there would be no effect on the quality of these beds.

The in-water work window for the proposed project is between July 16 and February 15 for each construction year. As discussed in Section 3.8.2.1, construction within the in-water work window would minimize impacts to all juvenile salmonid species. Therefore, significant impacts to juvenile salmonids are not expected.

Adult salmonids return to Hood Canal during the in-water work window. Construction may impact adult salmon and steelhead that could be harvested by the tribes, since pile driving (hammer and vibratory) would be conducted during adult salmon and steelhead return to Hood Canal, which may cause the salmon and steelhead to move to a different location within Hood Canal. Although most adult salmonid species are not as dependent on the nearshore environment as their juvenile life stages, adult summer-run chum salmon are more abundant in the nearshore during their return migration than other species, and, therefore, have the potential to experience greater impacts from the project, notably during construction. This would not result in a net loss of tribal resources, but could increase the time allocated to observe the tribes' fishing rights. During construction, it is possible that adult salmon and steelhead could come within the injury zone (13 feet single strike, 1,522 feet multiple strikes) of the impact hammer. No injury zone has been identified for vibratory hammers. Since juvenile salmon and steelhead are predominately out of the area during the in-water work window, impacts to future salmon and steelhead populations are not anticipated. Although some adult salmon and steelhead could be injured

during impact pile driving, the impact would be localized, and no significant impacts to the overall quantity of available adult salmon and steelhead in Hood Canal are expected with the construction or operation of the proposed project.

As discussed in Section 3.4.2.1, scuba divers between Hazel Point and Termination Point on the Toandos Peninsula could experience underwater noise levels that could cause a behavioral response including increased breathing and elevated heart rate within 40,000 feet of the construction site during pile driving activity, but they would not receive levels sufficient to cause injury. Tribal divers engaged in resource harvest within this area could experience these effects.

3.19.2.1.2 OPERATION/LONG-TERM IMPACTS

The long-term presence, operation, and maintenance of the EHW-2 structure is not anticipated to substantially alter the general migration patterns of Hood Canal salmonids or forage fish. In the immediate vicinity of the structure, these species are expected to either migrate underneath the nearshore trestles or around the offshore structures, but are not expected to cross to the western shoreline of Hood Canal to avoid the structure altogether. The structure's presence is not anticipated to result in broadscale changes in presence or distribution of these species. In addition, the structure occurs within the enclosed waterfront restricted area; there is currently no tribal fishing access within the waterfront restricted area. Although the structure may provide some habitat for ambush predators, this increase would not be large enough to affect salmonids or forage fish at a species or regional population level. As a result, the long-term presence, operation, and maintenance of the EHW-2 structure is not anticipated to adversely affect the migration or predator-prey relationships for salmonids or forage fish in a manner that would impact tribal net fishing activities. The Navy anticipates no significant impacts to shellfish and finfish harvest or cedar bark harvest areas as a result of operation and maintenance of the EHW-2 nor would the three relocated facilities or the pure water facility affect tribal access to traditional use areas. Tribes have expressed concerns about the level of impact._The pure water facility would not discharge wastewater or untreated stormwater to the marine environment.

3.19.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.19.2.2.1 CONSTRUCTION

The differences between Alternative 2 and 1 lie solely in the configuration of piles. Impacts to traditional resources would be the same as Alternative 1.

3.19.2.2.2 OPERATION/LONG-TERM IMPACTS

As with Alternative 1, the Navy anticipates no significant impact to shellfish and finfish harvest or cedar bark harvest areas as a result of operation and maintenance of Alternative 2. Tribes have expressed concerns about the level of impact.

3.19.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.19.2.3.1 CONSTRUCTION

From the viewpoint of the traditional resources, Alternative 3 would be similar to Alternative 1. Impacts to traditional resources would be the same as Alternative 1.

3.19.2.3.2 OPERATION/LONG-TERM IMPACTS

As with Alternative 1, the Navy anticipates no significant impact to shellfish and finfish harvest or cedar bark harvest areas as a result of operation and maintenance of Alternative 3. Tribes have expressed concerns about the level of impact.

3.19.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.19.2.4.1 CONSTRUCTION

Alternative 4 would be similar to Alternative 1. Impacts to traditional resources would be the same as Alternative 1.

3.19.2.4.2 OPERATION/LONG-TERM IMPACTS

As with Alternative 1, the Navy anticipates no significant impact to shellfish and finfish harvest or cedar bark harvest areas as a result of operation and maintenance of Alternative 4. Tribes have expressed concerns about the level of impact.

3.19.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.19.2.5.1 CONSTRUCTION

Under this alternative, the differences from the other alternatives lie in the design of the trestles and the lack of pilings for the wharf. The onshore project elements are the same as Alternative 1. Impacts to traditional resources would be the same as Alternative 1.

3.19.2.5.2 OPERATION/LONG-TERM IMPACTS

As with Alternative 1, the Navy anticipates no significant impact to shellfish and finfish harvest or cedar bark harvest areas as a result of operation and maintenance of Alternative 5. Tribes have expressed concerns about the level of impact.

3.19.2.6 No-Action Alternative

With the No-Action Alternative, the EHW-2 would not be constructed. The Navy would continue to manage its traditional resources in accordance with treaties, Navy regulations, and other existing laws.

3.19.2.7 Mitigation Measures and Regulatory Compliance

In accordance with DoD policy and Navy instructions, the Navy has invited and is in government-to-government consultation with American Indian tribes regarding impacts to tribal treaty rights and resources. The Navy would implement actions detailed in the Mitigation Action Plan to address tribal concerns. The Navy would notify the tribes of anticipated construction vessel traffic. Divers, including tribal divers, would receive notice of pile driving activities through the Notice to Mariners, as well as notification to the public about upcoming construction activities and noise at the beginning of each construction season.

3.19.3 Summary of Impacts

Impacts to American Indian tribal treaty rights and resources associated with the construction and operation phases of each of the project alternatives, along with mitigation measures, are summarized in Table 3.19–1.

Table 3.19–1. Summary of Impacts to American Indian Resources

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO AMERICAN INDIAN RESOURCES
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* No changes are anticipated to the status quo regarding tribal access to traditional resources at the NBK at Bangor facility. No significant impacts to the overall quantity of available adult salmon and steelhead in Hood Canal are expected with construction. Potential increased time to observe tribes' fishing rights. Tribal divers engaged in resource harvest could experience increased underwater noise levels. Tribes have expressed concerns about the level of impact. *Operation/Long-term Impacts:* None.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* No changes are anticipated to the status quo regarding tribal access to traditional resources at the NBK at Bangor facility. No significant impacts to the overall quantity of available adult salmon and steelhead in Hood Canal are expected with construction. Potential increased time to observe tribes' fishing rights. Tribal divers engaged in resource harvest could experience increased underwater noise levels. Tribes have expressed concerns about the level of impact. *Operation/Long-term Impacts:* None.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* No changes are anticipated to the status quo regarding tribal access to traditional resources at the NBK at Bangor facility. No significant impacts to the overall quantity of available adult salmon and steelhead in Hood Canal are expected with construction. Potential increased time to observe tribes' fishing rights. Tribal divers engaged in resource harvest could experience increased underwater noise levels. Tribes have expressed concerns about the level of impact. *Operation/Long-term Impacts:* None.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* No changes are anticipated to the status quo regarding tribal access to traditional resources at the NBK at Bangor facility. No significant impacts to the overall quantity of available adult salmon and steelhead in Hood Canal are expected with construction. Potential increased time to observe tribes' fishing rights. Tribal divers engaged in resource harvest could experience increased underwater noise levels. Tribes have expressed concerns about the level of impact. *Operation/Long-term Impacts:* None.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* No changes are anticipated to the status quo regarding tribal access to traditional resources at the NBK at Bangor facility. No significant impacts to the overall quantity of available adult salmon and steelhead in Hood Canal are expected with construction. Potential increased time to observe tribes' fishing rights. Tribal divers engaged in resource harvest could experience increased underwater noise levels. Tribes have expressed concerns about the level of impact. *Operation/Long-term Impacts:* None.
No-Action Alternative	No impact.

Table 3.19–1. Summary of Impacts to American Indian Resources (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO AMERICAN INDIAN RESOURCES
Mitigation • The Navy would notify the tribes of anticipated construction vessel traffic. • Divers, including tribal divers, would receive notice of pile driving activities through the Notice to Mariners, as well as notification to the public about upcoming construction activities and noise at the beginning of each construction season. • The Navy would implement actions detailed in the Mitigation Action Plan to address tribal concerns.	
Consultation and Permit Status • The Navy will continue consultation on a government-to-government basis with affected tribes. • No permits are required.	

3.20 COASTAL AND SHORELINE MANAGEMENT

This section identifies the enforceable policies that govern the management of coastal resources and the shoreline in the project area. The CZMA states that federal actions that have reasonably foreseeable effects on coastal users or resources must be consistent to the maximum extent practicable with the enforceable policies of approved state coastal management programs. This section discusses the CZMA and federal consistency with the Washington State CZMP.

CZMA

Congress passed the federal CZMA in 1972 to encourage the appropriate development and protection of the nation's coastal and shoreline resources (16 USC 33:1451-1465). The CZMA gives states the primary role in managing these areas. To assume this role, each state develops a CZMP that describes the state's coastal resources and how these resources are to be managed. In 1976, Washington was the first state to receive federal approval of its CZMP. The CZMP, titled *Managing Washington's Coast — Washington State's Coastal Zone Management Program,* was most recently revised in 2001 (WDOE 2001). WDOE's Shorelands and Environmental Assistance Program is the entity responsible for implementing Washington's program.

The CZMA applies to lands within the coastal zone, including Hood Canal (WDOE 2001). However, the CZMA excludes "…lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal Government, its officers or agents" (16 USC 1453 definition of coastal zone). A CCD for these federal properties is then conducted to determine if project-related impacts to neighboring properties would be consistent under CZMA regulations.

WASHINGTON COASTAL ZONE MANAGEMENT PROGRAM

Washington's CZMP defines Washington State's coastal zone to include the 15 counties with marine shorelines: Clallam, Grays Harbor, Island, Jefferson, King, Kitsap, Mason, Pacific, Pierce, San Juan, Skagit, Snohomish, Thurston, Wahkiakum, and Whatcom. The CZMP applies to activities within the 15 counties, as well as activities outside these counties that may impact Washington's coastal resources. Most, but not all, activities and development outside the coastal zone are presumed to not impact coastal resources.

Hood Canal is identified in the CZMP as a Specially Designated Area and an Area of Concern. These are areas of unique, scarce, fragile, or vulnerable natural habitat; have historic, cultural, or scenic value; are areas of high productivity; or are areas needed to protect and maintain coastal resources.

KITSAP COUNTY SHORELINE MANAGEMENT MASTER PROGRAM

The project site is located within Kitsap County. The Kitsap County Shoreline Management Master Program does not apply to lands owned by federal government, and Kitsap County considers NBK at Bangor as non-designated (Kitsap County Code Title 22).

The Kitsap County Code Title 22, Shoreline Management Master Program, considers Hood Canal to be a Shoreline of Statewide Significance and has established three policies with respect to preservation of natural resources in Hood Canal. These policies include: (1) assessing the potential for adverse impacts to water quality, sediment quality, shellfish, finfish, wildlife, boating, recreational and commercial fishing, public access, scenic vistas, and wetlands;

(2) prohibiting development within the shorelines of Hood Canal that would degrade these resources; and (3) encouraging development that would improve these resources.

FEDERAL CONSISTENCY

Under Washington's CZMP, federal activities that impact any land use, water use, or natural resource within the coastal zone must comply with the enforceable policies of six laws identified in the program document:

- SMA (including local government shoreline master programs),
- State Environmental Policy Act (SEPA) (compliance with NEPA is considered a SEPA-equivalent action under CZMA),
- Clean Water Act,
- Clean Air Act,
- Energy Facility Site Evaluation Council requirements, and
- Ocean Resource Management Act.

The Energy Facility Site Evaluation Council requirements and the Ocean Resource Management Act do not apply to the proposed action because the project is not an energy-generating facility, and does not involve oil and gas development off the coast of Washington, respectively.

Activities and development impacting coastal resources that involve the federal government are evaluated through a process called federal consistency, in which the proponent agency is required to prepare a CCD. This process gives the public, local governments, tribes, and state agencies an opportunity to review federal actions likely to impact Washington's coastal resources or uses. Three categories of activities trigger a federal consistency review: (1) activities undertaken by a federal agency, (2) activities requiring federal approval, and (3) activities using federal funding.

WDOE is responsible for review of the CCD and for making a federal consistency determination. This determination may be in the form of concurrence, conditional concurrence, or objection. The action proposed on NBK at Bangor would be considered an activity undertaken by a federal agency, as well as an activity requiring federal approval, and an activity using federal funding.

SHORELINE MANAGEMENT ACT

Washington's SMA (RCW 90.58) was adopted in 1972 and was established to provide broad policy giving preferences to uses that protect the quality of water and the natural environment, depend on proximity to the shoreline, and preserve and enhance public access or increase recreational opportunities for the public along shorelines. The SMA applies to marine waters; streams with a mean annual flow greater than 20 cubic feet per second; water areas of the state larger than 20 acres; upland areas called shorelines 200 feet landward from the edge of these waters; and the following areas when they are associated with one of the above: biological wetlands and river deltas, and some or all of the 100-year floodplain including wetlands within the floodplain. Hood Canal and its shorelines are designated as "Shorelines of Statewide Significant" under Washington's SMA.

Under the SMA, each city and county adopts a shoreline master program based on state guidelines but tailored to the specific needs of the city or county.

Consultation and Permit Compliance Status. Because proposed construction activities would occur within the Washington Coastal Zone (Hood Canal), the proposed action would be subject to a federal Coastal Zone Consistency Review for compliance with the CZMA. The Navy submitted a Phase I CCD (included in Appendix I of this FEIS) to WDOE in June 2011 and WDOE concurred with the Phase I CCD in August 2011. The Navy will submit an updated Phase II CCD to WDOE in spring 2012.

3.20.1 Existing Environment

Waters in Washington are considered a natural resource owned and managed by Washington State. Bedlands (tidelands, shorelands, and/or submerged lands) may also be owned by the state, a federal entity, or private individuals. The Navy has agreements for rights to bedlands along the Bangor waterfront, extending to the extreme low tide line. The bedlands beyond the extreme low tide line are state lands under the jurisdiction of the Washington Department of Natural Resources.

3.20.2 Environmental Consequences

The evaluation of impacts to coastal and shoreline management considers if a proposed action would have an adverse impact to coastal resources within the project area and evaluates a proposed action's compatibility with applicable coastal management plans and policies.

3.20.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.20.2.1.1 CONSTRUCTION

Proposed construction activities, including excavation of the abutment, pile installation, and in-water construction of new structures, could potentially have an adverse impact to coastal resources in the project area. Proposed construction activities for Alternative 1 would be consistent to the maximum extent practicable with SMA and Kitsap County Shoreline Management Master Program provisions for shorelines of statewide significance that require preservation of the natural character of the shoreline and protection of the shoreline's resources and ecology.

Construction activities would have localized, temporary effects on fish and wildlife in the vicinity, possibly resulting in the avoidance of the area and/or displacement of some species to nearby areas with similar habitats. In-water construction activities would occur during the Puget Sound Marine Area 13 (northern Hood Canal) work window for special status fisheries species. Please refer to Section 3.8 for additional details.

Construction activities would have short-term and localized impacts to water quality associated with resuspension of bottom sediments from pile installation and barge and tug operations, as well as accidental losses or spills of construction debris into Hood Canal. Construction activities would not discharge wastewaters other than stormwater runoff, which would be controlled by a construction stormwater discharge permit and SWPPP. The Navy would require the construction contractor to prepare and implement a Debris Management Plan with procedures for retrieving and cleaning up any debris spilled into Hood Canal. Following completion of in-water construction activities, an underwater survey would be conducted to

remove any remaining construction materials that may have been missed during periodic cleanups. Please refer to Section 3.2 for additional details.

Impacts to surface water from construction activities would result from ground-disturbing activities (e.g., clearing and regrading for roads, utilities, buildings, and construction laydown areas, and excavation for the underground tank) that could cause erosion and increased turbidity and sedimentation in surface water bodies, including removal of a portion of a small wetland. During construction, BMPs would be implemented to control runoff and sedimentation and to minimize the impact to surface water. To the extent practicable, final design of the paved access road, utilities and laydown areas would minimize impacts by locating these features in areas away from surface water bodies or areas of significant seepage. Impacts to coastal vegetation would be minimal. In addition, the Navy would implement compensatory wetland mitigation in accordance with the Section 404 permit. Please refer to Section 3.12 for additional details.

Construction activities and the minimal increase in impermeable surface area in the project area near the shore would not impact groundwater recharge, as most of this area lies in a groundwater discharge zone. The small footprint of the paved roadway and abutment would not affect discharge. Therefore, groundwater resources would not be impacted by this alternative. Please refer to Section 3.12 for additional details.

Impacts to air quality from construction of Alternative 1 would occur from combustive emissions due to the use of fossil fuel-powered construction equipment and support vessels. Since most construction activities would occur over water, they would produce minimal fugitive dust emissions. As Alternative 1 is located in an attainment area and does not exceed the PSCAA threshold, General Conformity would not be applicable. Although Alternative 1 would emit HAPs, construction activities would produce less than significant impacts to public health. Alternative 1 would produce short-term emissions of GHGs. However, since GHG emissions from Alternative 1 would equate to minimal amounts of the U.S inventory, they would not substantially contribute to global climate change. Please refer to Section 3.17 for additional details.

Access to NBK at Bangor, including the project site, is controlled by the Navy and is restricted to authorized military personnel, civilians, contractors, and local tribes. Based on their location, the three relocated facilities and associated infrastructure, replacement parking spaces, and the pure water facility would not affect tribal access to traditional use areas (Section 3.19.2.1). The pure water facility is located behind the shoreline bluff, approximately 1,000 feet north of the tribal shellfishing area and is not located near the access route to this area. Since no public recreational uses occur at the EHW-2 or other project sites, construction of Alternative 1 would have no direct impact to recreational uses or access in the surrounding community. Due to the distance of the closest recreational uses, turbidity and lighting would not impact recreational opportunities in the project area. However, as described in Section 3.16.2.1, noise from pile driving would have a localized, indirect, and short-term adverse impact to recreational uses adjacent to the base and on the western shore of Hood Canal, including fishing, sightseeing, shellfish harvesting, kayaking, and other recreational activities. Noise from construction of the three new buildings would be audible in nearby (0.1 mile southwest) off-base residential areas; temporary construction noise is exempt from state limitations.

Construction activities along the waterfront would occur within public views from individuals traveling on vessels within the project vicinity; however, these activities would be visually compatible with existing military waterfront activities. Construction activities associated with

upland improvements would occur in developed and forested areas that are accessible only to military personnel. Access to tribal traditional use areas would not be affected.

In order to maintain adequate levels of safety for vessel navigation during in-water construction activities, a Notice to Mariners would be issued to minimize navigational hazards outside the existing floating security fence. In addition, barge trips and associated Hood Canal bridge openings would be scheduled to avoid peak commuting hours. Divers, including tribal divers, would receive notice of pile driving activities through the Notice to Mariners, as well as notification to the public about upcoming construction activities and noise at the beginning of each construction season.

3.20.2.1.2 OPERATION/LONG-TERM IMPACTS

Alternative 1 operations would be compatible with existing land uses, and no significant impacts would occur to access. Development of the EHW-2 at the project site would not represent a substantial change from its existing developed military character. In addition, proposed facilities and support infrastructure (including the pure water facility) would be visually compatible with existing marine-industrial activity in the project vicinity. Because of the distance and intervening features, visibility of the EHW-2 from off-base land areas would be limited. The closest viewing locations are on the opposite shore in Jefferson County located about 2 miles from the project site, and from the adjacent waters of Hood Canal. Because the EHW-2 would conform visually to other development along the waterfront, the EHW-2 would not substantially change the overall visual character of the Bangor waterfront. Upland project features would be compatible with existing land uses and would not adversely impact public views.

Long-term impacts of Alternative 1 would include the loss and shading of marine habitat including eelgrass, macroalgae, and benthic communities; benthic changes due to in-water structures and new abutment (erosion/accretion); and impacts to fish, marine mammals, and birds. Potential impacts to water quality during operations could occur as a result of accidental spills (fuel or oil spill). However, the number and size of potential spills and releases of contaminants would not increase from the existing conditions, because the level of operations and number of ships involved would not increase. Impacts to surface water and groundwater during operations would not be significant: new stormwater structures and utilities would be operated using BMPs to collect and handle runoff, drainage structures along the access road would control runoff, and the area along the access road would be revegetated. Alternative 1 operations would produce a nominal increase in emissions that would not exceed the PSCAA annual emission thresholds. As discussed in Section 3.18, there would be an adverse impact to the historical integrity (visual setting) of the existing EHW, which is eligible for inclusion in the NRHP. However, EHW-2 operations would be visually compatible with the overall military waterfront. No part of the project would affect access to tribal traditional use areas. Maintenance of the EHW-2, including routine inspections, repair, and replacement of facility components as required, would have negligible impacts to the coastal zone. Noise from the three new buildings would be audible in a residential area approximately 0.1 mile away, but this noise would not exceed existing levels from Navy facilities at the site or violate noise standards (Section 3.16.2.1).

3.20.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

Alternative 2 would use a larger number (1,460) of smaller piles for construction of the wharf, which would result in a longer in-water construction period (3 to 4 in-water work seasons) compared to Alternative 1 (2 to 3 seasons). Under this alternative, the impact to coastal and shoreline management would be similar but slightly greater than that described for Alternative 1. As Alternative 2 would require a longer in-water construction period, noise from pile driving activities would occur over a longer period, resulting in an increased localized, indirect, and short-term adverse impact to recreational uses adjacent to the base and on the western shore of Hood Canal.

3.20.2.2.1 OPERATION/LONG-TERM IMPACTS

Operational and long-term impacts would be the same as Alternative 1.

3.20.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

Alternative 3 differs from Alternative 1 in that it would construct separate entry and exit trestles; however, this alternative would have an in-water construction period similar to that of Alternative 1. Under Alternative 3, the impacts to coastal and shoreline management would be similar to those described for Alternative 1.

3.20.2.3.1 OPERATION/LONG-TERM IMPACTS

Operational and long-term impacts would be the same as Alternative 1.

3.20.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

Alternative 4 differs from Alternative 1 in that it would construct separate entry and exit trestles and use a larger number (1,500) of smaller piles for construction of the wharf, which would result in a longer in-water construction period (3 to 4 in-water work seasons) compared to Alternative 1 (2 to 3 seasons). Under Alternative 4, impacts to coastal and shoreline management would be similar to those described for Alternative 1. The longer in-water construction period would generate noise from pile driving activities over a longer period, resulting in increased localized, indirect, and short-term adverse impacts to recreational uses adjacent to the base and on the western shore of Hood Canal.

3.20.2.4.1 OPERATION/LONG-TERM IMPACTS

Operational and long-term impacts would be the same as Alternative 1.

3.20.2.5 Alternative 5: Combined Trestle, Floating Wharf

Alternative 5 would construct a larger main wharf and warping wharf on fewer piles (up to 440 vs. up to 1,250), and a shorter in-water construction period (2 in-water work seasons) than Alternative 1. Under Alternative 5, the impact to coastal and shoreline management would be similar but slightly less than that described for Alternative 1. As Alternative 5 would result in a reduced in-water construction period, the localized, indirect, and short-term adverse noise impact to recreational uses adjacent to the base and on the western shore of Hood Canal would be less than for Alternative 1. Similar to Alternative 1, Alternative 5 operations would be compatible with existing land uses; no impacts would occur to access or recreational opportunities, and this

alternative would be visually compatible with existing marine-industrial activity in the project vicinity.

3.20.2.5.1 OPERATION/LONG-TERM IMPACTS

Operational and long-term impacts would be the same as Alternative 1.

3.20.2.6 No-Action Alternative

With no facility construction and no change in operations, there would be no impact to coastal and shoreline management under the No-Action Alternative.

3.20.2.7 Mitigation Measures and Regulatory Compliance

The Navy would implement the following mitigation measures to ensure impacts to fish and wildlife were reduced to the maximum extent feasible: the areas adjacent to pile driving activities would be monitored by trained observers for the presence of marine mammals and birds; the majority of piles would be installed using a vibratory pile driver, which produces less noise and vibration effects compared to an impact hammer; air bubble curtains would be used during impact hammer pile driving to minimize noise impacts to fish and wildlife; and prior to pile driving activities, a soft-start approach would be used for pile driving to induce marine mammals and birds to leave the immediate area. A Mitigation Action Plan (Appendix F) would be implemented to compensate for the impacts of the proposed action to marine habitat, wetlands, and species. A Notice to Mariners would be issued during construction as a mitigation measure for navigational hazards outside the existing floating security fence at the Bangor waterfront. Divers, including tribal divers, would receive notice of pile driving activities through the Notice to Mariners, as well as notification to the public about upcoming construction activities and noise at the beginning of each construction season.

The discussions of impacts to water quality (see Section 3.2) and wetlands (see Section 3.14) provide details regarding the proposed action's federal consistency with the CWA.

The Navy submitted a Phase I CCD to WDOE in June 2011. WDOE concurred with the CCD on August 26, 2011. The Navy will submit an updated Phase II CCD to WDOE in spring 2012.

3.20.3 Summary of Impacts

Impacts to coastal and shoreline management associated with the construction and operation phases of each of the project alternatives are summarized in Table 3.20–1.

Table 3.20–1. Summary of Impacts to Coastal and Shoreline Management

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO COASTAL AND SHORELINE MANAGEMENT
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Localized, temporary impacts to fish, wildlife, and water quality; erosion and increased turbidity and sedimentation in surface water bodies; noise impacts to adjacent recreational and residential uses. *Operation/Long-term Impacts:* Loss and shading of marine habitat, benthic changes, and impacts to fish, marine mammals, and birds; adverse impact to the historical integrity (visual setting) of the existing EHW.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Localized, temporary impacts to fish, wildlife, and water quality; erosion and increased turbidity and sedimentation in surface water bodies; noise impacts to adjacent recreational and residential uses. *Operation/Long-term Impacts:* Loss and shading of marine habitat, benthic changes, and impacts to fish, marine mammals, and birds; adverse impact to the historical integrity (visual setting) of the existing EHW.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Localized, temporary impacts to fish, wildlife, and water quality; erosion and increased turbidity and sedimentation in surface water bodies; noise impacts to adjacent recreational and residential uses. *Operation/Long-term Impacts:* Loss and shading of marine habitat, benthic changes, and impacts to fish, marine mammals, and birds; adverse impact to the historical integrity (visual setting) of the existing EHW.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Localized, temporary impacts to fish, wildlife, and water quality; erosion and increased turbidity and sedimentation in surface water bodies; noise impacts to adjacent recreational and residential uses. *Operation/Long-term Impacts:* Loss and shading of marine habitat, benthic changes, and impacts to fish, marine mammals, and birds; adverse impact to the historical integrity (visual setting) of the existing EHW.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Localized, temporary impacts to fish, wildlife, and water quality; erosion and increased turbidity and sedimentation in surface water bodies; noise impacts to adjacent recreational and residential uses. *Operation/Long-term Impacts:* Loss and shading of marine habitat, benthic changes, and impacts to fish, marine mammals, and birds; adverse impact to the historical integrity (visual setting) of the existing EHW.
No-Action Alternative	No impact.

Table 3.20–1. Summary of Impacts to Coastal and Shoreline Management (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO COASTAL AND SHORELINE MANAGEMENT
Mitigation • Under all alternatives, the Mitigation Action Plan (Appendix F), which includes restricting in-water construction activities to seasonal work windows, implementation of a Debris Management Plan, BMPs, a Notice to Mariners, and scheduling barge trips through the Hood Canal Bridge passage to avoid peak commuting hours, would compensate for the impacts of the EHW-2.	
Consultation and Permit Status: • The Navy submitted a Phase I CCD. WDOE concurred with the CCD on August 26, 2011. The Navy will submit a Phase II CCD to WDOE in spring 2012. • The Navy has requested a CWA Section 404 permit from USACE, a CWA Section 401 Water Quality Certification from WDOE, and an NPDES Stormwater Permit from USEPA Region 10.	

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3.21 LAND USE AND RECREATION

Land use is the classification of either natural or human-modified activities occurring at a given location. Natural land uses include undeveloped coastlines, forested areas, or other natural open space. Human-modified land uses include developed land (such as residential, commercial, industrial, recreational, or other developed areas). Land uses are often regulated by management plans, policies, regulations, and ordinances (e.g., zoning) that determine the type and extent of land use allowable in specific areas and protect specially designated or environmentally sensitive areas.

Under the doctrine of federal supremacy, the federal government is not subject to local or state land use or zoning regulations unless specifically consented to by Congress. The federal government takes state and local land use plans, guidelines, and ordinances into consideration and cooperates with agencies to avoid conflicts when possible. The applicable federal regulation for land use along the Bangor waterfront, including the EHW-2 project site, is the CZMA (see Section 3.20, Coastal and Shoreline Management). However, the CZMA excludes federally owned and managed areas within the coastal zone, specifically military reservations and installations.

NAVY LAND USE MANAGEMENT PLANS

The U.S. Navy incorporates sustainable planning practices into facility planning, construction, and operations as required under various environmental laws and EOs. Specifically, Naval Facilities Instruction 11010.45, *Regional Planning Instruction—Sustainable Planning* addresses general principles and guidance for sustaining compatible conditions through coordination with neighboring communities. Sustainable planning instructions include various strategies to meet goals embodied in federal laws and EOs and ensure long-term flexibility for supporting mission needs. To the extent practicable, NBK at Bangor attempts to follow local policies (e.g., the Kitsap County Shoreline Management Master Program) by minimizing adverse impacts to water quality, sediment quality, shellfish, finfish, wildlife, boating, recreational and commercial fishing, public access, scenic vistas, and wetlands.

The Navy Waterfront Functional Plan, 2009 Update (Navy 2009c) focuses on waterfront activities and infrastructure in Navy Region Northwest. The plan develops a long-range improvement strategy that addresses operational shortfalls caused by facility inadequacies and reduces infrastructure by identifying excess assets. The Navy Waterfront Functional Plan states that a second EHW is required to meet TRIDENT program requirements.

The original EIS for establishment of a TRIDENT base at Bangor includes a second EHW (Navy 1974, 1976, and 1978). In 1975, the Navy prepared a Trident Support Site Master Plan (Trident Joint Venture 1975) for NBK at Bangor "to identify the capital improvement projects necessary to meet mission requirements, and to recommend locations for future development which promote both optimum land utilization and the accomplishment of assigned missions." The plan was guided by objectives for the mission, traffic and circulation, community involvement, physical form, and environmental quality. The plan focuses on the Upper Base (the south part of the base), where a mixture of mission industrial, administrative, community, and residential uses were occurring, and identified alternative layouts for arranging functional areas in compliance with the NOSSA and DDESB requirements for the northern portion of the base. The plan contains recommendations and goals for organizing future development and siting new projects on the base. Specifically, for the waterfront area, the need for three EHW

facilities was identified in the plan. The plan identifies visual integration, provision of desirable buffers between various land uses, recreational amenities, and circulation as needing further consideration.

Pursuant to the Sikes Act, the Navy prepared an INRMP that provides policy goals for land use on NBK at Bangor (Navy 2001). Land use goals include:

- Maintaining the grounds in an environmentally safe and sensitive manner that compliments the military mission,
- Ensuring that multiple land uses are compatible,
- Applying land management practices consistent with the ecosystem management approach, and
- Making land available for non-military productive uses.

The INRMP also directs that future land development should occur in the following order of priority: (1) reconstruction, renovation, and rehabilitation of obsolete facilities; (2) development on previously disturbed grounds and military use areas where intensive development already exists; (3) undisturbed areas contiguous to developed areas; and (4) natural areas.

Consultation and Permit Status. No consultations or permits are required.

3.21.1 Existing Environment

Land use around NBK at Bangor is mostly rural residential with some small pockets of more dense residential development and forest. Land use on NBK at Bangor is a mix of natural areas and open space, residential and transient housing, industrial facilities, administration offices, and military uses related to support and operations of submarines. The waterfront area consists of wharves, piers, and laydown areas for temporary equipment and construction, in addition to docking facilities (see Figure 3.11–3). An existing EHW is located just to the north of the EHW-2 project site. A military security buffer zone (closed to public access) is located across Hood Canal on Toandos Peninsula (Figure 3.21–1). Recreational uses on NBK at Bangor include pedestrian and bicycle trails, and indoor and outdoor facilities (such as gyms, hardcourts, and playfields). Water-based recreation opportunities exist off base and include sea kayaking, fishing, boating, shellfish harvesting, and sightseeing. The Kitsap County Comprehensive Plan identifies NBK at Bangor as military use (Kitsap County 2006).

3.21.1.1 Land Uses

Comprising 7,149 acres, NBK at Bangor is located approximately 20 miles west of Seattle and 3 miles northwest of Silverdale, Washington, in Kitsap County (Figure 3.21–1). Land uses surrounding NBK at Bangor are generally semi-rural with pockets of residential development. Land uses adjacent to the base have been zoned by Kitsap County as Rural Residential (one development unit per 5 acres) (Kitsap County 2006). Small unincorporated communities close to NBK at Bangor include Vinland (located on the northern boundary of NBK at Bangor), and Olympic View (located southeast of the base, and along the coastal area bordering the western base boundary) (Figure 3.21–1). The next largest incorporated city near NBK at Bangor is Poulsbo, about 2 miles east of the base.

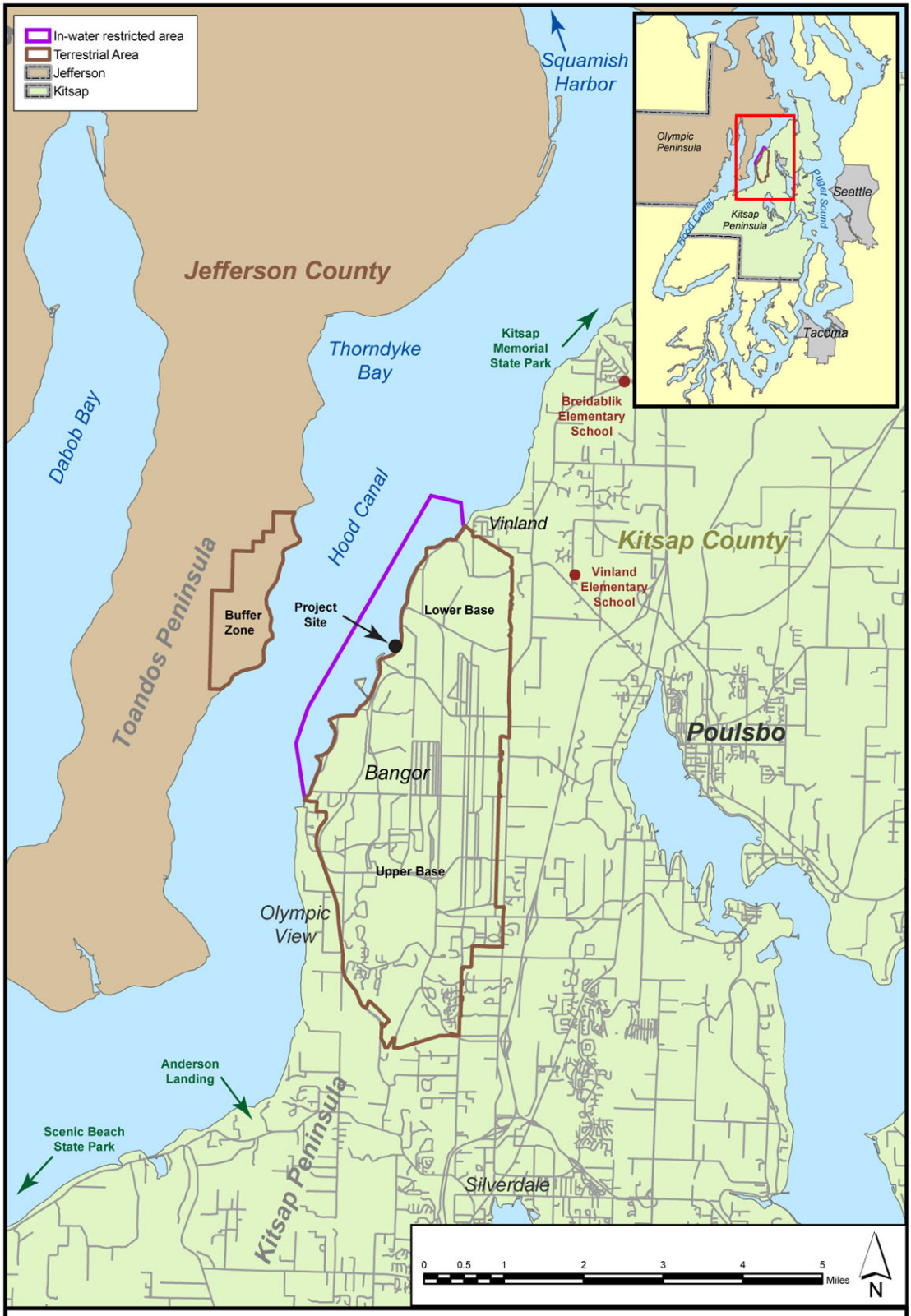

Figure 3.21–1. Communities and Public Use Areas in the Vicinity of NBK at Bangor

The EHW-2 project site is located along the eastern bank of Hood Canal within the Bangor waterfront (Figure 3.21–1). That portion of Hood Canal adjacent to the EHW-2 project site averages 1.5 miles in width and is bordered on the west by a 768-acre Navy-owned buffer strip on the Toandos Peninsula, in Jefferson County (Navy 2001).

NBK at Bangor is entirely owned by the federal government and is divided into two major land-use sectors: Lower Base and Upper Base (Figure 3.21–1). The Lower Base includes about three-fourths of the land area in the northern portion of the base, and contains most of the industrial facilities, the waterfront area, and maintenance and production facilities. The waterfront area at the Lower Base consists almost entirely of wharves and docking facilities distributed along a 4-mile section of shoreline. These facilities include the EHW, Delta Pier, Marginal Wharf, Carderock Pier, Service Pier, Keyport Dock, and MSF. Base residential areas are located on Upper Base approximately 4.5 miles south of the proposed EHW-2 site.

The EHW-2 project site is within the WRA about 2.6 miles south of the northern boundary of the base. There are several large facilities located along the waterfront shoreline in the vicinity. Aside from the existing EHW, Marginal Wharf is the closest large facility to the EHW-2 project site, on a promontory about 2,400 feet to the south. The three new buildings, associated paved areas and replacement parking, and associated utilities would be located in an existing industrial area of the lower base where maintenance and repair activities occur, approximately 2.2 miles south of the EHW-2 project site. The relocated pure water facility would be located in an existing operations area adjacent to the southern trestle of Delta Pier, approximately 1 mile south of the EHW-2 project site. The planned emphasis for the Lower Base is to directly support TRIDENT mission activities and industrial-type uses. The existing land uses at the Lower Base and at the EHW-2 project site are consistent with the land use planning emphasis for this part of the installation (Trident Joint Venture 1975).

A portion of the Toandos Peninsula located west of NBK at Bangor across Hood Canal is used as a military security buffer zone for activities taking place on NBK at Bangor, and is closed to public access. The Toandos Peninsula is rural in character, and Jefferson County has designated this buffer zone as Military Reservation. Land use designations surrounding the buffer area are Rural and Commercial Forest (Jefferson County 2005). Washington State Parks manages 10,000 feet of shoreline at the southern tip of this peninsula for shellfish harvesting. The shellfish harvesting site is accessed by boat only; there is no upland access.

3.21.1.2 Recreation

Recreation opportunities have decreased on NBK at Bangor since 2001 as a result of access restrictions developed for base security. NBK at Bangor continues to provide some outdoor activities to military personnel, their families, and federal employees associated with the base; however, recreational activities are prohibited at the Lower Base. No hunting is allowed anywhere on base and no public shellfish harvesting is allowed along the Bangor waterfront. NBK at Bangor is restricted from general public access.

Outside of NBK at Bangor boundaries, Hood Canal provides water-based activities (such as fishing, sightseeing, shellfish harvesting, and other recreational activities). Sea kayaking and some scuba diving are also increasingly common ways for visitors to enjoy the scenic resources of the coastline. Public recreation areas in the vicinity of NBK at Bangor include Kitsap Memorial State Park (about 5 miles north of the base) and Scenic Beach State Park (about 8 miles south of the base). The closest public water access site on the eastern shore is Anderson

Landing, about 3.5 miles south of the base (Figure 3.21–1). A floating security barrier prevents recreational and commercial boater access to the waterfront area of the base. Boaters are allowed to pass by the security fencing but must be outside the restricted area.

3.21.2 Environmental Consequences

The evaluation of impacts to land use considers a proposed action's compatibility with existing land use, adopted land use, and shoreline plans and policies.

The relative importance of land use impacts is based on the level of land use sensitivity in areas affected by the proposed action. In general, land use impacts would be adverse if they would: (1) be inconsistent or noncompliant with applicable land use plans and policies, (2) preclude the viability or use of existing land use, or (3) be incompatible with adjacent or vicinity land use to the extent that public health and safety is threatened.

3.21.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

This alternative would be consistent with the Trident Support Site Master Plan for NBK at Bangor (Trident Joint Venture 1975) and would not have a direct impact to adjacent land uses or recreation in the community of Vinland or Olympic View, the closest off-base residential areas to the proposed action. Recreational users in the project vicinity would be affected by construction noise, especially pile driving noise.

3.21.2.1.1 CONSTRUCTION

3.21.2.1.1.1 LAND USE

Under Alternative 1, construction would have no direct impact to land use. Proposed construction would not displace any adjacent land uses and is compatible with Base Plans. The commitment of land/water resources is consistent with the Trident Support Site Master Plan (Trident Joint Venture 1975), which proposes the development of a second EHW as a priority project in the waterfront operations area. This project is consistent with the Master Plan goal of meeting the TRIDENT mission requirements. The three new buildings (including the replacement parking spaces) and new pure water facility would be compatible with existing land uses. The new buildings and replacement parking spaces would be located in an industrial area; the new pure water facility would be located in an operations area.

3.21.2.1.1.2 RECREATION

Because no public recreational uses occur at the EHW-2 project site, construction of Alternative 1 would have no direct impact to recreational uses or access in the community of Vinland.

Noise during construction, specifically from pile driving, would diminish qualities of tranquility and solitude that many persons seek while recreating in areas nearby the base.

The noise levels on the western shore of Hood Canal would exceed WAC-permissible exposure levels for residential areas, and, therefore, would have an adverse noise impact to recreation in this area. Those recreating in such activities as boating, scuba diving, kayaking, and fishing on Hood Canal adjacent to the base would also be exposed to noise levels exceeding permissible residential exposure levels as they could be closer to the construction than land-based receptors. Impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to

protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). Upland construction activities would occur between 7:00 AM and 10:00 PM. Pile driving would end after approximately 2 to 3 years (211 to 411 pile driving days). The base is off limits to the general public, which provides separation between construction noise sources and the recreating public. Construction noise may have a localized, indirect, and short-term adverse impact to the quality of recreational activities such as fishing, hiking, and bird watching that benefit from quiet settings. The adverse noise impact would be experienced by greater numbers of recreationists during the summer months when recreational uses are likely to increase.

3.21.2.1.2 OPERATION/LONG-TERM IMPACTS

This alternative would be consistent with the Trident Support Site Master Plan (Trident Joint Venture 1975) and would not impact adjacent land uses or recreation. While operation of the EHW-2 would increase the number of EHW personnel by approximately 20, this increase would not have a perceptible impact to land uses and recreation, nor on the community of Vinland. There would be no impacts to land use and recreation from maintenance of the EHW-2 under Alternative 1.

3.21.2.1.2.1 LAND USE

A total area of approximately 12.6 acres, including 10.3 acres that presently supports second-growth forest or other native vegetation, would be cleared for construction. Most (6.9 acres) of the vegetated area would be revegetated with native plants at the end of construction. This alternative would permanently impact a total of 3.4 vegetated acres, including 1.4 acres for roads and other structures at the land end of the access trestles, 1.7 vegetated acres for the three new buildings, and 0.3 acre for the pure water facility. A total of 3.6 acres of new impervious surface would be created.

This alternative would result in an increase of approximately 20 operations personnel that would work at the waterfront site. Because this is currently an active military industrial area, the proposed activities are typical of the uses in this area and would cause no perceptible change to land use functions on the installation.

Overall, uses of the proposed facilities are consistent with the Master Plan goals of supporting the TRIDENT mission, developing a second EHW, and using the Lower Base to support industrial aspects of the installation's mission.

Operation and maintenance of the EHW-2 would have no perceptible impact to the residential area of Vinland.

3.21.2.1.2.2 RECREATION

Operation of Alternative 1 would not change ongoing land uses, nor displace any current uses, including recreational uses. Indirect impacts such as noise generated by operations and maintenance would be similar to current conditions and thus have no impact to recreation.

This alternative would result in an increase of approximately 20 operations personnel that would work at the waterfront site. Because this is currently an active military industrial area, the proposed activities are typical of the uses in this area and would cause no perceptible change to recreational uses on the installation.

3.21.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.21.2.2.1 CONSTRUCTION

Alternative 2 differs from Alternative 1 in that a larger number of smaller piles would be used for construction of the wharf. The trestle alignments and dimensions would be the same. Impacts would be expected to be the same as for Alternative 1, except the duration of pile driving noise impacts to recreation would be longer (286 to 561 days vs. 211 to 400 days).

3.21.2.2.2 OPERATION/LONG-TERM IMPACTS

Operational impacts would be expected to be the same as for Alternative 1.

3.21.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.21.2.3.1 CONSTRUCTION

The construction practices for Alternative 3 would be similar to those described for Alternative 1, except that the trestle dimensions would be approximately 20 percent larger and the total overwater area would increase by 0.3 acre. Impacts to recreation, including from pile driving noise, would be similar to Alternative 1.

3.21.2.3.2 OPERATION/LONG-TERM IMPACTS

Operational impacts would be expected to be the same as for Alternative 1.

3.21.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.21.2.4.1 CONSTRUCTION

The construction practices for Alternative 4 would be similar to those described for Alternative 1, except that the trestle dimensions would be approximately 20 percent larger and the total overwater area would increase by 0.3 acre. Impacts to recreation would be similar to those for Alternative 1, except the duration of pile driving noise would be longer than for Alternative 1 (306 to 586 days vs. 211 to 411 days).

3.21.2.4.2 OPERATION/LONG-TERM IMPACTS

Operational impacts would be expected to be the same as for Alternative 1.

3.21.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.21.2.5.1 CONSTRUCTION

The construction practices for Alternative 5 would be similar to those described for Alternative 1, except that the main wharf dimensions would be approximately 18 percent larger, the total overwater area would increase by approximately 2.2 acres, and there would be fewer piles needed to support the floating pier. Impacts to recreation would be similar to those for Alternative 1, except the duration of pile driving noise would be less than for Alternative 1 (146 to 186 days vs. 211 to 411 days).

3.21.2.5.2 OPERATION/LONG-TERM IMPACTS

Operational impacts would be expected to be the same as for Alternative 1.

3.21.2.6 No-Action Alternative

Under the No-Action Alternative, no EHW-2 would be built. Therefore, there would be no impacts to land use and recreation.

3.21.2.7 Mitigation Measures and Regulatory Compliance

The Navy will notify the public about upcoming construction activities and noise at the beginning of each construction season. Construction activities will not be conducted during the hours of 10:00 PM to 7:00 AM. Impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). Upland construction activities would occur between 7:00 AM and 10:00 PM. The Navy will request that the U.S. Coast Guard issue a Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity.

The proposed action would be consistent with the Navy Waterfront Functional Plan, Trident Support Site Master Plan, and INRMP. There are no other regulations pertaining to land use or recreation applicable to the proposed action.

No consultations are required.

3.21.3 Summary of Impacts

Impacts to land use and recreation associated with the construction and operation phases of each of the project alternatives are summarized in Table 3.21–1.

Table 3.21–1. Summary of Impacts to Land Use and Recreation

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO LAND USE AND RECREATION
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Compatible with Navy Waterfront Functional Plan and Trident Support Site Master Plan; temporary adverse noise impacts to recreational areas from pile driving (including abutment piles) for 211–411 days. *Operation/Long-term Impacts:* None.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Same as Alternative 1 (compatible with Navy Waterfront Functional Plan and Trident Support Site Master Plan) except longer duration of noise impacts to recreational areas from pile driving, including abutment piles (286–561 vs. 211–411 days). *Operation/Long-term Impacts:* None.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Similar to Alternative 1 (compatible with Navy Waterfront Functional Plan and Trident Support Site Master Plan) except slightly longer duration of noise impacts to recreational areas from pile driving, including abutment piles (226–436 vs. 211–411 days). *Operation/Long-term Impacts:* None.

Table 3.21–1. Summary of Impacts to Land Use and Recreation (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO LAND USE AND RECREATION
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Similar to Alternative 1 (compatible with Navy Waterfront Functional Plan and Trident Support Site Master Plan) except longer duration of noise impacts to recreational areas from pile driving, including abutment piles (306–586 vs. 211–411 days). Operation/Long-term Impacts: None.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Similar to Alternative 1 (compatible with Navy Waterfront Functional Plan and Trident Support Site Master Plan) except shorter duration of noise impacts to recreational areas from pile driving, including abutment piles (146–186 vs. 211–411 days). Total overwater area would increase by approximately 2.2 acres over Alternative 1. This is would be consistent with current land use plans and policies. *Operation/Long-term Impacts:* None.
No-Action Alternative	No impact.
Mitigation • Impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). Upland construction activities would occur between 7:00 AM and 10:00 PM. • The Navy will request that the U.S. Coast Guard issue a Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity. • Divers, including tribal divers, would receive notice of pile driving activities through the Notice to Mariners. • The Navy will notify the public about upcoming construction activities and noise at the beginning of each construction season.	
Consultation and Permit Status: No consultations or permits are required.	

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3.22 AESTHETICS

Visual resources are the natural and manmade features that give a particular environment its aesthetic qualities. In undeveloped areas, landforms, water surfaces, and vegetation are the primary components that characterize the landscape. Manmade elements (such as buildings, fences, piers, and wharves) may also be visible. These may dominate the landscape or be relatively unnoticeable. In developed areas, the natural landscape is more likely to provide a background for more obvious manmade features. The size, form, material, and function of buildings, structures, roadways, and infrastructure will generally define the visual character of the built environment. These features form the overall impression of an area or its landscape character that an observer receives. Attributes used to describe the visual resource value of an area include landscape character, perceived aesthetic value, and uniqueness.

There are no specific laws and regulations for aesthetic resources, but the Trident Support Site Master Plan for the base contains policies that relate to visual resources (Trident Joint Venture 1975). The plan contains long-range development goals and planning objectives that are useful for aesthetics. One of the long-range goals was to "…provide for an aesthetically pleasing physical working and living environment without compromising the efficient and economic accomplishment of assigned missions." This goal is further outlined in the plan's physical form objectives:

- Coordinate the development of facilities, exterior spaces, and landscaping to present a coherently organized image to residents, employees, and visitors.
- Maximize the use of views and site vistas in order to integrate site features and assets into the visual environment.
- Develop a series of landscaped spaces, as a visual focus and functional relief for support site activities, in the residential areas, as well as the community, personnel support, and administration areas.

As discussed in Section 3.18, Cultural Resources, the existing EHW, Delta Pier, and Shelton-Bangor Railroad are eligible for listing in the NRHP. The Navy has consulted with the SHPO regarding the potential effect of the EHW-2 on the visual context and aesthetic environment of the existing EHW and Delta Pier. See Section 3.18, Cultural Resources, for a discussion of the historic significance of the existing EHW and potential impacts of the proposed action.

Consultation and Permit Compliance Status. The SHPO has concurred with the Navy's finding that the EHW-2 project would have no adverse effect on historic properties.

3.22.1 Existing Environment

The aesthetics on NBK at Bangor are typical of facilities and structures used to support military operations. For offsite views of NBK at Bangor, the base blends well with the surrounding area because much of it is forested and hidden from view and is compatible with the surrounding rural landscape. The prevalent view of NBK at Bangor is from the west looking east across Hood Canal to the wharves and piers of the waterfront. Views from NBK at Bangor depend upon location, but include the Olympic Mountains, Hood Canal, and the various facilities on the base.

3.22.1.1 Visual Resources

NBK at Bangor is an active military base located on the eastern shoreline of Hood Canal. The base topography is characterized by flat-topped ridges on the eastern and southern portions of the base. The shoreline of Hood Canal lies adjacent to steep ravines and hillsides leading to the upper portions of the base. The Olympic Mountains lie to the west and provide a scenic backdrop for the base.

Much of NBK at Bangor is undeveloped with large stands of coniferous trees. As shown in Table 3.13–1, approximately 68 percent of the base is forested, 27 percent is developed, and 4 percent is brush and shrubland (the forested and brush/shrub categories include wetlands). Many of the views within the base are of forested areas with adjacent development. The aesthetics within the base, including the proposed site for the three new buildings, are typical of office buildings, residences, industrial facilities, and other structures used to support military operations. Common views from the base consist of the Hood Canal waterway in the foreground with the undeveloped forested Toandos Peninsula and Olympic Mountains in the background to the west. A military security buffer zone (closed to public access) is located across Hood Canal on Toandos Peninsula (Figure 3.21–1). Views to the east are largely obscured by forest.

Development along the waterfront is centered on support structures for naval vessels. The waterfront area, which includes the site of the proposed EHW-2 and pure water facility, of the base includes structural facilities, such as piers, wharves, and cranes. In addition, military submarines and other support craft traversing Hood Canal use these piers and wharves for berthing.

Although physical access to the base and associated facilities is restricted from the general public, the public has visual access to a large area along the waterfront from a distance. The principal public viewpoints of NBK at Bangor available to the general public are from boats on Hood Canal and from the southern shore of Toandos Peninsula where public access is allowed. The view of the Bangor waterfront from the water where the public could see the base consists of open water in the foreground, industrial waterfront type facilities such as piers and wharves in the middle ground, and forested hillsides in the background. Most of the base waterfront is enclosed within a floating barrier consisting of metal pontoons approximately 18 feet apart, topped by a metal mesh screen extending approximately 14 feet above the water surface. This barrier affects the appearance of the open-water areas along the base shoreline. Recreational boaters are allowed to pass by the base but are not allowed to stop or slow down. Yellow buoy markers about 0.5 mile offshore have been installed to define military water boundaries. Views from the water-side include naval vessels that traverse the area, as well as other commercial vessels and private boaters.

From the landside (north, east, and south), offsite views of NBK at Bangor are mostly forested, similar to and blending with the surrounding rural landscape. Off-base views of the developed areas on base are largely concealed by terrain and vegetation. Rural residential areas on the north and south end of the base have oblique views to the Bangor waterfront. Some existing structures (such as piers and wharves) may be visible. Specifically, some properties along the shore in Vinland have line-of-sight to the existing MSF wharf. Also, large naval vessels operating on Hood Canal are fairly prominent depending on the viewer's distance and the vegetation on particular private parcels.

The Bangor waterfront operates during the evening hours and the wharves, piers, and related upland facilities are lighted. Thus, the light from the waterfront area is visible from a distance at night, such as from locations on the west side of Hood Canal, approximately 2 miles away.

Aesthetics at the EHW-2 project site are typical of the Bangor waterfront. Lighting on facilities and piers in the vicinity of the EHW-2 project site is visible from surrounding locations in Hood Canal and the opposite shore at night time. However, brightness is attenuated by distance to viewing locations. Some facilities extend offshore and have direct line of sight with a few residential parcels to the north of the base; however, these residences do not have line-of-sight to the EHW-2 project site due to intervening land and topography. Indirect light (i.e., a lightened night sky) from the waterfront area may also be visible at adjacent properties located north of the base. The proposed sites for the three new buildings (including the replacement parking spaces) and the pure water facility have lighting typical of industrial areas of the base.

3.22.2 Environmental Consequences

The evaluation of impacts to visual resources considers the degree of visible change that a proposed action may cause, accounting for the value and sensitivity of the visual environment. An impact to aesthetics would occur if the changes in the existing environment were visually incompatible with surrounding areas, affected a large number of viewers, or modified the visual character of an area that is a valued visual resource.

Views of the EHW-2 project include those from off base and to a lesser extent those from the base itself, including the existing EHW and Delta Pier, the adjacent upland vicinity, and Hood Canal.

3.22.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

Overall, due to limited visual access, distance, and the current modified visual context, Alternative 1 would have little impact to the visual context and aesthetic environment outside of NBK at Bangor during construction or operation of Alternative 1. There is, however, the potential for the EHW-2 to affect the visual context and aesthetic environment of the existing EHW, Delta Pier, and Shelton-Bangor Railroad mainline, which are eligible for listing in the NRHP for their Cold War and World War II contexts. See Section 3.18, Cultural Resources, for a discussion of the historic significance of the existing EHW, Delta Pier, and Shelton-Bangor Railroad mainline, and potential impacts of the proposed action.

3.22.2.1.1 CONSTRUCTION

Construction and construction activities tend to cause visual disturbance to the landscape because of the changing nature of the views as construction proceeds. Visual clutter is caused by heavy construction equipment such as barges, cranes, backhoes, etc. and stockpiled materials, which move or are moved around a construction site. However, these activities are temporary and impacts to visual character are also temporary, lasting only for the duration of construction (in this case, 42 to 64 months depending on the alternative).

The project site along the waterfront, including the site of the pure water facility, is mostly shielded from onshore close-in views by topography and the base itself on the east. To the west, the in-water restricted access area creates a buffer and separates viewers from the waterfront by at least a half mile, which reduces the apparent visual scale of construction equipment. The

closest off-base viewing locations on land are approximately 2 miles from the EHW-2 project site on the far side of Hood Canal. There are no publicly accessible places on land from which to view the project site close up. The 5-acre laydown area to be temporarily de-vegetated would be visible only to on-base personnel. Although there are off-base residences within 0.1 mile of the site of the three new buildings, due to intervening vegetation this site is not visible from outside the base, so there would be no aesthetic impacts from this site.

Although construction activities would be visible, there would be no long-term disruption to the viewshed from construction.

3.22.2.1.2 OPERATION/LONG-TERM IMPACTS

Although the EHW-2 would be large in size and would change the appearance of the immediate site, it would be consistent with the Bangor industrial waterfront, as would the pure water facility. The surrounding visual context is already modified by manmade features such as Delta Pier, Marginal Wharf, and the existing EHW, and the EHW-2 would conform to the existing scale, lighting, and distribution of sites along the waterfront. Also, because of distance and intervening features, visibility of EHW-2 from off-base land areas would be limited. The closest viewing locations are on the opposite shore in Jefferson County located about 2 miles from the project site. Because the EHW-2 would conform visually to other development along the waterfront, the EHW-2 would not substantially change the visual character of the existing setting.

Vessels passing by would have closer, more direct views of the EHW-2 project site; however, similar to land-based viewpoints, the visual character of the EHW-2 would be similar to other uses and not visually distinct.

The 5-acre laydown area would be viewed by on-base viewers as different from surrounding vegetated areas during the time needed for native vegetation to become established, approximately 10 years (full biological recovery would take longer). The three new buildings (including the replacement parking spaces) would be visually compatible with the surrounding buildings and would not be visible from outside NBK at Bangor.

Although there are potential impacts to the Cold War context of the existing EHW and Delta Pier, and the World War II context of the Shelton-Bangor Railroad mainline (as discussed in Section 3.18), operation of the EHW-2 and pure water facility would not substantially change the overall visual character of the Bangor industrial waterfront.

There would be no aesthetic impacts from maintenance of the EHW-2 under Alternative 1.

3.22.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.22.2.2.1 CONSTRUCTION

Alternative 2 would have a longer in-water construction period (3 to 4 work seasons) compared to Alternative 1 (2 to 3 work seasons). Under this alternative, the impact to visual resources would be slightly greater than that described for Alternative 1, due to the longer presence of in-water construction equipment.

3.22.2.2.2 OPERATION/LONG-TERM IMPACTS

Operational impacts would be expected to be the same as those described for Alternative 1.

3.22.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.22.2.3.1 CONSTRUCTION

Because Alternative 3 has the same in-water construction period (2 to 3 work seasons) as Alternative 1, impacts to visual resources would be similar to those described for Alternative 1.

3.22.2.3.2 OPERATION/LONG-TERM IMPACTS

Operational impacts would be expected to be the same as those described for Alternative 1.

3.22.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.22.2.4.1 CONSTRUCTION

Alternative 4 would have a longer in-water construction period (3 to 4 work seasons) compared to Alternative 1 (2 to 3 work seasons). Under this alternative, the impact to visual resources would be slightly greater than that described for Alternative 1, due to the longer presence of in-water construction equipment.

3.22.2.4.2 OPERATION/LONG-TERM IMPACTS

Operational impacts would be expected to be the same as those described for Alternative 1.

3.22.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.22.2.5.1 CONSTRUCTION

Because Alternative 5 would have a slightly reduced in-water construction period (2 work seasons) compared to Alternative 1 (2 to 3 work seasons), the impact to visual resources would be similar but slightly less than that described for Alternative 1.

3.22.2.5.2 OPERATION/LONG-TERM IMPACTS

Because of the larger wharf under Alternative 5, the visual impact would be slightly greater than that described for the other alternatives, but still not significant.

3.22.2.6 No-Action Alternative

Under the No-Action Alternative, no EHW-2 would be built. Therefore, there would be no impacts to aesthetics.

3.22.2.7 Mitigation Measures and Regulatory Compliance

As there would be no adverse environmental impacts to aesthetics from construction or operation of the proposed action, no mitigation measures are necessary. However, because the existing EHW and Delta Pier are eligible for listing in the NRHP for their Cold War context, and the Shelton-Bangor Railroad mainline for its World War II context, the Navy consulted with the SHPO regarding the potential effect of the EHW-2 on cultural resources. The SHPO has determined that the EHW-2 would have no adverse effect on historic properties.

3.22.3 Summary of Impacts

Impacts to aesthetics associated with the construction and operation phases of each of the project alternatives are summarized in Table 3.22–1.

Table 3.22–1. Summary of Impacts to Aesthetics

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO AESTHETICS
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Temporary disturbance of existing visual landscape. *Operation/Long-term Impacts:* Impact of additional industrial structure.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Temporary disturbance of existing visual landscape. *Operation/Long-term Impacts:* Impact of additional industrial structure.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Temporary disturbance of existing visual landscape. *Operation/Long-term Impacts:* Impact of additional industrial structure.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Temporary disturbance of existing visual landscape. *Operation/Long-term Impacts:* Impact of additional industrial structure.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Temporary disturbance of existing visual landscape. *Operation/Long-term Impacts:* Slightly greater impact than other alternatives due to larger wharf.
No-Action Alternative	No impact.
Mitigation • Because construction and operation of the EHW-2 would not adversely affect aesthetics, mitigation measures are not necessary.	
Consultation and Permit Status • The Navy consulted with the SHPO, who concurred with the finding that there would be no adverse effect on historic properties. • No permits are required.	

3.23 SOCIOECONOMICS

Socioeconomic resources are defined as the basic characteristics associated with the human environment, generally including factors associated with regional demographics and economic activity. This section also describes issues of environmental justice (minority and low income populations). The area described includes Kitsap County with emphasis on NBK at Bangor and the cities of Bremerton and Poulsbo, and the community of Silverdale, and portions of Jefferson County, as appropriate.

There are no governing regulations with regard to socioeconomics. For environmental justice, EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, directs federal agencies to address disproportionate environmental and human health impacts to minority and low-income communities, which also includes American Indian populations.

Consultation and Permit Compliance Status. No consultations or permits are required.

3.23.1 Existing Environment

3.23.1.1 Population and Housing

NBK at Bangor employs 11,500 military personnel and 14,900 DoD civilians (Kitsap Economic Development Alliance 2010). It is estimated that NBK at Bangor and the surrounding military installations also support up to 15,000 retired military personnel and DoD civilians from the U.S. Navy, Coast Guard, and Marine Corps in Kitsap County. Approximately 9,900 of the total number of retirees are military retirees once assigned to NBK at Bangor or Bremerton. It is estimated that approximately 25 percent of the active duty military population resides on the base. Housing for NBK at Bangor is privatized with the exception of the Jackson Park community on NBK at Bangor, which remains as government-owned military family housing. The current military family housing inventory on NBK at Bangor includes 1,279 units. Unaccompanied bachelor housing on NBK at Bangor includes 952 permanent rooms and 113 transient rooms.

Population figures for Kitsap County, the cities of Bremerton, Bainbridge Island, and Poulsbo, and the community of Silverdale are presented in Table 3.23–1. Based on these figures, the number of military personnel and DoD civilians associated with NBK at Bangor comprises approximately 10.9 percent of Kitsap County's population. The city of Bremerton is the largest city in Kitsap County, comprising 14.5 percent of the county's population. Between 2000 and the estimated population in 2009, Kitsap County's population increased at an annual average rate of 0.9 percent per year.

Population in Kitsap County is projected to increase at an average annual rate of 1.12 percent for the next 15 years, reaching a population of 299,073 persons in 2025. As depicted in Table 3.23–2, the most growth is anticipated during the 5-year period from 2010 to 2015. The growth rate in Kitsap County is anticipated to exceed that of the state in the period from 2020 through 2025 (Washington State Office of Financial Management 2007).

Table 3.23–1. Demographic Characteristics

Location	Estimated 2009 Population	2000 Population
City of Bremerton	34,974	37,259
City of Bainbridge Island	21,923	20,308
City of Poulsbo	7,955	6,813
Silverdale CDP[1]	15,192	15,816
Kitsap County	240,862	231,969
State of Washington	6,664,195	5,894,121

Sources: U.S. Census Bureau 2010a-e.

1. The unincorporated community of Silverdale is a Census Designated Place (CDP). A CDP is defined as a statistical entity comprising a dense concentration of population that is not within an incorporated place but is locally identified by a name.

Table 3.23–2. Population Projections for Kitsap County and Washington State

Year	Kitsap County		Washington State	
	Number	Percent Increase	Number	Percent Increase
2000	231,969	n/a	5,894,121	n/a
2005	240,400	3.6	6,256,400	6.1
2010	249,050	3.6	6,792,318	8.6
2015	262,052	5.2	7,255,672	6.8
2020	283,242	8.1	7,698,939	6.1
2025	299,073	5.6	8,120,510	5.5

Source: Washington State Office of Financial Management 2007.

Housing characteristics for Kitsap County, the cities of Bremerton, Bainbridge Island, Poulsbo, and the community of Silverdale are presented in Table 3.23–3. There were an estimated 102,774 housing units in Kitsap County in 2009, of which 90,756 units were occupied. The homeowner vacancy rate in the county was 3.7 percent and the rental vacancy rate was 9.6 percent. The total number of vacant rental units in the county numbered 12,018 units (U.S. Census Bureau 2010j).

Table 3.23–3. Estimated 2009 Housing Characteristics

Location	Housing Units	Occupied Units	Vacant Units	Homeowner Vacancy Rate	Rental Vacancy Rate
City of Bremerton	17,254	15,009	2,245	4.8	6.5
City of Bainbridge Island	9,709	8,903	806	1.5	4.4
City of Poulsbo	3,760	3,424	336	0.0	14.0
Silverdale CDP	6,623	5,981	642	1.2	6.4
Kitsap County	102,774	90,756	12,018	3.7	9.6
State of Washington	2,814,297	2,559,288	255,009	2.4	6.0

Source: U.S. Census Bureau 2010f-k.

3.23.1.2 Economic Activity

Employment characteristics for the region are presented in Table 3.23–4. The civilian labor force in Kitsap County included an estimated 114,233 persons in 2009, of which an estimated 103,123 were employed. The unemployment rate was 9.7 percent. Median household income was $60,882, and persons below the poverty level represented 7.4 percent of the population (U.S. Census Bureau 2010p). The nationwide recession beginning in 2007 resulted in higher rates of unemployment and unemployment insurance claims. The decline in the housing market resulted in a particularly high rate of unemployment and unemployment insurance claims in the construction industry. According to the state of Washington's Employment Security Department, the number of initial unemployment insurance claims in the construction industry in July 2006 was 53 claims as compared to 396 initial claims in July 2009 and 258 initial claims in July 2010 (Washington State Employment Security Department 2010). The same trend is shown in the number of continuing unemployment insurance claims during the same time period. In July 2006, the number of continuing claims was 246 claims as compared to 1,117 claims in July 2009 and 844 claims in July 2010.

Table 3.23–4. Estimated 2009 Employment Characteristics

LOCATION	CIVILIAN LABOR FORCE	EMPLOYMENT	UNEMPLOYMENT RATE
City of Bremerton	16,439	14,417	12.3
City of Bainbridge Island	10,722	10,165	5.2
City of Poulsbo	3,633	3,339	8.1
Silverdale CDP	7,388	6,890	6.7
Kitsap County	114,233	103,123	9.7
State of Washington	3,438,309	3,110,355	9.5

Source: U.S. Census Bureau 2010l-q.

Government and government enterprises comprise the largest employment sector in the region, accounting for over one-third of all jobs in Kitsap County, as depicted in Table 3.23–5. The military accounted for 9.4 percent of total employment in Kitsap County overall, as compared to military employment in the state of Washington accounting for 2.0 percent of total employment (U.S. Bureau of Economic Analysis 2010). In terms of private employment, primary industries in Kitsap County are business services, retail trade, and health care. The military, specifically the Navy, has the largest economic impact to Kitsap County. It is estimated that the direct impact of military bases in Kitsap County includes 27,375 jobs (uniformed and civilian) and $1.1 billion in annual payroll. Furthermore, much of the private industry in the county is related to military activities, including defense-related suppliers and contractors. The military presence in Kitsap County is estimated to support 46,935 total jobs, representing 48 percent of all jobs in the county, and providing $1.8 billion in annual wages (Washington State Office of Financial Management 2004).

Table 3.23–5. 2008 Employment by Industry in Kitsap County and Washington State

Industry	Kitsap County		Washington State	
	Number	Percent of total	Number	Percent of total
Total	130,123	100	4,012,270	100
Private				
Farm employment	677	0.5	82,497	2.1
Forestry, fishing, and related activities	476	0.4	37,620	0.9
Mining	189	0.1	7,268	0.2
Utilities	201	0.2	5,522	0.1
Construction	8,270	6.4	273,800	6.8
Manufacturing	2,024	1.6	310,930	7.7
Wholesale trade	1,958	1.5	142,203	3.5
Retail Trade	15,561	12.0	411,559	10.3
Transportation and warehousing	1,518	1.2	118,716	3.0
Information	1,869	1.4	117,365	2.9
Finance and insurance	3,838	2.9	160,894	4.0
Real estate and rental and leasing	6,598	5.1	200,240	5.0
Professional and technical services	8,415	6.5	283,704	7.1
Management of companies and enterprises	205	0.2	36,063	0.9
Administrative and waste services	5,447	4.2	201,742	5.0
Educational services	1,860	1.4	67,343	1.7
Health care and social assistance	13,110	10.1	378,094	9.4
Arts, entertainment, and recreation	3,198	2.5	93,353	2.3
Accommodation and food services	7,467	5.7	254,791	6.4
Other services, except public administration	6,665	5.1	202,551	5.0
Government				
Government and government enterprises	40,577	31.2	626,015	15.6
Federal, civilian	14,960	11.5	70,078	1.7
Military	12,198	9.4	81,107	2.0
State and local	13,419	10.3	474,830	11.8

Source: U.S. Bureau of Economic Analysis 2010.

3.23.1.3 Education and Childcare

There are no primary or secondary schools on the base. Central Kitsap School District #401 in Silverdale serves the educational needs of the region's youth, including military dependents associated with NBK at Bangor. Enrollment in the district is approximately 12,400 students in the elementary through high school grades (Central Kitsap School District 2008). Enrollment in the district began to decline in the late 1990s, decreasing by 10 percent during the past 10 years and resulting in unused capacity at district schools.

Military family dependents comprise 26 percent of the district's students, and a total of 50 percent of the student body are in families economically tied to the military sector in Kitsap County. The Navy Region Northwest Child Development Center is located on NBK at Bangor and provides care for children from birth to 5 years of age. Services are primarily for families seeking full-time care. The center has the capacity to care for 103 children (Navy 2008b).

3.23.1.4 Environmental Justice

EO 12898 entitled "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (59 FR 7629) was issued in 1994 to focus Federal agency attention on the environmental, human health, and socioeconomic conditions of minority and low-income (MLI) populations, to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide MLI populations with access to public information on, and an opportunity for, public participation in matters relating to human health and the environment. EO 12898 applies equally to American Indian populations. EO 12898 directs preparers of EISs to address the following:

- Identify MLI populations in the area relative to the general demographic population.
- Identify and analyze potential Environmental Justice issues, concerns, or impacts, whether direct, indirect, or cumulative; this includes environmental (contaminants), human health (noise), socioeconomic (sacred grounds/selling resources), and subsistence resource use (fish, shellfish, etc.).
- Determine whether there will be a disproportionately high and adverse human health, environmental, or socioeconomic effect on MLI communities including tribes.
- Provide opportunities for community input from MLI populations and American Indian tribes.
- Identify potential effects and mitigation measures in consultation with affected communities; improve accessibility of meetings, crucial documents, and notices, and ensure they are concise, understandable, and translated.
- Ensure that the EIS: (1) describes the study area relative to its composition of potentially affected MLI communities; (2) provides the method used and analysis in order to determine how the effects on the environment, human health, and socioeconomics are distributed within the study area; (3) analyzes Environmental Justice issues, concerns, and impacts for the Proposed Action and each alternative including the No-Action Alternative; (4) determines from the analysis whether impacts to MLI populations (including Indian tribes) are disproportionately high and adverse as compared to/relative to the general population or comparison group; (5) determines if impacts can be mitigated when disproportionately high and adverse environmental, human health, and socioeconomic effects on MLI populations are identified; (6) identifies mitigation measures, if appropriate; (7) elicits participation of affected stakeholders including MLI populations and American Indian tribes and considers community input in response to comments.

Environmental justice assessment applies to disadvantaged populations in the region, which includes minority and low-income persons. The youth population also is analyzed for potential health and safety risks. These populations are defined as follows:

- *Minority Population.* Blacks, American Indians, Eskimos, Aleuts, Asians, Pacific Islanders, and persons of Hispanic or Latino origin of any race.

- *Low-Income Population.* Persons living below the poverty level, based on a 2005 equivalent annual income of $19,971 for a family of four persons.
- *Youth Population.* Children under the age of 18 years.

Table 3.23–6 identifies total population and percentage of disadvantaged and youth populations in Bremerton, Poulsbo, Silverdale, Kitsap County, Jefferson County, and Washington State. Minority persons range from 14.1 percent of the population in Poulsbo to 27.7 percent in Bremerton, compared to 17.8 percent for Kitsap County overall. Minority persons comprise 9.7 percent of the population in Jefferson County. In Washington State, minorities comprise 21.1 percent of the population. Asians are the predominant minority group in each jurisdiction with the exceptions of Bremerton, where Blacks are the dominant minority group, and Jefferson County where Hispanics are the dominant minority. With the exception of Jefferson County, American Indians account for less than 2 percent of the population in each jurisdiction, comparable to the state native population of 1.6 percent. The American Indian population, as a share of the total population, ranges from 0.8 percent in Silverdale to 2.4 percent in Jefferson County (U.S. Census Bureau 2002a-e and 2010r).

Table 3.23–6. Environmental Justice and Youth Populations

Location	Total Population	Percent Minority	Percent Low-Income	Percent Youth
City of Bremerton	37,259	27.7	17.9	24.5
City of Poulsbo	6,813	14.1	8.9	24.2
Silverdale CDP	15,816	25.1	4.7	28.0
Kitsap County	231,969	17.8	8.4	26.8
Jefferson County	29,676	9.7	12.4	15.6
State of Washington	5,894,121	21.1	10.4	25.7

Source: U.S. Census Bureau 2002a-e and 2010r.

The incidence of poverty in the affected region is below state levels with the exception of Bremerton, which has a poverty rate of 17.9 percent — 7 percent higher than the state and 9 percent higher than Kitsap County, and Jefferson County, which has a poverty rate of 12.4 percent – 2 percent higher than the state. Individuals living below the poverty level account for 4.7 percent of the population in Silverdale, 8.9 percent in Poulsbo, and 8.4 percent in Kitsap County.

In general, waterfront areas along the western shore of Hood Canal south of Squamish Harbor, including Thorndyke Bay, within Jefferson County are sparsely populated, rural residential areas. According to the Jefferson County Comprehensive Plan map of eastern Jefferson County, the waterfront areas are designated as rural residential with one residence per 5 acres or one residence per 10 acres depending on the specific area as well as rural forest and commercial forest (Jefferson County 2005). The population in Jefferson County is primarily located in the northeastern portion of the county outside of the APE from noise or other environmental impacts. The population for the waterfront areas potentially impacted is only available by Census tract. The waterfront area in Jefferson County across Hood Canal from NBK at Bangor is contained in Census Tract 9502.02 and in 2000 had a population of 1,617 (U.S. Census Bureau 2000). In 2010, the estimated population in Census Tract 9502.02 is 1,836 representing an annual increase of 1.3 percent between 2000 and 2010 (Washington State Office of Financial Management 2010). In 2010, there are an estimated 1,192 housing units in Census Tract 9502.02 of which 791 housing units are occupied.

3.23.2 Environmental Consequences

The evaluation of impacts to socioeconomics considers the magnitude of any increases in employment and population created by the proposed action, and the resulting impact to supporting services such as housing and education, as well as to regional economic activity. The economic impact analysis was conducted using the Impact Analysis for Planning (IMPLAN) economic forecasting model (MIG 2009). The IMPLAN model uses data from the U.S. Bureau of Labor Statistics and the U.S. Bureau of Economic Analysis to construct a mathematical representation of a local economy using region-specific spending patterns, economic multipliers, and industries. In this analysis, the IMPLAN model provided representations of the 2009 Kitsap County economy. Economic impacts are analyzed by introducing a change to a specific industry in the form of increased employment or spending; the IMPLAN model mathematically calculates the resulting changes in the local economy. In this analysis, the IMPLAN model estimates the economic effects of the estimated number of construction workers, construction expenditures, and the operations personnel on spending and employment in Kitsap County. The economic impact analysis separates effects into three components: direct, indirect, and induced. Direct effects are the additional employment and income generated directly by the expenditures of the personnel and construction expenditures. To produce the goods and services demanded by the change in employment and construction expenditures, businesses, in turn, may need to purchase additional goods and services from other businesses. The employment and incomes generated by these secondary purchases would result in the indirect effects. Induced effects are the increased household spending generated by the direct and indirect effects. The total effect from the economic impact analysis is the total number of jobs created throughout the Region of Influence by the direct, indirect, and induced effects.

The evaluation of impacts to environmental justice analyzes the potential for the proposed action to cause disproportionate public health and environmental effects on minority and low-income populations. Environmental justice analysis is conducted only on adversely impacted populations. Once an adverse impact has been established, further analysis needs to be conducted for the populations of concern.

3.23.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

Construction of Alternative 1 would generate approximately 100 to 260 additional construction jobs, and the related income would provide short-term benefits to the Kitsap County area during construction. There would be no other construction-related socioeconomic impacts including any impacts to environmental justice populations. Operations would provide permanent employment for approximately 20 people and could increase county population by 45 persons.

The additional population would not create undue demand on housing, schools, or child care services.

3.23.2.1.1 CONSTRUCTION

Construction activities associated with facility construction under Alternative 1 would generate between approximately 100 and 260 direct temporary jobs at various times during the construction period, and would contribute to local earnings and induced spending. The direct, indirect, and induced economic impacts of construction workers, an estimated amount of construction expenditures, and the operation of the EHW-2 are summarized in Table 3.23–7.

The requirement for up to 100 to 260 construction workers would create an additional 45 to 117 jobs through indirect and induced impacts. For every $100 million spent by the Navy in construction expenditures, an estimated 874 direct jobs would be created as well as an estimated 394 indirect and induced jobs. These new jobs created by the required construction workers and potential construction expenditures would be focused within the following industries: food services and drinking places, real estate establishment, health care, architectural engineering, wholesale trade, and retail stores. The project cost is estimated to be in excess of $500 million, for a total economic impact of 4,370 direct jobs and 1,970 indirect and induced jobs. Total economic output to the region would be in excess of $722 million. Based on the economic analysis for the proposed action, construction would provide a substantial economic benefit to the local and regional economy.

Employment of 100 construction workers represents approximately 1.2 percent of the existing construction industry in Kitsap County (Table 3.23–5). As discussed in Section 3.23.1.2, the recession has resulted in a higher rate of unemployment in the local economy, particularly in the construction industry. It is anticipated that the job creation from the required construction workers and estimated expenditures would be accommodated by labor resources in Kitsap County. The construction period would last 42 to 48 months. Because the socioeconomic impacts related to construction employment and expenditures would occur only for the duration of the construction period, no permanent or long-lasting socioeconomic impacts are anticipated as a result of construction associated with Alternative 1. As discussed in Section 3.19.2.1, the proposed action would not affect traditional or subsistence resource use by American Indian tribes.

Table 3.23–7. Economic Impact of Construction and Operation of the EHW-2

	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Construction Workers (Non-Recurring)				
Output	$11,439,327	$1,443,254	$3,641,753	$16,524,335
Income	$5,502,867	$521,008	$1,201,012	$7,224,887
Employment	100–260	11–29	34–88	145–377
Construction Expenditures per $100,000,000 (Non-Recurring)				
Output	$100,000,000	$12,616,602	$31,835,385	$144,451,988
Income	$48,104,811	$4,554,537	$10,498,973	$63,158,322
Employment	874	98	296	1,268
Operations (Recurring)				
Output	$2,932,193	$0	$1,219,107	$4,151,299
Income	$2,029,454	$0	$402,466	$2,431,920
Employment	20	0	11	31

Source: Analysis using the IMPLAN computer program (MIG 2009).

Environmental justice concerns related to construction activity typically include exposure to noise, pollutants, other hazardous materials, and safety hazards. As stated in Section 3.16.2, Noise, Environmental Consequences, residential areas along the waterfront on the western shore of Hood Canal south of Squamish Harbor, including Thorndyke Bay, within Jefferson County would experience increased noise levels during impact pile driving activities. The increase in

noise levels would be about 2 dBA during impact pile driving activities compared to local background noise levels (50 dBA). However, this impact would not be disproportionately high and adverse to minority and low-income populations, as this area does not constitute a low-income population when compared to the general population (Table 3.23–6). The same is true for the Olympic View neighborhood that would be affected by construction noise for the three new buildings. Therefore, this impact would not represent a disproportionately high and adverse impact to minority and low-income populations.

3.23.2.1.2 OPERATION/LONG-TERM IMPACTS

Under Alternative 1, NBK at Bangor would add approximately 20 operations personnel to support the EHW-2. The number of operational personnel associated with the relocated facilities would not change. Table 3.23–7 summarizes the recurring economic impacts from the increase in operations personnel. An estimated 11 induced jobs would be created primarily in the food services and drinking places industry, real estate establishments, health care, and retail stores. Based on estimated family size ratios, 25 military dependents (including 12 school-age dependents) would accompany the incoming military personnel, yielding a direct population impact of 45 persons (less than 0.02 percent of the Kitsap County population of over 230,000 persons). An increase of this size would yield an imperceptible impact to socioeconomic resources in the region. Sufficient vacant housing and school enrollment capacity exist within the region to accommodate the anticipated incoming population. There would be no impacts to environmental justice populations from operation of this alternative. As discussed in Section 3.19.2, the proposed action would not affect traditional or subsistence resource use by American Indian tribes. Maintenance of the EHW-2 would not result in socioeconomic impacts.

3.23.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.23.2.2.1 CONSTRUCTION

Alternative 2 would require approximately the same number of construction workers as Alternative 1. The impacts of construction employment and expenditures would reflect the longer duration of construction (54 to 64 months vs. 42 to 49 months) under Alternative 2. As described for Alternative 1, there would be no adverse impacts to Environmental Justice populations during construction of Alternative 2, as no concentrations of environmental justice populations reside near the project.

3.23.2.2.2 OPERATION/LONG-TERM IMPACTS

Impacts to socioeconomic conditions from operation of Alternative 2 would be the same as for Alternative 1.

3.23.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.23.2.3.1 CONSTRUCTION

Alternative 3 would require approximately the same number of construction workers and expenditures as Alternative 1 and construction duration (42 to 48 months) would also be the same. As described for Alternative 1, there would be no adverse impacts to Environmental Justice populations during construction of Alternative 3, as no concentrations of environmental justice populations reside near the project.

3.23.2.3.2 OPERATION/LONG-TERM IMPACTS

Impacts to socioeconomic conditions from operation of Alternative 3 would be the same as for Alternative 1.

3.23.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.23.2.4.1 CONSTRUCTION

Alternative 4 would require approximately the same number of construction workers and expenditures as Alternative 1. The impacts of construction employment would reflect the longer duration of construction (54 to 64 months vs. 42 to 48 months) for Alternative 4 (same as Alternative 2). As described for Alternative 1, there would be no adverse impacts to Environmental Justice populations during construction of Alternative 4, as no concentrations of environmental justice populations reside near the project.

3.23.2.4.2 OPERATION/LONG-TERM IMPACTS

Impacts to socioeconomic conditions from operation of Alternative 4 would be the same as for Alternative 1.

3.23.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.23.2.5.1 CONSTRUCTION

Alternative 5 would require approximately the same number of construction workers and expenditures as Alternative 1. However, the overall duration of construction would be shorter (42 to 44 months vs. 42 to 48 months). As described for Alternative 1, there would be no adverse impact to Environmental Justice populations during construction of Alternative 5, as no concentrations of environmental justice populations reside near the project.

3.23.2.5.2 OPERATION/LONG-TERM IMPACTS

Impacts to socioeconomic conditions from operation of Alternative 5 would be the same as for Alternative 1.

3.23.2.6 No-Action Alternative

Under the No-Action Alternative, the EHW-2 would not be built and EHW-operations would not change. Therefore, there would be no socioeconomic impacts.

3.23.2.7 Mitigation Measures and Regulatory Compliance

As there would be no adverse environmental impacts to socioeconomics or Environmental Justice populations from construction or operation of the proposed action, no mitigation measures are necessary. No consultations are required.

3.23.3 Summary of Impacts

Impacts to socioeconomics associated with the construction and operation phases of each of the project alternatives are summarized in Table 3.23–8.

Table 3.23–8. Summary of Impacts to Socioeconomics

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO SOCIOECONOMICS
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Approximately 100–260 direct temporary jobs generated at various times during construction; up to 874 direct jobs created for every $100 million in construction expenditures; a total of 394 indirect and induced jobs generated; no disproportionate effects from construction on minority or disadvantaged populations. *Operation/Long-term Impacts:* Estimated 20 additional operations personnel; 11 induced jobs generated. No impact on tribal subsistence resource use.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Approximately 100–260 direct temporary jobs generated at various times during construction; up to 874 direct jobs created for every $100 million in construction expenditures; a total of 394 indirect and induced jobs generated; no disproportionate effects from construction on minority or disadvantaged populations. *Operation/Long-term Impacts:* Estimated 20 additional operations personnel; 11 induced jobs generated. No impact on tribal subsistence resource use.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Approximately 100–260 direct temporary jobs generated at various times during construction; up to 874 direct jobs created for every $100 million in construction expenditures; a total of 394 indirect and induced jobs generated; no disproportionate effects from construction on minority or disadvantaged populations. *Operation/Long-term Impacts:* Estimated 20 additional operations personnel; 11 induced jobs generated. No impact on tribal subsistence resource use.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Approximately 100–260 direct temporary jobs generated at various times during construction; up to 874 direct jobs created for every $100 million in construction expenditures; a total of 394 indirect and induced jobs generated; no disproportionate effects from construction on minority or disadvantaged populations. *Operation/Long-term Impacts:* Estimated 20 additional operations personnel; 11 induced jobs generated. No impact on tribal subsistence resource use.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Approximately 100–260 direct temporary jobs generated at various times during construction; up to 874 direct jobs created for every $100 million in construction expenditures; a total of 394 indirect and induced jobs generated; no disproportionate effects from construction on minority or disadvantaged populations. *Operation/Long-term Impacts:* Estimated 20 additional operations personnel; 11 induced jobs generated. No impact on tribal subsistence resource use.
No-Action Alternative	No impact.

Table 3.23–8. Summary of Impacts to Socioeconomics (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO SOCIOECONOMICS
Mitigation • Because construction and operation of the EHW-2 would not adversely affect socioeconomics, mitigation measures are not necessary.	
Consultation and Permit Status: No consultations or permits are required.	

3.24 UTILITIES AND ENERGY

Utilities are defined as basic services (water, electricity, and natural gas) that serve NBK at Bangor to support military mission activities. This section describes those utilities, including water supply, wastewater treatment, electricity, and natural gas, and identifies existing utility infrastructure within the project area.

In order to reduce environmental impacts and address limited resources, the Navy has adopted guidance and policies that promote sustainable planning, design, development and operations. The guidelines work to decrease energy use, minimize reliance on traditional fossil fuels, protect and conserve water, and reduce the environmental impact of materials use and disposal. The Navy's approach is based on federal mandates including: EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance and EO 13423, Strengthening Federal Environmental, Energy, and Transportation Management.

Consultation and Permit Compliance Status. No consultations or permits are required.

3.24.1 Existing Environment

The utilities serving NBK at Bangor include water supply, wastewater treatment, and electricity. These utilities are provided through a combination of NBK at Bangor facilities and commercial sources off base. Potable water and water for fire suppression is supplied by four onsite deep wells and an internal water infrastructure system. NBK at Bangor also operates a wastewater treatment system that removes heavy metals, oils, and other contaminants from industrial operations prior to discharge into the Kitsap County wastewater system. Sanitary sewer and ship wastewater is collected and conveyed through onsite facilities, which also discharges to the Kitsap County wastewater system. Electricity is supplied to NBK at Bangor by the Bonneville Power Administration.

3.24.1.1 Utility Service and Demand

The utilities systems on NBK at Bangor support a physical plant of 2,000 buildings and structures encompassing approximately 5 million square feet, and seven existing in-water structures (Carderock Pier, Service Pier, KB Docks, Delta Pier, Marginal Wharf, the existing EHW, and MSF) (Reid Middleton 2008). The proposed sites for the three new buildings and the pure water facility have existing services for water supply, wastewater, and electricity.

3.24.1.1.1 WATER SUPPLY

As NBK at Bangor is a federal military facility, the Navy owns and maintains the water supply system located on the project site. The primary source of potable (drinking) water on NBK at Bangor is several deep wells, which are located at depths ranging from 300 to 500 feet below ground level (Parametrix 1994a). The NBK at Bangor water distribution system provides potable water and water for firefighting, and includes 123 miles of piping, storage tanks, and pump stations. Water supply support systems include two chlorination stations and four water storage facilities (two above ground and two below ground). The existing demand for potable water on NBK at Bangor is approximately 314 million gallons per year. The water distribution system has more than sufficient capacity to meet existing water demands (Reid Middleton 2008).

Water is provided to the project site by an existing water main located within Archerfish Road. The water main supplies the project site through two 12-inch water lines. Hydrant flow

test data indicate that 115 psig static pressure is available at the hydrant located north of the EHW-2 approach trestles, which would serve the project site. Existing water pressure is adequate to meet existing and EHW-2 water demands (Gibson 2011, personal communication).

3.24.1.1.2 WASTEWATER COLLECTION AND TREATMENT

The NBK at Bangor wastewater system empties into a 30-inch main connected to the Kitsap County sewage collection system. An industrial wastewater treatment plant on NBK at Bangor reduces heavy metals and removes oil prior to discharge to the county's sewage treatment facility. All sewage collected within NBK at Bangor boundaries is treated at the central Kitsap County sewage treatment plant, which is operated and maintained by the Kitsap County Public Works Department (Kitsap County Public Works 2006). The central Kitsap County sewage treatment plant currently processes 3.7 million gallons per day (mgd), but has a design capacity of 6 mgd (Kitsap County Public Works 2010). Existing annual wastewater flows from NBK at Bangor's wastewater system are approximately 164 million gallons (i.e., approximately 0.4 mgd).

The existing Ship's Overboard Discharge Facility that serves the existing EHW and would serve the EHW-2 consists of a 10,000-gallon aboveground holding tank, a 500-gallon-per-minute (gpm) oil/water separator, and a 500-gallon underground waste oil holding tank. This facility is located on the shoreline adjacent to the existing approach trestles. The tanks are serviced by truck for transport to industrial treatment.

Wastewater generated at the project site is transported to an existing lift station located on the uplands side of the EHW-2 approach trestle. The existing lift station has adequate capacity to accommodate the increased wastewater flows from simultaneous operations of the existing EHW and the EHW-2 (Reid Middleton 2008).

3.24.1.1.3 ELECTRICITY

Bonneville Power Administration maintains a network of power stations that supply electricity throughout Kitsap County, including NBK at Bangor. The electrical system consists of aboveground lines, underground infrastructure (e.g., electrical ducts and banks), transformers, and substations. Electrical power is supplied to NBK at Bangor by an existing, dedicated 115 kilovolt (kV) transmission line. Annual consumption is approximately 179,000 megawatt-hours, and maximum demand on the system is approximately 27 megawatts.

Electrical power is provided to the project site by two existing underground power lines located on the northeastern portion of the project site.

3.24.2 Environmental Consequences

The evaluation of impacts to utilities and energy considers whether the proposed action would result in increased demand for utilities that would exceed the capacity of the existing delivery system and/or require construction of new infrastructure. The electrical service, potable water, and sanitary sewer upgrades required for this project each would have impacts localized to the project area shown on Figure 2–3. No additional upgrades or improvements to existing utility systems would be required for this project outside of the action area shown on Figure 2–3.

3.24.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.24.2.1.1 CONSTRUCTION

Under Alternative 1, utility system upgrades and modifications would be required to support the EHW-2 and support facilities. All utility infrastructure would be routed to the main wharf and warping wharf via utility corridors (covered utility trenches) in the approach trestles and within the wharves. With the exception of stormwater systems, the utility systems for the three new buildings, replacement parking, and the pure water facility would connect to the existing systems at those sites; capacity is sufficient to meet demand for the new facilities and no upgrades would be needed. Surface disturbance resulting for these connections would be within the overall areas disturbed for construction of these facilities (Section 3.11.2.1).

3.24.2.1.1.1 POTABLE WATER SYSTEM

Implementation of Alternative 1 would include construction of two new 12-inch water lines, approximately 200 feet long, to connect to an existing water line on Archerfish Road. Both lines would have a 20- by 20-foot back flow preventer vault; construction of booster pumps would not be required. The backflow preventers would be constructed to prevent backflow into the Navy's water system. The first backflow preventer vault would be located at the northwest corner of the new paved access road and Archerfish Road intersection. The second would be located approximately 5 feet west of the existing paved access road in the construction area.

Construction workers (maximum 100 workers per day) would create increased demands on water supply. However, as water demands during construction would be intermittent and temporary, these amounts would be considered a nominal percentage of the total demand on the water system. Therefore, construction worker activities would not substantially contribute to impacts to water supply infrastructure. Significant impacts to the potable water system would not occur.

3.24.2.1.1.2 WASTEWATER COLLECTION AND TREATMENT

Construction of Alternative 1 would extend wastewater mains from the existing infrastructure on NBK at Bangor to serve the proposed wharf proper (main and warping wharfs) that would be constructed on the project site. Additional infrastructure required would include a new underground sewer main, new underground Ship's Overboard Discharge Main, new storm drains, and associated catch basins. The existing infrastructure has the capacity to handle the additional flow that would be generated by the proposed site improvements.

The new 6-inch Sanitary Sewer Forced Main would extend approximately 220 feet to the existing sanitary sewer manhole located approximately 40 feet east of the existing EHW and at the end of Archerfish Road. The new Sanitary Sewer Forced Main would connect to the existing lift station in Building 7005.

The new 4-inch Ship's Overboard Discharge Main would be approximately 100 feet and tie into the existing aboveground 10,000-gallon Ship's Overboard Discharge Tank. This alternative would require relocating the existing aboveground holding tank for the Ship's Overboard Discharge a short distance from its current location to accommodate the minimum required clearance to the fence surrounding the access road to the EHW-2. Relocation would require minimum modification to the existing pipe. The method of relocation would be determined by future construction contractor, but typically the tank would be moved via crane. No remediation would be required. No underground storage tank work would be required.

The new 8-inch storm drains would be connected to approximately 18 catch basins. Storm drains and catch basins would be solely located on the wharf structure. Each catch basin would contain filter cartridges to remove contaminants prior to discharge into the canal.

For the three new buildings, including replacement parking, and the pure water facility, the existing stormwater systems would be upgraded as needed in accordance with a national NPDES permit.

Construction workers (maximum 100 workers per day) would create increased demands on wastewater treatment; portable chemical toilets would be used for onsite wastewater collection. However, as wastewater demands during construction would be intermittent and temporary, these amounts would be considered a nominal percentage of the total demand on wastewater infrastructure. As construction activities would not substantially contribute to impacts to existing wastewater infrastructure, significant impacts to wastewater would not occur.

3.24.2.1.1.3 ELECTRICITY

Construction of Alternative 1 would extend the 12.47 kV transmission lines from the existing infrastructure on NBK at Bangor to serve the proposed wharf proper (main and warping wharfs) that would be constructed on the project site. Additional infrastructure required would include a new utility building, three new 8- by 10-foot utility manholes, new underground duct banks, two double-ended substations with associated transformers and switchgear, grounding and lightning protection system, communication lines, mass notification system, lighting, and shore power terminals for submarine hotel services. All electrical utility construction would be contained within the project site between Archerfish Road and the retention pond.

The new utility building would replace an existing utility building located between the southeast corner of the existing EHW and the existing retention pond. The new 40- by 15-foot utility building would be made of steel and located approximately 70 feet north of the existing utility building. No remediation would be required. Two of the new manholes would be located adjacent to the new utility building on the east side. The third would be located on the south side of the end of Archerfish Road.

Two double-ended substations would be constructed on the wharf structure. One substation would contain two 2,500 kVA transformers and the second would contain two 2,000 kVA transformers. Approximately 10 smaller transformers would be required to meet the energy needs of the new facility and would be located on the wharf structure. The substation switchgear would be provided with circuit breakers with substation controls co-located with the transformers. One 200 kW generator and one 125 kW generator are required and would be located on the wharf structure.

Approximately 500 feet of existing underground utility ducting would be removed and replaced with approximately 1,200 feet of utility ducting. All the utility ducting would be connected to three existing manholes co-located at the southeast corner of the intersection of Archerfish Road and the existing paved access road. All other electrical utility conduits would be contained within utilidors on the wharf structure.

Construction of new electrical infrastructure would be conducted in a manner designed to prevent service interruptions for adjacent properties, and new construction would be in conformance to current design standards. As Alternative 1 would not affect existing electrical distribution systems in the project vicinity, significant impacts would not occur.

3.24.2.1.2 OPERATION/LONG-TERM IMPACTS

Maintenance of the EHW-2, including routine inspections, repair, and replacement of facility components as required, would result in negligible impacts to utilities. Maintenance of the EHW-2 would not require utilities or energy beyond existing capacity.

3.24.2.1.2.1 POTABLE WATER SYSTEM

Alternative 1 would require only minimal increases to the existing water supply to support proposed facilities (i.e., main wharf and warping wharf). Approximately 380 gpm of potable water and 2,750 gpm of fire water would be required to support Alternative 1. As existing water distribution infrastructure was designed to provide sufficient capacity to support future development in the EHW area, sufficient capacity exists to accommodate the minimal increase in water (potable and fire suppression) that would be generated by Alternative 1 (Gibson 2011, personal communication). As the number of new employees (20) and increased water demands would not be substantial relative to existing and projected regional utility supplies, significant impacts to the potable water system would not occur. The potable water systems for the three new buildings and the pure water facility would connect to the existing systems at those sites; capacity is sufficient to meet demand for the new facilities and no upgrades would be needed.

3.24.2.1.2.2 WASTEWATER COLLECTION AND TREATMENT

Alternative 1 would result in an increase in wastewater demands due to operation of the wharf proper. Alternative 1 would result in an increase in wastewater demands of approximately 17,105 gallons per day (gpd) (peak demand) and an additional 6,000 gpd during vessel arrivals and departures. Existing wastewater mains would be extended to serve the proposed wastewater infrastructure (underground sewer main, underground Ship's Overboard Discharge Main, and storm drains and catch basins) at the wharf proper (main and warping wharfs). The system capacity of the existing sewer and vessel wastewater system was designed to provide sufficient capacity to support future development in the EHW area; therefore, sufficient capacity exists to accommodate wastewater flows generated from the EHW-2 (Reid Middleton 2008). As the number of new employees (20) and increased wastewater demands would not be substantial relative to existing and projected regional utility supplies, significant impacts to the wastewater system would not occur. The stormwater and wastewater systems for the three new buildings and the pure water facility would connect to the existing systems at those sites; capacity is sufficient to meet demand for the new facilities and no upgrades would be needed.

3.24.2.1.2.3 ELECTRICITY

Proposed operations would result in an electrical increase of approximately 5,000 kVA. The proposed transmission lines would connect to the existing distribution systems in the project vicinity, which were designed to provide sufficient capacity to support future development in the EHW area (Reid Middleton 2008). Alternative 1 would not affect the existing electrical distribution system in the project vicinity. Therefore, no significant impacts to the electrical systems would occur. The electrical systems for the three new buildings and the pure water facility would connect to the existing systems at those sites; capacity is sufficient to meet demand for the new facilities and no upgrades would be needed.

3.24.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.24.2.2.1 CONSTRUCTION

Impacts to utilities and energy from construction of Alternative 2 would be the same as those described for Alternative 1.

3.24.2.2.2 OPERATION/LONG-TERM IMPACTS

Impacts to utilities and energy from operation of Alternative 2 would be the same as those described for Alternative 1.

3.24.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.24.2.3.1 CONSTRUCTION

Impacts to utilities and energy from construction of Alternative 3 would be the same as those described for Alternative 1.

3.24.2.3.2 OPERATION/LONG-TERM IMPACTS

Impacts to utilities and energy from operation of Alternative 3 would be the same as those described for Alternative 1.

3.24.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.24.2.4.1 CONSTRUCTION

Impacts to utilities and energy from construction of Alternative 4 would be the same as those described for Alternative 1.

3.24.2.4.2 OPERATION/LONG-TERM IMPACTS

Impacts to utilities and energy from operation of Alternative 4 would be the same as described for Alternative 1.

3.24.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.24.2.5.1 CONSTRUCTION

Impacts to utilities and energy from construction of Alternative 5 would be the same as those described for Alternative 1.

3.24.2.5.2 OPERATION/LONG-TERM IMPACTS

Impacts to utilities and energy from operation of Alternative 5 would be the same as those described for Alternative 1.

3.24.2.6 No-Action Alternative

Under the No-Action Alternative, the construction of the EHW-2 and support facilities would not occur. Existing conditions would remain and utility demands would remain unchanged. Therefore, no impacts to utilities and energy would occur under the No-Action Alternative.

3.24.2.7 Mitigation Measures and Regulatory Compliance

There would be no adverse impacts to utilities and energy; thus, no mitigation measures are necessary. There are no applicable regulations pertaining to utilities and energy. The proposed action would be implemented in accordance with Navy and other federal requirements regarding energy conservation and alternative energy sources. No consultations are required.

3.24.3 Summary of Impacts

Impacts to utilities and energy associated with the construction and operation phases of each of the project alternatives are summarized in Table 3.24–1.

Table 3.24–1. Summary of Impacts to Utilities and Energy

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO UTILITIES AND ENERGY
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Minor increases in utility demands; construction of new utilities and connections, including some stormwater system upgrades. *Operation/Long-term Impacts:* None (sufficient utility capacity exists to service the EHW-2).
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Minor increases in utility demands; construction of new utilities and connections, including some stormwater system upgrades. *Operation/Long-term Impacts:* None (sufficient utility capacity exists to service the EHW-2).
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Minor increases in utility demands; construction of new utilities and connections, including some stormwater system upgrades. *Operation/Long-term Impacts:* None (sufficient utility capacity exists to service the EHW-2).
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Minor increases in utility demands; construction of new utilities and connections, including some stormwater system upgrades. *Operation/Long-term Impacts:* None (sufficient utility capacity exists to service the EHW-2).
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Minor increases in utility demands; construction of new utilities and connections, including some stormwater system upgrades. *Operation/Long-term Impacts:* None (sufficient utility capacity exists to service the EHW-2).
No-Action Alternative	No impact.
Mitigation • Because construction and operation of the EHW-2 would not adversely affect utilities and energy resources, mitigation measures are not necessary.	
Consultation and Permit Status: No consultations or permits are required.	

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3.25 TRANSPORTATION

Transportation resources include roads, public transit, railroads, waterways, and non-motorized travel. The transportation setting for ground transportation includes those streets and intersections that would be used by both automobile and truck traffic to gain access to and from a project site, as well as those streets that would be used by construction traffic (i.e., equipment and commuting workers). The marine vessel setting includes the waterways (e.g., Hood Canal and Puget Sound) that would provide access to the project site.

The Military Surface Deployment and Distribution Command Transportation Engineering Agency provides the DoD with transportation engineering, policy guidance, research, and analytical expertise. Several DoD directives apply to transportation planning and implementation at military bases, including:

- DoD Directive 4500.9 Transportation and Traffic Management, and
- DoD Directive 4510.11 Transportation Engineering.

These directives apply policies to proposed transportation improvements, travel, traffic management, and traffic safety.

For vessel traffic, the Protection of Naval Vessels rule (33 CFR 165.2010) issued under the authority in 14 USC 91 provides protective measures for both vessels and bases. This regulation establishes naval vessel protection zones surrounding U.S. Naval vessels in navigable waters of the U.S. Within a Naval Vessel Protection Zone, no vessel or person is allowed within 100 yards of a U.S. Naval vessel unless authorized by the U.S. Coast Guard or senior Naval officer in command. Two restricted areas are associated with NBK at Bangor: Naval Restricted Areas 1 and 2 (33 CFR 334.1220) (Figure 1–2). Naval Restricted Area 1 covers the area to the north and south along Hood Canal encompassing the Bangor waterfront. Naval Restricted Area 2 encompasses the waters of Hood Canal within a circle of 1,000 yards (3,000 feet) diameter centered at the north end of NBK at Bangor and partially overlapping Naval Restricted Area 1. Navigation within Naval Restricted Area 2 is not permitted when magnetic silencing operations are in progress (33 CFR 334.1220). Magnetic silencing operations are required to neutralize the magnetic field of submarines. Existing magnetic silencing operations in the project vicinity would not interfere with construction and/or operation of the EHW-2.

Consultation and Permit Compliance Status. No consultations or permits are required.

3.25.1 Existing Environment

The area to be evaluated includes the road network within NBK at Bangor and main access road routes to and from the base, railroads, and marine waterways, such as Hood Canal and Puget Sound. The proposed action is not anticipated to use rail service. Therefore, rail traffic is not discussed further.

Primary transport is by automobile, although bus service to the base is available from some parts of Kitsap County, as well as taxi service. The major population centers within Kitsap County—Silverdale, Poulsbo, Bremerton, Port Orchard, and Bainbridge Island—are all between a 10- and 40-minute drive from NBK at Bangor.

3.25.1.1 Marine Vessel Traffic

The Vessel Traffic Service – Puget Sound, part of the U.S. Coast Guard and based in Seattle, monitors approximately 250,000 vessel movements in the sound annually. These movements are composed of tankers, cargo ships, ferries, and tug boats with tows (U.S. Coast Guard 2004). Table 3.25–1 summarizes vessel transits in Puget Sound via the Strait of Juan de Fuca.

Naval ships and support vessels access the base via the Strait of Juan de Fuca, Puget Sound, and Hood Canal. The majority of vessel traffic in Hood Canal consists of Navy-related marine traffic including submarines, escort vessels, tugs, and other vessels transiting to and from NBK at Bangor. As Hood Canal is not a deep draft vessel operating area, this area is infrequently transited by commercial vessels (Venture 2010, personal communication). Larger vessels (i.e., vertical clearance greater than 50 feet) transiting Hood Canal require opening of the Hood Canal bridge. Typical bridge openings take approximately 30 minutes (WSDOT 2010b). As bridge openings are not scheduled in advance, vehicles traveling along State Route 104 (Hood Canal bridge) are subject to unexpected delays.

Table 3.25–1. Vessel Transits through the Strait of Juan de Fuca, 2007–2009

VESSEL TYPE AND DESTINATION	2007	2008	2009
Cargo and Passenger > 300 gross tons			
Washington Ports in Puget Sound	2,306	2,531	2,293
Canadian Ports via Strait of Juan de Fuca	1,882	1,937	1,798
Tank Ships			
Washington Ports in Puget Sound	614	539	636
Canadian Ports via Strait of Juan de Fuca	231	193	204
Tank Barges			
Washington Ports in Puget Sound	2,472	2,967	3,569
Commercial Fishing			
Washington Ports in Puget Sound	97	110	98
Canadian Ports via Strait of Juan de Fuca	14	13	5
Factory Fishing			
Washington Ports in Puget Sound	118	120	86
Canadian Ports via Strait of Juan de Fuca	3	5	4
Total	**7,737**	**8,415**	**8,693**

Sources: WDOE 2008c, 2009e, 2010.

3.25.1.2 Public Transit

Kitsap Transit operates a regularly scheduled shuttle bus that provides access to NBK at Bangor from Silverdale, with connections from Silverdale to other parts of the county including ferry terminals. An internal bus system operates 18 hours per day within the base. Taxi service is also available at the base from several private companies located in Bremerton, Silverdale, Bainbridge Island, and Port Orchard. Kitsap Transit buses and taxis do not service the Bangor waterfront area; however, the Navy's internal bus system provides service to the Bangor waterfront for Navy and contract personnel.

3.25.1.3 Vehicle Traffic

3.25.1.3.1 ROADWAY CHARACTERISTICS

The primary access to NBK at Bangor is State Route (SR)-3, which is the major roadway serving Bremerton, Poulsbo, Silverdale, and the Hood Canal Bridge. SR-3 has a posted speed limit of 60 mph and is a controlled access four-lane, north-south highway located 1/3 mile east of the base. SR-3 connects with SR-305 near Poulsbo providing access from NBK at Bangor to Bainbridge Island and the Seattle ferry. Travel time is approximately an hour and 15 minutes from Seattle. Travel time by highway from Tacoma is less than an hour.

There are two entrance routes to NBK at Bangor from SR-3, either NW Trigger Avenue or NW Luoto Road (referred to as Trident Boulevard inside of base boundaries). Trident Avenue/Luoto Road has six lanes with 12-foot travel lanes and 6-foot paved shoulders extending from the main gate to SR-3. Trigger Avenue has five lanes with 12-foot travel lanes and 6-foot paved shoulders. Both roads are posted for speeds up to 40 mph.

The internal NBK at Bangor road system is composed of two and four-lane paved roads that provide access to Naval and commercial facilities, housing, and the waterfront area. Roads that are in the vicinity of the waterfront are two-lane roads. Generally, travel lanes are from 10 to 12 feet in width with wide paved shoulders ranging from 5 to 10 feet or gravel shoulders from 2 to 5 feet in width. Speed limits on the base range from 20 to 45 mph. Traffic lights and signals have been installed where needed but generally occur near the commercial area and main gates. Other intersections are controlled by four-way or two-way stop signs. Internal roads are improved and maintained by the Navy. The key access streets serving the project site are Trigger Avenue, Trident Boulevard, Escolar Road, Greenling Road, and Archerfish Road.

3.25.1.3.2 TRAFFIC VOLUMES

A series of traffic counts were collected at two regional roadways that provide direct access to NBK at Bangor: Trigger Avenue and Luoto Road. Table 3.25–2 provides the average daily traffic volumes on NW Trigger Avenue and NW Luoto Road immediately outside base boundaries. NW Luoto Road has an average daily traffic volume of 12,295 vehicles, with automobiles comprising approximately 65 percent (7,984 vehicles) of the total. NW Trigger Avenue has a lower average daily traffic volume of 11,426 vehicles, with almost 72 percent of those trips (8,213 vehicles) being automobiles.

Table 3.25–2. Average Daily Traffic Volumes (2008) – Regional Roadways

LOCATION	CARS	TRUCKS	TOTAL
NW Trigger Avenue	8,213	3,213	11,426
NW Luoto Road	7,984	4,311	12,295

Source: All Traffic Data Services 2008.

Vehicle trips for AM and PM peak hours are shown in Table 3.25–3. Peak hour trips on NW Trigger Avenue typically occur from 7:00 to 8:00 AM and 3:00 to 5:00 PM. The average AM and PM peak hour volumes on NW Trigger Avenue are 676 and 844, respectively. The peak volumes on NW Luoto Road occur at slightly different times than on NW Trigger Avenue and are more evenly distributed between the AM and PM peak periods. On NW Luoto Road, the peak volumes occur from 6:00 to 7:00 AM and 4:00 to 5:00 PM. Average AM and PM peak hour volumes on NW Luoto Road are 978 and 918 vehicles, respectively.

Table 3.25–3. Average Peak Hour Volumes (2008) – Regional Roadways

LOCATION	AM PEAK	PM PEAK
Trigger Avenue	676	844
Luoto Road	978	918

Source: All Traffic Data Services 2008.

Existing average daily traffic volumes were obtained for internal base intersections and roadways that would be used during construction activities associated with the proposed action (Table 3.25–4). All intersection and roadway traffic count data are provided in Appendix K. These roadways were selected because they are key access routes to and from the project site. In addition to traffic counts, travel lane configuration, roadway grade, and type of traffic control were verified and documented. Table 3.25–5 shows the existing average peak hour volumes at study intersections. Specifically, traffic counts were gathered during peak periods of 6:00 AM to 8:00 AM and 2:30 PM to 4:30 PM, on a typical weekday at the following intersections:

- Trigger Avenue and Ohio Street,
- Trigger Avenue and Trident Boulevard,
- Trigger Avenue and Escolar Road,
- Escolar Road and Sturgeon Street,
- Escolar Road and Greenling Road, and
- Archerfish Road and Seawolf Road.

Traffic counts were also collected for the following roadway segments:

- Trigger Avenue south of Trident Boulevard,
- Trident Boulevard east of Trigger Avenue,
- Trigger Avenue East of Escolar Road,
- Escolar Road north of Trigger Avenue,
- Escolar Road north of Sturgeon Street,
- Greenling Road west of Archerfish Road, and
- Archerfish Road north of Seawolf Road.

Table 3.25–4. Average Daily Traffic Volumes – NBK at Bangor Roadways

LOCATION	CARS	TRUCKS/BUSES	TOTAL
Trigger Avenue north of Thresher Avenue	6,854	266	7,120
Trigger Avenue East of Escolar Road	8,676	702	9,378
Trident Boulevard East of Scorpion Avenue	10,830	751	11,581
Escolar Road south of Goldfinch Lane	4,026	226	4,252
Escolar Road north of Sturgeon/Attu	3,446	96	3,542
Greenling Road west of Archerfish Road	829	25	854
Archerfish Road north of Tinian Road	446	2	448

Source: Parametrix 2011.

Table 3.25–5. Average Peak Hour Volumes – NBK at Bangor Roadways

LOCATION	AM PEAK	PM PEAK
Trigger Avenue/Ohio Street	1,267	1,424
Trigger Avenue/Trident Boulevard	1,693	1,512
Trigger Avenue/Escolar Road	1,445	1,480
Escolar Road/Sturgeon Road	625	460
Escolar Road/Greenling Road	398	347
Archerfish Road/Seawolf Road	91	72

Source: Parametrix 2011.

Traffic from NBK at Bangor does not cause congestion problems outside the base. This is due to the location of the base in close proximity to major highways or roads such as SR 3 and SR 308, which provide direct access to NW Trigger Avenue and NW Luoto Road. In addition, the two access roads, NW Trigger Avenue and NW Luoto Road, are multi-lane roads capable of handling large volumes of traffic.

3.25.1.3.3 LEVEL OF SERVICE

Level of service (LOS) is a measure of roadway operation, which uses a qualitative grading scale from A to F. LOS A represents the best traffic operations and LOS F represents the worst traffic operations. LOS can be used to characterize the overall traffic operations along a roadway or at intersections. Tables 3.25–6 and 3.25–7 provide descriptions of LOS in terms of intersection delay.

The minimum standard for road operations in Kitsap County is LOS D. The LOS on NW Trigger Avenue is LOS A (Kitsap County Department of Community Development 2005) and NW Luoto Road is LOS C (Rogers 2008, personal communication).

Table 3.25–6. Level of Service for At-Grade Signalized Intersections

LOS	AVERAGE CONTROL DELAY	GENERAL DESCRIPTION
A	< 10 seconds	Free Flow
B	10-20 seconds	Stable Flow
C	20-35 seconds	Stable Flow (Acceptable Delay)
D	35-55 seconds	Approaching Unstable Flow (Tolerable Delay)
E	55-80 seconds	Unstable Flow (Intolerable Delay)
F	> 80 seconds	Forced Flow (Jammed)

Source: Transportation Research Board 2000.

Table 3.25–7. Level of Service for At-Grade Unsignalized Intersections

LOS	AVERAGE CONTROL DELAY	GENERAL DESCRIPTION
A	< 10 seconds	Free Flow
B	10-15 seconds	Stable Flow
C	15-25 seconds	Stable Flow (Acceptable Delay)
D	25-35 seconds	Approaching Unstable Flow (Tolerable Delay)
E	35-50 seconds	Unstable Flow (Intolerable Delay)
F	> 50 seconds	Forced Flow (Jammed)

Source: Transportation Research Board 2000.

3.25.1.3.4 SPECIAL TRAFFIC CONDITIONS

Several internal roads are periodically closed to traffic to enable the movement of assets on NBK at Bangor. These road closures are part of routine operations, and personnel on the base are familiar with these procedures. These closures may last several days and no access is allowed on these roads. During these events, alternate routes are used.

3.25.1.4 Non-Motorized Traffic

Several of the roads have designated bicycle lanes for commuting traffic only. These bike lanes are approximately 3 feet wide, paved, and marked with lane striping and signage. The roads in the residential and commercial areas on the base have sufficiently wide paved shoulders to accommodate bicyclists. There are also paved pathways and sidewalks in some areas such as between parking areas and buildings and in the commercial and residential areas for pedestrian travel.

Kitsap County has extended the existing off-road Clear Creek Trail to the NW Trigger Avenue/SR-3 interchange. This trail creates a commuting route between the Ridgetop community, NBK at Bangor, and Silverdale.

3.25.1.5 Airspace

The Federal Aviation Administration designated a prohibited area (P-51) over NBK at Bangor, which replaced a Temporary Flight Restriction that restricted aircraft flight operations in the vicinity of the base. This designation was requested by the Navy in the interest of national defense to protect TRIDENT submarines by preventing aircraft overflights at low altitudes near NBK at Bangor. Per Title 14 Code of Federal Regulations (14 CFR) part 73, P-51 consists of that airspace from the surface up to, but not including, 2,500 feet MSL, to include base property on the east side of Hood Canal, the water across Hood Canal, and the base-owned land portion of the Toandos Peninsula. No person may operate an aircraft within a prohibited area unless authorization has been granted by the using agency.

The closest public use airport, Apex Airport, is located approximately 5.75 miles south of NBK at Bangor.

3.25.2 Environmental Consequences

The evaluation of impacts to transportation resources considers whether traffic volumes increase sufficiently to create a need to construct new transportation infrastructure, including new roads, stormwater design and culvert restoration along existing roads, traffic diversions needed during construction, new transit options for construction workers, or new parking areas.

Marine vessel traffic impacts are evaluated to determine whether marine-based construction equipment would interfere with normal navigational activities in Hood Canal or substantially increase vessel traffic volumes that would warrant construction of new facilities.

3.25.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.25.2.1.1 CONSTRUCTION

3.25.2.1.1.1 MARINE VESSEL TRAFFIC

Proposed in-water construction activities would require use of marine-based construction equipment (i.e., derrick/supply barges and cranes, pile barges, and tugboats) to support construction of the access trestles and wharves (main wharf and warping wharf) and transport materials to and from the project site. Construction materials (including piles, concrete panels, and structural materials) would remain on barges until used for construction. Marine-based construction equipment would be present within the project area for approximately 2 to 3 in-water work seasons. Approximately three one-way barge trips per week would be required to support proposed wharf construction activities; weekly barge trips would be substantially reduced subsequent to construction of the wharf deck. Barges are expected to transit from various locations in Central Puget Sound to the construction site via Admiralty Inlet to Hood Canal. Construction vessels would require additional openings of the Hood Canal bridge to access the project site.

Any support boat or barge used during in-water construction activities would generally be located in NBK at Bangor restricted areas away from normal navigational activities. Standard U.S. Coast Guard safety precautions would be used by all contractors. A maximum of three one-way barge trips per week would not be sufficient to interfere with marine vessel traffic in Hood Canal.

Within the NBK at Bangor restricted areas, marine-based construction equipment would be highly visible, well-marked, and would be relatively stationary as equipment (e.g., barge/tugboat and pile drivers) would only be moved prior to and after completion of in-water construction activities. Movement of construction vessels within the restricted areas would be coordinated with NBK at Bangor Port Operations to ensure no interference with other Navy vessel movements. To maintain adequate levels of safety for vessel navigation during in-water construction activities, the Navy will request that the U.S. Coast Guard issue a Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity.

The three additional weekly, one-way, barge trips and associated bridge openings would result in negligible delays (on average 30 minutes per opening for a total of 90 minutes per week) for motorists traveling on SR 104. The increase in weekly barge trips and associated bridge openings would not appreciably increase vessel traffic levels in the project area. This level of vessel traffic is not expected to adversely impact vessel transit routes in Hood Canal or

Puget Sound. Based on a review of data on Hood Canal Bridge openings, the bridge typically opens 400 to 450 times per year for an average opening of just over once per day. June through October represents the period with the majority of openings due to an increase in pleasure boat traffic (Crawford 2010, personal communication). Impacts to motorists would be minimized by avoiding barge trips through the Hood Canal Bridge opening during peak commute hours of 6:00 AM to 8:30 AM and 3:30 PM to 6:00 PM, Monday through Friday.

Construction would not require changes to the marine Restricted Areas on NBK at Bangor (Section 1.1) nor to vessel traffic related to tribal fishing access, which does not occur in the Restricted Areas at present (access for shellfishing is from land).

As marine-based construction equipment would not interfere with normal navigational activities in Hood Canal and barge trips through the Hood Canal Bridge opening would be avoided during peak commute hours, no significant impacts to marine vessel traffic during construction would occur.

3.25.2.1.1.2 VEHICLE TRAFFIC

During construction, a paved access road approximately 610 feet in length would be built to provide access from Archerfish Road to the upland construction area at the EHW-2 project site. During operations at the existing EHW, construction access on the existing road would be restricted. The access road would allow construction access during operations at the existing EHW. In addition, a permanent paved road approximately 140 feet in length would be built to connect the new trestle(s) to an existing road. Paved driveways and parking areas would be constructed at the sites for the three new facilities (including the replacement parking) and the replacement pure water facility.

A 5-acre laydown area (i.e., parking lot, material/equipment storage, and soil stockpiling) would be located on the east side of Archerfish Road approximately 4,000 feet south of the EHW-2. The temporary laydown area would accommodate construction worker parking, temporary material storage, and assembly. The laydown area would generate traffic by supporting material deliveries, removal of debris, and distribution of construction personnel from the staging site to the construction location(s). Archerfish Road would be the primary haul route for construction. Construction workers would be transported between the parking site and the construction site using contractor-provided buses. These buses would run approximately 20 times per day, which would not be sufficient to impact base circulation.

Truck traffic would be generated by the need to deliver construction materials and remove demolition and construction debris from project sites, including the upland area at the site of the EHW-2, and sites of the demolition of five facilities and construction of the four relocated facilities. Approximately 228 total truck trips would be required to transport demolition debris off site to the Olympic View Landfill in Port Orchard, approximately 23 miles from NBK at Bangor. Approximately 24,491 truck trips and 45,411 other construction traffic trips would occur over the construction period (i.e., 3.5 years or 910 work days). The daily construction-related traffic trips are predicted to average approximately 177 trips per day (Table 3.25–8, Table 3.25–9). During peak construction activities including cement work, delivery of precast deck sections, and heavy machinery operations there would be a substantial increase in the peak number of truck trips per day. Peak period truck trips are estimated to increase up to 150 trips per day for a period estimated at 1 to 10 days. In other construction periods, truck trips could reach a peak of 80 trips per day. Likewise, this peak period would only be anticipated for a short duration of 1 to 10 days. The existing roads planned for construction traffic could accommodate

the additional vehicles and trucks, and would not need to be upgraded to accommodate construction traffic. However, the additional traffic volumes may create longer wait times to enter the base, particularly during the AM peak hour, as vehicles queue up to pass through the security checkpoint.

Table 3.25–8. Daily Average Traffic Volumes on NW Luoto Road for Alternative 1 (2012 to 2015)

	2012	2013	2014	2015
Non-Project Traffic	12,896	13,051	13,207	13,366
Construction Automobile Trips[1]	100	100	100	100
Construction Truck Trips[2]	27	27	27	27
Other Construction Traffic	50	50	50	50
Total	13,073	13,228	13,384	13,543

1. The daily average number of construction workers is a conservative estimate based on the maximum workers onsite during the 42- to 48-month construction period.
2. The daily average construction truck trip includes transport of demolition debris to the Olympic View Landfill in Port Orchard.

Table 3.25–9. Daily Average Traffic Volumes on NW Trigger Avenue for Alternative 1 (2012 to 2015)

	2012	2013	2014	2015
Non-Project Traffic	11,984	12,128	12,274	12,421
Construction Automobile Trips[1]	100	100	100	100
Construction Truck Trips[2]	27	27	27	27
Other Construction Traffic	50	50	50	50
Total	12,161	12,305	12,451	12,598

1. The daily average number of construction workers is a conservative estimate based on the maximum workers onsite during the 42- to 48-month construction period.
2. The daily average construction truck trip includes transport of demolition debris to the Olympic View Landfill in Port Orchard.

REGIONAL ROADWAYS

Onshore construction activities would add traffic to NW Luoto Road/Trident Boulevard and NW Trigger Avenue. NW Luoto Road/Trident Boulevard has six lanes with 12-foot travel lanes and 6-foot paved shoulders extending from the main gate to SR-3. NW Trigger Avenue has five lanes with 12-foot travel lanes and 6-foot paved shoulders. These roads are capable of handling large volumes of traffic higher than existing levels plus projected increases due to construction. Non-project traffic volumes are assumed to increase by 1.2 percent annually (Rogers 2008, personal communication). However, the additional traffic volumes could create longer wait times to enter the base, as vehicles queue up to pass through the security checkpoint.

NBK AT BANGOR ROADWAYS

Intersection LOS Analysis

Construction-related traffic would have minor impacts (a few seconds or less) on the following intersections: Trigger Avenue/Ohio Street; Trigger Avenue/Trident Boulevard; Trigger Avenue/Skipjack Circle; and Escolar Road/Greenling Road during both the AM and PM peak hour (Table 3.25–10). In fact, during the AM peak hour, the impact at all intersections would be relatively minor, except at the Trigger Avenue/Trident Boulevard intersection, which would operate at an acceptable LOS D. Large trucks would use the main Trident Boulevard gate, not the Trigger Avenue gate.

Table 3.25–10. Peak Hour Intersection Level of Service Analysis – NBK at Bangor Roadways

	AM PEAK				PM PEAK			
	BASELINE		WITH CONSTRUCTION TRAFFIC		BASELINE		WITH CONSTRUCTION TRAFFIC	
INTERSECTION	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)
Trigger & Ohio[1]	A	9.7	A	9.7	B	10.0	A	10.0
Trigger & Trident[1]	C	25.1	D	38.4	A	9.1	A	9.3
Trigger & Escolar[1]	A	7.1	A	8.2	D	45.2	F	100.1
Trigger & Skipjack[1]	A	6.1	A	6.1	D	45.1	D	52.0
Escolar & Sturgeon[2]	B	14.3	C	16.6	C	23.3	F	50.9
Escolar & Greenling[2]	B	11.0	C	16.1	B	10.2	C	15.9
Archerfish & Seawolf[2]	A	9.4	B	11.5	A	9.3	B	12.3

Source: Parametrix 2011.

1. Signalized intersection. LOS and Delay shown for overall intersection average.
2. Unsignalized intersection. LOS and Delay shown for worst-case direction only.

However, during the PM peak hour, the intersection of Trigger Avenue/Escolar Road would experience an increase of nearly 55 seconds of delay per vehicle and would degrade from LOS D to LOS F. In addition, delays at the intersection of Escolar Road/Sturgeon Road would increase approximately 27 seconds, and would degrade from LOS C to LOS F. Please refer to Appendix K for additional details regarding intersection LOS calculations.

Roadway LOS Analysis

Construction traffic would impact the level of service for Escolar Road, Greenling Road, and Archerfish Road (Table 3.25–11). During peak times of heavy construction traffic, the overall average speed of vehicles would degrade the level of service. However, these roadways would operate at an acceptable LOS D or better. Please refer to Appendix K for additional details regarding roadway LOS calculations.

3.25.2.1.1.3 PUBLIC TRANSIT

Alternative 1 would not increase transit demand such that demands could not be accommodated by existing or planned transit capacity. Workers would be transported between the parking site and the construction site using contractor-provided buses. The NBK at Bangor

internal bus system could also be used to transport construction workers to and from the project site.

3.25.2.1.1.4 NON-MOTORIZED TRAFFIC

As no bicycle routes in the project area would be affected by construction activities, Alternative 1 would not reduce bicycle safety on designated routes used by bicycles.

Table 3.25–11. Peak Hour Roadway Level of Service Analysis – NBK at Bangor Roadways

	AM PEAK		PM PEAK	
	BASELINE	WITH CONSTRUCTION TRAFFIC	BASELINE	WITH CONSTRUCTION TRAFFIC
ROADWAY LINK	LOS	LOS	LOS	LOS
Trigger north of Ohio[1]	A	A	A	A
Trident east of Trigger[1]	A	A	A	A
Trigger east of Escolar[1]	B	B	B	B
Escolar north of Trigger[1]	C	D	C	C
Escolar north of Sturgeon[2]	C	C	C	C
Greenling west of Archerfish[2]	B	C	A	C
Archerfish north of Seawolf[2]	B	C	A	C

Source: Parametrix 2011.
1. Multilane highway
2. Two-lane highway

3.25.2.1.1.5 AIRSPACE

The EHW-2 would be constructed within the P-51 designated area. Based on the designated altitude limitation for P-51 of 2,500 feet MSL and the highest elevation of the proposed EHW-2 structure (205 feet MSL), the EHW-2 would be within the vertical limits of P-51. However, as the proposed structure would be over 200 feet in height, airspace navigation lighting would be required. As the EHW-2 would not extend beyond base boundaries or waters across Hood Canal, modifications to the existing P-51 designation would not be required. Therefore, Alternative 1 would not affect the use of the existing airspace environment. No significant impacts to airspace during construction would occur.

3.25.2.1.2 OPERATION/LONG-TERM IMPACTS

3.25.2.1.2.1 MARINE VESSEL TRAFFIC

The EHW-2 would be constructed to support current operations at the existing EHW. A portion of the existing operations and associated vessel traffic at the EHW and other Bangor waterfront facilities would be diverted to the EHW-2, but overall vessel activity on NBK at Bangor would not increase as a result of the proposed action. Due to the proximity of the project site to the existing EHW, relocation of operations would not appreciably alter existing vessel transit routes or the amount of vessel traffic. Furthermore, maintenance of the EHW-2, including routine inspections, repair, and replacement of facility components as required, would not substantially increase the amount of vessel traffic. Therefore, no significant impacts to marine vessel traffic during operations would occur.

Operations would not require changes to the marine Restricted Areas on NBK at Bangor (Section 1.1) nor to vessel traffic related to tribal fishing access, which does not occur in the Restricted Areas at present (access for shellfishing is from land).

3.25.2.1.2.2 VEHICLE TRAFFIC

The EHW-2 is projected to be in operation in 2016. Operations would create positions for approximately 20 additional employees in the year 2016. Operation of the EHW-2 would generate approximately 40 additional vehicle trips per day (Table 3.25–12). Existing parking lots would accommodate these additional vehicles. The access road would allow construction access during operations at the EHW-2.

Table 3.25–12. Non-Project and Project Daily Average Traffic Volumes (2016)

LOCATION	2008 TRAFFIC[1]	ESTIMATED NON-PROJECT TRAFFIC 2016	ESTIMATED PROJECT TRAFFIC 2016	TOTAL 2016 TRAFFIC
NW Luoto Road	12,295	13,526	20	13,546
NW Trigger Road	11,426	12,570	20	12,590
Total	23,721	26,096	40	26,128

1. Source: All Traffic Data Services 2008.

In 2016, traffic volume on NW Luoto Road and NW Trigger Avenue is expected to increase 10 percent compared to existing conditions. This increase includes traffic generated by operations of the EHW-2. These roads would operate at acceptable levels of service and have capacity for the future level of traffic without reducing the existing level of service on these roadways. However, the additional traffic volumes are expected to create longer wait times to enter the base, particularly during the AM peak hour, as vehicles queue up to pass through the security checkpoint. Maintenance of the EHW-2, including routine inspections, repair, and replacement of facility components as required, would not result in substantial impacts to transportation. Operation of the three new buildings and pure water facility would not increase traffic, because existing operations would be shifted to the new sites and new operations would not be added. Operational traffic for these facilities would be minimal and would not impact traffic flow on the affected roads.

Operations workers would park at a parking lot to be built in the vicinity of the EHW-2 as part of another project. Workers would walk to the work site.

Alternative 1 operations would have negligible effects on existing transit services or non-motorized traffic in the project vicinity. Airspace in the project vicinity would not be affected for the reasons discussed above under Construction (Section 2.25.2.1.1.5).

3.25.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

3.25.2.2.1 CONSTRUCTION

Alternative 2 would have a longer in-water construction period (3 to 4 work seasons) compared to Alternative 1 (2 to 3 work seasons). Under this alternative, the impact to marine vessel traffic would be slightly greater than that described for Alternative 1, due to the longer presence of in-water construction equipment and increased barge trips. Similar to Alternative 1, the Navy will develop a local Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity. In addition, barge trips and associated

bridge openings would be scheduled to avoid peak commuting hours on Hood Canal Bridge (6:00 AM to 8:30 AM and 3:30 PM to 6:00 PM, Monday through Friday). As with Alternative 1, construction would not require changes to marine Restricted Areas nor to vessel traffic related to tribal fishing.

The impact to vehicle traffic from construction of Alternative 2 would be greater than that described for Alternative 1. The primary difference under this alternative would be the additional truck traffic generated over a longer construction period by the delivery of equipment/materials and construction workers. Approximately 28,897 truck trips and 45,411 other construction traffic trips would occur over the construction period (i.e., 4.5 years or 1,170 work days). The daily average traffic volume generated by construction-related traffic trips (e.g., construction workers, construction truck trips, and other construction traffic) would be slightly less than Alternative 1 (164 vs. 177) due to the longer construction schedule. During peak construction activities, including cement work, delivery of precast deck sections, and heavy machinery operations, there would be a substantial increase in the peak number of truck trips per day. Peak period truck trips are estimated to increase up to 150 trips per day for a period estimated at 1 to 10 days. In other construction periods, truck trips could reach a peak of 80 trips per day. Likewise, this peak period would only be anticipated for a short duration of 1 to 10 days. The existing roads could accommodate the additional construction vehicles and trucks, and would not need to be upgraded to accommodate construction traffic.

Impacts to public transit, non-motorized traffic, and airspace during Alternative 2 construction activities would be the same as those described for Alternative 1.

3.25.2.2.2 OPERATION/LONG-TERM IMPACTS

Impacts to traffic from Alternative 2 operations would be the same as those described for Alternative 1, because this alternative would create the same number of jobs and associated employee-generated vehicle trips. Impacts to marine vessel traffic, public transit, non-motorized traffic, and airspace during Alternative 2 operations would be the same as those described for Alternative 1.

3.25.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

3.25.2.3.1 CONSTRUCTION

Since Alternative 3 has the same in-water construction period (2 to 3 work seasons) as Alternative 1, impacts to marine vessel traffic would be similar to those described for Alternative 1. Similar to Alternative 1, the Navy will develop a local Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity. In addition, barge trips and associated bridge openings would be scheduled to avoid peak commuting hours on Hood Canal Bridge (6:00 AM to 8:30 AM and 3:30 PM to 6:00 PM, Monday through Friday). As with Alternative 1, construction would not require changes to marine Restricted Areas nor to vessel traffic related to tribal fishing.

The impact to vehicle traffic from construction of Alternative 3 would be similar but slightly greater than that described for Alternative 1. The primary difference under this alternative would be the additional truck traffic generated by constructing the paved onshore road. Construction of the road would take approximately 22 days, slightly longer than for Alternative 1 (18 days). Approximately 24,914 truck trips and 45,411 other construction traffic trips would occur over the construction period (i.e., approximately 3.5 years or 932 work days). The daily average

traffic volume generated by construction-related traffic (e.g., construction workers, construction truck trips, and other construction traffic) would be the same as for Alternative 1. During peak construction activities, including cement work, delivery of precast deck sections, and heavy machinery operations, there would be a substantial increase in the peak number of truck trips per day. Peak period truck trips are estimated to increase up to 150 trips per day for a period estimated at 1 to 10 days. In other construction periods, truck trips could reach a peak of 80 trips per day. Likewise, this peak period would only be anticipated for a short duration of 1 to 10 days. The existing roads planned for construction traffic could accommodate the additional vehicles and trucks, and would not need to be upgraded to accommodate construction traffic.

Impacts to public transit, non-motorized traffic, and airspace during Alternative 3 construction activities would be the same as those described for Alternative 1.

3.25.2.3.2 OPERATION/LONG-TERM IMPACTS

Impacts to traffic from Alternative 3 operations would be the same as those described for Alternative 1, because this alternative would create the same number of jobs and associated employee-generated vehicle trips. Impacts to marine vessel traffic, public transit, non-motorized traffic, and airspace during Alternative 3 operations would be the same as those described for Alternative 1.

3.25.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

3.25.2.4.1 CONSTRUCTION

Alternative 4 would have a longer in-water construction period (3 to 4 work seasons) compared to Alternative 1 (2 to 3 work seasons). Under this alternative, the impact to marine vessel traffic would be similar but slightly greater than that described for Alternative 1, due to the longer presence of in-water construction equipment and increased barge trips. Similar to Alternative 1, the Navy will develop a local Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity. In addition, barge trips and associated bridge openings would be scheduled to avoid peak commuting hours on Hood Canal Bridge (6:00 AM to 8:30 AM and 3:30 PM to 6:00 PM, Monday through Friday). As with Alternative 1, construction would not require changes to marine Restricted Areas nor to vessel traffic related to tribal fishing.

The impact to vehicle traffic from construction of Alternative 4 would be greater than that described for Alternative 1. The primary difference under this alternative would be the additional truck traffic generated over a longer construction period by the delivery of equipment/materials and construction workers. Approximately 28,897 truck trips and 45,411 other construction traffic trips would occur over the construction period (i.e., 4.5 years or 1,170 work days). The daily average traffic volume generated by construction-related traffic (e.g., construction workers, construction truck trips, and other construction traffic) would be slightly less than Alternative 1 (164 vs. 177) and the same as for Alternative 2. The existing roads planned for construction traffic could accommodate the additional vehicles and trucks, and would not need to be upgraded to accommodate construction traffic.

Impacts to public transit, non-motorized traffic, and airspace during Alternative 4 construction activities would be the same as those described for Alternative 1.

3.25.2.4.2 OPERATION/LONG-TERM IMPACTS

The impact to traffic from Alternative 4 operations would be the same as that described for Alternative 1, because this alternative would create the same number of jobs and associated employee-generated vehicle trips. Impacts to marine vessel traffic, public transit, non-motorized traffic, and airspace during Alternative 4 operations would be the same as those described for Alternative 1.

3.25.2.5 Alternative 5: Combined Trestle, Floating Wharf

3.25.2.5.1 CONSTRUCTION

Since Alternative 5 would have a slightly reduced in-water construction period (2 work seasons) compared to Alternative 1 (2 to 3 work seasons), the impact to marine vessel traffic would be similar but slightly less than that described for Alternative 1. Similar to Alternative 1, the Navy will develop a local Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity. In addition, barge trips and associated bridge openings would be scheduled to avoid peak commuting hours on Hood Canal Bridge (6:00 AM to 8:30 AM and 3:30 PM to 6:00 PM, Monday through Friday). As with Alternative 1, construction would not require changes to marine Restricted Areas nor to vessel traffic related to tribal fishing.

The impact to vehicle traffic from construction of Alternative 5 would be similar to but slightly less than that described for Alternative 1 due to the reduced construction period (42 to 44 months). Approximately 24,897 truck trips and 45,411 other construction traffic trips would occur over the construction period (i.e., approximately 3.5 years or 931 work days). The daily average traffic volume generated by construction-related traffic (e.g., construction workers, construction truck trips, and other construction traffic) would be the same as for Alternative 1. The existing roads planned for construction traffic could accommodate the additional Impacts to public transit, non-motorized traffic, and airspace during Alternative 5 construction activities would be the same as those described for Alternative 1.

3.25.2.5.2 OPERATION/LONG-TERM IMPACTS

The impact to traffic from Alternative 5 operations would be the same as that described for Alternative 1, because this alternative would create the same number of jobs and associated employee-generated vehicle trips. Impacts to marine vessel traffic, public transit, non-motorized traffic, and airspace during Alternative 5 operations would be the same as those described for Alternative 1.

3.25.2.6 No-Action Alternative

Under the No-Action Alternative, construction of the EHW-2 and support facilities would not occur. Existing conditions would remain and existing ground and vessel traffic levels would remain unchanged. Therefore, no impacts to transportation would occur under the No-Action Alternative.

3.25.2.7 Mitigation Measures and Regulatory Compliance

To maintain adequate levels of safety for vessel navigation during in-water construction activities, the Navy will request that the U.S. Coast Guard issue a Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity. The

local Notice to Mariners would increase the awareness of all waterway users in the project vicinity and ensure adequate communication between the U.S. Coast Guard, Marine Exchange of Puget Sound, dredging contractors, dredge and vessel operators, and transiting vessels.

Traffic detours, congestion areas, and use of transit services would follow DoD transportation directives including DoD Directive 4500.9, Transportation and Traffic Management, and DoD Directive 4510.11, Transportation Engineering.

Impacts to motorists can be minimized by avoiding barge trips through the Hood Canal Bridge passage during peak commute hours of 6:00 AM to 8:30 AM and 3:30 PM to 6:00 PM, Monday through Friday.

No consultations or permits are required.

3.25.3 Summary of Impacts

Impacts to transportation associated with the construction and operation phases of each of the project alternatives are summarized in Table 3.25–13.

Table 3.25–13. Summary of Impacts to Transportation

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO TRANSPORTATION
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Increased marine vessel and vehicular traffic levels, including the new access road and laydown area, would not be sufficient to require improvement to infrastructure. *Operation/Long-term Impacts:* Slight increase in traffic levels.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Alternative 2 would have an extended duration of increased marine vessel and vehicular traffic levels due to longer construction period (54 to 64 vs. 42 to 48 months); impacts, including the new access road and laydown area would not be sufficient to require improvement to infrastructure. *Operation/Long-term Impacts:* Slight increase in traffic levels.
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Increased marine vessel and vehicular traffic levels, including the new access road and laydown area, would not be sufficient to require improvement to infrastructure. *Operation/Long-term Impacts:* Slight increase in traffic levels.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Alternative 4 would have an extended duration of increased traffic levels due to longer construction period (54 to 64 vs. 42 to 48 months); impacts, including the new access road and laydown area would not be sufficient to require improvement to infrastructure. *Operation/Long-term Impacts:* Slight increase in traffic levels.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Alternative 5 would have reduced marine traffic impacts due to shorter in-water construction duration than Alternative 1 (2 seasons); impacts, including the new access road and laydown area, would be not sufficient to require improvement to infrastructure. *Operation/Long-term Impacts:* Slight increase in traffic levels.
No-Action Alternative	No impact.

Table 3.25–13. Summary of Impacts to Transportation (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO TRANSPORTATION
Mitigation • The Navy will request that the U.S. Coast Guard issue a Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity. • Barge trips and associated bridge openings would be scheduled to avoid peak commuting hours on Hood Canal Bridge (6:00 am to 8:30 am and 3:30 pm to 6:00 pm, Monday through Friday).	
Consultation and Permit Status: Although no consultations or permits are required, the Navy would notify the tribes of anticipated construction vessel traffic.	

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3.26 PUBLIC HEALTH AND SAFETY

Public health and safety relates to current and future operations on NBK at Bangor, including explosives safety and hazardous material handling, as well as any health and safety hazards resulting from construction of the EHW-2.

Project activities on NBK at Bangor that may affect public health and safety are subject to regulatory authority at the federal and state level.

COMNAVREGNWINST 5090.1, Integrated Contingency Plan, Annex G, *Commander Navy Region Northwest Oil and Hazardous Substance Integrated Contingency Plan* and the *NBK Bangor Spill Prevention, Control, and Countermeasure Plan* provide guidance that would be used in a spill response, including response procedures, notification, and communication plan; roles and responsibilities; and response equipment inventories. In the event of an accidental spill, response measures would be implemented immediately to minimize potential impacts.

OPNAVINST 5100-23G *Occupational Safety and Health* addresses noise levels and occupational safety and health pertinent to industrial activities on NBK at Bangor.

NAVSEA OP5, *Ammunition and Explosives Safety Ashore*, provides criteria for establishing the distance from given types and quantities of explosives within which activities and facilities are restricted to assure protection to life and property in the event of an accident.

WAC Chapter 173-60 establishes maximum allowable noise levels. Title 10, Section 10.28.040 of the Kitsap County Code limits the maximum permissible environmental noise levels for residential zones. Sounds originating from temporary construction sites as a result of construction activity are exempt from these provisions between the hours of 7:00 AM and 10:00 PM.

EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks* (Protection of Children) requires each federal agency to "make it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children and shall…ensure that its policies, programs, activities and standards address disproportionate risks to children…."

Consultation and Permit Compliance Status. No consultations or permits are required.

3.26.1 Existing Environment

There has never been an accident at the existing EHW that jeopardized the safety of the base, the local population, or the environment. The Navy's strategic weapons programs use a layered safety system that includes highly trained personnel, detailed administration, and specifically designed equipment to ensure its missiles and weapons are safe and reliable.

The Navy maintains contingency plans and conducts regular emergency response training to ensure rapid and effective actions in the unlikely event of an accident. In any emergency, or in the highly unlikely event of an accident at the existing EHW, the Navy would coordinate with traditional regional media (radio, television, and internet) and county- or state-based emergency response capabilities to immediately notify the public. A Mutual Aid Agreement between the Navy emergency response components, local communities, county, tribes, state and federal agencies ensures an adequate response force is available to respond to an emergency or accident.

3.26.1.1 Operations

The existing EHW on NBK at Bangor, as well as two EHWs at Naval Submarine Base Kings Bay, Georgia, have operated safely for over 30 years. The explosives handled at the existing EHW are mainly in the form of missile motor propellant. Accidents are prevented by incorporating test results and over 30 years of experience into an overall system of safety which includes facilities, equipment, training, and personnel. Weapons systems are tested under extreme conditions well above conditions to which the weapons system might be subjected during the Navy's weapons handling operations.

NAVSEA OP5, Ammunition and Explosives Safety Ashore, provides criteria for establishing the distance from given types and quantities of explosives within which activities and facilities are restricted to assure protection to life and property in the event of an accident. This distance, plotted as a circle with the location of the explosives handling operation at the center, provides an arc that designates the area in which restrictions apply. Arcs for the existing EHW and the proposed EHW-2 are shown in Appendix C, Explosives Safety Arcs for Existing EHW and Proposed EHW-2, marked DoD UCNI. For reasons of national security, UCNI information cannot be included in a public document. Facilities and operations located within the arc that designates the area restricted due to proximity to the existing EHW, comply with DDESB and NOSSA requirements.

3.26.1.2 Safety Certification and Training

The Navy is qualified to handle missiles based on a comprehensive and lengthy certification process. The DDESB and NOSSA provide extensive oversight of all ordnance handling at Navy facilities, including NBK at Bangor. The Navy's military and civilian personnel responsible for handling explosives must complete rigorous qualification training, and must demonstrate continuing proficiency annually.

Effective preparedness is critical for an effective response during any accident, and as part of the National Response Framework, the Navy trains regularly in direct emergency response coordination with federal agencies, the state, tribes, and surrounding communities. The National Response Framework was produced by the Department of Homeland Security. It details how the nation conducts any emergency response, from the smallest incident to the largest catastrophe. Navy Region Northwest responders are trained accordingly, and continually exercise responses with federal, state, local, and tribal officials. The Framework identifies the key response principles, as well as the roles and structures that organize national response. It describes how communities, states, the federal government, tribal, private-sector, and non-governmental partners apply these principles for a coordinated, effective response.

3.26.1.3 Trident Training Facility

The Trident Training Facility trains officers and enlisted personnel in the knowledge and skills required to proficiently and safely operate and maintain TRIDENT submarines and associated systems. It is the first and only DoD school accredited by the Northwest Association of Schools and Colleges.

3.26.1.4 Strategic Weapons Facility Pacific

On NBK at Bangor, the Strategic Weapons Facility supports the strategic mission of TRIDENT homeported submarines, including missile storage and handling. The facility

undergoes safety inspections every year. All military and civilian personnel are required to meet rigorous qualifications training.

3.26.2 Environmental Consequences

The evaluation of impacts to public health and safety considers whether conditions resulting from project construction and operation are consistent with federal, state, and local standards and regulations and whether public health and safety would be compromised as a result of the proposed action.

3.26.2.1 Alternative 1: Combined Trestle, Large Pile Wharf (Preferred Alternative)

3.26.2.1.1 CONSTRUCTION

No explosives would be handled or used for construction of the EHW-2. All construction activities would be conducted on Navy-owned land or restricted waters.

As discussed in Section 3.2, accidental spills of debris, fuel, or other contaminants into Hood Canal could occur during construction. In the event of an accidental spill, response measures would be implemented immediately to minimize potential impacts to the surrounding environment. As described in Section 3.16, noise from pile driving would have a localized, indirect, and short-term adverse impact to residential and recreational uses adjacent to the base and near the western shore of Hood Canal. As discussed in Section 3.4.2.1, recreational scuba divers diving between Hazel Point and Termination Point on the Toandos Peninsula could experience underwater noise levels that could cause a behavioral response including increased breathing and elevated heart rate (154 dB_{PEAK}), but would not receive levels sufficient to cause injury (SPL of 200 dB).

Approximately 20 existing facilities and/or structures on NBK at Bangor would be modified or demolished to comply with DDESB and NOSSA requirements to protect buildings located in the vicinity of explosives handling operations at the EHW-2. The scope of facility modifications would primarily include replacement of doors and windows and possibly the modification or addition of building structural components such as walls, interior and exterior columns, beams, and joists and the replacement of existing roof systems. Because of the age of some of these facilities and structures, hazardous materials such as asbestos, lead, or other heavy metals (cadmium, mercury), or polychlorinated biphenyls could have been used in construction. If not already surveyed, facilities or structures would be surveyed for such materials prior to modification or demolition. Should any hazardous materials be found, procedures for proper handling and disposal of the specific materials would be put into place. These procedures would comply with applicable federal, state, and local health and safety and environmental regulations.

Five of the affected buildings would be demolished and four replacement buildings would be built in industrial areas of the Lower Base (Section 2.2.1). Construction noise would exceed WAC limitations at an off-base residential area near the site of the three new buildings (Section 3.16.2.1). Although temporary construction noise is exempt from the WAC noise limitations, this construction noise is expected to be an annoyance for residents in this area.

The proposed EHW-2 facility would be located on the Bangor waterfront in a high security area. Access to this location is restricted. It would not be possible for children to enter the location during construction or operations of the facility. As discussed in Section 3.16, estimated maximum noise levels at Vinland would be 42 dBA during impact pile driving, which would not

exceed WAC maximum allowable noise levels; construction noise received at the closest schools (Vinland Elementary School and Breidablik Elementary School) would not exceed these anticipated noise levels. Therefore, no disproportionate environmental health and safety risks specific to children are expected.

As discussed in Section 3.4.2.1, scuba divers between Hazel Point and Termination Point on the Toandos Peninsula could experience underwater noise levels that could cause a behavioral response including increased breathing and elevated heart rate within 40,000 feet of the construction site during pile driving activity, but would not receive levels sufficient to cause injury. Divers would receive notice of pile driving activities through the Notice to Mariners, as well as notification to the public about upcoming construction activities and noise at the beginning of each construction season.

3.26.2.1.2 OPERATION/LONG-TERM IMPACTS

The proposed EHW-2 on NBK at Bangor would operate within the existing TRIDENT explosives handling program, which has a 30-year record of safe operations. Operations at the EHW-2 would be no different from operations at the existing EHW. The weapons system would remain the same — the TRIDENT II D5 missile. Like the existing EHW, the explosives that would be handled at the EHW-2 would be mainly in the form of missile motor propellant identical to the propellant that has been safely handled at the existing EHW for more than 30 years. The EHW-2 would operate within the existing TRIDENT explosives handling program.

The Navy's military and civilian personnel responsible for handling explosives at the EHW-2 would be as well trained and qualified as personnel currently working at the existing EHW and would also be required to demonstrate continuing proficiency annually. Procedures currently in place to inform the public of an emergency or accident at the existing EHW would be used in the event of an emergency or accident at the EHW-2.

Operational noise from the site of the three new buildings would be audible at the nearby residential area but would not exceed noise levels from existing Navy facilities at this site. Therefore, there would be no resulting impact to public health or safety.

3.26.2.2 Alternative 2: Combined Trestle, Conventional Pile Wharf

Impacts and mitigation for public health and safety would be the same as those described for Alternative 1.

3.26.2.3 Alternative 3: Separate Trestles, Large Pile Wharf

Impacts and mitigation for public health and safety would be the same as those described for Alternative 1.

3.26.2.4 Alternative 4: Separate Trestles, Conventional Pile Wharf

Impacts and mitigation for public health and safety would be the same as those described for Alternative 1.

3.26.2.5 Alternative 5: Combined Trestle, Floating Wharf

Impacts and mitigation for public health and safety would be the same as those described for Alternative 1.

3.26.2.6 No-Action Alternative

Under the No-Action Alternative, the EHW-2 would not be built and overall operations would not change from current levels. Therefore, there would be no impacts to public health and safety.

3.26.2.7 Mitigation Measures and Regulatory Compliance

The Navy will comply with the *Commander Navy Region Northwest Oil and Hazardous Substance Integrated Contingency Plan,* the SWPPP, and NPDES permit conditions.

The Navy would require the construction contractor to prepare and implement a Debris Management Plan with procedures for retrieving and cleaning up any accidental spills. The contractor would also prepare and implement a spill response plan.

To minimize noise impacts to residential uses, construction activities would not be conducted during the hours of 10:00 PM to 7:00 AM. In addition, impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset). Upland construction would occur between 7:00 AM and 10:00 PM. The Navy will notify the public about upcoming construction activities and noise at the beginning of each construction season. Divers, including tribal divers, would receive notice of pile driving activities through the Notice to Mariners, as well as notification to the public about upcoming construction activities and noise at the beginning of each construction season.

No consultations or permits are required.

3.26.3 Summary of Impacts

Impacts to public health and safety associated with the construction and operation phases of each of the project alternatives are summarized in Table 3.26–1.

Table 3.26–1. Summary of Impacts to Public Health and Safety

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO PUBLIC HEALTH AND SAFETY
Impact	
Alternative 1: Combined Trestle, Large Pile Wharf (Preferred)	*Construction:* Potential for spills (fuels or hazardous materials), but conditions are not expected to exceed water quality standards. Short-term noise impact to residential and recreational uses. *Operation/Long-term Impacts:* No increased danger or change from current safe operations. No disproportionate effects on children.
Alternative 2: Combined Trestle, Conventional Pile Wharf	*Construction:* Potential for spills (fuels or hazardous materials), but conditions are not expected to exceed water quality standards. Short-term noise impact to residential and recreational uses. *Operation/Long-term Impacts:* No increased danger or change from current safe operations. No disproportionate effects on children.

Table 3.26–1. Summary of Impacts to Public Health and Safety (continued)

ALTERNATIVE	ENVIRONMENTAL IMPACTS TO PUBLIC HEALTH AND SAFETY
Alternative 3: Separate Trestles, Large Pile Wharf	*Construction:* Potential for spills (fuels or hazardous materials), but conditions are not expected to exceed water quality standards. Short-term noise impact to residential and recreational uses. *Operation/Long-term Impacts:* No increased danger or change from current safe operations. No disproportionate effects on children.
Alternative 4: Separate Trestles, Conventional Pile Wharf	*Construction:* Potential for spills (fuels or hazardous materials), but conditions are not expected to exceed water quality standards. Short-term noise impact to residential and recreational uses. *Operation/Long-term Impacts:* No increased danger or change from current safe operations. No disproportionate effects on children.
Alternative 5: Combined Trestle, Floating Wharf	*Construction:* Potential for spills (fuels or hazardous materials), but conditions are not expected to exceed water quality standards. Short-term noise impact to residential and recreational uses. *Operation/Long-term Impacts:* No increased danger or change from current safe operations. No disproportionate effects on children.
No-Action Alternative	No impact.

Mitigation

- The Navy will comply with existing facility response and prevention plans.
- The Navy will ensure preparation and implementation of a Debris Management Plan and spill response plan during construction.
- Construction activities would not be conducted during the hours of 10:00 pm to 7:00 am. In addition, impact pile driving during the first part of the in-water work window (July 16 to September 15) would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Vibratory pile driving and other construction activities occurring in the water between July 16 and September 15 could occur during daylight hours (sunrise to sunset). Between September 16 and February 15, construction activities occurring in the water would occur during daylight hours (sunrise to sunset) Upland construction would occur between 7:00 AM and 10:00 PM.
- The Navy will notify the public about upcoming construction activities and noise at the beginning of each construction season.
- Divers, including tribal divers, would receive notice of pile driving activities through the Notice to Mariners, as well as notification to the public about upcoming construction activities and noise at the beginning of each construction season.

Consultation and Permit Status: No consultations or permits are required.

CHAPTER 4

CUMULATIVE IMPACTS

4.0 CUMULATIVE IMPACTS

4.1 PRINCIPLES OF CUMULATIVE IMPACTS ANALYSIS

The approach taken herein to analyze cumulative effects[1] meets the objectives of the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality (CEQ) regulations, and CEQ guidance. CEQ regulations (40 CFR 1500-1508) provide the implementing procedures for NEPA. The regulations define "cumulative effects" as:

> . . . the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

CEQ provides guidance on cumulative impacts analysis in *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997). This guidance further identifies cumulative effects as those environmental effects resulting "from spatial and temporal crowding of environmental perturbations. The effects of human activities will accumulate when a second perturbation occurs at a site before the ecosystem can fully rebound from the effects of the first perturbation." Noting that environmental impacts result from a diversity of sources and processes, this CEQ guidance observes that "no universally accepted framework for cumulative effects analysis exists," while also noting that certain general principles have gained acceptance. One such principle provides that "cumulative effects analysis should be conducted within the context of resource, ecosystem, and community thresholds—levels of stress beyond which the desired condition degrades." Thus, "each resource, ecosystem, and human community must be analyzed in terms of its ability to accommodate additional effects, based on its own time and space parameters." Therefore, cumulative effects analysis normally will encompass a Region of Influence (ROI) or geographic boundaries beyond the immediate area of the proposed action, and a time frame including past actions and foreseeable future actions, to capture these additional effects. Bounding the cumulative effects analysis is a complex undertaking, appropriately limited by practical considerations. Thus, CEQ guidelines observe that it "is not practical to analyze cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful."

For the proposed action to have a cumulatively significant impact to an environmental resource, two conditions must be met. First, the combined effects of all identified past, present, and reasonably foreseeable projects, activities, and processes on a resource, including the effects of the proposed action, must be significant. Second, the proposed action must make a substantial contribution to that significant cumulative impact. Finally, if the effects of the proposed action alone would have a significant impact to an environmental resource within its ROI, then the impacts of the proposed action in combination with all other past, present, and reasonably foreseeable actions would normally be cumulatively significant.

Cumulative impacts are those changes to the physical, biological, and socioeconomic environments that would result from a proposed action when added to other past, ongoing, and

[1] CEQ Regulations provide that the terms "cumulative impacts" and "cumulative effects" are synonymous (40 CFR § 1508.8[b]).

reasonably foreseeable actions, regardless of what agency of government or person undertakes such other actions (40 CFR 1508.7).

4.1.1 Identifying Region of Influence or Geographical Boundaries for Cumulative Impacts Analysis

The ROI or geographic boundaries for analyses of cumulative impacts can vary for different resources and environmental media. CEQ guidance (CEQ 1997) indicates that geographic boundaries for cumulative impacts almost always should be expanded beyond those for the project-specific analyses. This guidance continues, indicating that one way to evaluate geographic boundaries is to consider the distance an effect can travel, and it identifies potential cumulative assessment boundaries. For air quality, the potentially affected air quality regions are the appropriate boundaries for assessment of cumulative impacts from releases of pollutants into the atmosphere. For water resources and land-based effects, watershed boundaries may be the appropriate regional boundary. For wide-ranging or migratory wildlife, specifically marine mammals, fish, and sea birds, any impacts of the proposed action might combine with the impacts of other activities or processes within the range of the population. Based on this guidance, the ROI or geographic boundary for the majority of resources analyzed for cumulative impacts in this Environmental Impact Statement (EIS) is Hood Canal and the Hood Canal watershed.

The cumulative impacts analysis for the EHW-2 considers known past, present, and reasonably foreseeable future actions throughout Hood Canal, including NBK at Bangor and its 4.5-mile shoreline on the canal. Although some marine organisms occurring along the Bangor shoreline move beyond Hood Canal, these organisms are likely to spend the majority of their time in Hood Canal, and thus cumulative impacts to such organisms are most likely to result from actions within Hood Canal. Hood Canal (and its watershed) is the most relevant region for defining populations or communities of marine and coastal resources occurring along the Bangor shoreline. Surrounding communities in which actions on NBK at Bangor are most likely to contribute to cumulative social impacts include Silverdale, Poulsbo, and Bremerton, all of which are on the Kitsap Peninsula and within Kitsap County, as well as Jefferson County on the western shore of Hood Canal across from NBK at Bangor and Mason County to the south of NBK at Bangor. An ROI for evaluating the cumulative impacts of the proposed action is defined for each resource in Section 4.3.

4.2 PROJECTS AND OTHER ACTIVITIES ANALYZED FOR CUMULATIVE IMPACTS

4.2.1 Past, Present, and Reasonably Foreseeable Future Actions

Identifiable present effects of past actions are analyzed to the extent they may be additive to impacts of the proposed action. In general, the Navy lists and analyzes the effects of individual past actions only where appropriate; cumulative impacts analysis typically focuses on aggregate effects of past actions. This analysis depends on the availability of data and the relevance of future effects of past, present, and future actions. Although certain data (e.g., extent of forest cover) may be available for extensive periods in the past (i.e., decades), other data (e.g., water quality) may be available only for much shorter periods. Because specific information and data on past projects and actions are usually scarce, the analysis of past effects is often qualitative (CEQ 1997). Analysis will primarily include present and reasonably foreseeable future actions that may have effects additive to the effects of the proposed action. These actions include all

likely future development of the region even when foreseeable future action is not planned in sufficient detail to permit complete analysis (CEQ 1997).

Table 4–1 lists the past, present, and reasonably foreseeable future actions on NBK at Bangor and within the ROI that have had, continue to have, or would be expected to have some impact to the natural and human environment. The projects in this table are limited to those implemented in the last 5 years or those with ongoing contributions to environmental effects. Navy projects were selected based on a review of NEPA and permitting documentation for past actions. Projects with measurable contributions to impacts within the ROI for a resource area were selected for inclusion in the cumulative analysis.

The cumulative analysis considers reasonably foreseeable proposed plans and actions that are focused on shoreline developments in the Hood Canal watershed (Figure 4–1) and that have a potential to result in cumulative impacts to the marine environment. Although no official boundaries exist along the waterway, the northeastern section of the canal, extending from the mouth of the canal at Admiralty Inlet to the southern tip of Toandos Peninsula, is referred to as northern Hood Canal, the reach from Toandos Peninsula south to Great Bend is referred to as mid-Hood Canal, and the reach from Great Bend to Lynch Cove is referred to as southern Hood Canal. The EHW-2 project site is within northern Hood Canal. These projects were identified through contacts with the Kitsap County, Mason County, and Jefferson County Departments of Community Development, WSDOT, natural resource agencies, and American Indian tribes.

Overlap in the construction periods for multiple, closely located projects can result in short-term, cumulative impacts that are additional to standard, longer-term cumulative impacts. Based on current projected schedules, construction of the following projects may overlap with construction of the EHW-2: EHW-1 Pile Replacement, Land-Water Interface construction, Service Pier barge mooring replacement, potential Service Pier Extension, installation of Electromagnetic Measurement Range Sensor System equipment, and reuse or replacement of the Magnetic Silencing Facility Pier and upland monitoring buildings to support Maritime Force Protection Unit (Coast Guard) personnel and vessels at the Bangor waterfront. The EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electromagnetic Measurement Range projects would entail substantial pile driving that would result in cumulative impacts with the proposed action. The EHW-1 Pile Replacement project includes removal of degraded piles and vibratory and impact driving of steel replacement piles. The Land-Water Interface project entails construction of connections between security fencing on water and security fencing on land, including a modest amount of pile driving. The Test Pile Program, which required 21 days of pile driving, was conducted between August and October 2011, a year prior to commencement of construction of the EHW-2. Thus, the Test Pile Program did not overlap with construction of the EHW-2, but did expose marine biota to pile driving noise for an additional season, albeit a relatively short one (21 days of pile driving over a two-month period). Cumulative impacts arising from the potential construction overlaps described above are addressed in this chapter where appropriate.

Table 4–1. Past, Present, and Reasonably Foreseeable Future Projects in Hood Canal

Project	Project Description	Project Timeframe		
		Past	Present	Future
NBK at Bangor Waterfront Operations	Waterfront operations include the overall integration of all port operations at the Bangor waterfront. Activities include vessel traffic movement and management, personnel clearance and tracking, and ingress/egress within the restricted areas.	X	X	X
NBK at Bangor Waterfront Facilities Maintenance	Common maintenance activities include pressure washing of waterfront piers to remove bird fecal material, marine debris (i.e., clam and mussel shells) and foreign materials (i.e., dirt and algae). Maintenance area includes walkways and approaches to the piers. Other maintenance activities may involve repair and replacement of structures or facilities as needed. Upcoming maintenance actions would include pile driving for KB Dock repair.	X	X	X
EHW-1 Maintenance	This multiyear project involves removal and replacement of 138 deteriorated steel and/or concrete piles. The most recent phase, which began in July 2011 and will continue until July 2013, is installation of 29 30-inch steel piles. Phased repair of this structure is expected to continue until 2024.	X	X	X
NBK at Bangor Test Pile Program	This project involved installation and removal of 29 test and reaction piles on NBK at Bangor, WA, to more clearly ascertain the geological and biological conditions along the Bangor waterfront in order to reduce the uncertainty and extrapolations necessary for planning future projects along the Bangor waterfront, including EHW-2. Test piles were removed because their location and the stresses applied to these piles during testing make them unsuitable for use in future projects. The test pile program required a total of 21 days of pile-driving: 10 days had both vibratory and impact hammer pile driving, 4 days had impact hammer only, and 7 days had vibratory only. Pile driving was conducted from August through October 2011. The potential effects of this project were analyzed in an Environmental Assessment under NEPA, including providing time for public review and comment. A Finding of No Significant Impact was issued on June 29, 2011.	X		
Relocate Nearshore Port Security Barriers	The proposed project would move four mooring buoys and anchoring systems, presently located between EHW-1 and Marginal Wharf and used to moor the nearshore port security barriers when they are not in use. The mooring system would be relocated to an area within Naval Restricted Area 1, near the Delta pier. The project is proposed for 2011. This will result in minor seafloor disturbance when the anchors are lifted from the seafloor and repositioned.		X	
Force Protection and Weapons Security Measures	This project involves installation and operation of facilities, including 14-foot-high above-water fencing on pontoons along the Waterfront Restricted Area; construction of an Auxiliary Reaction Force Facility (14,000 sq ft) and an Armored Fighting Vehicle Operational Storage Facility (16,146 sq ft); alteration of two buildings for a new armory (2,500 sq ft); and replacement of an Alert Force Garage (2,530 sq ft) including a new paved access road.	X	X	X
Road Improvements	Road clearing and grading are continuous. Loss of vegetation and habitat can be expected from road improvements, including those for the D5 Road and Transfer Facilities and Missile Haul Road.	X	X	X

Table 4–1. Past, Present, and Reasonably Foreseeable Future Projects in Hood Canal (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
CSDS-5 Support Facilities	The Navy implemented upgrades to waterfront and shore-based support facilities for its Submarine Development Squadron FIVE Detachment on NBK at Bangor. These upgrades were completed in July 2005. Anticipated levels of mission support and the operational tempo of assigned submarines require additional shore-side buildings for administration, operations, industrial, and support functions. Security requirements and operational efficiency dictate consolidation of off-base contractor space onto a contiguous site adjacent to the shore-based support facilities. At the existing Service Pier south of the EHW-2 project site, the Navy plans to improve barge mooring capacity by replacing an existing 4,025 sq ft research barge with a 22,100 sq ft research barge and installing new mooring piles to anchor the larger research barge. This work is planned to occur in summer of 2013, and would involve installation of 18 new piles over a 3-week period. The Navy also plans to add 18,000 sq ft to the existing Service Pier, construct a new waterfront support facility (12,560 sq ft), and expand existing shore-based support facilities. Extension of the Service Pier would involve installation of 320 new piles.	X	X	X
Mission Support Facilities	Mission support facilities may include activities or projects such as the addition of power booms, captivated camels, and piles for support or attachment; installation of emergency power generation capability; and other activities to support facilities or operations.	X	X	X
Navy Surface Warfare Center Carderock Division (NSWCCD) Detachment Bremerton Command Consolidation	Construction of in-water facilities includes a new access pier (8,800 sq ft), pontoon (21,600 sq ft), vessel overwater footprint (13,623 sq ft) and associated mooring components, and 102 new steel piles. Project tasks also include road improvements to Carlson Spit Access Road, a 23,000 sq ft building, and the addition of 100 workers.	X	X	
Waterfront Security Enclave and Security Barriers	In process is creation of enclave fencing for the entire Bangor Waterfront Restricted Area and construction of an associated parking area. Mitigation action will restore tidal influence to Cattail Lake, thereby increasing intertidal habitat.			X

Table 4–1. Past, Present, and Reasonably Foreseeable Future Projects in Hood Canal (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
Waterfront Restricted Area Land-Water Interface	The Navy plans to address this project in an EIS. Its object is to provide security upgrades to the existing Bangor Waterfront Restricted Area by constructing two Waterfront Restricted Area Land-Water Interface barriers, which will connect both ends of the Waterfront Restricted Area enclave to the existing floating barriers. The Land-Water Interface barriers will extend from the high water mark to the terminations of the port security barriers and will be capable of moving in the full tide range and providing an anchorage for the floating barriers. The project consists of two separate construction features. The first is the delay system, which connects the high tide termination with the existing Port Security Barrier to prevent entry of unauthorized persons, vehicles, and/or vessels. The second is construction of the sensor equipment that will provide detection. This project will require relocation of existing port security barriers to connect to the end of the new Land-Water Interface structures, as well as installation of an additional string of port security barriers up-coast and down-coast of the new structures. This project is scheduled for FY 2014.			X
Swimmer Interdiction Security System In-water Structure and Support Facilities	The Navy implemented a Swimmer Interdiction Security System to meet special U.S. Government security requirements for military installations in response to the terrorist attacks of September 11, 2001. The system would protect waterside Navy assets and sailors, and would remain in operation as long as valuable naval assets were located at the Bangor waterfront. The Navy examined various alternatives for implementing the system: marine mammals (preferred alternative), combat swimmers, and remotely operated vehicles. Under the preferred alternative, specially trained marine mammals and their human teammates would respond rapidly to security alerts by detecting, classifying, and marking the location of underwater objects or intruders. Humans would work aboard small power boats, and marine mammals would be in enclosures. A Draft EIS was made available to the public for comment in December 2008, with a Record of Decision signed in 2009.		X	X
Electromagnetic Measurement Range	The proposed Electromagnetic Measurement Range Sensor System equipment project includes installation of sensor equipment, including an underwater instrument array, data/power cables, a pile-supported platform, an in-water navigation aid, and an upland monitoring system on NBK at Bangor.			X
Reuse or Replacement of Magnetic Silencing Facility Pier	Reuse or replacement of the Magnetic Silencing Facility Pier and upland monitoring building locations to support Maritime Force Protection Unit (Coast Guard) personnel and vessels would be limited to the MSF area, shifting current operations from the existing KB Dock location.			X

Table 4–1. Past, Present, and Reasonably Foreseeable Future Projects in Hood Canal (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
Northwest Training Range Complex EIS	A wide variety of military training activities are conducted in the W-237 operating areas west of Washington, including training exercises in anti-air, anti-surface, and anti-submarine warfare; electronic combat exercises; mine countermeasures training; naval special warfare training; and various support operations. The Navy has developed policies and procedures to preclude harm and to minimize the effects of Navy training on terrestrial and marine species and habitats. This action involves activities at Floral Point, which is within the Region of Influence for this cumulative analysis. The Navy prepared an EIS/OEIS to assess effects of ongoing and potential future training activities in the Northwest Training Range Complex. The Draft EIS/OEIS was made available to the public in December 2008. A No-Action Alternative and two action alternatives were assessed in the Draft EIS/OEIS. A Biological Opinion from NMFS was signed in June 2010. A second Biological Opinion from USFWS was signed in August 2010. The ROD was signed October 2010.	X	X	X
NAVSEA NUWC Keyport Range Complex Extension	This project involves an increase in the underwater Hood Canal Military Operating Area, including areas in and outside Hood Canal. The EIS included the Dabob Bay Range Complex and a proposed expansion of the MOAs both to the north and south of their existing limits. The Draft EIS was made available to the public in September 2008. A Biological Opinion (BO) from the USFWS was issued in March 2010. The Final EIS was made available to the public in May 2010. A programmatic BO was issued by NMFS in June 2010. NMFS signed a BO on the Letter of Authorization (LOA) in May 2011. NMFS issued the LOA from NMFS in May 2011. The ROD was signed July 7, 2011.	X	X	X
Port Gamble Dock	The Olympic Property Group has applied for a permit for a dock at a former mill site in Port Gamble. A preliminary design for a 165-foot dock was initially submitted for review.			X
Kitsap Memorial State Park	Washington State Parks is conducting a slope stabilization project for an approximately 1,000-foot-long creosote-treated bulkhead at Kitsap Memorial State Park in Poulsbo on Hood Canal. The treated wood bulkhead is being removed and the shoreline “naturalized” as part of the project. The project, currently under way, has been permitted by both an approved shoreline exemption under normal maintenance repair and replacement and an approved Site Development Activity Permit. Naturalization of the shoreline will improve nearshore habitat in this stretch of Hood Canal.		X	X

Table 4–1. Past, Present, and Reasonably Foreseeable Future Projects in Hood Canal (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
Olympic View Marina	Olympic View Marina, LLC, is proposing to replace the abandoned Seabeck Marina on Seabeck Bay approximately 7 miles south of NBK at Bangor on the east side of Hood Canal. Ongoing construction of a new marina involves the installation of 72,510 sq ft of piers, floats, and gangways (approximately 1.66 acres of overwater structures) for the moorage of approximately 200 boats. The design calls for 250 steel piles (14- to 20-inch-diameter). This project would result in short-term water quality and noise impacts during construction, as well as long-term shading under the new overwater structures and loss of marine habitats from installation of the breakwater and pier pilings. Upland vegetation would be cleared for the on-land structures. In order to permit rebuilding of the marina, the shoreline designation of the old Seabeck Marina in the Kitsap County Shoreline Management Master Program was amended from “conservancy” to “rural” in April 2009. In January 2010, workers began installing pilings for the docks. Construction was put on hold from mid-February until July in compliance with the fish window. Removal of concrete debris from the beach was completed in October 2010. The completion date for this project is uncertain.			X
Thorndyke Resources Operation Complex (T-ROC) Conveyor and Pier	As proposed, the project proponent, Fred Hill Materials, would move gravel from the Shine gravel pit, owned by Miles Sand & Gravel, on a 4-mile-long conveyor belt to Thorndyke Bay on Hood Canal. The gravel would then be loaded onto barges and ships at a 1,000-foot-long pier. Assuming an average width of 13 feet, the overwater coverage of the pier plus that of two proposed buildings would be approximately 0.32 acre. The pier would be supported on piles spaced approximately 100 feet apart. Approximately 45 piles (18- and 30-inch-diameter) would be required for the pier and support structures. The new pier would be located approximately 3 miles north of the Bangor waterfront on the west side of Hood Canal. There would be aesthetic impacts and potential interference with marine vessel traffic due to the high volume of barge and tug traffic proposed for this project. Upland vegetation would be cleared for construction of the conveyor belt, with potential erosion and water quality impacts. This is the same project also referred to as the Pit-to-Pier. The T-ROC conveyor and pier proposal is undergoing the environmental review process for permitting, and Jefferson County is waiting for Fred Hill Materials to submit updated studies to complete a gap analysis. The application is still open, but there is considerable uncertainty as to whether this project will be implemented.			X

Table 4–1. Past, Present, and Reasonably Foreseeable Future Projects in Hood Canal (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
Pleasant Harbor Marina and Golf Resort	The Statesman Group of Companies is proposing a new master-planned development at Pleasant Harbor south of Brinnon. The project locale is on the west side of Hood Canal approximately 9 miles southwest of NBK at Bangor. The 256-acre development includes resort housing, a hotel, a restaurant, a spa, a clubhouse, an 18-hole golf course, and other resort-type facilities. It would involve refurbishment of an existing 285-boat marina and development of resort facilities along the shoreline. Planning is ongoing for this project, and a supplemental EIS is being prepared (the original EIS was published on November 27, 2007). Both the draft and final EIS documents addressed nine issues and impacts: (1) shellfish, (2) water quality, (3) transportation, (4) public services, (5) shorelines, (6) fish and wildlife, (7) rural character, (8) archaeology and cultural resources, and (9) critical areas. Project construction would likely result in short-term water quality and noise impacts. Refurbishing the marina would result in some loss of nearshore marine benthic habitat in the immediate project vicinity. The golf course and upland facilities would likely require considerable clearing of upland vegetation (estimated at 50 percent or 128 acres), with a potential for erosion and water quality impacts. Impervious surfaces are predicted to be approximately 15 percent of the total area, or approximately 38 acres.			X
Belfair Sewer Line	Mason County is constructing a sewer line in the Belfair area (extreme south end of Hood Canal, approximately 25 miles south of NBK at Bangor, and not shown in Figure 4–1) to replace aging and failing septic systems with a sanitary sewer system. The sewer line would run on both the north and south shores of southern Hood Canal. The project was developed as part of the Mason County Facilities Plan approved in 2002, which received state funding from the 2005 Legislature. The sewer line would not be located directly adjacent to Hood Canal, so construction would have little potential for marine impacts. Construction has begun, and to date almost 4,000 feet of pipe have been laid for the project along State Road 3, Old Belfair Highway, and Clifton Road. Deadlines for hookup to the sewer have not yet been established; however, the system is slated to come online in spring 2011. There would be at least temporary disturbance of upland habitat along the sewer line route. One purpose of the project is to reduce the impact of failing septic systems to water quality in Hood Canal. The Belfair Sewer Line would help to decrease water quality impacts to Hood Canal by eliminating inadequate septic systems.			X
Hood Canal Bridge improvements	The Washington State Department of Transportation recently completed upgrades to the Hood Canal Bridge. This project involved reconstruction of the east half of the Hood Canal Bridge to current design standards and improvements to the remainder of the structure. The bridge was redesigned to current wind, wave, and seismic standards. To improve safety and mobility, it now features two 12-foot traffic lanes and 8-foot shoulders. The resulting dependability of the drawspan has reestablished the 600-foot opening for large vessels that pass through the bridge.	X		

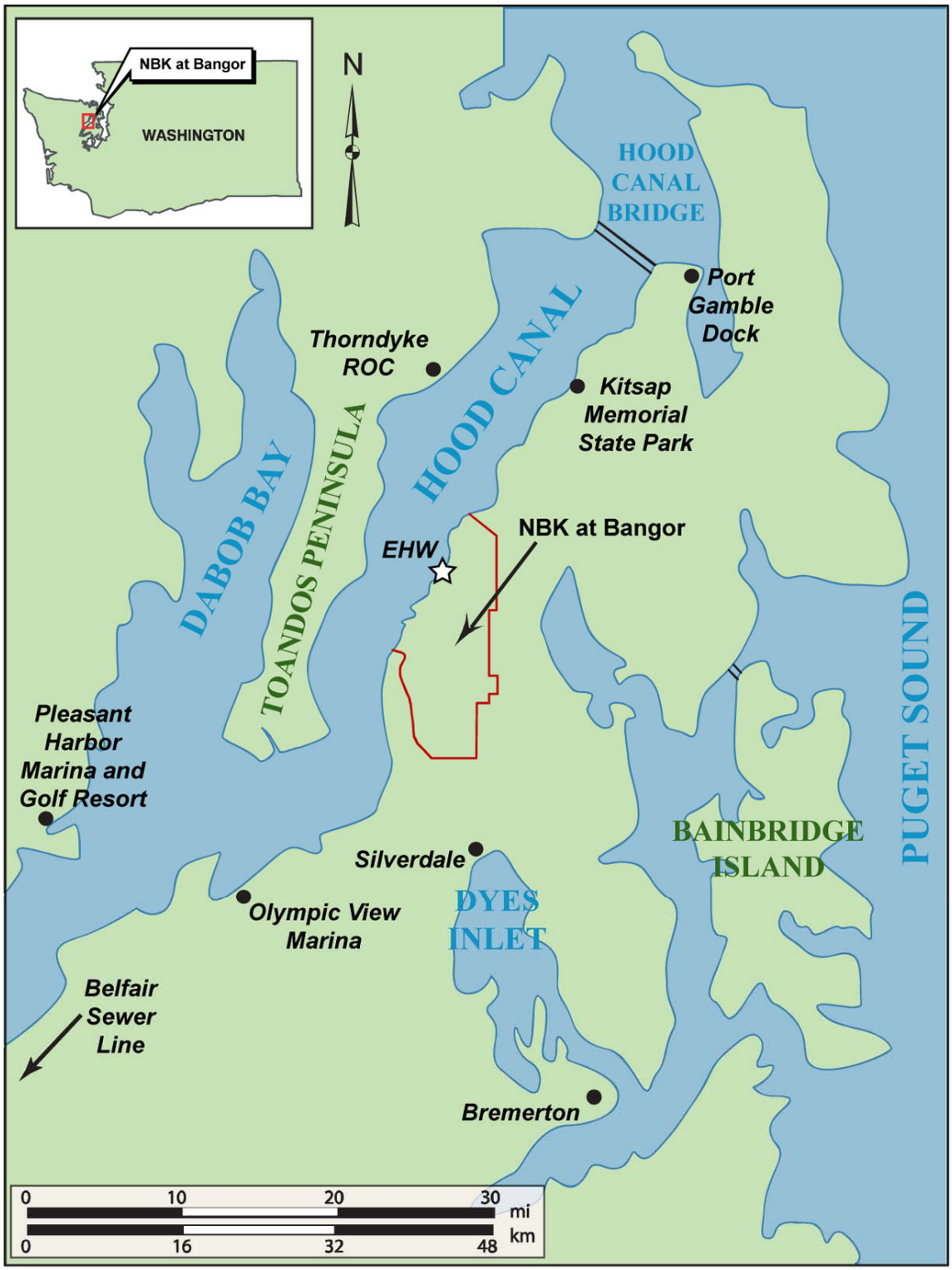

Figure 4–1. Location of Future Non-Navy Actions

4.2.2 Other Regional Activities, Processes, and Trends

In addition to those past, present, and planned future projects listed in Table 4–1, other activities were considered in the cumulative impact analysis. A description of those activities is provided in the following sections.

4.2.2.1 Shoreline Development

Hood Canal and its shorelines are designated as "Shorelines of Statewide Significant" under Washington's SMA. As stipulated in Washington's SMA, preferred uses for shorelines of statewide importance include the following: (1) recognize and protect the statewide interest over local interest, (2) preserve the natural character of the shoreline, (3) favor long-term over short-term benefits, (4) protect the resources and ecology of the shoreline, (5) increase public access to publicly owned shorelines, and (6) increase shoreline recreational opportunities (RCW 90.58.020 and 173-26-181).

Development along the shoreline of Hood Canal has been relatively intense. Residential uses predominate, with lot sizes smaller than those in the upland area. Some of these residences have docks. Commercial facilities are scattered along the shoreline; the community of Seabeck, to the south, has a store, a few businesses, a marina, and a retreat center. The Hood Canal Bridge is north of NBK at Bangor and the project area. Farther south is Scenic Beach State Park. Future general development in the Hood Canal watershed would increase impervious surface and thereby affect vegetation and soils, with potential impacts to water quality in streams and Hood Canal.

The shoreline of Hood Canal has been, and continues to be, subject to development by property owners. Over the past 5 years, an average of 15 shoreline development permit applications (i.e., Joint Aquatic Resource Permit Applications) per year have been submitted by property owners within the ROI. The actions permitted (e.g., pier/dock construction, shoreline stabilization, stairways/beach access, shoreline construction, submarine cable installation) are likely to continue within this region at the same pace (i.e., approximately 15 per year) over the next several years.

The rate of development in the area has been and will be influenced by zoning and land use designations. Kitsap County has zoned land uses adjacent to the base designated as Rural Residential (maximum of one dwelling unit per 5 acres) (Kitsap County Department of Community Development 2010). Small unincorporated communities close to the base include Vinland on the northern boundary, Olympic View to the south, and Silverdale to the south east. The Vinland and Olympic View communities are predominantly designated as Rural Residential. The land uses of the nearby Silverdale community are mostly designated as Urban Industrial and Urban Low-Density Residential (one to nine dwellings per acre). The residential areas only allow for single family dwellings and, coupled with the low density designation, would allow for slow development rates in those areas with an expected overall county growth rate of less than 9 percent over a 7-year period. This rate is down from 22 percent over the previous decade. The largest incorporated city near the base is Poulsbo, about 2 miles east of the base.

Approximately 27 percent of the Hood Canal shoreline is modified with bulwarks, riprap, or other structures (Puget Sound Partnership 2008); approximately 25 percent of the Kitsap County shoreline is modified (Judd 2010). In comparison, approximately 6 percent of the Bangor shoreline is modified (Judd 2010).

4.2.2.2 Agency Plans for Improving Environmental Conditions in Hood Canal

As described in previous chapters, there are several water quality parameters of concern in Hood Canal, including low DO levels and high nutrients, particularly in the southern part of the canal. The area of concern for low DO levels is south of the Bangor waterfront. Because of these water quality problems, and concern for salmon and the overall environmental health of Hood Canal, several government entities and community groups have joined together to plan and develop programs to improve environmental conditions in Hood Canal. The primary action plan was developed by the Hood Canal Coordinating Council (HCCC), a consortium of county governments, tribes, and other groups that was formed to help recover summer-run chum salmon populations in Hood Canal and the eastern Strait of Juan de Fuca and to restore native plant communities along adjacent shorelines. These governments and groups work together to educate and help landowners restore nearshore areas, remove invasive plants and weeds, control septic runoff into Hood Canal, and identify properties for conservation acquisition. The purpose of these actions is to counteract the adverse effects of past actions and thus improve environmental conditions in Hood Canal.

Recommended key actions in the HCCC's plan include updating Kitsap County's Shoreline Master Plan and critical areas ordinances, conducting a nearshore assessment, adopting the Kitsap County draft shoreline environmental designations, and continuing to monitor the Big Beef Creek summer-run chum salmon reintroduction project (HCCC 2005). Under its Marine Riparian Initiative, the HCCC is working with several existing entities and programs to develop a coordinated approach to revegetating marine shorelines (HCCC undated). This initiative involves training Master Gardeners, Water Watchers, and other volunteer groups to provide site-specific planting plans for landowners that address soil and slope stability, sediment control, wildlife, microclimate, shade, nutrient input for detrital food webs, fish prey production, habitat/large woody debris structure, water quality, human health and safety, and aesthetics.

The Kitsap County Health District (2005) has also identified part of Upper Hood Canal as a restoration area. The goals of the Upper Hood Canal Restoration Project are to protect public health and the environment by identifying and correcting sources of fecal coliform contamination from failing onsite sewage systems and inadequate animal waste management, obtaining water quality data, and educating Upper Hood Canal residents about the low DO problem and actions they can take to reduce bacteria and nutrient concentrations in Hood Canal. The restoration area extends approximately 20 miles along the eastern shore of Hood Canal from Olympic View Road in the north to the Kitsap County–Mason County line in the south. Most of this area lies directly south of NBK at Bangor, but a portion lies along the western edge of the southern part of the base. Of particular concern are low DO levels resulting from algal blooms, which are triggered by increases in nutrients from failing onsite sewage systems, inadequate animal waste management (i.e., hobby farms), and stormwater flowing into Hood Canal.

4.2.2.3 Puget Sound Trend Data (Including Hood Canal)

Trend data in the Puget Sound region have been summarized in the *2007 Puget Sound Update—Ninth Report of the Puget Sound Assessment and Monitoring Program* (PSAT 2007a). These trends were used, where applicable, in Section 4.3, Cumulative Impacts to Environmental Resources, to help indicate the cumulative impacts of past, present, and future actions. Some of the relevant trends include the following:

- A decrease in marine birds (particularly scoters, loons, and grebes) and increase in California sea lions and harbor seals;
- A decline in native eelgrass in Hood Canal;
- An increase in the size and duration of phytoplankton blooms and a corresponding decrease in overall DO levels;
- A decrease in some fish stocks (salmon, rockfish, spiny dogfish, Pacific cod, and hake);
- Increased shoreline sediment erosion due to shoreline armoring and in-water structures; and
- An overall decline in fecal coliform levels.

4.2.2.4 Habitats of Migratory Marine Animals

Migratory or wide-ranging marine animals that may be present in the project area may be affected by natural events and anthropogenic activities in areas far removed from Hood Canal waters—on breeding grounds, migration routes, wintering areas, or other habitats within a species' range. Events and activities that affect the habitats and populations of these marine species outside Hood Canal include the following:

- Disease
- Natural toxins
- Weather and climatic influences
- Navigational errors
- Natural predation
- Fishing
- Hunting
- Ocean pollution
- Habitat modification or destruction
- Commercial shipping, fishing, and other vessel traffic
- Scientific whaling

4.3 CUMULATIVE IMPACTS TO ENVIRONMENTAL RESOURCES

Following is an assessment of the cumulative environmental impacts of the EHW-2 when combined with past, present, and reasonably foreseeable actions. The purpose of the cumulative impacts analysis is to identify and describe impacts of the proposed action that may be insubstantial by themselves but would be considered substantial in combination with the impacts of other actions and trends. The impacts of other actions are assessed using available information, and trends in environmental conditions are derived from the *2007 Puget Sound Update—Ninth Report of the Puget Sound Assessment and Monitoring Program* (PSAT 2007a).

Since the information available on past, present, and reasonably foreseeable actions varies in quality and level of detail, impacts of these actions were quantified where available data made it possible; otherwise, professional judgment and experience were used to make a qualitative assessment of impacts. In some cases, there may be a combination of both quantitative and qualitative analysis. Where this is the case, professional judgment was used to evaluate the impact.

Several major sources of quantitative information were available, particularly concerning past and present Navy actions. Among these were NEPA and ESA documentation, including environmental impact statements, environmental assessments, and biological assessments.

In this assessment of cumulative impacts, the impacts of the proposed action are represented by those of the preferred alternative (1). If the alternatives would differ in their contribution to cumulative impacts, this is noted. All of the alternatives would contribute to the same types of cumulative impacts, but the magnitude of such contributions would differ. The primary difference in impacts between the Combined Trestle Alternatives (1 and 2) and Separate Trestle Alternatives (3 and 4) would be the increased overwater coverage in shallow water for the Separate Trestle Alternatives. As a result, Alternatives 3 and 4 would have a somewhat greater impact to eelgrass, marine algae, the benthic community, and shallow-water fish habitat than Alternatives 1 and 2. The Large Pile Alternatives (1 and 3) would entail fewer piles and a shorter duration of pile driving than the Conventional Pile Alternatives (2 and 4), resulting in less of an impact from pile driving noise than that for Alternatives 1 and 3. The Floating Wharf Alternative (5) would have considerably fewer piles than the other alternatives, resulting in less of an impact from pile driving and less displacement of soft-bottom habitat. Alternative 5 would result in more total overwater coverage, and resulting impacts to marine habitats would generally be greater than those for the other alternatives.

Regardless of the alternative selected, the proposed Mitigation Action Plan (Appendix F) would be designed and implemented to compensate for the impacts to marine habitats and species so that the proposed action would make no net contribution to cumulative impacts. Effects of this mitigation for specific resources are delineated in the following sections.

MARINE ENVIRONMENT

4.3.1 Hydrography Cumulative Impacts

The ROI for hydrography is defined as Hood Canal. Other ROI scales were considered for the analysis of hydrography such as the drift cell along the Bangor shoreline, which would represent a smaller, more localized area, and Puget Sound, which would represent a much larger ROI. Given the hydrodynamics and currents, Hood Canal was determined to be the appropriate scale for the cumulative analysis. Several of the management and recovery plans and modeling efforts have been focused on Hood Canal. The ROI was large enough to capture projects with similar impacts but small enough to provide meaningful information. The hydrographic impacts of the proposed action are localized. In addition, hydrographic processes in Hood Canal mix, disperse, and redistribute the watershed loadings such that marine water and sediment quality conditions at different locations within Hood Canal reflect the magnitude and relative contributions of inputs from multiple sources within the ROI.

The overall hydrography of Hood Canal has not changed much over time, except for localized changes in water movement around in-water structures. Past and present placement of in-water structures during construction (e.g., anchors, pilings, floats, boat ramps) for Navy actions such as Marginal Wharf, Service Pier, KB Docks, Delta Pier, and EHW has impacted or is impacting the circulation and pattern of currents by creating eddies and increasing or decreasing current velocity in the vicinity of these structures. Particularly during peak tides, the flow patterns around pilings become more chaotic and fractured as the water mass is forced

against the pilings, thus deflecting the linear flow laterally and downward. This produces a decrease in velocities of the water column downcurrent of the pilings, but an overall increase in the turbulence and mixing in the water mass.

These localized changes in circulation have resulted in adverse as well as some beneficial impacts. Changes in current velocities have altered bottom sediment characteristics such as the ratio of fine to coarse-grained sediments near pilings, anchors, and boat ramps. However, increased turbulence has also resulted in greater mixing in the water column, which benefits water quality. Past and present actions are estimated to have altered circulation patterns within and immediately adjacent to the 24.7 acres of overwater structures on NBK at Bangor.

Future actions (Navy and non-Navy) would result in approximately 3 additional acres of impacted area, for a total estimated area of 27.7 acres. An additional unknown area has been affected by past non-Navy actions. The proposed Land-Water Interface at the Bangor waterfront may affect littoral drift in the vicinity of that project. The EHW-2 would impact 6.3 to 8.5 acres, for a known total of 34 to 36 acres in which in-water structures have affected or will affect circulation patterns. The EHW-2 structure is expected to have little additional impact to overall shoreline processes at the base (Section 3.1.2.1). The impacts of the proposed action would be strictly localized, and given the circulation and current movement produced by tides, winds, and density differences throughout the entire Hood Canal water body, the changes to circulation from the proposed action are not expected to contribute to cumulative impacts in Hood Canal. Differences between alternatives in the contribution of the EHW-2 to the cumulative affected area are minor. Thus, the other project alternatives would not contribute to significant cumulative impacts to hydrology.

4.3.2 Water Quality Cumulative Impacts

The ROI for marine water quality is defined as Hood Canal and its watershed. The evaluation for the ROI for water quality also considered several different scales of ROI for use in the cumulative analysis. Sub-basins and drift cells were considered as smaller, more discrete ROI, and the larger Puget Sound region was considered as a larger scale. Upon considering the available information on management of water quality, planning, recovery efforts, and trend data, the Hood Canal Basin was determined to be an appropriate ROI for water quality. This ROI is large enough to capture projects contributing to water quality impacts and also had useful water quality management plans and data. Watershed drainage represents an important source for freshwater and sediments, as well as human-derived pollutants associated with the watershed runoff that contributes to the contaminant loading of Hood Canal. Hydrographic processes in Hood Canal mix, disperse, and redistribute the watershed loadings such that marine water conditions at different locations within Hood Canal reflect the magnitude and relative contributions of inputs from multiple sources within the ROI.

The impacts of past and present actions are reflected in the description of existing water quality conditions in Section 3.2.1. Water quality in Hood Canal has been and is being impacted by past and present in-water and upland actions and would potentially be impacted by future actions. Specific impacts include (1) incidental spills associated with boat operations, such as fueling, or other activities conducted on piers, wharves, and floats; (2) sediment disturbance and turbidity from propeller wash in shallow areas; (3) toxin leakage attributable to the use over time of materials such as treated wood pilings; (4) stormwater runoff; and (5) nutrient and pollutant loading from septic systems or development. Most of these events, except for treated materials,

result in periodic inputs of pollutants (i.e., fuel, oil, and other contaminants) directly to Hood Canal, which can impact turbidity, pH, temperature, salinity, DO, and biochemical oxygen demand (BOD).

Most development in the Hood Canal watershed (excepting NBK at Bangor) uses septic systems, and many older systems have failed over time. Fecal coliform bacteria and nutrients are periodically discharged into Hood Canal through stormwater runoff from areas with inadequate septic systems. Though fecal coliform bacteria are not harmful to humans, the presence of fecal coliform indicates the possible presence of pathogenic viruses or bacteria. Fecal coliform bacteria can also by absorbed and concentrated in shellfish making them unsuitable for human consumption.

Nutrients are a larger problem because they can cause algae to bloom. When algal blooms occur, they cause DO to be rapidly used up during bacterial decomposition of dead plankton. This rapid loss of DO can result in fish kills. Animal wastes from hobby farms or sites where animals are bred are also a source of nutrients. These sources of nutrients have long been recognized as causing the low DO problem in Hood Canal. Efforts have been made to eliminate the use of septic systems or to repair failing systems to the extent possible, particularly in nearshore areas, and to control point sources such as hobby farms. However, in the Hood Canal watershed, some future development would continue to use septic systems because sewers are not available in many areas.

Recent trend data point to an overall reduction in fecal coliform in the future (PSAT 2007b), particularly in light of plans to construct new sewer lines in southern Hood Canal and other actions (e.g., Belfair Sewer Line; see also Section 4.2.2.2, Agency Plans for Improving Environmental Conditions in Hood Canal).

Although fecal coliform levels are expected to decrease, the *State of the Sound Report* (PSAT 2007b) states that the overall trend is for continued deterioration of water quality in Hood Canal due to a rise in toxic contaminants and a lowering of DO levels, regarded as water quality parameters of major concern. Various waters in Puget Sound are listed as impaired by WDOE, including southern Hood Canal (PSAT 2007b).

Most of the future actions would have no impact or variable (sometimes minimal) short-term impact, and some future actions would be designed to minimize such impacts. For example, all new piers, including the proposed action, would use concrete or steel pilings, which, unlike creosote-treated piles used in the past, would not have the potential for leaching toxic compounds into the water. Several proposed projects (e.g., the Belfair Sewer Line) and actions (e.g., initiatives reflected in agency plans) would be implemented specifically to improve water quality in Hood Canal (see Section 4.2.2.2). The projects identified as Routine Operations and Maintenance and Transit Protection Systems Operations, which entail various port and vessel operation activities, could have longer-term impacts to water quality.

Implementation of the proposed action would not be expected to add appreciably to cumulative water quality impacts because its construction phase would not overlap in time or space with those of other actions. Even if the construction periods for the proposed action, Service Pier barge mooring replacement, Service Pier Extension, or Land-Water Interface projects were to overlap in time, their water quality impacts would be localized, with little potential to overlap in space.

The proposed action would not result in an increase in boat traffic that could otherwise contribute cumulatively to increased potentials for vessel-related spills. Further, the operational phase of the proposed action would not involve the discharge of materials that would contribute to depletion of DO or exacerbate the low DO conditions in parts of Hood Canal. Therefore, it is not expected that operations consistent with the proposed action would result in cumulative water quality impacts that would affect mobile species such as fish, marine mammals, and marine birds in Hood Canal (see Sections 4.3.8, 4.3.9, and 4.3.10, respectively). Similarly, the other project alternatives would not contribute to significant cumulative impacts to water quality.

4.3.3 Sediment Cumulative Impacts

Sediment impacts include changes in the transport and distribution of sediments (sedimentation) as well as changes in sediment quality or characteristics. The ROI for marine sediments is defined as Hood Canal and its watershed. As with the decision on other ROIs for analysis, various scales were considered for sediment impacts. However, hydrodynamic modeling data and trend data for the watershed suggest that using Hood Canal as the ROI was an appropriate scale. Watershed drainage represents an important source of fresh water and sediments, as well as human-derived pollutants that contribute to the contaminant loading of Hood Canal. Hydrographic processes in Hood Canal mix, disperse, and redistribute the watershed loadings such that marine sediment quality conditions at different locations within Hood Canal reflect the magnitude and relative contributions of inputs from multiple sources within the ROI. The impacts of past and present actions are reflected in the description of existing sediment conditions in Section 3.3.1.

Past, present, and future actions involving in-water construction (i.e., pile driving and dredging) in Hood Canal have caused, are causing, or would cause short-term disturbances to sediment. Disturbed sediment creates plumes of turbid water that carry fine-grained material downcurrent from the disturbed area. Thus, it is assumed that there have been some very slight changes in the ratio of fine- to coarse-grained sediment in localized areas over time. Shoreline armoring and pier placement have resulted in erosion and coarsening of shoreline sediments in some areas of Hood Canal (see Section 3.3, Sediment). In areas protected by in-water structures, such as the existing EHW, accretion of sediments has occurred, and some erosion may have occurred on the downdrift side of these structures. These changes result in alteration of the benthic community (see Section 3.7, Benthic Communities Including Shellfish). Many of the in-water projects including marinas, boat ramps, and Navy piers have resulted in an increased use of boats in the nearshore area. Boats that operate in these areas have the potential to disturb sediments from their propeller wash. The impact is similar to what was described in Section 3.2.2.1, Water Quality, Construction, for in-water work, where there is a slight change in the ratio of fine- to coarse-grained sediment in localized areas. Future shoreline development and placement of in-water structures, including the Land-Water Interface and the Olympic View Marina, would likely add to existing erosion and accretion of shoreline sediments. The cumulative impacts of in-water construction and propeller wash have been inconsequential when compared with movement of sediment by tides and currents.

Sediment quality has also been impacted by development over time. In some locations, chemicals discharged into Hood Canal via stormwater runoff, streams, and other sources have accumulated in sediments and been absorbed in the tissues of marine organisms. In general, however, levels of chemical contaminants and toxicity in Hood Canal sediments are low (WDOE et al. 2007). Current sediment quality in the vicinity of the proposed action is generally

good (Hammermeister et al. 2009). The organic content of sediment is low, and levels of all measured contaminants, such as metals, butyltins, polycyclic aromatic hydrocarbons, PCBs, and pesticides, are below thresholds specified in sediment quality standards. Although past, present, and future actions have had, continue to have, or would be expected to have sediment quality impacts, as described above, the proposed action would not contribute substantively to cumulative impacts to sediment quality in Hood Canal. The presence of a proposed action structure would add to existing accretion, and possibly erosion, of shoreline sediments that has resulted from other in-water structures and shoreline armoring at the Bangor waterfront and elsewhere in Hood Canal (the cumulative biological impacts of sediment accretion and erosion are discussed in Section 4.3.7, Benthic Communities Including Shellfish, and Section 4.3.8, Marine Fish). Otherwise, impacts to sediment from the construction and operational phases of the proposed action would be limited to temporary and localized impacts from construction activities or accidental spills. However, these are not expected to contribute to substantial cumulative impacts to sediment quality. Similarly, the other project alternatives would not contribute to significant cumulative impacts to sediment quality.

4.3.4 Underwater Noise Cumulative Impacts

The ROI for evaluating cumulative impacts from underwater noise is identified as the underwater area of Hood Canal bounded by Toandos Peninsula to the west, and the eastern shoreline of Hood Canal stretching as far north as Suquamish Harbor. This ROI was determined using modeling data for the proposed action and evaluating areas where there was potential for overlap with other noise sources to produce a cumulative impact.

Background underwater noise levels currently range from 96 dB re 1 µPa at the Magnetic Silencing Facility (north of the EHW-2 project site) to 114 dB re 1 µPa near Marginal Wharf (south of the EHW-2 project site). The Navy installed an active-acoustic Underwater Surveillance System within the designated Restricted Area on NBK at Bangor (Navy 2005b). The system operates at the same frequency and range as a commercial “fish finder” and is in operation full time.

Planned Navy actions such as the Service Pier barge mooring replacement, Service Pier Extension, Electromagnetic Measurement Range platform, EHW-1 Pile Replacement, and the Land-Water Interface would generate underwater noise from sources such as boat traffic, cranes, and other human activities on the overwater structures, including potential use of impact or vibratory pile drivers. Thus, it is anticipated that underwater noise levels along the Bangor waterfront would increase over time. Other non-Navy actions could also increase underwater noise, particularly from sources such as boats (i.e., most of the future non-Navy actions involve facilities for boats), which may operate in the vicinity of the Bangor waterfront. Construction of the EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electromagnetic Measurement Range projects may overlap in time with the EHW-2 construction, so marine biota would be exposed to pile driving noise from multiple projects simultaneously (the cumulative biological impacts of pile driving are discussed in Sections 4.3.7 through 4.3.10).

During construction, noise from pile driving and other activities could be cumulative with noise from other sources in the northern Hood Canal region. After completion of construction, the proposed action would contribute no underwater noise beyond that attributable exclusively to EHW operation. Therefore, there would be no cumulative impacts from underwater noise

following completion of construction. Cumulative noise impacts to fish, marine mammals, and marine birds, which can occur without spatial or temporal overlap, are addressed in Sections 4.3.8, 4.3.9, and 4.3.10, respectively.

Because construction activities, primarily pile driving, could overlap for the EHW-2 and EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electromagnetic Measurement Range projects, cumulative impacts from underwater noise could be expected. The principal effect of this temporal overlap in pile driving would be to extend the affected area approximately 1.5 miles farther south than for the EHW-2 alone (the Service Pier site is approximately 1.5 miles south of the EHW-2 project site). Noise levels at a given location would not generally increase the levels at most other locations; increases of up to 3 dB would occur infrequently at a location equidistant between the two construction sites when pile driving noise was being generated concurrently at both sites, which could affect marine mammals or marine birds and humans on boats on Hood Canal or on the western shore of Hood Canal. Noise from multiple simultaneous sources produces an increase in the overall noise field. A doubling in sound power results in an increase of 3 dB, which is the result of two sources incoherently adding acoustic pressures in the combined noise environment. The resultant sound pressure level (SPL) from *n*-number of multiple sources is computed with the following relationship using principles of decibel addition:

$$CombinedSPL = 10 \cdot \log_{10}\left(10^{\frac{SPL1}{10}} + 10^{\frac{SPL2}{10}} + \ldots + 10^{\frac{SPLn}{10}}\right)$$

In all other cases, noise levels at a given location would be dominated by the closer pile driving activity (the intervening points of land between the EHW-2 and Service Pier sites would further reduce the potential for additive noise levels from the two projects). The actual overlap between construction periods for these projects may be less than currently projected, and there could be no overlap. This would reduce the cumulative noise impacts accordingly. Actions to mitigate additive noise effects could include reduction of project overlap in time and the use of a bubble curtain during impact pile driving. The Test Pile Program did not overlap in time with the EHW-2 project, but it did add an additional season (August to October 2011), during which marine biota along the Bangor shoreline were exposed to pile driving noise. A total of 21 days of pile driving were needed to complete this program.

4.3.5 Marine Vegetation Cumulative Impacts

The ROI for evaluating cumulative impacts to marine vegetation is defined as Hood Canal. Recent regional surveys indicate decreasing eelgrass in Hood Canal (PSAT 2007a), so the proposed action's potential to contribute to such impacts is important. Therefore, Hood Canal as a whole is relevant for determining cumulative impacts to marine vegetation, eelgrass in particular. Marine vegetation in Hood Canal would not be affected by actions outside Hood Canal. Larger ROIs such as the Puget Sound Region were also considered for use in the marine vegetation cumulative analysis. Puget Sound Partnership has established a region-wide goal for eelgrass protection in Puget Sound. However, Hood Canal differs from many other areas of the region, which are more developed, and the trends and abundance of the resource in Hood Canal differ from other areas. Given the management plans, recovery efforts, and resource management efforts focused on Hood Canal, this was determined to be an appropriate ROI for the analysis.

The impacts of past and present actions are reflected in the description of existing marine vegetation conditions in Section 3.5.1. Marine vegetation in Hood Canal has been, is being, or would be disturbed by past, present, and future placement of in-water structures such as pilings and anchors, dredging, underwater fills, and construction of overwater structures. These impacts include temporary or permanent loss of vegetation, reduced productivity, and changes in the type or abundance of vegetation. Recent trend data indicate that some of the more sensitive and important vegetation for critical habitat in Hood Canal, such as eelgrass, has decreased over time; eelgrass coverage declined between 8 and 15 percent in every year between 2001–2002 and 2004–2005 (PSAT 2007a).

There are currently approximately 37.7 acres of eelgrass running in a strip along the intertidal/nearshore zone of the Bangor waterfront. Based on the known extent of current eelgrass beds, an estimated 5.2 acres of eelgrass may have been lost over time due to placement of in-water structures such as pilings and anchors, or to displacement by the invasive brown alga, *Sargassum muticum*. Approximately 24.7 acres of overwater shading have been created by past actions along the Bangor waterfront (Table 4–2). The overwater shading reduces the productivity of marine vegetation such as eelgrass and macroalgae. Information is not readily available to quantify the amount of shading and eelgrass loss attributable to all past and present non-Navy actions in Hood Canal, although that area is likely to be similar to or greater than the area affected by past and present Navy actions.

Table 4–2. Cumulative Loss of Marine Vegetation at the Bangor Waterfront (acres)

PARAMETER	TOTAL OVERWATER SHADING	EELGRASS LOSS [1]	MACROALGAE LOSS [1]
Past Navy Waterfront Construction	24.7	5.2	Not determined
EHW-2 [2]	6.3 – 8.5	0.09 – 0.16	0.13 – 0.2
Service Pier barge mooring replacement	0.4 [3]	To be determined	To be determined
Service Pier Extension	0.83	To be determined	To be determined
Land/Water Interface	< 0.1	< 0.1	< 0.1
Non-Navy Future Hood Canal Projects	2	Not determined	Not determined
Total	**34.3 – 36.5**	**5.4 plus undetermined amount**	**0.14 – 0.3 plus undetermined amount**

1. For the purposes of cumulative impact assessment, eelgrass loss and macroalgae loss is the known areas of flora under the proposed structures.
2. Impacts to eelgrass and other marine vegetation from the proposed project would be mitigated as part of the Mitigation Action Plan.
3. Acreage total is net increase (replace 0.1-acre barge with 0.5-acre barge).

It is estimated that known future actions at the Bangor waterfront (Land-Water Interface, Service Pier barge mooring replacement, and Service Pier Extension) would result in approximately 1.3 acres of shading and loss of less than 0.1 acre of eelgrass. Shading of eelgrass and macroalgae from the Service Pier barge mooring replacement and Service Pier Extension have not yet been determined. The location of the platform for the Electromagnetic Measurement Range has not yet been determined. Relocation of the nearshore port security barriers would result in minor impacts to marine vegetation, considering the relatively deep water (greater than 40 feet) in which these actions would take place. These actions would be designed to avoid eelgrass beds to the fullest extent possible. Other future non-Navy actions

involving the placement of pilings and anchors and resultant shading would also reduce the amount of eelgrass and macroalgae. Future actions impacting eelgrass would require mitigation (in compliance with the USACE rule on compensatory mitigation for losses of aquatic resources) such that there is no net loss of this resource. It is estimated that less than 1 acre of overwater structure would be created by the actions described in Table 4–1. As described in Section 3.5.2.1.2, macroalgae are generally less sensitive to the effects of shading due to lower light requirements.

The estimated combined impact of past Navy actions, future non-Navy actions, and the EHW-2 and other future Navy actions is 34.3 to 36.5 acres of shading, as well as a related loss of eelgrass and macroalgae; that is, actions that have contributed to past declines can be expected to contribute to future declines in eelgrass in Hood Canal (PSAT 2007a). Hood Canal currently supports approximately 550 acres of eelgrass; northern Hood Canal (north of the tip of Toandos Peninsula) supports approximately 220 acres (Simenstad et al. 2008). Cumulative impacts to eelgrass beds would affect the functions of these habitats, including primary productivity, habitat for invertebrates and epiphytic algae, and feeding and refuge for juvenile fish (including ESA-protected salmonids and their forage species) (see Section 4.3.8, Marine Fish). The impacts of the EHW-2 to marine vegetation, including eelgrass, would be mitigated as part of the Mitigation Action Plan described in Appendix F. Impacts to eelgrass would be mitigated through preservation of high density, high value existing beds, enhancement of existing beds, or creation or enhancement of other habitats providing the same functions as eelgrass beds, as determined through the In-Lieu Fee (ILF) program or alternative compensatory mitigation strategies (Appendix F). Therefore, construction and operation of the EHW-2 would not have a long-term net impact to marine vegetation.

4.3.6 Plankton Cumulative Impacts

The ROI for evaluating cumulative impacts to plankton is defined as Hood Canal. Recent regional surveys indicate an increasing trend in phytoplankton blooms in Hood Canal (PSAT 2007a). Therefore, Hood Canal as a whole is relevant for determining cumulative impacts to plankton. Plankton in Hood Canal would not be affected by actions outside Hood Canal.

The impacts of past and present actions are reflected in the description of existing plankton conditions in Section 3.6.1. Plankton populations have been largely unaffected by past and present in-water development in the ROI, and future in-water development is also unlikely to adversely impact plankton. When wharves and piers are constructed, slight changes in plankton abundance and community type may occur from disturbance to the water column, increased nighttime lighting, overwater shading, and an increase in plankton filter feeders that colonize new underwater structures. However, since plankton are not sessile and tides and currents continually move the water column, residence time under structures is typically short. Thus, slight increases in predation or disturbances to the water column from in-water structures would have little impact to plankton given the available habitat for plankton in Hood Canal.

Plankton have been impacted by upland developments that contribute sources of nutrients to Hood Canal. For example, upland projects that use fertilizers are likely to produce stormwater runoff that contains nutrients such as nitrogen and phosphorus. Other sources include failing septic systems and runoff from sites where animals are raised. Projects that contribute nutrients to Hood Canal cause plankton blooms close to the source of the nutrients. While these nutrients

favor plankton productivity, their blooms reduce the available DO in the water and adversely impact other marine organisms that rely on DO. In Hood Canal, there has been an increasing trend in phytoplankton blooms, primarily due to changes in nutrient levels, mostly in southern Hood Canal. Blooms of plankton are lasting longer and occurring more frequently (PSAT 2007a).

Cumulative impacts to plankton attributable to past, present, and foreseeable future actions include the creation of sites for plankton filter feeders, nighttime artificial lighting, and shading, all of which reduce plankton productivity. The proposed action would have similar impacts. Because the area affected by other actions is such a small part of the available habitat in Hood Canal, the impacts thereof have been immeasurable, and it is anticipated that the cumulative impacts from the proposed action to plankton would also be immeasurable.

4.3.7 Benthic Communities Including Shellfish Cumulative Impacts

The ROI for evaluating cumulative impacts to benthic communities and shellfish is defined as Hood Canal. Many of the management and harvest plans for benthic communities are focused on the entire Hood Canal. Regional surveys indicate a reduction in abundance and diversity for the benthic community in Hood Canal (PSAT 2007a), so the proposed action's contribution to such impacts is important. Therefore, Hood Canal as a whole is relevant for determining cumulative impacts to benthic communities and shellfish. Benthic communities and shellfish in Hood Canal would not be affected by actions outside Hood Canal.

The impacts of past and present actions are reflected in the description of existing conditions for benthic communities in Section 3.7.1. Past, present, and future Navy and non-Navy actions, including marinas, residential docks, boat ramps, and piers involving placement of pilings and anchors have resulted or would result in the direct loss of the natural benthic soft-bottom habitat. This habitat is replaced by the hard surfaces of pilings and anchors, and as a result, the types of benthic organisms have changed and are changing in these localized areas. Hard surfaces create sites for colonization by species adapted to these surfaces, such as mussels and sea anemones. Thus, the cumulative impact of in-water structures has been to replace native soft-bottom habitat with hard-surface habitat over time. This has adversely impacted some species (including prey species for juvenile salmonids) while benefiting others. It is estimated that approximately 2.4 acres of benthic soft-bottom habitat has been lost and converted to hard-surface habitat due to placement of in-water structures along the Bangor waterfront to date.

The overwater portion of structures has also increased shading and nighttime lighting impacts to the benthic community. Shading can impact the abundance of some benthic organisms and lighting can increase predation rates. Shading and loss/alteration of soft-bottom habitat has impacted the type and abundance of benthic organisms that occur in the vicinity of these structures. In addition, in-water structures such as pilings can alter localized water flow patterns in a manner that causes changes to the sediment texture and, as a consequence, the composition and abundances of benthic assemblages. In general, areas of erosion would result in adverse impacts to sediment-dwelling species. Conversely, areas of accretion would favor benthic species typical of finer-grained sediments. Juvenile salmon prefer species typical of fine-grained sediments and eelgrass beds. Thus, changes in sediment texture and benthic assemblages could affect salmon foraging habitat. However, the spatial scale of changes in sediment texture typically is limited to the immediate vicinity of the structure and not to the Bangor shoreline overall. The spatial extent also may vary seasonally related to the energy of storm waves.

Evidence from bathymetric surveys and aerial photographs confirms the presence of sediment deposits along the shoreline near pier facilities, suggesting that the pilings in the pier foundations promote a depositional environment and the accretion of unconsolidated material in the form of shallow subtidal shoals and broadening intertidal beaches. However, in other cases, the co-occurrence of shoreline structures and shoals may be coincidental; for example, an aerial photograph of EHW-1 shortly after the structure was constructed shows the presence of a shoal inshore of the wharf, suggesting that the shoal was present at the time the wharf was constructed (Prinslow et al. 1979; Plate 1). Other studies (Golder Associates 2010a) show that the shoreline in the region is fairly stable as a result of the relatively sheltered environment and relatively low net longshore transport rates. Therefore, the cumulative effect of in-water structures on benthic resources would be minimal.

The recent trend for the benthic community in Hood Canal is a reduction in abundance and diversity (PSAT 2007a). This trend is strongest in southern Hood Canal and in deeper waters and includes decreases in the native Olympia oyster, which occurs intertidally in Hood Canal but has not been detected in surveys along the Bangor waterfront. Stress-sensitive species (i.e., those species that cannot tolerate poor water quality conditions such as low DO levels or high toxicant concentrations in sediments) are more abundant in northern Hood Canal, which includes NBK at Bangor, than in southern Hood Canal. Low DO levels are considered a likely cause of this trend, but other contributing factors such as sediment contamination are being investigated (PSAT 2007a).

Future in-water structures would similarly result in a direct loss of soft-bottom habitat; in fact, given the number of piles in the proposed Navy structures, it is estimated that approximately 0.2 acre of soft-bottom habitat would be replaced with hard surfaces. Other future non-Navy actions are estimated to result in a loss of less than 0.01 acre of soft-bottom habitat, based on reviews of available information for those projects.

The conversion of soft-bottom habitat to hard surfaces from past, present, and foreseeable future actions would include approximately 2.5 acres from Navy actions and an unquantified area from past non-Navy actions. The proposed action would add 0.2 acre of this impact, putting the total impacts from all actions at less than 3 acres. An additional approximately 2 acres is expected to experience accretion of sediments, and areas downdrift (north) of the EHW-2 may experience erosion and loss of sediment-dwelling benthic community. The trend for Hood Canal as a whole is for decreasing abundance and diversity of the benthic community, although this trend is stronger in southern Hood Canal than in the NBK at Bangor area. Considering all factors, the 0.2 acre of benthic habitat impacted by the proposed action would contribute only negligibly to cumulative impacts to the benthic community in Hood Canal. This contribution would be compensated for by the Mitigation Action Plan described in Appendix F.

4.3.8 Marine Fish Cumulative Impacts

The ROI for evaluating cumulative impacts to marine fish is defined as Hood Canal. The resource and harvest management plans for marine fish are focused on Hood Canal as a whole. While the fish may migrate beyond Hood Canal, the management of the resource and key habitat elements are contained within Hood Canal. Sub-basins were also considered but, given the fish migration patterns, Hood Canal was determined to be an appropriate scale of analysis. Depending on the species, there is varying potential for actions elsewhere in Hood Canal to impact fish affected by the EHW-2 project. Those species that are the most transitory would be

Hood Canal salmonids, whereas resident species are more restricted in their movement. Juvenile salmonids originating from Hood Canal streams migrate northward along the shoreline. In general, upon exiting Hood Canal these fish turn west toward the Strait of Juan de Fuca and the Pacific Ocean and do not enter the waters of Puget Sound proper. Therefore, with respect to impacts from outside Hood Canal, resident Hood Canal fish species would not be affected by such actions. Migratory fish such as salmon move beyond Hood Canal, but the potential for human actions to affect these fish as they move between the mouth of Hood Canal and the Pacific Ocean is considered low. The contribution of effects on fish occurring in the ocean to cumulative impacts of the proposed action is very difficult to define, but it is acknowledged that there is such a contribution.

4.3.8.1 Salmonids

The impacts of past and present actions are reflected in the description of existing marine fish conditions in Section 3.8.1. Past actions have adversely impacted populations of salmonids (salmon, steelhead, and trout, including threatened and endangered species) in Hood Canal and tributaries through loss of foraging and refuge habitat in shallow areas, reduced function of migratory corridors, loss and degradation of spawning habitat in streams, interference with migration, adverse impacts to forage fish habitat and spawning, contamination of water and sediments, and depletion of DO. Another factor that has resulted in adverse impacts to salmonid abundance is the overharvest by fisheries. This impact has been greatest on native stocks. Practically all chum salmon and most Chinook salmon spawning in Hood Canal stream systems are derived from naturalized hatchery stock. Populations of pink salmon, coho salmon, bull trout, and steelhead are also in decline. The net result is that several Hood Canal salmonid species have been listed as threatened under the ESA. Existing Navy structures have affected salmonid and forage fish habitat, and similar to in-water structures throughout Puget Sound (Salo et al. 1980; Simenstad et al. 1999; Nightingale and Simenstad 2001a; and Southard et al. 2006) have probably impeded and continue to impede juvenile salmon migration to some degree (Section 3.8.2.1.1). Current and future projects at the Bangor waterfront would be designed and implemented to minimize impacts to salmonid habitat and migration, and to forage fish. Design aspects include large spacing (e.g., 25 feet) between piles, increased structure height-over-water in nearshore waters, and building materials (e.g., grating) that allow the transmission of light.

The *State of the Sound Report* (PSAT 2007b) describes several trends that may be indicative of cumulative impacts to the growth and development of salmonids. There is an increasing trend for toxics to be concentrated in the tissues of Puget Sound Chinook and coho salmon. These salmon have been found to have in their bodies 2 to 6 times the PCBs and 5 to 17 times the polybrominated diphenyl ethers (PBDEs) of other West Coast salmon populations. Wild salmon stocks declined from 93 to 81 healthy stocks between 1992 and 2002, and 7 stocks became extinct during that same period. Commercial, tribal, and sport fishing contribute to impacts to fish stocks in Puget Sound in general.

Future Navy and non-Navy actions could have some of the same impacts as described above for past actions, notably habitat loss or alteration, and the decreased function of migratory corridors. However, federal or federally funded actions that have occurred since legislation, such as the ESA and NEPA, was enacted have been considering and are required to consider environmental impacts to threatened and endangered species, prepare analysis (including a biological assessment), and consult with federal regulatory agencies to minimize project impacts. Future actions are also required to go through this same process. Future actions at the Bangor

waterfront will be designed and implemented to minimize impacts to salmonids. For the proposed action, these measures include designing projects offshore away from intertidal and shallow subtidal habitats to the maximum extent practicable, limiting in-water work to the maximum extent practicable, observing work windows, taking measures to reduce construction-related noise, and effecting habitat mitigation. The above processes and actions will help to ensure that the impacts of projects are below levels that would endanger the continued existence of these species.

Currently, efforts are being made to reverse the decline of fish populations by regulating development and restoring fish habitat. Numerous salmon preservation and restoration groups have proposed and constructed habitat restoration projects in Hood Canal. Most of these projects are on the east and south sides of the canal. The majority of Hood Canal salmonid-bearing river systems also occur in the southern portion of the canal. Efforts to reduce construction impacts to salmonids and other fish have resulted in a schedule of in-water work periods that all projects must adhere to if authorized by state (WDFW) or federal (USACE) regulatory authorities. The work windows help minimize adverse impacts to migrating and spawning fish.

Past, present, and future development projects have had, continue to have, or would be expected to have the potential to result in many of the impacts to salmonids described above, and add to declining population trends. Although there are ongoing and future actions and plans to improve conditions for salmonids in Hood Canal (described above), the impacts of the proposed action would result in short-term increases in underwater noise and turbidity, and long-term degradation of some nearshore physical habitats and biological communities, thereby contributing to cumulative impacts to these species. The proposed action's contribution to cumulative impacts to nearshore habitat would be compensated for by the Mitigation Action Plan described in Appendix F.

Because the EHW-2 construction may overlap with construction of the EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electromagnetic Measurement Range projects at the Bangor waterfront, salmonids (which are migratory) would be exposed to pile driving noise and increased turbidity levels within a short period, and so could experience cumulative impacts. Observing the in-water work window would avoid such construction-related impacts to 95 percent of juvenile salmonids. It is likely there would still be adverse impacts to salmonids from pile driving. As described in Section 4.3.4, Underwater Noise, the main effect of concurrent pile driving would be to extend the area over which fish and other marine biota are exposed to pile driving noise by up to 1.5 miles. Increased noise levels at a given location would generally not occur. However, if two closely located pile driving projects such as EHW-2 and EHW-1 pile replacement occurred at the same time, underwater noise levels could increase by as much as 3 dB at sites roughly equidistant between the multiple pile driving rigs (Section 4.3.4). If the actual construction schedules for these projects overlapped for less than two construction seasons, or did not overlap, cumulative impacts would be reduced accordingly. The Test Pile Program did not overlap in time with the EHW-2 project, but it did add an additional season (August to October 2011), during which marine biota along the Bangor shoreline were exposed to pile driving noise. A total of 21 days of pile driving were needed to complete this program.

4.3.8.2 Other Marine Fish Species

Prior to the 1980s, in-water construction of docks, piers, and boat ramps in Hood Canal impacted fish species presence and abundance (including threatened and endangered species).

Underwater noise from pile driving, for example, can cause fish mortality, as well as changes in fish behavior. Since the 1980s, in-water construction has been limited to work windows that minimize adverse impacts to migrating juvenile salmonids. Even so, underwater construction noise continues to adversely impact the abundance and occurrence of some fish close to the construction activities.

Navy and non-Navy actions involving placement of in-water structures have changed and would continue to change fish habitat in and around these structures. In-water structures can impact fish in several ways: (1) increasing the presence of predators that prey on juvenile fish; (2) posing a barrier to fish movement, particularly juvenile fish; (3) causing direct loss of marine vegetation such as eelgrass, which is important habitat for forage fish and other species; and (4) creating shade that reduces the productivity of aquatic vegetation and benthic organisms, which are preyed on by fish.

Water quality has been and is being impacted by past and present actions and could be impacted by potential future development. In particular, DO levels in Hood Canal are chronically impacted by nutrient levels from development activities that have increased over time. Nutrients can cause algal blooms that deplete DO and result in fish kills (see Section 4.3.2, Water Quality). Many of the other types of past and ongoing impacts described above for salmonids also apply to other marine species.

Trend data have shown a decrease in some fish species such as rockfish (including threatened and endangered species), spiny dogfish, Pacific cod, and hake, as well as increased toxics in the tissues of some species such as Chinook salmon (PSAT 2007a). Commercial, tribal, and sport fishing contribute to impacts to fish stocks in Puget Sound in general.

Future Navy and non-Navy actions could have impacts similar to those described above for past actions. Impacts to fish populations are expected to be reduced by (1) the protective measures taken to minimize impacts during construction activities, (2) the design elements that reduce long-term impacts to nearby habitats, and (3) the strengthened environmental planning and design of recent and future actions. Future actions, including Navy actions, will be designed and implemented to minimize impacts to fish and their habitat. In addition, many of the habitat restoration projects discussed above for salmonids would also benefit non-salmonid fish species.

Past, present, and future development actions have had, continue to have, or would be expected to result in many of the impacts to marine fish described above, and thus to add to declining population trends. Although ongoing and future actions and plans are intended to improve conditions for marine fish species in Hood Canal (described above), the impacts of the proposed action would result in short-term increases in underwater noise and turbidity (as described above for salmonids), and long-term degradation of some nearshore physical habitats and biological communities, thereby contributing to cumulative impacts to these species. It is not possible to define the significance of this contribution for the impacted species, except that it would occur at a time of a downward trend for these populations. All construction-related actions at the Bangor waterfront are designed and implemented to minimize impacts to marine fish species. These measures include designing projects offshore away from highly productive intertidal and shallow subtidal habitats to the maximum extent practicable, limiting in-water work to the maximum extent practicable, observing work windows, and taking measures to reduce construction-related noise. Although these actions do not necessarily mean that the proposed action and all future actions would have no impact to marine fish species, such actions would help to ensure that the impacts of projects were below levels that would endanger the

continued existence of these species. Cumulative impacts from a possible overlap between the construction periods for the EHW-2, EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electromagnetic Measurement Range projects would be similar to those described above for salmonids (Section 4.3.8.1).

4.3.9 Marine Mammals Cumulative Impacts

The ROI for evaluating cumulative impacts to marine mammals is defined as Hood Canal. Depending on the species, there is a varying potential for actions elsewhere in Hood Canal to affect marine mammals affected by the EHW-2 project. A larger ROI was also considered for these species given the extensive migratory distance. However, the ability to develop meaningful data of specific contributions of other projects and factors on a very large scale is limited by the available data. Resident harbor seals are unlikely to be affected by actions outside Hood Canal. Other marine mammal species (sea lion species and cetaceans) are migratory or wide-ranging and may be affected by such actions. The contribution of effects on marine mammals occurring in the ocean and inland waters outside of Hood Canal to cumulative impacts of the EHW-2 project is very difficult to define, but it is acknowledged that there is such a contribution.

Construction of some past, present, and future shoreline projects has involved, is involving, and would involve activities such as pile driving or dredging that generate high levels of noise. While these impacts are usually temporary, they may be of an intensity to cause short-term behavioral impacts to marine mammals (e.g., avoidance or changes in feeding behavior). These higher noise levels can constitute harassment (a type of “take”) of marine mammals under the ESA and MMPA. Operations on the NBK waterfront, including Delta Pier and KB Docks, as well as non-Navy actions, have resulted in increased human presence, noise, boat movement, and other activities.

In-water facilities themselves tend to have minimal impacts to marine mammals and may provide some benefits. There may be an impact to some species such as harbor seals, which may avoid areas of human presence and activities on piers and wharfs, but these same facilities may be used as haul outs for other species such as California sea lions.

Past, present, and future development have contributed and would contribute to a continuing increase in concentrations of toxic materials and PCBs in waters such as Hood Canal (PSAT 2007a). There are numerous sources and pathways for toxics to enter the water. For example, toxics may enter marine waters through the following: surface water runoff, aerial deposition, wastewater discharges, combined sewer overflows, groundwater discharge, leaching from contaminated bottom sediments, direct spills into marine waters, and migrating biota such as salmon. These contaminants are affecting the health of marine mammals. For example, the levels of contaminants in harbor seals have increased dramatically over the past 20 years (PSAT 2007a).

Future in-water projects (Service Pier barge mooring replacement, Service Pier Extension, Electromagnetic Measurement Range platform, EHW-1 Pile Replacement, and the Land-Water Interface) may also generate high levels of underwater and airborne noise during construction (Section 4.3.4). Future Navy and non-Navy actions would increase the number of in-water structures, and human presence (e.g., noise from increased boat operations) could cause disturbance to marine mammals.

Because marine mammals are highly mobile, the noise impacts of the proposed action could be cumulative with noise impacts to marine mammals from other actions and activities in the Hood Canal region. However, the fact that the noise impacts would be temporary would reduce the magnitude of cumulative effects. Because other impacts to marine mammals from the proposed action and other projects are expected to be minimal (as described above and in Section 3.9.2), other cumulative impacts to marine mammals are considered unlikely.

The greatest potential for cumulative impacts to marine mammals would be simultaneous exposure to pile driving noise (underwater and airborne) from the EHW-2, EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electromagnetic Measurement Range projects. This is likely to impact more marine mammals (through behavioral harassment and possible temporary hearing impacts, but not permanent effects) than any project alone. As described in Section 4.3.4, Underwater Noise, the main effect of concurrent pile driving would be to extend by approximately 1.5 miles the area over which marine mammals and other marine biota are exposed to pile driving noise; increased noise levels at a given location would generally not occur. However, if two closely located pile driving projects such as EHW-2 and EHW-1 pile replacement occurred at the same time, noise levels could increase by as much as 3 dB at sites roughly equidistant between the multiple pile driving rigs (Sections 4.3.4 and 4.3.16). The overlap in construction is based on currently projected schedules for the multiple projects and is subject to change (reduction in the period of overlap). Cumulative impacts would be reduced through the implementation of impact minimization measures similar to those proposed for the EHW-2. The Test Pile Program did not overlap in time with the EHW-2 project, but it did add an additional season (August to October 2011), during which marine biota along the Bangor shoreline were exposed to pile driving noise. A total of 21 days of pile driving were needed to complete this program. As discussed in Section 3.9.2.1, noise from construction of the pure water facility would not affect marine mammals and so would not contribute to cumulative impacts.

4.3.10 Marine Birds Cumulative Impacts

The ROI for evaluating cumulative impacts to marine birds is defined as Hood Canal. Depending on the species, there is a varying potential for actions elsewhere in Hood Canal to affect marine birds affected by the EHW-2 project. Resident species are unlikely to be affected by actions outside Hood Canal. Migratory or wide-ranging marine bird species, however, may be affected by such actions. The full migratory range was not selected as an ROI due to the limitation on availability of scientific data to assess contributions to cumulative impacts. Trend data and Natural Resource management plans are focused on more localized regions such as Hood Canal. The contribution of effects on marine birds occurring in other inland waters and the ocean to cumulative impacts of the EHW-2 project is very difficult to define, but it is acknowledged that there is such a contribution.

Construction and operation of past and present waterfront projects, such as Delta Pier and KB Docks, as well as any future Navy or non-Navy actions, have resulted or would result in increased human presence, noise, boat movement, and other activities, driving away some water-dependent wildlife such as marine birds from these areas. Marine birds typically avoid areas with continuous activity or periodic loud noise. Often, birds will return to these areas when human presence is lower or there is less activity. There may also be some benefits, as some birds may use these in-water structures for roosting or nesting.

Trend data for Hood Canal indicate that marine bird species have been on the decline. Of the 30 most common marine birds, 19 have experienced declining populations of 20 percent or more over the past 20 years. It is unknown what is causing this decline, but possible reasons include increased predation, habitat loss, changing migration patterns, decreases in forage fish populations, hunting, and disturbance to breeding grounds in the Arctic (PSAT 2007a). The population of the marbled murrelet, a species listed as threatened under the ESA, declined more than 20 percent in the Puget Sound region between the 1970s and 1990s but has been fairly stable in recent years (PSAT 2007a). The principal reason for the earlier decline was loss of nesting habitat (old-growth forest).

Future in-water projects (Service Pier barge mooring replacement, Service Pier Extension, Electromagnetic Measurement Range platform, EHW-1 Pile Replacement, and the Land-Water Interface) may also generate high levels of underwater and airborne noise during construction (Section 4.3.4). Future Navy and non-Navy actions would increase the number of in-water structures, and human presence (e.g., noise from increased boat operations) could cause disturbance to marine birds. Proposed projects along the Bangor waterfront, such as the EHW-2, would occur in areas that are largely undisturbed but adjacent to facilities with higher activity and noise levels, such as Marginal Wharf. Thus, marine birds in the area may be somewhat used to these higher levels of activity and less impacted by ongoing waterfront development.

Past, present, and future development projects have had, continue to have, or would be expected to have many of the impacts to marine birds described above, and add to past or current declining population trends. Because marine birds are highly mobile, the noise impacts of the proposed action could be cumulative with noise impacts to marine birds from other actions and activities in the Hood Canal region. The fact that the noise impacts of the proposed action to marine birds would be temporary would tend to reduce the magnitude of cumulative effects. Because other impacts to marine birds from the proposed action and other projects are expected to be minimal (as described above and in Section 3.10.2), other cumulative impacts to marine birds are considered unlikely.

The greatest potential for cumulative impacts to marine birds would be simultaneous exposure to pile driving noise (underwater and airborne) from the EHW-2, EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electromagnetic Measurement Range projects. This is likely to impact more marine birds (through behavioral disturbance) than any project alone. As described in Section 4.3.4, the main effect of concurrent pile driving would be to extend by approximately 1.5 miles the area over which marine birds and other marine biota are exposed to pile driving noise; increased noise levels at a given location would generally not occur. However, if two closely located pile driving projects such as EHW-2 and EHW-1 pile replacement occurred at the same time, noise levels could increase by as much as 3 dB at sites roughly equidistant between the multiple pile driving rigs (Sections 4.3.4 and 4.3.16). The overlap in construction is based on currently projected schedules for the multiple projects and is subject to change (reduction in the period of overlap). Cumulative impacts would be reduced through the implementation of impact minimization measures similar to those proposed for the EHW-2. The Test Pile Program did not overlap in time with the EHW-2 project, but it did add an additional season (August to October 2011), during which marine biota along the Bangor shoreline were exposed to pile driving noise. A total of 21 days of pile driving were needed to complete this program. As discussed in Section 3.10.2.1, noise from construction of the pure water facility would not affect marine birds and so would not contribute to cumulative impacts.

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4.3.11 Geology and Soils Cumulative Impacts

The ROI for evaluating cumulative impacts to geology and soils is defined as the Hood Canal watershed within and in the vicinity of NBK at Bangor or portions of WRIA 15. Major contributors to the cumulative impacts to this area include land clearing and soil disturbance, particularly on geologically hazardous slopes; erosion; and the creation of impervious surfaces.

Land clearing and disturbance to soils from past, present, and future Navy actions and non-Navy actions have resulted, are resulting, or would result in the loss of soil due to erosion caused by wind and rain. Soil loss can affect the ability of vegetation to become established, and eroded soils can be carried into surface water by stormwater runoff and thus impact water quality. Some past non-Navy development has also adversely impacted geologically hazardous areas such as steep slopes by increasing stormwater runoff and/or overburdening the tops of slopes with structures, which has led to slope failures. However, geologically hazardous areas are now managed more carefully by following the guidance or standards of local governments or agencies (e.g., Kitsap County Code for Geologically Hazardous Areas) and applying construction BMPs for sloped surfaces. Standard stormwater construction BMPs have also reduced the amount of soil erosion that occurs during land disturbing activities.

There are no trend data indicating whether soil is being lost at an increasing rate in the Hood Canal region. However, it is assumed that the rate of soil loss has decreased over time because of better management techniques for protecting disturbed or hazardous soils and controlling stormwater runoff.

Future Navy and non-Navy actions would result in earth disturbance from land clearing, and there would be some soil lost due to wind or rain erosion. Given that construction BMPs would largely control erosion, no significant soil loss is expected. Future development is expected to have less of an adverse impact to geologically hazardous areas due to the implementation of full geotechnical and engineering investigations or simple avoidance of these areas. The EHW-2 project and all future Navy projects would be designed to meet seismic requirements for the area.

Past, present, and future Navy actions, including the proposed action, have disturbed or would disturb approximately 1,500 acres of soil on NBK at Bangor. Construction of the EHW-2 facility would contribute to cumulative impacts by disturbing a total of approximately 12.6 acres of onshore land (Table 2–1). It is anticipated that there would be little loss of soil and no mass wasting activities during construction because of rather gentle slopes and the use of erosion-control BMPs. A total of 9 acres, including the 5-acre laydown area, would be temporarily disturbed during construction. A total area of 3.6 acres would be permanently covered by pavement or structures; these include 1.4 acres at the EHW-2 site, 1.7 acres for the new buildings area, and 0.5 acre for the pure water facility site; the latter two locations would be constructed to replace the demolished buildings. The road extension area would be stabilized with a shoreline abutment structure. The increased contribution of land clearing for the EHW-2 facility would be a negligible fraction of the total amount of existing and proposed cleared land on NBK at Bangor. While the proposed action would add to the total amount of disturbed land, when combined with other Navy and non-Navy actions, the cumulative impact in terms of soil disturbance would be negligible.

Any localized loss of soil during construction of the EHW-2 facility (BMPs would greatly reduce erosion) likely would represent a *de minimus* contribution to the total soil lost from other past, present, or future Navy and non-Navy actions. Essentially no cumulative impact is anticipated.

4.3.12 Surface Water and Groundwater Cumulative Impacts

The ROI for evaluating cumulative impacts to surface water and groundwater is defined as the Hood Canal watershed within and in the vicinity of NBK at Bangor. Major contributors to the cumulative impacts to this area include sedimentation and contamination in water bodies, the creation of impervious surfaces, and groundwater recharge.

Development that has created impervious surfaces, such as roads, buildings, and parking lots, has considerably impacted surface water and groundwater. Past, present, and future Navy actions and non-Navy actions have produced, are producing, or would produce impervious surfaces. Impervious surfaces impact surface water by increasing stormwater runoff and often concentrating runoff into peak discharges. The higher volumes of runoff entering surface water during storms can erode stream banks and channels, disturb fish habitat, and degrade water quality by increasing turbidity. Runoff from impervious surfaces can entrain and carry sediment and contaminants such as fuel or oil into receiving waters, where it adversely impacts water quality. Impervious surfaces also impact groundwater by limiting the rate of groundwater recharge, which is an important consideration for drinking water supplies that rely on groundwater. Thus, impervious surfaces may have a detrimental impact to aquifer recharge areas. Based on review of aerial photographs of existing structures, it is estimated that past and present Navy actions on NBK at Bangor have resulted or are resulting in the creation of approximately 909 acres of impervious surface.

Regionally, the amount of impervious surface has increased over time, and this trend is expected to continue. For example, between 1991 and 2001 there was an increase of 10.4 percent in the Puget Sound region, and by 2001 approximately 7.3 percent of the region below 1,000 feet of elevation was covered with impervious surfaces (PSAT 2007b). According to the *State of the Sound Report*, there is a substantial decline in biological function when a watershed nears 10 percent impervious surface (PSAT 2007b). While the trend is for impervious surface to increase, the rate at which this is occurring in Kitsap County is rather slow relative to other counties in the Puget Sound region.

On the basis of existing project depictions, it is estimated that future Navy actions would create approximately 55 acres of impervious surface, and non-Navy actions would create 38 acres. The added impervious surface would have the same potential to impact surface and groundwater as described in Section 3.12.2. However, there are requirements for controlling runoff from impervious surface, and most development would have to include implementation of runoff detention and/or treatment measures. Projects in areas of aquifer recharge may also be required to implement measures to ensure that groundwater recharge is not adversely impacted. Thus, impervious surface created by future projects is less likely than past actions to adversely impact surface and groundwater.

Construction of the EHW-2 facility would contribute to this cumulative impact, though not substantially, by creating impervious surface on the trestles and wharf, as well as on the upland portion of the project site (small paved road surface, some buildings and other structures). For combined overwater and upland areas, it is estimated that the EHW-2 facility would create

approximately 6.3 to 8.5 total acres of impervious surface over the water and 3.6 acres on land (Table 2–1). Stormwater runoff from uncovered areas of the facility would be controlled by being collected, detained, and treated prior to discharge into Hood Canal, and there would be no discharge into other surface waters. Since stormwater runoff from uncovered areas would be controlled, the only impact to surface water would be the necessary additional treatment volume. In terms of groundwater recharge loss, the 3.6 acres of new impervious surface in upland areas (including the three new buildings, replacement parking, and pure water facility) would have a negligible impact to groundwater supply and quality because stormwater would be captured and discharged to the existing stormwater system, and because the proposed sites are in a groundwater discharge zone, which is not utilized as a water source. None of the facility components, including a new 10,000-gallon underground storage tank, would have an impact to groundwater quality.

While the proposed action would add slightly to the total amount of impervious surface attributable to Navy and non-Navy actions, the cumulative impact to surface water would be negligible given additional measures to control and treat stormwater runoff (for wetlands impacts, see Section 4.3.14, Wetlands). No additional impacts to groundwater are expected.

4.3.13 Vegetation Cumulative Impacts

The ROI for evaluating cumulative impacts to native vegetation is defined as the Hood Canal watershed. Larger ROIs such as the Puget Sound region and smaller, more localized ROIs for vegetation such as NBK at Bangor were also considered for use in the cumulative analysis. Given the available data and resource management plans, Hood Canal was deemed the most appropriate ROI for the analysis. Overall, native upland vegetation in the vicinity of Hood Canal has decreased in extent due to shoreline and upland development, and the contribution of such development in the Hood Canal watershed is relevant for determining cumulative impacts to vegetation. Native vegetation in the watershed would not be affected by actions outside Hood Canal.

On NBK at Bangor, past and present development has resulted or is resulting in the loss of approximately 1,100 acres of the forested area to development and 300 acres to grassland/ shrubland habitat. Similarly, past and present non-Navy actions have contributed or are contributing to vegetation loss or conversion due to residential and commercial development in the general area. Since the 1960s approximately 1,000 acres on NBK at Bangor have been replanted with native species, although the long-term impact of these replantings on vegetation resources at the base has not been quantified. The vegetation community on NBK at Bangor and the surrounding area provides habitat for a variety of wildlife species, as well as other functions, such as shading and a source of woody debris for fish habitat in streams.

The overall trend in the project area has been a decrease in vegetation as land has been developed. This has been a noted problem along the shoreline areas of Hood Canal. To mitigate the loss of vegetation from shoreline development along Hood Canal, the HCCC has been supporting projects that increase shoreline vegetation; it has, for example, initiated a Marine Riparian Initiative to reestablish more native vegetation and eradicate noxious weeds (see Section 4.2.2.2, Agency Plans for Improving Environmental Conditions in Hood Canal).

Future Navy and non-Navy actions would also result in loss of vegetation. Based on review of information on other future Navy projects, and available information on past, present, and future non-Navy actions, it is estimated that future Navy and non-Navy actions would result in a

loss of approximately 300 and 128 acres of vegetation, respectively. The EHW-2 would temporarily remove approximately 10.3 acres of second-growth forest and shrub habitat. Most (6.9 acres) of the cleared area would be revegetated following construction and the remainder (3.4 acres) would be permanently lost due to construction. As there are no rare, threatened, or endangered plant species on NBK at Bangor, there would be no cumulative impact from the proposed action to ESA-listed plant species.

The proposed action would at most contribute less than 1 percent to the total area of vegetation cleared on NBK at Bangor by past, present, and future Navy actions. While the proposed action would cause loss of vegetation, given the amount and location of this loss, there would be little impact to wildlife habitat or the vegetative community on NBK at Bangor (there is an abundance of vegetation in the immediate vicinity of the proposed action and on NBK at Bangor), and even less in the broader Hood Canal region. Therefore, the proposed action would make a minimal contribution to cumulative impacts to vegetation.

4.3.14 Wetlands Cumulative Impacts

The ROI for evaluating cumulative impacts to wetlands is defined as the Hood Canal watershed. A smaller, more localized ROI such as the portion of WRIA 15 on NBK at Bangor was considered for use in the analysis. However, as the project is in the marine environment a larger ROI was selected. Overall, wetlands in the vicinity of Hood Canal have decreased in extent due to shoreline and upland development (Todd et al. 2006), and the contribution of such actions in the Hood Canal watershed is relevant for determining cumulative impacts to wetlands. Wetlands in the watershed would not be affected by actions outside Hood Canal.

Existing records are not adequate to fully estimate how much wetland was or is being lost or impacted by past and present development on NBK at Bangor and in the surrounding area. There are approximately 254 acres of wetlands on NBK at Bangor and several in the immediate vicinity of the proposed action. Wetlands and their buffers provide valuable functions such as flood storage, wildlife habitat, and improved water quality, and these functions have been lost with the filling and disturbance of wetlands.

Wetlands are now protected, and regulations on filling or disturbance require replacement of wetland or buffer area and function. The goal of many federal agencies, including the Navy, is no net loss of wetlands, particularly high-quality wetlands. Therefore, the trend is toward either a gain in wetland area or maintenance of the existing amounts of wetland and wetland function. On NBK at Bangor, current development will result in the loss of 2.1 acres of wetlands and waters of the U.S. due to the Waterfront Security Enclave and Security Barriers project (P-977). A compensatory mitigation plan has been developed and approved by the USACE. Future Navy or non-Navy actions may result in loss of wetland area, but mitigation would be required in accordance with the requirements of CWA Section 404. Thus, it is assumed that future actions would not result in an overall loss of wetland area over the long term.

The EHW-2 would result in a loss of approximately 0.2 acre of wetlands due to construction of the paved access road. As with all of its projects, the Navy first looked at avoiding and minimizing wetland impacts from the EHW-2 project. After adoption of such measures, compensatory mitigation is still needed. The Navy will implement compensatory mitigation to replace lost functions of aquatic resources in Hood Canal, using a Hood Canal-wide watershed approach (Appendix F, Section 6.0). The proposed action would add to the cumulative impacts of past, present, and other future actions.

4.3.15 Wildlife Cumulative Impacts

The ROI for evaluating cumulative impacts to terrestrial wildlife is defined as Hood Canal. Depending on the species, there is a varying potential for actions elsewhere in Hood Canal to affect wildlife species affected by the EHW-2 project. Certain species may have a much more localized ROI. Resident species are unlikely to be affected by actions outside Hood Canal. Migratory birds or other wide-ranging wildlife species, however, may be affected by such actions. The contribution of effects on migratory or wide-ranging species to cumulative impacts of the EHW-2 project is very difficult to define, but it is acknowledged that there is such a contribution.

Approximately 1,400 acres of forested wildlife habitat have been or are being lost or impacted by past and present development on NBK at Bangor. These projects and future projects have resulted in or would result in the removal of mostly second- and third-growth forested habitat; this forested area has been replaced by buildings, parking lots, or grassland that is not considered optimum wildlife habitat. Over time, this combination of loss of wildlife habitat and increased human activity has resulted in fewer native species and occasional replacement by non-native wildlife more adaptive to an urban environment. In addition, forest fragmentation due to roads, buildings, fences, and other development affect an animal's freedom of movement within a contiguous habitat. Similar loss of wildlife habitat has occurred throughout the Hood Canal region due to past and present non-Navy development.

There is a general trend toward loss or conversion of wildlife habitat due to development, although the pace of this conversion is slower in the Hood Canal region than in other areas because that region is less urbanized. There are large, rather undeveloped areas, such as NBK at Bangor, outside the urban areas of Kitsap County, and development is on rather large lots (i.e., lots greater than 5 acres). Owing to explosives safety requirements, future EHW activities will continue to restrict the development of land around NBK at Bangor.

With future growth of developed areas, more wildlife habitat is expected to be converted or lost. Approximately 300 acres and 128 acres of wildlife habitat would be lost due to future Navy and non-Navy actions, respectively (see Section 4.3.13, Vegetation). An additional 111 acres of forest habitat would be isolated from contiguous habitat and the marine shoreline by security barriers, although this vegetation would not be cleared. The loss or conversion of habitat and loss of access to habitat would impact wildlife as discussed above. The EHW-2 would remove approximately 10.3 acres of second-growth forest and shrub habitat. Most of this acreage (6.9 acres) would be revegetated with native plants following construction. Even with revegetation, however, the impact is considered long-term, and thus there would be some loss of wildlife habitat. The proposed action would at most contribute 0.4 percent to the area of wildlife habitat lost to development on NBK at Bangor, and given the amount and location of this loss, would have little impact to wildlife habitat or movement. There is an abundance of wildlife habitat in the immediate vicinity of the proposed action and on NBK at Bangor. Therefore, the proposed action would make a minimal contribution to cumulative impacts to wildlife.

Upland wildlife would be exposed to construction noise from multiple projects on NBK at Bangor. Sensitive wildlife receptors, including a bald eagle nest near Devil's Hole, could be impacted by an increase in airborne construction noise. The most important example of this would be pile driving noise from the EHW-2 project and the EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electromagnetic Measurement Range projects, as described in Section 4.3.4, Underwater Noise,

and Section 4.3.9, Marine Mammals. Pile driving for these projects may overlap for an unknown number of construction seasons. The main effect of concurrent pile driving would be to extend the area over which biota were exposed to pile driving noise. Noise levels at a given location would not generally increase; increases of up to 3 dB would occur only infrequently at a location equidistant between two construction sites (e.g., the existing EHW and EHW-2) when pile driving at those sites was concurrent. This could affect sensitive wildlife receptors located along the eastern shore of Hood Canal or the bald eagle nest site near Devil's Hole. The Test Pile Program did not overlap in time with the EHW-2 project, but it did add an additional season (August to October 2011), during which wildlife on NBK at Bangor were exposed to pile driving noise. A total of 21 days of pile driving were needed to complete this program.

SOCIAL ENVIRONMENT

4.3.16 Noise Cumulative Impacts

The ROI for evaluating cumulative impacts for airborne noise includes the waterfront and woodland areas near the project site, extending to the Vinland neighborhood just north of the NBK at Bangor northern property boundary; the waterfront industrial area encompassing Delta Pier and Marginal Wharf; and shoreline properties on the west side of Hood Canal, west and northwest of the project site.

Most past, present, and future actions have generated, are generating, or would generate some type of noise, either from a facility itself, from vehicles traveling to and from a site, or from humans. Noise is typically a nuisance factor for sensitive receptors such as residences, hospitals, or parks, where quiet conditions are important. This is particularly true during evening hours. Close proximity to high sound levels can result in physiological problems or hearing damage. Over time the trend has been for noise levels to increase as development has occurred, particularly during daytime hours when activity levels are highest. Noise levels tend to be fairly low outside the urban areas of Kitsap County due to development on large lots (greater than 5 acres) and a general lack of industrial activity. However, some industrial areas, such as the Bangor waterfront, generate higher noise levels.

Future Navy and non-Navy actions would also generate noise. The type of noise and noise levels produced would be dependent on the specific project. The impact of these noise sources would depend on their location relative to sensitive receptors, but it is likely that some of these future actions would produce nuisance noise. There are requirements to limit the level of noise produced by residential, commercial, or industrial land uses. Thus, some future development would have requirements to provide soundproofing measures. The proposed action would generate noise from equipment, industrial activities, vessel movement, and humans. The highest noise levels would be generated by pile driving during construction. Impact hammer pile driving would generate average (i.e., root-mean-square [RMS]) noise levels of 105 dBA re 20µPa at a distance of 50 feet, while vibratory pile driving would generate RMS noise levels of 95 dBA re 20µPa at 50 feet. Residential areas near Thorndyke Bay, and to a lesser extent Suquamish Harbor on the western shore of Hood Canal, would experience increased noise levels during pile driving, as would recreational users on Hood Canal or the western shores of Hood Canal. The cumulative impacts of pile driving noise to fish, mammals, marine birds, and surrounding communities are discussed in Sections 4.3.8, 4.3.9, 4.3.10, and 4.3.21, respectively. The residential area of Olympic View would experience construction noise from the site of the three

new buildings, but would not be affected by noise from other projects. Construction of the pure water facility would extend the area exposed to conventional construction noise about one mile to the south of the EHW-2 site proper, increasing slightly the potential for cumulative noise impacts with other projects in that industrial area (Land-Water Interface).

In the long term, noise produced by operation of the EHW-2 would expand the area over which industrial noise was generated, but these noise levels would be similar to those currently generated by the existing EHW and other wharves at the Bangor waterfront. Overall, EHW industrial activity and noise levels would not increase. Therefore, operation of the proposed action would not add to the cumulative noise impacts of past, present, and other future actions.

As discussed in Section 4.3.4, Underwater Noise, construction activities may overlap for the EHW-2 and EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electromagnetic Measurement Range projects. This would result in cumulative airborne noise impacts during the period of overlap. The principal effect of this temporal overlap in pile driving would be to extend the affected area farther south than for the EHW-2 alone. Noise levels at a given location would not generally increase; increases of up to 3 dB would occur only for the infrequent case of a location equidistant between two construction sites (e.g., the existing EHW and EHW-2) when pile driving at those sites was concurrent. This could affect sensitive wildlife receptors located along the eastern shore of Hood Canal, including a bald eagle nesting area near Devil's Hole, as could residential areas and recreational users on the western shore of Hood Canal. In all other cases, noise levels at a given location would be dominated by the closer pile driving activity. (The intervening headland between the EHW and Service Pier sites would reduce the potential for additive noise levels from projects at both locations.) General construction noises for each of the two projects would also overlap, but these noise levels would be similar to existing levels along this industrial waterfront and thus much lower than the levels from pile driving. Therefore, the resulting cumulative noise impacts from general construction are expected to be minimal. If the actual period of construction overlap for the two projects were less than currently projected, resulting cumulative impacts would be reduced accordingly.

4.3.17 Air Quality Cumulative Conditions

The ROI for air quality is the Puget Sound Clean Air Agency (PSCAA) region, which encompasses localities in Kitsap County or the Hood Canal region, as the PSCAA is delegated by the state of Washington to regulate the state's Clean Air Act (CAA). Since short-term construction air quality impacts will be limited to the Kitsap County or Hood Canal region only, the cumulative air quality impacts are addressed in terms of contributions to the PSCAA region.

Existing air quality has been, is being, or would potentially be impacted by past, present, and future actions to varying degrees, depending on the project. For example, residences and facilities such as parks have had little impact to air quality, while vehicles and industrial operations may produce a number of emissions, including VOCs, nitrogen oxides, particulates, or other emissions.

The trend for air quality is fairly stable, since point sources have been targeted by regulations and are limited in their emissions. Also, outside the urban areas of the county, air emission sources such as woodstoves are fairly spread out due to large lot development, and any impacts are localized. The Hood Canal region is rated as good (the highest rating) in air quality (PSCAA 2009b), is in compliance with all air quality standards, and is currently in an attainment

area for all pollutants. Kitsap County is in attainment for all NAAQS. The most recent emissions inventory for the PSCAA shows that a rather low percentage of total emissions is associated with stationary and mobile sources in Kitsap County. Past development and subsequent operation of emission sources in Kitsap County have not contributed to exceedances of the NAAQS, and the region is in attainment for all applicable air quality standards.

Future Navy and non-Navy actions that produced sizeable air emissions would be required to install abatement measures to limit emissions and would be required to comply with permit conditions on the amount of air pollutants generated. Thus, it is not anticipated that future actions would result in violations of air quality standards. Planned future development in Kitsap County is consistent with or below the emissions estimates contained in the State Implementation Plan. The proposed action would generate short-term air emissions, such as VOCs, carbon monoxide, nitrogen oxide, and particulates from boats, vehicles, and equipment. However, the impacts would be localized, and individual emissions of these criteria pollutants would be well below the air quality standard compliance levels.

Combined emissions from concurrent construction of the EHW-2 and the EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electromagnetic Measurement Range projects would be well below air quality standard compliance levels. Emissions from the proposed action are not expected add to the cumulative impacts to existing air quality of all past, present, and reasonably foreseeable actions. This is because existing levels of criteria pollutants and greenhouse gas emissions are low, emissions from the proposed action would be localized, future point sources would be required to control emissions, and the level and the type of development that would occur in the reasonably foreseeable future would not produce substantial emissions.

4.3.17.1 Greenhouse Gases

It has been generally accepted in the scientific community that human-generated emissions of greenhouse gases (GHGs) over the past century have led to increasing global air temperatures. GHGs, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases, have a propensity to trap heat in the atmosphere. CO_2 is the predominant greenhouse gas emitted by human activities, primarily from the combustion of fossil fuels such as coal, oil, and natural gas. The observed increase in average global air temperatures since the mid-twentieth century is very likely a result of increased atmospheric concentrations of GHGs (Intergovernmental Panel for Climate Change 2007). This phenomenon is commonly referred to as “global warming.” Global warming due to GHG emissions induces climate change through the complex interaction of increased temperature with various natural processes such as ocean and atmospheric circulation. Effects of climate change in turn create complex feedback loops, such as loss of reflective snow and ice cover, which increase the rate of climate change. Scientists are now in general agreement that climate change is occurring (American Meteorological Society 2007), and that current trends are very likely to continue unless worldwide emissions and atmospheric concentrations of CO_2 and other GHGs are substantially reduced (Ledley et al. 1999; Energy Information Administration 2008).

4.3.17.1.1 CLIMATE CHANGE

The effects of climate change may not be readily apparent in all geographic areas, including the immediate project area, as the effects occur on a global scale. Among the effects are rising air and ground temperatures, loss of sea ice, loss of protection from fall storms, and retreat of the

permafrost boundaries. Sea ice has retreated by about 14 percent since 1978, and thinned by 60 percent since the 1960s, resulting in widespread effects on marine ecosystems, coastal climates, and human settlements. Recent warming has been accompanied by increases in forest disturbances, including insect infestations.

Effects of climate change on marine mammals are poorly understood due to lack of integrated baseline data (Burek et al. 2008). This lack of data on health, diseases, and toxic effects in marine mammals severely limits our ability to predict the effects of climate change on marine mammal health. The overall health of an individual animal is the result of complex interactions among immune status, body condition, pathogens and their pathogenicity, toxicant exposure, and the various environmental conditions that interact with these factors. Climate change could affect these interactions in several ways. There may be direct effects of loss of the sea ice habitat, elevations of water and air temperature, and increased occurrence of severe weather. Some of the indirect effects of climate change on animal health will likely include alterations in pathogen transmission due to a variety of factors, effects on body condition due to shifts in the prey base/food web, changes in toxicant exposures, and factors associated with increased human habitation in the Arctic (e.g., chemical and pathogen pollution in the runoff due to human and domestic-animal wastes and chemicals and increased ship traffic with the attendant increased risks of ship strike, oil spills, ballast pollution, and possibly acoustic injury). The extent to which climate change will impact marine mammal health will also vary among species, with some species more sensitive to these factors than others. Baseline data on marine mammal health parameters along with matched data on the population and climate change trends are needed to document these changes (Burek et al. 2008).

4.3.17.1.2 OCEAN ACIDITY

It has been posited that the continued emission of CO_2 is causing seawater to become more acidic as CO_2 from the atmosphere dissolves in the oceans. Ocean acidification from the invasion of CO_2 is a recognized phenomenon (Cicerone et al. 2004; Feely et al. 2004; Sabine et al. 2004). Scientists estimate that the oceans are now about 25 percent more acidic than they were at the start of the industrial revolution about 300 years ago. The negative effects of ocean acidification are likely to be felt on biological processes such as calcification (Orr et al. 2005; Kleypas and Eakin 2007). Ocean acidification from CO_2 invasion and reduced ventilation also may result in decreases in sound absorption for frequencies lower than 10 kHz (Hester et al. 2008). This would result in increases in ambient noise levels in ocean environments, and enhanced propagation of anthropogenic sound. The scale of potential acidification is presently unknown due to a lack of data and challenges associated with sampling on a basin-wide or regional scale. While this phenomenon is under study (Hester et al. 2008), the effects of CO_2 emissions on ocean acidity and the resultant potential for enhanced sound propagation remain indeterminate due to incomplete information.

4.3.17.1.3 GHG CUMULATIVE EFFECTS

The potential effects of proposed GHG emissions are by nature global and cumulative impacts, as individual sources of GHG emissions are not large enough to have an appreciable effect on climate change. Therefore, an appreciable impact to global climate change would only occur when proposed GHG emissions combined with GHG emissions from other manmade activities on a global scale.

Currently there are no formally adopted or published NEPA thresholds of significance for GHG emissions. Formulating such thresholds is problematic, as it is difficult to determine what level of proposed emissions would substantially contribute to global climate change. Therefore, in the absence of an adopted or science-based NEPA significance threshold for GHGs, this EIS compares GHG emissions that would occur from the preferred alternative to the U.S. GHG baseline inventory of 2006 to determine the relative increase in proposed GHG emissions. The GHG emissions associated with the proposed action would be low, emissions would be localized, and emission controls on future point sources would be required, the effect being that the level and the type of development in prospect for the reasonably foreseeable future would not produce substantial emissions or have an appreciable contribution to cumulative GHG impacts.

4.3.17.2 Navy Stewardship and Energy Conservation

In response to concerns over climate change, the Navy has initiated broad programs to reduce energy consumption and shift energy demand to renewable and alternative fuels to an extent consistent with its national security mission, thereby reducing emissions of CO_2 and other GHGs. A number of shore installation and fleet programs have substantially reduced the generation of GHGs, primarily through the conservation of fossil fuels and electricity.

Ashore, the Navy has aggressively encouraged its installations to reduce energy use, both through facility competitions and through investments in solar, wind, and geothermal technologies. Since 1985, the Navy has sponsored a worldwide energy management program that has reduced its energy use by more than 29 percent (NAVFAC Public Affairs 2005). At Pearl Harbor, for example, the installation of approximately 2,800 energy-efficient light fixtures has reduced electricity use by about 758 megawatt-hours per year, equal to 448 tons per year of CO_2 emissions (NAVFAC Public Affairs 2008). New air conditioning chillers also installed at this installation will save another 252 megawatt-hours of electricity per year, equal to about 149 tons per year of CO_2 emissions. Implementing similar energy conservation measures at Navy shore installations worldwide has substantially decreased the Navy's carbon footprint, and the Navy continues to identify new energy conservation measures.

Energy conservation aboard Navy vessels at sea also has achieved substantial reductions in fuel consumption, and thus emissions of GHGs. Naval Sea Systems Command has established an Energy Conservation Awards Program to reward leading fuel conservers among underway surface ships with special recognition and cash incentives. During the first half of 2009, this program reduced the Navy's fuel consumption by about 682,000 barrels, or about 346,000 tons of CO_2 emissions (Navy News Service 2009).

The Navy also is researching and implementing new technologies that may result in substantial additional fuel savings. The new amphibious assault ship Makin Island, using a new hybrid power propulsion system, saved an estimated 900,000 gallons of fuel (equal to about 11,000 tons of CO_2) on its initial voyage from the Gulf of Mexico to San Diego. As new Navy ships are placed into service and older ships are retired, the overall fuel efficiency of the Navy's fleet will substantially increase (Biello 2009).

The Navy also is investigating new hull-cleaning technologies that could substantially reduce drag from fouling of vessel hulls by marine organisms, potentially saving millions of gallons of fuel per year. Finally, the Navy has successfully tested the use of biofuels with camelina oil to power aircraft. The Green Hornet biofuel program is the first aviation test program to test and evaluate the performance of a 50/50 biofuel blend in supersonic (above mach 1) operations – a

critical test point to successfully clear the F/A-18 E/F for biofuel operations through its entire flight envelope (Navy News Service 2010). Camelina jet biofuel produces 80 percent lower carbon emissions than conventional jet fuels (Biello 2009).

These examples illustrate the Navy's leadership role in achieving large-scale energy reductions that will substantially contribute to a long-term national effort to mitigate global climate change.

4.3.18 Cultural Resources Cumulative Impacts

The ROI for evaluating cumulative impacts to cultural resources is defined as NBK at Bangor facilities. Cultural resources are unique as well as finite in nature, so that an adverse impact to a single historic property affects the complement of historic properties within the ROI. Continued construction projects and modifications to Navy facilities have the potential to adversely affect historic properties. However, the Navy would comply with Section 106 of the NHPA for the EHW-2 project and other reasonably foreseeable further actions within the ROI. This includes mitigation of adverse impacts that could not be avoided or minimized, thereby addressing the cumulative impact of those undertakings.

The trend associated with cultural resources is ongoing identification and preservation of resources. Federal laws and regulations have been established to protect and preserve archaeological and cultural resources. Future Navy or non-Navy actions that involve earth disturbance have some potential for disturbing archaeological resources. However, some potential for such disturbance may go unrecognized and unrecorded. Future Navy actions that involve alterations to NRHP-eligible buildings or structures, the construction of new buildings or structures, or square footage reductions all have the potential for direct or indirect impacts to historic properties.

While unlikely, construction-related clearing and excavation operations associated with the proposed action could inadvertently disturb unknown archaeological resources. The proposed action would occur within the setting of two architecturally historic properties: the existing EHW, which is NRHP-eligible based on its Cold War era associations, and the Shelton-Bangor Railroad mainline, which is NRHP-eligible based on its World War II associations. The Navy determined that the proposed action would not have an adverse effect on these two resources, and the SHPO concurred (Appendix I). Delta Pier, also eligible for listing on the NRHP, will not be affected. Otherwise, the proposed action would not cause any known impacts to archaeological cultural resources, and the Navy would comply with Section 106 of the NHPA by consulting with the SHPO on the mitigation of any adverse impacts, and would take the same action in consequence of any unanticipated archaeological discovery. With these procedures in place, the proposed action would not add to the cumulative impacts to archaeological or architectural resources.

4.3.19 American Indian Traditional Resources

The ROI for evaluating cumulative impacts to American Indian traditional resources consists of NBK at Bangor. The Navy has an active consultation process in place, with emphasis on protection and avoidance of areas of traditional cultural importance, as well as access to the resources found on the installation. Because of this ongoing process, traditional resources on NBK at Bangor will continue to be protected and accessible.

American Indian traditional resources, such as traditional use areas (e.g., cedar growth for bark gathering), subsistence resources (e.g., shellfish), and special places (religious and traditional), have been impacted over time as a result of land development and population growth that resulted in increased use of natural resources such as fish and shellfish. Traditional use areas and subsistence resources are known to lie both within and outside of the project area. Impacts to cultural resources include loss of access to traditional use areas, conversion of a traditional area or special place to another land use, and reduction in the abundance of tribal resources for economic, subsistence, or ceremonial/religious uses.

The trend associated with American Indian traditional resources is ongoing identification and preservation of resources. Federal laws and regulations have been established to protect and preserve traditional cultural resources. In addition, American Indian tribes have been proactive in acquiring traditional areas and preserving cultural resources, including subsistence resources. Most cultural resources on the base that are considered American Indian traditional use areas, subsistence resources, and special places have been identified and will be avoided whenever possible. Access to these resources is also allowed for American Indian tribes with treaty rights.

The Navy will continue to consult with affected American Indian tribes regarding Navy activities that may have the potential to significantly affect protected tribal treaty rights and resources on NBK at Bangor. The proposed action, including relocation of the pure water facility and water line at Delta Pier, would not affect access to or use of tribal traditional resource areas. Construction of the proposed action may impact Hood Canal adult salmon and steelhead, which are tribal resources. Some adult salmon and steelhead could be injured during impact pile driving. No significant impacts to the overall quantity of available adult salmon and steelhead in Hood Canal are expected with the construction of the proposed project. As discussed in Section 3.19.2.1, the presence/operation of the EHW-2 is not expected to have a significant impact on tribal fish resources.

Future Navy projects at the Bangor waterfront such as the Land-Water Interface, the Electromagnetic Measurement Range, Service Pier barge mooring replacement, and Service Pier Extension could have impacts to tribal treaty rights and traditional resources similar to those identified for the proposed action. The Navy will conduct government-to-government consultation with affected American Indian tribes regarding these and other future Navy projects. For future Navy projects that require USACE permits, the Navy will comply with the USACE/EPA rule on compensatory mitigation for aquatic resources. Additionally, for non-Navy projects requiring USACE permits, USACE considers the potential effects on traditional resources and, in its decision making regarding permit issuance, may consult with the affected tribes.

4.3.20 Coastal and Shoreline Management

The ROI for coastal and shoreline management is defined as the Hood Canal shoreline and coastal resources. The preservation of natural resources within the coastal zone is regulated through Washington's CZMP, which governs development within the coastal zone. Past, present, and future actions within the project vicinity have been and would be subject to guidelines for preservation of natural resources within the coastal zone stipulated in Washington's CZMP. Washington's CZMP has been adopted by WDOE, and all past development projects have been approved pursuant to the adopted CZMP, ensuring compliance with the federal CZMA. The Kitsap County Shoreline Management Master Program is the instrument by which the county regulates continued development within the coastal zone. Over

the years, the county has employed the Shoreline Management Master Program to ensure consistency with shoreline preservation guidelines intended to minimize impacts to natural resources. Future Navy and non-Navy actions in the project vicinity would also be modified during the project review process to ensure consistency with the CZMA, Washington's CZMP, SMA, and Kitsap County Shoreline Management Master Program provisions for protection of shoreline resources. For the proposed action to be approved, the CZMA requires that it be found consistent to the maximum extent practicable with the Washington SMA. The Navy will submit a CCD to the WDOE, which will make a federal consistency determination in the form of concurrence, conditional concurrence, or objection. The consistency determination is intended to ensure that the project is consistent to the maximum extent practicable with the enforceable policies of the SMA. The consistency determination will demonstrate that the proposed action minimizes coastal impacts to the extent feasible. Impacts to coastal and shoreline management would be the same for all proposed alternatives.

As the proposed action will be reviewed for consistency with the CZMA and the Navy expects the proposed action to be consistent to the extent feasible with Washington's CZMP, it would be unlikely to add to the cumulative impacts to the coastal zone of past, present, and other reasonably foreseeable future actions.

4.3.21 Land Use and Recreation Cumulative Impacts

The ROI for evaluating cumulative impacts to land use and recreation is defined as the surrounding communities in which actions on NBK at Bangor are most likely to contribute to cumulative impacts, which includes portions of Kitsap Peninsula and Kitsap County in the NBK at Bangor vicinity, as well as Hood Canal and Jefferson County on the western shore of Hood Canal across from NBK at Bangor.

Land development from past and present actions has converted or is converting the natural environment to land uses ranging from rural to urban and industrial. For example, NBK at Bangor has changed from its rural residential, agricultural, and heavily forested beginnings to its present use as the base of operations and support for the TRIDENT submarine program, with approximately 20 percent of the property developed. Recreational facilities (e.g., parks, trails) have also been developed in concert with land development.

Land development and changes in land use could have impacts in various areas such as noise, air quality, water quality, socioeconomics, utilities and energy use, and transportation. These impacts are discussed in the other sections in this chapter. Changes in land use could also create issues as to compatibility with adjacent land uses. Land use laws, planning policies, and project reviews attempt to minimize or eliminate such compatibility issues.

The trend is for development to continue converting natural areas to residences, businesses, and other developed uses. Recreational facilities would also be developed as population and demand for public recreation increased. Future Navy and non-Navy actions would also convert undeveloped land to developed use, with impacts similar to those discussed above.

The proposed action would change the land/water use at the immediate project site and add to the developed areas attributable to past, present, and other future Navy and non-Navy actions. That contribution, however, would be minimal: less than 0.2 percent of the extent of existing developed areas on NBK at Bangor. Thus, despite temporary impacts from construction noise, the proposed action would make a minimal contribution to cumulative impacts to land use and recreation.

4.3.22 Aesthetics Cumulative Impacts

The ROI for evaluating cumulative impacts to aesthetics is defined as the surrounding areas in which actions on NBK at Bangor are most likely to contribute to cumulative visual impacts, which include Hood Canal and Jefferson County on the western shore of Hood Canal across from NBK at Bangor.

Visual conditions have been or are being altered by past and present actions as development changes portions of the natural environment to a built environment. However, much of the area around Hood Canal has retained its natural and rural visual quality because of large-lot residential development, an abundance of forested land, and unobstructed views of Hood Canal and the Olympic Mountains. Approximately 4,888 acres or 64 percent of NBK at Bangor is forested, and this has helped retain the natural visual quality at the base.

The trend is for development to continue, which would alter visual resources. Since development in the county is rather slow and continues to occur on larger lots in many areas, visual resources will change, but at a slow pace. Distant views to the west would not likely be blocked by new development because of the height and proximity to the Olympic Mountains. Future Navy and non-Navy actions would continue the trend of converting land from natural or undeveloped conditions to built conditions. Thus, visual resources would change to more urbanized views. Navy policies (Trident Joint Venture 1975) recommend using existing developed areas and maintaining natural areas in their existing condition as much as is practicable. This would help to minimize impacts to visual quality on NBK at Bangor. During the period of potential concurrent construction of the proposed action and the EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electromagnetic Measurement Range projects, a cumulative aesthetic impact to views from Hood Canal could be expected.

While the EHW-2 would contribute to a change in visual conditions along the waterfront, it would be visually compatible with adjacent facilities and not alter the existing visual resources substantively. Nevertheless, the EHW-2 would make a minor contribution to the cumulative aesthetic impacts of past, present, and other future actions. Alternative 5 would make a somewhat greater contribution to cumulative visual impacts than the other alternatives.

4.3.23 Socioeconomics Cumulative Impact

The ROI for evaluating cumulative impacts to socioeconomics and environmental justice is defined as the surrounding communities in which actions on NBK at Bangor are most likely to contribute to cumulative socioeconomic impacts (i.e., Silverdale, Poulsbo, and Bremerton, all of which are located on the Kitsap Peninsula and within Kitsap County) as well as Jefferson County on the western shore of Hood Canal across from NBK at Bangor.

Socioeconomic conditions have been or are being profoundly changed by past and present development. For example, NBK at Bangor has become one of the primary employers in Kitsap County. Development of the TRIDENT base and other military installations has increased the population, long-term employment opportunities, and income of Kitsap County, as well as the demand for housing and various public services (e.g., police, fire, emergency and medical services, schools). It is estimated that approximately 40,000 personnel—military personnel, civilians, and contractors—work for the military in Kitsap County.

Population, housing, and economic activity are increasing at a moderate rate in Kitsap County (see Section 3.23, Socioeconomics). These changes are attributable to development, population in-migration, changes in economic conditions, and changes in social or political factors. Future Navy and non-Navy actions would generate employment and income. Projects that prompt in-migration would increase the demand for housing and public and social services. However, these conditions would vary over time based on the changing conditions discussed above.

Construction of the proposed action would employ approximately 100 to 260 people at various times during the construction period. Construction of the EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electromagnetic Measurement Range projects would employ approximately 90 people. During the period of potential construction overlap between these projects, the cumulative socioeconomic effect would be approximately twice what it would be for one of the projects alone (see Section 3.23.2.1).

In the long term, the proposed action would employ approximately 20 additional permanent military and civilian staff. This would provide some long-term benefit in terms of income and spending to the regional economy. The additional staff and their dependents would increase the demand for public services.

For every $100 million spent by the Navy in construction expenditures, an estimated 874 direct jobs and an estimated 394 indirect or induced jobs would be created. These new jobs created by the potential construction expenditures would be concentrated in the following industries: food and beverage services, real estate, health care, architectural engineering, and wholesale and retail trade. The project cost is estimated to be in excess of $500 million, for a total economic impact of 4,370 direct jobs and 1,970 indirect and induced jobs. Total economic output to the region would be in excess of $722 million. Economic analysis thus shows that the contribution of spending for the proposed project, in addition to that for other military construction projects and activities, would constitute a substantial economic benefit to the local and regional economy.

The proposed action would not have disproportionately high or adverse human health, environmental, or socioeconomic impacts to minority or low-income (including American Indian) populations, because there are no such populations within the range of likely project impacts. (Subsistence resource use is addressed in Section 4.3.19.) Therefore, there would be no cumulative environmental justice impacts as a result of adding the proposed action to past, present, and other future actions. Any overlap between the construction period for the EHW-2 and those of the proposed EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electromagnetic Measurement Range projects would of course have a measurable employment impact in terms of an increase in the total number of construction jobs created.

4.3.24 Utilities and Energy Cumulative Impacts

The ROI for utilities and energy is the service area wherein increased demand for utility and energy services for the proposed action could affect the availability locally of such services. The service area for the Navy (water supply and wastewater collection) encompasses NBK at Bangor. The Kitsap County Public Works Department (wastewater treatment) serves most of Kitsap County. The Bonneville Power Administration (electricity) serves most of the Pacific Northwest. However, the analysis region for cumulative utilities impacts focuses on NBK at

Bangor and surrounding areas because the infrastructure immediately serving the proposed action is within this service area, and service subareas of utility providers are sufficiently separated that increased service demands for the proposed action would not threaten such provisions in other areas.

Future Navy and non-Navy actions would also increase the demand for energy and utility service. However, low-impact development principles and Leadership in Energy and Environmental Design construction requirements would require implementation of energy conservation strategies, including the use of renewable energy sources. NBK at Bangor provides some of its own utility services, including backup electrical power and water and sewer service (the internal sewer system discharges into the Kitsap County system where it is directed to a wastewater treatment plant). The base also stores fuel, and future Navy actions may increase the need for fuel storage capacity on NBK at Bangor. On-base and off-base utilities have adequate supplies to meet future demand over a 20-year planning horizon.

The proposed action would increase demand for energy and utility service. During the period of potential construction overlap between the proposed action and the EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, Electromagnetic Measurement Range projects, as well as other non-Navy projects, demands for energy and utility service would be increased. However, because on-base and off-base utilities have adequate supplies to meet demand over the next 20 years, the contribution of the proposed action to the cumulative impacts attributable to past, present, and other future actions would be minimal.

4.3.25 Transportation Cumulative Impacts

The ROI for ground transportation includes those streets and intersections that would be used by both automobile and truck traffic to gain access to and from the EHW-2, as well as those streets that would be used by construction traffic (i.e., transport of equipment and commuting workers). The streets most likely to be impacted by cumulative project-related auto and truck traffic include NW Trigger Avenue and NW Luoto Road (referred to as Trident Avenue outside of base boundaries). The ROI for marine vessel traffic is defined as Hood Canal.

Vehicle circulation patterns have changed and traffic volumes have increased in Kitsap County with increases in population and increased employment for past and present actions, particularly projects on NBK at Bangor and other Navy installations. Growth is inevitably accompanied by increased vehicle traffic and consequent impacts to road travel such as intersection delay, lowered levels of service, and decreased safety. The trend in Kitsap County, which parallels the national trend, is for people to own more vehicles and drive more vehicle miles. Recent increases in gas prices have caused some people to look for other transportation options (e.g., mass transit) or to alter their driving habits. Marine vessel traffic levels have increased throughout the years to accommodate growth in the project region.

Future Navy and non-Navy actions would generate additional traffic with impacts similar to those discussed above. Transportation agencies have attempted to keep up with increased traffic, but in many areas traffic volumes exceed the capacity of roads or intersections. Kitsap County has adequate capacity on most of its roads and intersections. However, in the more urbanized areas there are capacity problems on some road segments. Recent traffic counts of average daily traffic entering or leaving the base on Trigger Avenue or Luoto Road total 23,721 trips (All Traffic Data Services 2008). Traffic volumes on these two thoroughfares in fact are expected to

increase 10 percent by 2016—an increase prompted in part by operation of the EHW-2. Such an increase would contribute only negligibly to the cumulative impacts of past, present, and other future actions. Impacts to transportation would be the same for all proposed alternatives.

Future Navy and non-Navy projects along the shoreline could increase marine vessel traffic levels within Hood Canal.

The EHW-2 would be constructed to support current operations at the existing EHW. A portion of the existing operations and associated vessel traffic at the EHW and other Bangor waterfront facilities would be diverted to the EHW-2, but overall vessel activity at the Bangor waterfront would not increase as a result of the proposed action. Given the proximity of the project site to the existing EHW, relocation of operations would not appreciably alter existing vessel transit routes or the amount of vessel traffic. Impacts to marine vessel transportation would be the same for all proposed alternatives.

During the period of potential construction overlap between the proposed action and the EHW-1 Pile Replacement, Land-Water Interface, Service Pier barge mooring replacement, Service Pier Extension, and Electro-magnetic Measurement Range projects, the combined impact to base roads used by construction traffic would be approximately twice what it would be for one of the projects alone (see Section 3.25.2.1). This would still represent a minor contribution to cumulative traffic impacts both on and off base. Any overlap of the construction period for the EHW-2 with that for any of the other projects, of course, would tend to increase the traffic impacts.

The proposed action has the potential to overlap with the T-ROC project during construction. Potential interference from the T-ROC project associated with large amounts of tug/barge traffic in a narrow channel of Hood Canal would be minimized to the extent feasible through implementation of a local Notice to Mariners. This public notice would increase the awareness of all waterway users in the project vicinity and ensure adequate communication between the U.S. Coast Guard, Marine Exchange of Puget Sound, and vessel operators. Hood Canal Bridge openings would occur approximately three times per week to accommodate barge traffic associated with the proposed action. This increase in the number of openings would not be cumulatively considerable with respect to vessel traffic impact. Therefore, the proposed action would not substantially contribute to the cumulative impacts to marine vessel transportation of past, present, and reasonably foreseeable future actions.

4.3.26 Public Health and Safety Cumulative Impacts

The ROI for evaluating cumulative impacts to public health and safety is defined as NBK at Bangor and the immediately surrounding area, including Vinland. For potential noise impacts to public health and safety, the ROI is expanded to the waters of Hood Canal and areas on the Toandos Peninsula likely to be affected by construction noise from the proposed action (Sections 4.3.4 and 4.3.16). Other than the existing EHW there is no past or present Navy action that involves handling explosives at the Bangor waterfront. There has never been an accident at the existing EHW that jeopardized the safety of the base, the local population, or the environment. The Navy's strategic weapons programs use a layered safety system that includes highly trained personnel, detailed administration, and specifically designed equipment to ensure its missiles and weapons are safe and reliable. See Section 3.26.1 for more information on public safety and the existing EHW.

Like the existing EHW, the explosives handled at the proposed EHW-2 would be mainly in the form of missile motor propellant identical to the propellant that has been safely handled at the existing EHW for more than 30 years. A second EHW would operate within the existing TRIDENT explosives handling program, and personnel responsible for handling explosives at the EHW-2 would be as well trained and qualified as personnel working at the existing EHW. The Navy would, as always, follow extensive prevention, containment, and countermeasure plans to address any releases of fuels or hazardous materials. Restricted access to the project location would make it impossible for children to enter at any time during facility construction or operation. Construction noise levels at the nearest school would not be expected to exceed noise thresholds. The residential area of Olympic View would experience noise from construction of the three new buildings but would not be affected by other projects. In view of these factors, the project would not contribute to any cumulative impacts to public health and safety.

Construction activities for the proposed action may overlap with other construction activities or operations. This increase in the tempo of construction activities may result in an increased safety risk to construction workers or personnel. Due to the implementation of rigorous safety measures, this risk would be reduced to the maximum extent practicable. This incremental increase in the safety risk factor would represent a minimal cumulative impact.

4.4 SUMMARY OF CUMULATIVE IMPACTS

Marine and Upland Environment

Implementation of the EHW-2 would contribute to regional cumulative impacts to marine resources such as shallow-water habitat, including loss of eelgrass and macroalgae, as well as habitat for juvenile salmon and other fish and invertebrate species. However, given the beneficial effects of the proposed mitigation action to compensate for these impacts, the proposed action would make no net contribution to cumulative impacts. The following is a list of key environmental impacts of the proposed action that could contribute to cumulative impacts in the project region:

- Loss of soft-bottom habitat for benthic organisms and conversion to hard-surface habitat;
- Loss of eelgrass and marine vegetation and reduced vegetative productivity;
- Temporary underwater noise higher than background levels during construction;
- Temporary airborne noise impacts to humans and animals on the western side of Hood Canal;
- Potential harassment of, or other adverse impacts to, threatened and endangered or protected species such as marine mammals, salmonids, and marbled murrelets; and
- Changed fish habitat conditions, including barriers to movement, loss of refugia, and degradation of foraging habitat.

Social Environment

The proposed action would represent a substantial economic benefit to the local and regional economy. This contribution would be in addition to spending on other military construction projects and activities in the region. Thus, judged cumulatively, there would be a considerable net economic benefit to the region.

The No-Action Alternative would make no additional contribution to cumulative impacts.

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CHAPTER 5

OTHER CONSIDERATIONS REQUIRED BY NEPA

5.0 OTHER CONSIDERATIONS REQUIRED BY NEPA

5.1 UNAVOIDABLE ADVERSE IMPACTS

The analysis presented in this EIS has identified the potential for adverse environmental impacts. Mitigation measures that would be implemented to either avoid or minimize these impacts have been identified. The adverse impacts that remain after implementing mitigation measures are considered to be unavoidable. These impacts include increased noise during construction and its effect on fish, wildlife, and humans; loss of eelgrass; changes to marine habitat conditions due to the placement of new overwater structures along the Bangor shoreline; and the loss of upland vegetation for roads (permanently), and for staging areas and utility work (temporarily).

The proposed action would cause short-term unavoidable impacts during construction, particularly with regard to pile driving activities. Pile driving would generate high levels of underwater noise and vibration, as well as airborne noise. These high sound levels would adversely impact fish, marine mammals, and other wildlife and would be unavoidable. Pile driving would increase turbidity on a localized basis.

Placement of piles would result in an unavoidable loss of eelgrass, which is important habitat for threatened species of juvenile salmon. Placement of piles would also result in the loss of soft-bottom habitat.

The new in-water structures would cause localized changes in water circulation, shading, nighttime lighting, and sediment transport and deposition, which would change habitat conditions for fish, marine mammals, benthic organisms, and marine vegetation. These changes would unavoidably impact the type and/or abundance of some species in the vicinity of the in-water structures, and in addition could impact their behavior. For example, the in-water structures may cause a partial barrier to juvenile salmon migration.

In the upland areas, a small wetland and a small area of shrub vegetation would be permanently lost for new roads and buildings. Forest vegetation would be temporarily lost for the construction laydown area, and would revert to pre-construction conditions (native conifer forest) following completion of construction and revegetation. There would be an unavoidable increase in the use of utilities and energy to support the project, as well as increased demand on the transportation system. Pile driving noise during construction would adversely impact residential areas and recreation on the western side of Hood Canal and adjacent to NBK at Bangor, and general construction noise at the site of the three new buildings would affect a nearby residential area. Openings of the Hood Canal Bridge for the passage of construction vessels would delay traffic flow across the bridge.

5.2 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND THE ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Pursuant to NEPA regulations (40 CFR 1502.16), an EIS must consider the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. Construction and operation of the EHW-2 under the proposed action would cause temporary and long-term impacts and use of natural resources. Construction impacts would include increased noise, air pollutant emissions, traffic, disturbance to fish and wildlife, and lost marine and upland vegetation, wetlands, and soft-bottom habitat, as well as some project benefits such as increased employment and income. Ongoing impacts from operations would include

increases in nighttime lighting, shading of marine vegetation, partial barriers to fish migration, energy use, and traffic, but there would also be some benefits, such as increased employment.

The proposed action would somewhat reduce long-term productivity of resources in the project area. For example, the EHW-2 would cause shading impacts for the life of the facility, which would reduce the primary productivity of marine vegetation, fish, plankton, and benthic organisms. It would remove a small wetland and small area of upland vegetation and reduce the available wildlife habitat in the area. The proposed Mitigation Action Plan (Appendix F) would be designed and implemented to compensate for the impacts of the selected alternative to marine habitats and species so that the proposed action would make a no net contribution to cumulative impacts.

5.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Section 102(c)(v) of NEPA requires that an EIS identify "any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented." Implementation of this action would involve commitment of a range of natural, physical, human, and fiscal resources.

Raw construction materials, such as cement, aggregate, wood, steel, water, fossil fuel, and labor, would be expended in constructing the EHW-2. Natural resources and labor would also be used to fabricate material and equipment that would be used in the facility. These materials and labor, as well as the expenditure of funds, would be irreversibly committed to the project. However, these types of construction materials and labor are not in short supply and their continued use would not adversely impact the availability of these resources.

Resources would continue to be consumed during operation. The project would require expenditure of capital, energy, and natural resources, such as water. These resources once consumed are lost permanently.

5.4 ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL

Construction and operation of the EHW-2 would result in an increase in energy demand over current conditions. Although the required energy demands would be met by the existing utility infrastructure on NBK at Bangor, energy requirements would be subject to any established energy conservation practices. The use of energy sources would be minimized wherever possible without compromising the safety or efficiency of operations.

5.5 NATURAL OR DEPLETABLE RESOURCE REQUIREMENTS AND CONSERVATION POTENTIAL

Resources that will be permanently and continually consumed by project implementation include water, electricity, natural gas, and fossil fuels. To the extent practicable, pollution prevention considerations are included. In addition, sustainable management practices are in place that protect and conserve natural and cultural resources.

5.6 REGULATORY COMPLIANCE

Implementation of the Navy's alternatives, including the Proposed Action for the EHW EIS, would not conflict with the objectives or requirements of federal, state, or local plans, policies, or legal requirements (Table 5–1). The Navy consulted with regulatory agencies as appropriate during the NEPA process and will continue consultation, where appropriate, during implementation of the Proposed Action to ensure requirements are met.

Table 5–1. Summary of Regulatory Compliance for the EHW-2

LAW OR REGULATION	RESPONSIBLE AGENCY	COMPLIANCE
National Environmental Policy Act	DoN	This EIS has been prepared in accordance with NEPA, CEQ regulations, and Navy NEPA regulations and procedures. Public participation and review is being conducted in compliance with NEPA.
Federal Water Pollution Control Act (Clean Water Act)	USACE, USEPA and WDOE	Through the JARPA process, the Navy has applied to USACE for a 404 permit for wetland impacts and the removal and fill material below the MHHW tidal level for the shoreline abutment, and a Section 401 Water Quality Certification from WDOE. The Navy will also apply for a Construction Stormwater Permit from the U.S. Environmental Protection Agency, Region 10.
Rivers and Harbors Act	USACE	Through the JARPA process, the Navy has applied to USACE for a permit under Section 10 of the Rivers and Harbors Act for the placement of new structures in navigable waters.
Endangered Species Act	NMFS and USFWS	The EIS analyzes potential effects on species listed under the ESA, and the Navy has submitted a biological assessment to NMFS and USFWS. In accordance with ESA requirements, the Navy completed consultation under Section 7 of the ESA with the USFWS and NMFS on the potential that implementation of the Proposed Action may affect, or is likely to adversely affect, listed species. However, following issuance of authorizations for marine mammals under the MMPA, NMFS may amend the ESA Biological Opinion to include an Incidental Take Statement for marine mammals.
Marine Mammal Protection Act	NMFS	For the first year of construction, the Navy submitted an application for an Incidental Harassment Authorization (IHA) to NMFS and is in consultation with NMFS in accordance with the MMPA. After public review, NMFS will issue an IHA for the first year of construction. The Navy will submit additional MMPA authorization application(s) for the subsequent years of construction.
Magnuson-Stevens Fishery Conservation and Management Act	NMFS	The Navy submitted an Essential Fish Habitat Assessment to NMFS and completed consultation with NMFS under the MSA.
Migratory Bird Treaty Act	USFWS	The Navy coordinated with USFWS and has determined that the proposed action would not adversely affect migratory birds under the MBTA.
Bald and Golden Eagle Protection Act	USFWS	The Navy coordinated with USFWS and has determined that the proposed action would not adversely affect bald and golden eagles under the Bald and Golden Eagle Protection Act.
Coastal Zone Management Act	NOAA and WDOE	The Navy submitted a Phase I Coastal Consistency Determination (CCD) to WDOE in compliance with the CZMA, stating that the proposed action is consistent to the maximum extent practicable with the enforceable policies of the Washington State coastal management program. WDOE issued a concurrence with the Navy's Phase I CCD. The Navy will submit a final, Phase II CCD to WDOE in spring 2012.
Clean Air Act	USEPA	This proposed action has been analyzed in accordance with the federal CAA and will comply with the criteria in Section 176(c) regarding General Conformity. Kitsap County is in attainment for all NAAQS and no conformity determination is required.

Table 5–1. Summary of Regulatory Compliance for the EHW-2 (continued)

LAW OR REGULATION	RESPONSIBLE AGENCY	COMPLIANCE
National Historic Preservation Act	SHPO	The Navy has concluded consultation with the SHPO regarding archaeological and architectural resources; SHPO concurred with the Navy's definition of the APE and finding of no adverse effect.
Executive Order 13175, Government-to-Government Consultation	DoN	The Navy has initiated and is currently conducting government-to-government consultation with potentially affected American Indian tribes concerning potential effects of the proposed action on protected tribal resources and rights.
Native American Graves Protection and Repatriation Act	DoN and SHPO	If the Navy were to encounter human remains, funerary objects, sacred objects, or objects of cultural patrimony as defined by NAGPRA, the Navy would comply with NAGPRA and Navy instructions, and consult with the SHPO, affected American Indian tribes, USACE, and other interested parties.
Energy Independence and Security Act, Section 438	DoN	The proposed action would maintain site hydrology to the maximum extent feasible and would consider the USEPA technical guidance for compliance with Section 438 of the EISA.
Executive Order 12898, Environmental Justice	DoN	Implementation of the Proposed Action would not result in any disproportionately high and adverse human health or environmental effects on minority or low income populations.
Executive Order 13045, Children's Health and Safety	DoN	Implementation of the Proposed Action would not result in disproportionate environmental health or safety risks to children.

CHAPTER 6

REFERENCES AND LISTS

6.0 REFERENCES AND LISTS

6.1 DISTRIBUTION LIST

Federal Agencies, Commissions, and Elected Officials

Marine Mammal Commission
National Oceanic and Atmospheric Administration
- National Marine Fisheries Services, Northwest Region
- Northwest Fisheries Science Center
- Office of Protected Resources

Pacific States Marine Fisheries Commission
U.S. Army Corps of Engineers, Seattle District
U.S. Coast Guard, District 13
U.S. Department of the Interior, Office of Environmental Policy & Compliance
U.S. Environmental Protection Agency
- NEPA Compliance Division
- Region 10
- Washington Operations Office

U.S. Fish & Wildlife Service, Western Washington Office
U.S Representatives
- District 1
- District 2
- District 6
- District 7
- District 8
- District 9

U.S. Senators

State Agencies and Elected Officials

Governors Office of Indian Affairs
Governors Office of Regulatory Assistance
Puget Sound Partnership
Washington Department of Archaeology & Historic Preservation
Washington State Department of Ecology
- Northwest Region
- Shorelands and Environmental Assistance Program

Washington State Department of Fish and Wildlife
- Headquarters
- Region 6

Washington State Department of Natural Resources
- Aquatics Shoreline District
- Olympic Region
- South Puget Sound Region

Washington State Office of the Attorney General
Washington State Office of Financial Management, Governor's Executive Policy Office

Washington State Office of the Governor
Washington State Office of the Lieutenant Governor
Washington State Parks Foundation
Washington State Representatives, District 11
Washington State Representatives, District 23
Washington State Representatives, District 24
Washington State Representatives, District 26
Washington State Representatives, District 27
Washington State Representatives, District 30
Washington State Representatives, District 31
Washington State Representatives, District 32
Washington State Representatives, District 33
Washington State Representatives, District 34
Washington State Representatives, District 35
Washington State Representatives, District 36
Washington State Representatives, District 37
Washington State Representatives, District 43
Washington State Representatives, District 46
Washington State Senator, District 11
Washington State Senator, District 23
Washington State Senator, District 24
Washington State Senator, District 24
Washington State Senator, District 26
Washington State Senator, District 27
Washington State Senator, District 30
Washington State Senator, District 31
Washington State Senator, District 32
Washington State Senator, District 33
Washington State Senator, District 34
Washington State Senator, District 35
Washington State Senator, District 36
Washington State Senator, District 37
Washington State Senator, District 43
Washington State Senator, District 46

Local Agencies and Elected Officials

Central Kitsap Community Council
Central Kitsap Fire and Rescue
City of Bainbridge Island
City of Bremerton
City of Port Townsend
City of Poulsbo
City of Seattle
Hood Canal Coordinating Council
Hood Canal Dissolved Oxygen Program
Jefferson County Commissioners

Jefferson County Department of Natural Resources
King County Council
Kitsap County Commissioners
Kitsap County Community Development
Kitsap Regional Coordinating Council
Mason County Commissioners
Northwest Straits Commission

Native American Tribes and Organizations

Jamestown S'Klallam Tribe
Lower Elwha Klallam Tribe
Northwest Indian Fisheries Commission
Point No Point Treaty Council
Port Gamble S'Klallam Tribe
Skokomish Tribe
Suquamish Tribe

Organizations

41st Demo./Peace Action of Washington
Audubon Washington
Center for Biological Diversity
Center for Whale Research
Citizens for Overt Action
Defenders of Wildlife, Northwest Office
Earth Justice Northwest Office
Earth Share Washington
Fellowship for Reconciliation/Peace Action of Washington
Forterra
Great Peninsula Conservancy
Ground Zero Center for Nonviolent Action
Hood Canal Environmental Council
Hood Canal Salmon Enhancement Group
Kitsap Peninsula Visitors and Convention Bureau
Lake Forest Park for Peace; Ground Zero Center for Nonviolent Action
Long Live the Kings
Marine Conservation Biology Institute
Marine Exchange of Puget Sound
National Wildlife Federation
Natural Resources Defense Council
Nature Conservancy Washington Field Office
Navy League of the United States, Bremerton-Olympic Peninsula Council
Navy League of the United States, Seattle Council
North Kitsap Trails Association
North Olympic Salmon Coalition
Northwest Environmental Defense Center

Ocacker/Peace Action of Washington
Ocean Advocates; Friends of the Earth
Orca Network
Pacific Fishery Management Council
Pacific Northwest National Laboratory, Marine Sciences Lab
Pacific Northwest National Laboratory, Seattle Research Center
Peace Action of Washington
People for Puget Sound
Physicians for Social Responsibility
Port Townsend Peace Movement
Presbytery of San Jose/Peace Action of Washington
Preserve Our Islands
Public Employees for Environmental Responsibility
Quaker Church/Peace Action of Washington
Retired Public Employees, PSARA (retired Americans)/Peace Action of Washington
Save Our Wild Salmon
Seward Park Environmental & Audubon Center
Sierra Club Cascade Chapter
Sound Non Violent Opponents of War/Peace Action of Washington
South Sound Orca Advocates
University of Washington, College of Engineering
University of Washington, Program on the Environment
Veterans for Peace, Port Townsend Chapter
Washington Foundation for the Environment
Washington Sea Grant Program
Washington Water Trails Association
West Sound Conservation Council
Wild Fish Conservancy
Women in Black - Bainbridge

Libraries

Jefferson County Library
Kitsap Regional Library – Poulsbo Branch
Kitsap Regional Library – Silverdale
Kitsap Regional Library – Sylvan Way Branch
Port Townsend Public Library
Seattle Public Library – Central

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Darcy Rue
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Jeriene Walberg
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Beverly Webber
Anthony Wente
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Caroline Wildflower
Marian Wineman
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Jan Wold
Kathleen Wolfe
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Barbara Wood
Hardy Wood
Martha Worthley
David Wright
Isabella Wylde
Bill Yake
David Yao
William Young
Angeline Zalben
Heidi Zamzow
Ashley Zorrozua

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