INCIDENTAL HARASSMENT AUTHORIZATION APPLICATION FOR THE U.S. NAVY BARGE MOORING PROJECT CONDUCTED ON NAVAL BASE KITSAP, BANGOR

Submitted to:

Office of Protected Resources,

National Marine Fisheries Service,

National Oceanographic and Atmospheric Administration

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For:

Naval Base Kitsap, Bangor and Commander Submarine Development Squadron Five

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ACRONYMS AND ABBREVIATIONS

BSS	Beaufort Sea State
°C	Celsius
CA	California
CFR	Code of Federal Regulations
CSDS-5	Commander submarine Development Squadron Five
CV	Coefficient of Variation
dB	Decibel
dBA	Decibel with A-weighting filter
DPS	Distinct Population Segment
DO	Dissolved Oxygen
DoN	Department of the Navy
EEZ	Exclusive Economic Zone
EHW-1	Explosive Handling Wharf #1
ESA	Endangered Species Act
°F	Fahrenheit
Ft	Feet
HCDOP	Hood Canal Dissolved Oxygen Program
Hz	Hertz
IHA	Incidental Harassment Authorization
kHz	Kilohertz
kg	Kilogram
km	Kilometer
km^2	Square kilometers
lbs	Pounds
m	Meter
mg/L	Milligrams per Liter
MLLW	Mean Lower Low Water
MMPA	Marine Mammal Protection Act
ms	Millisecond
Navy	U.S. Navy
NAVBASE Kitsap	Naval Base Kitsap
NMFS	National Marine Fisheries Service
OR	Oregon
Pa	Pascal
PTS	Permanent threshold Shift
PSU	Practical Salinity Units
RMS	Root Mean Square
SEL	Sound Exposure Level
SPL	Sound Pressure Level

Sq	Square
TL	Transmission Loss
TS	Threshold Shift
TTS	Temporary Threshold Shift
TRIDENT	Trident Fleet Ballistic Missile
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
°W	West
WA	Washington
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDOE	Washington Department of Ecology
WSDOT	Washington State Department of Transportation
ZOI	Zone of Influence
µPa	Micropascal

EXECUTIVE SUMMARY

The U.S. Navy is applying for an Incidental Harassment Authorization under the Marine Mammal Protection Act of 1972, as amended, to initiate the Barge Mooring Project on Naval Base Kitsap, Bangor. The Navy proposes to replace an existing research barge at the Service Pier in order to support the mission and operations of Commander, Submarine Development Squadron Five.

The proposed action includes vibratory installation of up to 20 hollow steel piles ranging in diameter from 20 inches to 48 inches. The 36-inch diameter and 48-inch diameter piles will be used to moor the new 260-foot by 85-foot barge, which will replace a 115-foot by 35-foot barge currently located at the Service Pier. In order to allow space for the larger barge, existing floating pier sections used by Port Operations will be relocated to the opposite side of the Service Pier trestle. Additional floating sections will be attached and supported by 24-inch diameter steel piles. 20-inch diameter piles will be used to support a 12' ft x 16' ft electrical transformer platform.

Existing infrastructure not needed to support the new Service Pier configuration will be removed. This includes a gangway, fenders, pedestals, and a mooring dolphin. The mooring dolphin consists of a concrete platform supported by eight 24 to 30-inch diameter steel piles. The platform will be carefully cut into sections and removed. One 24-inch steel pile will be removed using vibratory pile driving equipment. The remaining piles will be cut off at the mudline and extracted.

The duration of the in-water construction activities is expected to be eight weeks and will occur between July 16 and September 30, 2013.

Seven species of marine mammals may be present at various times of the year within the waters surrounding Naval Base Kitsap, Bangor: the humpback whale (*Megaptera novaeangliae*), Steller sea lion (*Eumetopias jubatus*), the California sea lion (*Zalophus californianus*), the harbor seal (*Phoca vitulina*), the transient killer whale (*Orcinus orca*), the Dall's porpoise (*Phocoenoides dalli*), and the harbor porpoise (*Phocoena phocoena*). With the exception of the Steller and California sea lion, these species may occur year-round in Hood Canal, though Dall's porpoise and transient killer whales are only rarely sighted. Humpback whale sightings are extremely rare. The Steller sea lion is only present from October through May, and the California sea lion is only present from August to early June. While transient killer whales have been observed in Hood Canal occasionally, the Southern Resident killer whale stock (listed under the Federal Endangered Species Act), has not been observed in Hood Canal in over 15 years and was therefore excluded from further analysis. Individuals of the species potentially present during the project timeline could potentially be exposed to sound pressure levels associated with impact and vibratory pile driving.

The National Marine Fisheries Service has promulgated threshold criteria for assessing potential impacts to marine mammals potentially exposed to sound pressure levels during pile driving. Vibratory and impact pile installation can produce underwater noise levels at or above the threshold level for continuous and pulsed noise. The Navy modeled sound propagation from these sources based on empirically measured source levels to estimate the area above the thresholds where marine mammals may be exposed. Predicted exposures of marine mammals within each of the affected areas were calculated using estimated marine mammal densities. The modeling predicted no Level A (injury) harassments would occur from project activities. Level B harassments could occur during pile installation due to elevated underwater sound levels. Estimated potential exposures for each species potentially present are listed in the table below. No incidents of harassment were predicted from airborne sounds or any other construction activities. Conservative assumptions (including marine mammal densities) used to estimate the exposures likely overestimate the potential number of exposures. In addition, mitigation measures are proposed to limit exposure of marine mammals and their prey resources to potential project impacts.

Table ES-1: Summary of Estimated Level B Exposures by Species (July 16 through September 30, 2013)

Species	Potential Exposure to Disturbance Threshold (120dB re 20 µPa)
Humpback Whale	0
Steller Sea Lion	0
California Sea Lion	660
Harbor Seal	341
Transient Killer Whale	120
Dall's Porpoise	0
Harbor Porpoise	40
Total	**1,161**

Pursuant to the Marine Mammal Protection Act Section 101(a)(5)(D),[1] the Navy submits this application to the National Marine Fisheries Service for an Incidental Harassment Authorization for the incidental, but not intentional, taking of four marine mammal species during pile removal and installation activities as part of the Barge Mooring Project from July 16, 2013 through September 30, 2013. The number of potential exposures requested per species is listed in the above table. The taking would be in the form of non-lethal, temporary harassment and is expected to have a negligible impact on individuals and populations of these species. In addition, the taking would not have an unmitigatable adverse impact on the availability of these species for subsistence use.

[1] 16 U.S.C. § 1371(a)(5); 50 C.F.R. Part 216, Subpart I.

1 DESCRIPTION OF ACTIVITIES

A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals.

1.1 Introduction

Naval Base (NAVBASE) Kitsap, Bangor, Washington (Figure 1-1), provides berthing and support services to U.S. Navy (Navy) submarines and other fleet assets. Commander Submarine Development Squadron Five (CSDS-5) is a tenant command on NAVBASE Kitsap, Bangor and is the working repository for deep ocean technology and operational, at-sea application of that technology. CSDS-5 currently moors and operates a research barge at the Service Pier on NAVBASE Kitsap, Bangor and is proposing to install mooring for a new larger research barge equipped with upgraded technology necessary for continuing the Navy mission.

CSDS-5 currently conducts research equipment operations from an existing 115-foot (ft) by 35-ft barge with a 4-ft draft that was constructed in 1940 and cannot accommodate the new research equipment. A new larger barge measuring 260 ft by 85 ft with a 10-ft draft will replace the existing barge. Activities associated with the project include the removal of an existing mooring dolphin, the relocation and addition of floating pier sections, and the installation of up to 20 steel piles to support the barge, electrical transformer platform, and relocated pier sections. The current and proposed barge mooring locations are shown in Figure 1-2. The project will occur between July 16, 2013 and September 30, 2013.

Under Section 101 (a)(5)(D) of the Marine Mammal Protection Act (MMPA) of 1972, as amended in 1994, an Incidental Harassment Authorization (IHA) is requested from the National Marine Fisheries Service (NMFS) to the Navy for activities that have the potential to affect small numbers of marine mammals in the waterways adjacent to NAVBASE Kitsap, Bangor through behavioral harassment incidental to activities conducted during the project. The proposed project activities that could potentially result in behavioral harassment to marine mammals are the vibratory and impact installation of steel piles. Sections 1.2 and 1.3 describe the proposed activities in detail.

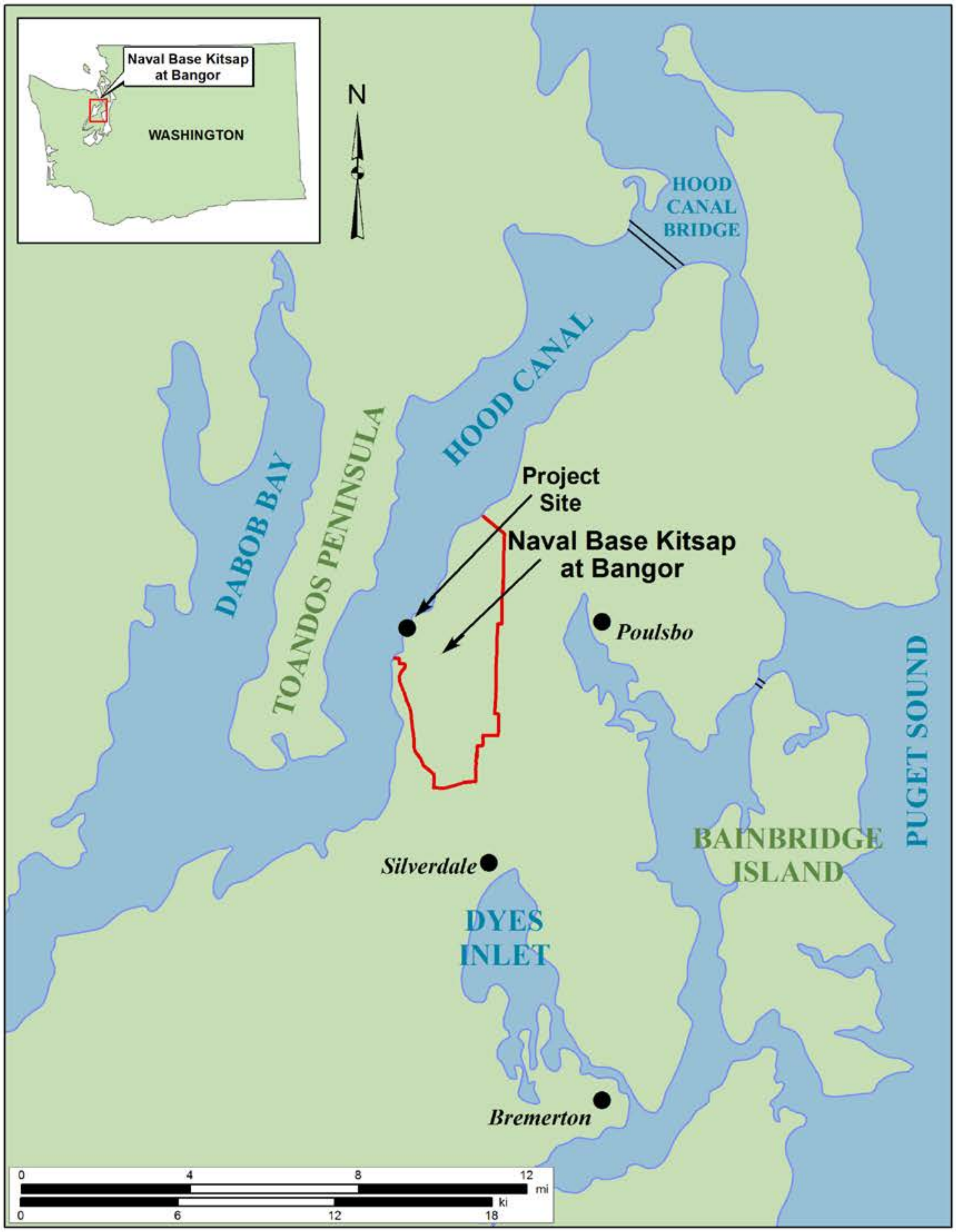


Figure 1-1: Naval Base Kitsap, Bangor Vicinity Map

Figure 1-2: Proposed Project Area

1.2 Proposed Action

The project consists of three components: the relocation and addition to the Port Operations pier, the removal of existing infrastructure, and the installation of the CSDS-5 research barge mooring piles. Each element is described below. The duration of the Barge Mooring Project is expected to be approximately eight weeks (40 workdays) and would occur between July 16 and September 30, 2013.

1.2.1 Relocation of Port Operations

In order to accommodate the new, larger CSDS-5 research barge, some portions of the Port Operations floating pier would be relocated to the south side of the Service Pier trestle[2]. This would require removing six 9-ft by 12-ft floating pier sections/modules running east-west on the north side of the trestle and placing them in a north-south orientation on the south side of the trestle. In addition, seven new modules (five added to the end of the relocated section and two installed in an east-west orientation) would be installed to complete the Port Operations infrastructure (Figure 1-3). Anchoring of the relocated and new floating pier modules would require the installation of three 24-inch diameter hollow steel pipe piles. Additionally, four 20-inch diameter piles would be installed to support a 12' ft x 16' ft electrical transformer platform.

1.2.2 Removal of Existing Infrastructure

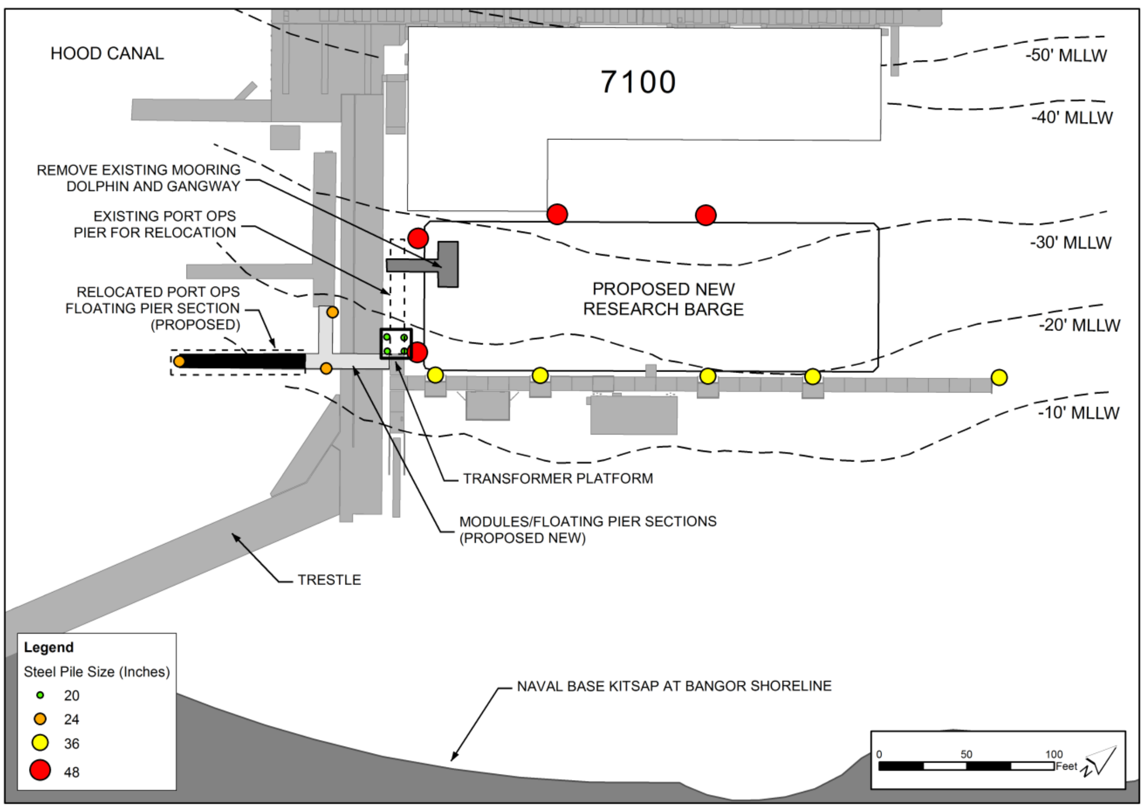
Existing infrastructure to be removed in order to accommodate the new barge includes the following (Figure 1-3):

- Mooring dolphin and concrete pile cap (Figure 1-4) located north of the proposed relocated floating pier modules. This includes the removal of six 24-inch diameter steel batter piles and two 30-inch diameter steel vertical piles;
  - The concrete pile cap would be carefully separated and removed from the pile dolphin.
  - One 24-inch steel pile would be removed with the use of vibratory pile driving equipment
  - The remaining piles would be removed by cutting them down at the mudline with hydraulic shears or by a diver utilizing a thermal lance, and lifting them out of the water for proper disposal.
- Gangway from the mooring dolphin (planned for removal) that crosses over the proposed relocated floating pier models.
- Fenders and two electrical pedestals located on existing Port Operations dock.

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

1.2.3 Installation of the Barge Mooring Piles

The new 260-ft by 85-ft research barge will be located at the east side of the Service Pier at approximately -20 to -30 ft mean lower low water (MLLW) (Figure 1-3). The barge will be moored by five 36-inch diameter and up to eight 48-inch diameter hollow steel pipe piles. This is a conservative estimate of the number of piles that will be needed to ensure some flexibility is maintained for the final design. Figure 1-3 shows the current design plan for barge mooring, which includes only four 48-inch steel piles. Table 1-1 shows the maximum number of piles that could be required to complete the entire project.



Site Plan of Proposed Barge Mooring Project

Figure 1-3: Site Plan of Proposed Barge Mooring Project

Figure 1-4: Mooring Dolphin with Concrete Pile Cap and Gangway Planned for Removal

Table 1-1: Total Number of Piles Required to Complete the Barge Mooring Project

Pile Size	**Total Number of Piles Required to be Installed**
20-inch diameter	4
24-inch diameter	3
36-inch diameter	5
48-inch diameter	8*
Total piles	20

*The current design requires only 16 piles; however, 20 piles (up to four additional 48-inch diameter piles) are being included in this IHA to allow for changes in the final design.

1.3 Description of Pile Installation

The project activities expected to result in the incidental harassment of marine mammals are pile installation and vibratory extraction. All piles will be installed/removed at the eastern side of the Service Pier and will include:

- Four 20-inch diameter steel pipe piles approximately 100 feet (30.48 meters) long will be driven to depth of 55 feet,
- Three 24-inch diameter steel pipe piles approximately 60 feet (18.29 meters) long will be driven to depth of 34 feet,
- Five 36-inch diameter steel pipe piles approximately 100 feet (30.48 meters) long will be driven to depth of 55 feet, and
- Eight 48-inch diameter steel pipe piles approximately 115 feet (35.05 meters) long will be driven to depth of 70 feet.
- One 24-inch diameter steel pipe will be removed using vibratory pile driving equipment.

It is anticipated that up to four piles can be driven per day. The total number of days for both extraction and installation are not likely to exceed 20 workdays. Pile driving work will begin on or shortly after July 16 with anticipated completion by September 30.

Piles will be installed using mainly vibratory pile driving. Vibratory pile driving involves hydraulic-powered weights to vibrate a pile until the surrounding sediment liquefies, enabling the weight of the pile plus the pile driver to push the pile into the ground.

During pile installation, some piles may be driven (proofed[3]) the final few feet with an impact hammer to ensure load bearing capacity or if substrate conditions do not allow the pile to reach the specified tip elevation with a vibratory driver. An impact hammer uses a rising and falling piston to repeatedly strike a pile and drive it into the ground. The total days of impact pile driving is not anticipated to exceed 20 days and no more than four piles will be installed in a given day. It is expected that 500 strikes will be necessary per pile, resulting in approximately 2,000 strikes per day. All piles driven with an impact hammer will be surrounded by a bubble curtain or other sound attenuation device over the full water column to minimize in-water noise. The Navy will monitor the presence and behavior of marine mammals during the impact and vibratory installation and vibratory removal[4] of piles. Section 11 provides the details proposed to reduce or mitigate the potential project impacts.

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[3] "Proofing" is driving the pile the last few feet into the substrate to determine the capacity of the pile. The capacity during proofing is established by measuring the resistance of the pile to a hammer that has a piston with a known weight and stroke (distance the hammer rises and falls) so that the energy on top of the pile can be calculated. The blow count in "blows per inch" is measured to verify resistance, and pile compression capacities are calculated using a known formula.

[4] The vibratory removal and impact and vibratory installation of piles is collectively referred to as pile driving throughout this document.

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2 LOCATION, DATES AND DURATION OF ACTIVITIES

The dates and duration of such activity and the specific geographical region where it will occur.

2.1 Dates and Duration of Construction

The proposed action will occur between July 16 and September 30 of 2013. No work will begin on the proposed action until all required permits and approvals are in place. In-water construction, including vibratory pile installation, proofing, structural removal, and float relocation and installation will likely begin on July 16 or shortly after, and will last approximately 8 weeks. Pile driving will be concluded by September 30, 2013.

Steel pile installation will occur at maximum rate of four piles per day. For each pile installed, the driving time is expected to be 15 minutes per pile for the vibratory portion of the project, resulting in approximately one hour of vibratory driving each day. The impact-driving portion of the project is anticipated to take approximately 25-40 minutes each day.

Construction activities will occur up to 6 days per week between 2 hours after sunrise and 2 hours before sunset to protect foraging murrelets. There will be approximately 20 total pile-driving work days, and work would begin on July 16 with the entire project completed by the end of September.

2.2 Region of Activity

NAVBASE Kitsap, Bangor is located on the Hood Canal in Kitsap County, approximately 20 miles west of Seattle, Washington (Figure 2-1). The Service Pier is located along the eastern shoreline of Hood Canal. The entirety of NAVBASE Kitsap, Bangor, including the land areas and adjacent water areas in the Hood Canal, is restricted from general public access (Figure 2-2).

The Hood Canal is a long, narrow fjord-like basin of the western Puget Sound. Throughout its 67-mile length, the width of the canal varies from one to two miles and exhibits strong depth/elevation gradients and irregular seafloor topography in many areas. 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 the northern Hood Canal. The Project Area is located within this region.

2.3 Activity Area Description

2.3.1 Bathymetric Setting

In the northern Hood Canal, water depths in the center of the waterway near Admiralty Inlet vary between 300 to 420 feet. As the canal extends southwestward toward the Olympic Mountain Range and Thorndyke Bay, water depths shoal to approximately 160 feet over a moraine deposit. This deposit forms a sill across the short axis of the canal near Thorndyke Bay, which has an important impact on deep circulation and seawater exchange. The width of the canal is approximately 2.2 miles at the northern end of NAVBASE Kitsap, Bangor and constricts to approximately 1.1 miles at the southern end near Hazel Point. The NAVBASE Kitsap, Bangor waterfront occupies approximately five 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.

Figure 2-1: Map of the Surrounding Vicinity

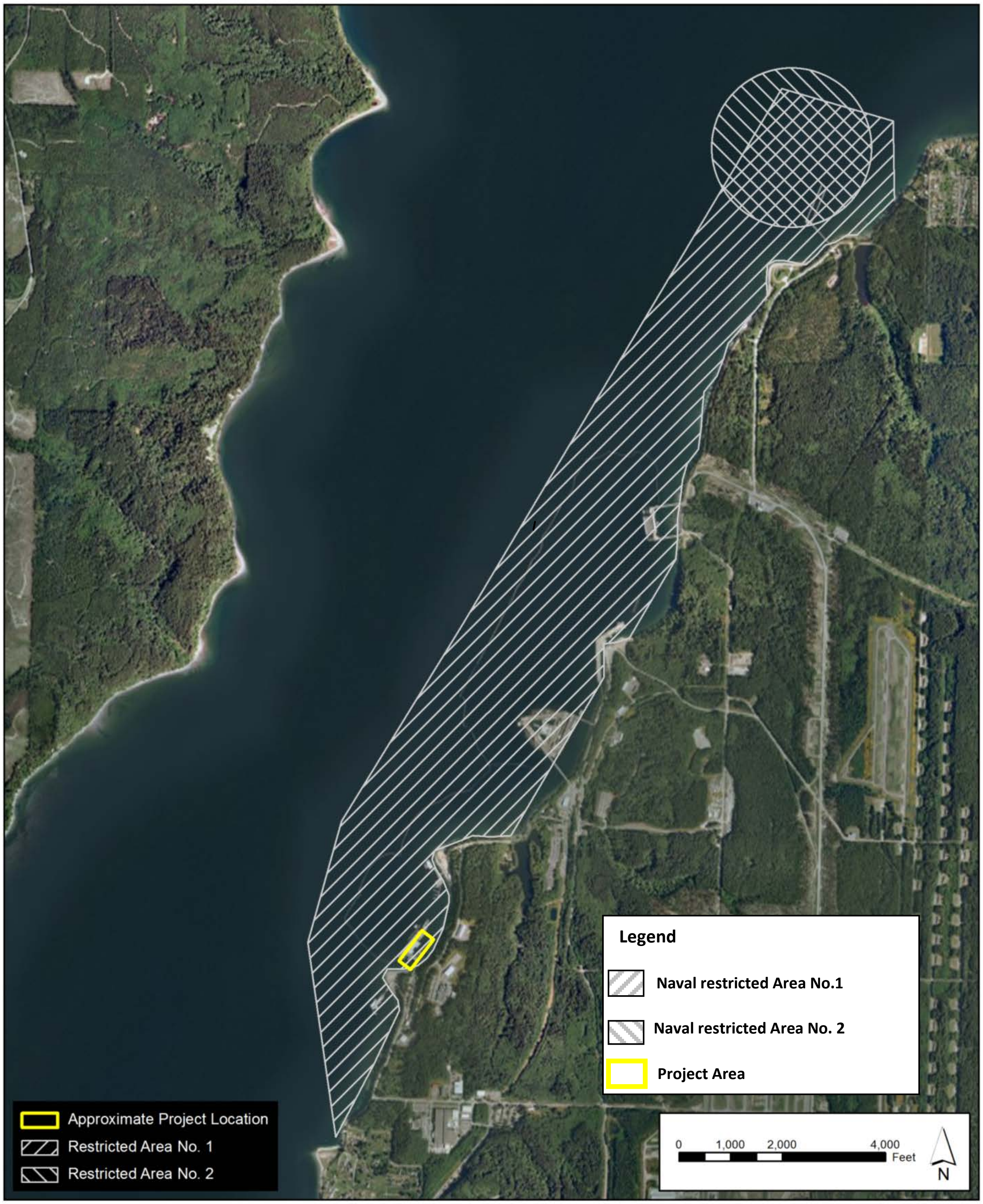

Figure 2-2: Restricted Areas on NAVBASE Kitsap, Bangor

2.3.2 Tides

The tides in Hood Canal are mixed, diurnal-semidiurnal with a range directly dependent upon the phase and alignment of the lunar and solar gravitational influences on the regional tides (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 to semi-diurnal, this body of water is subject to one major flushing event per tide day when approximately 1.1326 by 10^9 cubic yards (or 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.

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 NAVBASE Kitsap, Bangor waterfront area. As a result, the degree of flushing that occurs at the Project Area is relatively high and the characteristics of this seawater more closely track the physical, chemical, and biological conditions of Puget Sound than southern Hood Canal.

2.3.3 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). 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. Seawater entering 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.

Current flow (speed and direction) at the Project Area 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 Project Area are variable and complex. The magnitude or instantaneous velocity of these fluctuating water column currents range from 0 to 0.88 feet/second within the 30- to 65-foot water depth interval. 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 feet/second) exists to exceed the threshold for re-suspending 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 feet/second range in the upper water column and less than 0.03 feet/second in proximity to the seafloor.

The nearshore current observations at the Project Area and other NAVBASE Kitsap, 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 Project Area align 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).

2.3.4 Sea State

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 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.

The Project Area is also afforded some protection by the coastline of both Kitsap and Toandos Peninsula. The maximum fetch between the Project Area and the north shore of Thorndyke Bay to the north-northeast indicate that a 20-knot sustained wind has the capability to generate average wave heights of 1.9 feet (Beaufort Sea State [BSS] of 2) and a 30-knot wind event could produce wave heights of 3.1 feet (BSS = 3) (CERC 1984). The maximum fetch to the southwest could yield average waves of 1.3 feet in height (BSS = 2) in a 20-knot wind and 1.9 feet (BSS =2) in a 30-knot wind. Maximum wave heights during these weather conditions could 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 (BSS = 3) could also yield waves with maximum heights of 5.1 feet (BSS = 4) (CERC 1984).

2.3.5 Water Temperature

Water temperatures 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 (1 to 2 weeks). Monthly mean water temperatures along the NAVBASE Kitsap, Bangor waterfront are summarized in Table 2-1. Nearshore areas (water depths range from 1-30 m) are susceptible to greater temperature variations due to seasonal fluxes in solar radiation input.

Table 2-1: Monthly Mean Surface Water Temperatures (°C/°F)

SAMPLING MONTH (2005, 2006)[1]	NEARSHORE TEMPERATURE	OFFSHORE TEMPERATURE
July 2005	14.3°C (57.8°F)	11.6°C (52.9°F)
August 2005	13.8°C (56.8°F)	13.5°C (56.3°F)
September 2005	14.9°C (58.8°F)	11.6°C (52.9°F)
January 2006	8.2°C (46.8°F)	---
February 2006	8.1°C (46.6°F)	---
March 2006	8.5°C (47.3°F)	8.3°C (46.9°F)
April 2006	9.6°C (49.3°F)	9.3°C (48.7°F)
May 2006	10.9°C (51.6°F)	11.0°C (51.8°F)
June 2006	13.2°C (55.8°F)	---

Source: Phillips et al. 2009. Data are from 13 nearshore and 4 offshore stations along the Naval Base Kitsap, Bangor waterfront. --- No data were collected at this depth during this sampling month.

2.3.6 Dissolved Oxygen

Concentrations of dissolved oxygen (DO) in extraordinary quality marine surface waters should exceed 7.0 mg/L of DO, allowing for only 0.2 mg/L reductions in the natural condition by human-caused activities (Washington Administrative Code 173-201A). According to the WDOE Marine Water Quality Report for 1998 to 2000, fish are negatively affected by DO concentrations of less than 4.5 mg/L (Newton et al. 2002). 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). The 2008 Clean Water Act Section 303(d) list, the most recent list approved by the U.S. Environmental Protection Agency (USEPA), includes five segments within northern Hood Canal impaired by low DO levels (WDOE 2009). Two of these segments are located along the NAVBASE Kitsap, Bangor waterfront. The low DO for both of those segments is believed to be due to or influenced by human actions (WDOE 2009). However, these stations are offshore in deep water and would not necessarily be representative of nearshore conditions on the NAVBASE Kitsap, Bangor waterfront.

Although some waters along the NAVBASE Kitsap, Bangor waterfront are on the 303(d) list, mean DO measurements during July 2005 through June 2006 indicate that nearshore stations on the NAVBASE Kitsap, Bangor waterfront consistently met extraordinary quality standards for DO. From July 2005 through June 2006 and January 2007 through April 2008, DO levels met the extraordinary standard for surface waters (0 to 20 feet in depth) year round and for deep water (66 to 197 feet in depth) most of the year (deeper waters can drop to only a fair standard for DO in late summer). In late summer-early fall, DO levels in the action area drop from typical ranges of approximately 6 to 10 mg/L to a range of 4.7 to 9.1 mg/L (Phillips et al. 2009). The variation in mean DO measurements for deeper waters (66 to 197 feet in depth) near the project site was consistent with DO patterns within the rest of Hood Canal. During the late summer and early fall period (July through September 2005), mean DO measurements met fair to excellent quality standards.

At 66 to 197 feet in depth, these measurements are on the upper range of low DO conditions measured historically throughout Hood Canal during the late summer and fall periods (Warner 2007). Mean DO measurements at 66 to 197 feet in depth from March through May 2006 met Extraordinary Quality standards.

2.3.7 Stratification and Salinity

The waters of Hood Canal surrounding the Project Area are stratified, with less saline, warmer water overlying colder, more saline bottom waters. 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).

Freshwater input into Hood Canal comes from creeks, rivers, groundwater (including artesian wells [deep underground aquifer]), and stormwater outfalls. The freshwater inputs affect the salinity in Hood Canal. 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 NAVBASE Kitsap, 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 water quality surveys from 2005 through 2008, average surface water salinity levels along the NAVBASE Kitsap, Bangor waterfront ranged from 24 to 34 practical salinity units (PSU) (Phillips et al. 2009). Salinity measurements with depth reflected a stratified water column, with less saline surface water overlying cooler saline water at depth. The transition between the lower salinity surface waters and higher salinity subsurface waters occurred at a depth of about 33 feet (Phillips et al. 2009). The lowest surface water salinity (18.47 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 of salinity along the NAVBASE Kitsap, Bangor waterfront is typical for marine waters in Puget Sound (Newton et al. 1998, 2002).

2.3.8 Sediments

Existing sediment information is based on results from sampling near the Project Area during 2007 (Hammermeister and Hafner 2009). Sediment quality at the project site is generally good; levels of contaminants meet applicable state standards. 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 mudline in the intertidal zone, increasing to over 10 feet in the subtidal zone (URS 1994). The composition of sediment samples from the Project Area ranged from 65 to 100 percent for sand, less than 1 to 7 percent for gravel, 2 to 32 percent silt, and 2 to 11 percent clay.

2.3.9 Ambient Noise

Ambient noise by definition is background noise that does not have a single source or point (Richardson et al. 1995). Ambient noise varies with location, season, time of day, and frequency. Ambient noise is continuous, but with much variability on time scales ranging from less than one second to one year (Richardson et al. 1995). Ambient underwater noise is widely variable over time due to a number of natural and anthropogenic sources. Sources of naturally occurring underwater noise include wind, waves, precipitation, and biological noise (such as shrimp, fish, and cetaceans). There is also human generated noise from ship or boat traffic and other mechanical means (Urick 1983). 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.

Underwater ambient noise measurements taken approximately 1.85 miles from the project area at the Explosives Handling Wharf during the recent Test Pile Program project ranged from 112.4 decibels dB re 1µPa rms between 50 Hz and 20 kHz at mid depth to 114.3 dB at deep depth (Illingworth & Rodkin 2012). In 2009, the average broadband ambient underwater noise levels were measured at 114 dB re 1µPa between 100 Hz and 20 kHz (Slater 2009). 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.

Underwater broadband noise levels measured at the Project Area, 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. For the purposes of further noise analyses, the average background underwater noise levels at the Project Area were considered to be 114 dB rms re 1µPa between 100 hertz (Hz) and 20 kilohertz (kHz).

Airborne noise levels on NAVBASE Kitsap, 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 daytime hours (Cavanaugh and Tocci 1998). Airborne sound measurements were taken during a two-day period in October 2010 within the waterfront industrial area near the project site (Navy 2010a). 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. 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. These maximum noise levels are intermittent in nature and not present at all times. Existing maximum baseline noise conditions at the waterfront during a typical workweek are expected to be approximately 80 to 104 dBA 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. 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.

3 MARINE MAMMAL SPECIES AND NUMBERS

The species and numbers of marine mammals likely to be found within the activity area.

Seven marine mammal species, four cetaceans and three pinnipeds, have been historically documented in the waters near NAVBASE Kitsap, Bangor in Hood Canal. These include the humpback whale, transient killer whale, Dall's porpoise, harbor porpoise, Steller sea lion, California sea lion, and the harbor seal. One humpback whale was documented in Hood Canal during January and February 2012, over a period of several weeks. While present seasonally on NAVBASE Kitsap, Bangor, the Steller sea lion has not been documented in the project area during the project timeframe. The Southern Resident killer whale is resident to the inland waters of Washington State and British Columbia, it has not been observed in the Hood Canal in over 15 years, and therefore was excluded from further analysis. The Steller sea lion and humpback whale are listed under the Endangered Species Act (ESA). The U.S. Eastern stock/Distinct Population Segment (DPS) of Steller sea lion is listed as threatened. The humpback whale is listed as endangered. All marine mammal species are protected under the MMPA. Section 3 summarizes the population status and abundance of these species, while Section 4 contains detailed life history information. Table 3-1 lists the marine mammal species that occur near NAVBASE Kitsap, Bangor and their estimated densities within the Project Area. The densities were derived using the best available data.

Table 3-1: Marine Mammals Historically Sighted in Hood Canal near NAVBASE Kitsap, Bangor

Species	Stock(s) Abundance [1]	Potential Season(s) of Occurrence	Relative Occurrence [a]	Density (Individuals/ sq km [b]) during Project Timeframe [c]
Humpback Whale *Megaptera novaeangliae* CA/OR/WA stock	2,043[3] (CV=0.10)	Year-round in Puget Sound	Rare	0.000001
Steller sea lion *Eumetopias jubatus* Eastern U.S. stock/DPS	58,334–72,223 [2]	October-May	Seasonal	0.000
California sea lion *Zalophus californianus* U.S. stock	238,000 [3]	August-early June	Seasonal	0.28
Harbor seal *Phoca vitulina* WA inland waters stock	14,612 [3] (CV=0.15)	Year-round; resident species in Hood Canal	Likely	1.06
Killer whale *Orcinus orca* West Coast transient stock	354[2, d]	Year-round	Rare	0.001914
Dall's porpoise *Phocoenoides dalli* CA/OR/WA stock	42,000 [3] (CV=0.33	Year-round	Rare	0.000001
Harbor porpoise *Phocoena phocoena* WA inland waters stock	10,682[3] (CV=0.38)	Year-round	Likely	0.149000

Sources: 1. NMFS marine mammal stock assessment reports at: http://www.nmfs.noaa.gov/pr/sars/species.htm;
2. Allen and Angliss 2011; 3. Carretta et al. 2011.

a. RARE: There are a few confirmed sightings, or the distribution of the species is near enough to the area of concern that the species could occur there. The species may occur but only infrequently or in small numbers. LIKELY: Confirmed and regular sightings of the species in the area of concern year-round. SEASONAL: Confirmed and regular sightings of the species in the area of concern on a seasonal basis.
b. See density calculations in Section 6.7.
c. In-water work season is the period from July 16– September 30.
d. Combined catalog counts for West Coast stock.
CA = California; CV = coefficient of variation; OR = Oregon; WA = Washington

The harbor seal is an abundant year-round resident of Hood Canal. The cetacean species (humpback whale, killer whale, Dall's porpoise, and harbor porpoise), although either rarely or likely present, may be encountered in any season (Table 3–1). The two sea lion species have seasonal peaks of abundance in Hood Canal. The Steller sea lion use of Hood Canal extends from the end of September through May. The Steller sea lion appears consistently during those times in small numbers (maximum number observed was six individuals). California sea lions observed on NAVBASE Kitsap, Bangor are adult and sub-adult males from the California breeding population that spend the non-breeding season in the Pacific Northwest. The species has been observed at haulout locations on NAVBASE Kitsap, Bangor from August to early June.

3.1 ESA-Listed Marine Mammals

3.1.1 Humpback Whale

Species Description

The humpback whale is a large baleen whale with a worldwide distribution in all ocean basins, although it is less common in Arctic waters (Angliss and Outlaw 2005). In the summer, most humpback whales are found in high latitude or highly biologically productive feeding grounds. In the winter, they congregate in subtropical or tropical waters for mating.

The stock structure of humpback whales is defined based on feeding areas because distinct populations have a high degree of fidelity to specific feeding areas. Carretta et al. (2011) described distinct feeding populations in the eastern Pacific, and the waters off northern Washington may be an area of mixing between the California (CA)/Oregon (OR)/Washington (WA) stock and southern British Columbia/Alaska stock or whales in northern Washington and southern British Columbia may be a distinct feeding population and a separate stock.

Population Abundance

Humpback whales are increasing in abundance in much of their range, including the CA/OR/WA stock (NMFS 2012). Carretta et al. (2011) reported the best estimate for the CA/OR/WA stock is 2,043 (coefficient of variation = 0.10) based on mark-recapture estimated by Calambokidis et al. (2009). However, this estimate excludes some whales in Washington. Population trends from mark-recapture estimates have shown an overall long-term increase of approximately 7.5 percent per year for the California/Oregon Washington stock (Calambokidis 2009).

3.1.2 Steller Sea Lion

Species Description

Steller sea lions are the largest members of the Otariid (eared seal) family. Steller sea lions show marked sexual dimorphism, in which adult males are noticeably larger and have distinct coloration patterns from females. Males average approximately 1,500 pounds and 10 feet in length; females average about 700 pounds and 8 feet in length. Adult females have a tawny to silver-colored pelt. Males are characterized by dark, dense fur around their necks that appears like a mane and light tawny coloring over the rest of their body (NMFS 2008a).

Population Abundance

The eastern DPS of Steller sea lions includes the species distribution east of 144°W longitude (Loughlin 1997), including southeast Alaska, Canada, Washington, Oregon, and California (62 FR 30772). The eastern stock was estimated by NMFS in the Recovery Plan for the Steller Sea Lion to number between 45,000 to 51,000 animals (NMFS 2008a). This stock has been increasing approximately 3 percent per year over the entire range since the late 1970s (NMFS 2008a; Pitcher et al. 2007). The most recent population estimate for the Eastern stock ranges from 58,334 to 72,223 (Allen and Angliss 2011).

The Eastern stock is stable or increasing throughout the northern portion of its range (Southeast Alaska and British Columbia) and stable or increasing slowly in the central portion of its range (Oregon through northern California) (Angliss and Outlaw 2008; Olesiuk 2008). Steller sea lion numbers in southern and central California have declined from historic numbers, but they have been relatively stable since 1980. Although the population size has increased overall, the status of this stock relative to its optimum sustainable population is unknown (Angliss and Outlaw 2008).

In Washington, Steller sea lions use haulout sites primarily along the outer coast from the Columbia River to Cape Flattery, as well as along the Vancouver Island side of the Strait of Juan de Fuca (Jeffries et al. 2000). Numbers vary seasonally in Washington with peak numbers present during the fall and winter months and a decline in the summer months, which corresponds to the breeding season at Oregon and British Columbia rookeries (approximately late May to early June) (Jeffries et al. 2000). In the Puget Sound, Jeffries (pers. comm. 2012) identified five winter haulout sites used by adult and sub-adult Steller sea lions (see Figure 4-2). Numbers of animals observed at all of these sites combined were less than 230 individuals.

By May, most Steller sea lions leave inland waters and return to their rookeries to mate. However, occasionally sub-adult (immature or pre-breeding animals) or non-breeding adults remain in Puget Sound over the summer (Gearin pers. comm. 2008).

3.2 Non-ESA Listed Marine Mammals

3.2.1 California Sea Lion

Species Description

California sea lions are also members of the Otarrid family. The species *Zalophus californianus* includes three subspecies: *Z. c. wollebaeki* (on the Galapagos Islands), *Z. c. japonicus* (in Japan, but now thought to be extinct), and *Z. c. californianus* (found from southern Mexico to southwestern Canada; referred to here as the California sea lion) (Carretta et al. 2007).

The California sea lion is sexually dimorphic. Males may reach 1,000 pounds and 8 feet in length; females grow to 300 pounds and 6 feet in length. Their color ranges from chocolate brown in males to a lighter, golden brown in females. At around 5 years of age, males develop a bony bump on top of the skull called a sagittal crest. The crest is visible in the “dog-like” profile of male sea lion heads, and hair around the crest gets lighter with age.

Population Abundance

The U.S. stock of California sea lions occur in the marine waters nearby NAVBASE Kitsap, Bangor. The estimated stock is 296,750 and the minimum population size of this stock is 153,337 individuals (Carretta et al. 2011). These numbers are from counts during the 2001 breeding season of animals that were ashore at the four major rookeries in southern California and at haulout sites north to the Oregon/California border. Sea lions that were at-sea or hauled out at other locations were not counted (Carretta et al. 2007). 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 period (Jeffries et al. 2000).

3.2.2 Harbor Seal

Species Description

Harbor seals, which are members of the family Phocidae ("true seals"), inhabit coastal and estuarine waters and shoreline areas from Baja California to western Alaska. For management purposes, differences in mean pupping date (i.e., birthing) (Temte 1986), movement patterns (Jeffries 1985; Brown 1988), pollutant loads (Calambokidis et al. 1985) and fishery interactions have led to the recognition of three separate harbor seal stocks along the west coast of the continental U.S. (Boveng 1988). The three distinct stocks are: 1) inland waters of Washington State (including Hood Canal, Puget Sound, and the Strait of Juan de Fuca out to Cape Flattery), 2) outer coast of Oregon and Washington, and 3) California (Carretta et al. 2007). The inland waters of Washington state stock is the only stock that is expected to occur within the project area.

The average weight for adult seals is about 180 pounds and males are slightly larger than females. Male harbor seals weight up to 245 lbs and measure approximately 5 feet in length. The basic color of harbor seals' coat is gray and mottled but highly variable, from dark with light color rings or spots to light with dark markings (NMFS 2008b).

Population Abundance

Estimated population numbers for the inland waters of Washington, including the Hood Canal, Puget Sound, and the Strait of Juan de Fuca out to Cape Flattery, are 14,612 (CV = 0.15) individuals (Carretta et al. 2007). Harbor seals are the only species of marine mammals that is consistently abundant and considered resident in the 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, 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).

3.2.3 Killer Whale

Species Description

Killer whales are members of the Delphinid family and are the most widely distributed cetacean (e.g., whales, dolphins, and porpoises) species in the world. Killer whales have a distinctive color pattern, with black dorsal (top) and white ventral (bottom) portions. They also have a conspicuous white patch above and behind the eye and a highly variable gray or white saddle area behind the dorsal fin. The species shows considerable sexual dimorphism. Adult males develop larger pectoral flippers, dorsal fins, tail flukes, and girths than females. Male adult killer whales can reach up to 32 feet in length and nearly 22,000 lbs (10,000 kg) in weight; females reach 28 feet in length and weigh up to 16,500 lbs (7,500 kg).

Based on appearance, feeding habits, vocalizations, social structure, and distribution and movement patterns there are three forms or ecotypes of killer whales (Wiles 2004; NMFS 2005). The three distinct ecotypes of killer whales recognized in the North Pacific Ocean are: 1) resident, 2) transient, and 3) offshore. The resident and transient populations have been divided further into different subpopulations based mainly on genetic analyses and distribution; not enough is known about the offshore whales to divide them into subpopulations (Wiles 2004).

Within the transient ecotype, association data (Ford et al. 1994, Ford and Ellis 1999, Matkin et al. 1999), acoustic data (Saulitis 1993, Ford and Ellis 1999) and genetic data (Hoelzel et al. 1998; Barrett-Lennard 2000) confirms that three communities of transient whales exist and represent three discrete populations: 1) Gulf of Alaska, Aleutian Islands, and Bering Sea transients, 2) AT1 transients, and 3) West Coast transients. Among the genetically distinct assemblages of transient killer whales in the northeastern Pacific, only the West Coast transient stock, which occurs from southern California to southeastern Alaska, may occur in the project area.

Population Abundance

The West Coast transient stock includes animals that occur in California, Oregon, Washington, British Columbia, and southeastern Alaska. Analysis of photographic data resulted in the following minimum counts for West Coast transient stock. In British Columbia and southeastern Alaska, 219 transients have been catalogued (Ford and Ellis 1999, Dahlheim et al. 1997). Off the coast of California, 105 transients have been identified (Black et al. 1997), 10 of which match photos of whales in other catalogs and the remaining 95 were linked by association. An additional 14 whales in southeastern Alaska and 16 whales off the coast of California have been provisionally classified as transient by association. Combined, these counts give a minimum number of 354 (219 + 95+10+14+16) individuals belonging to the West Coast transient stock (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% 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).

3.2.4 Dall's Porpoise

Species Description

Dall's porpoises are members of the Phocoenid (porpoise) family and are common in the North Pacific Ocean. They can reach a maximum length of just under 8 feet and weight up to 480 lbs. Males are slightly larger and thicker than females, which reach lengths of just under 7 feet long. The body of Dall's porpoises is a very dark gray or black in coloration with variable contrasting white "thoracic" panels and white "frosting" on the dorsal fin and tail that distinguish them from other cetacean species. These markings and colorations vary with geographic region and life stage, with adults having patterns that are more distinct.

The distribution of Dall's porpoise through its range is highly variable between years and appears to be affected by oceanographic conditions (Forney 1997; Forney and Barlow 1998). The stock structure of eastern North Pacific Dall's porpoise is not known. For MMPA stock assessment reports, Dall's porpoises within the Pacific U.S. Exclusive Economic Zone (EEZ), i.e., a distance of 200 nautical miles out from the U.S. Pacific coast, are divided into two discrete, noncontiguous areas: (1) waters off California, Oregon, and Washington; and (2) those in Alaskan waters (Carretta et al. 2008). Individuals from the California/Oregon/Washington stock occur within the project area.

Population Abundance

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 (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) is not included in the overall estimate of abundance for this stock due to the need for more up-to-date information.

3.2.5 Harbor Porpoise

Species Description

Harbor porpoises belong to the Phocoenid (porpoise) family and are found extensively along the Pacific U.S. coast. Harbor porpoises are small with males reaching average lengths of approximately 5 feet. Females are slightly larger with average length of 5.5 feet. The average adult harbor porpoise weighs between 135 and 170 lbs. Harbor porpoises have a dark gray coloration on their backs with white bellies and throats. They have a dark gray chin patch and intermediate shades of gray along their sides.

Recent preliminary genetic analyses of samples ranging from Monterey, California to Vancouver Island, British Columbia indicate that there is small-scale subdivision within the U.S./Vancouver Island, British Columbia portion of this range (Chivers et al. 2002). These genetically distinguishable groupings are not geographically distinct by latitude, but results suggest a low mixing rate and limited movement of harbor porpoise along the west coast of North America. Survey data found significant differences in harbor porpoise mean densities between coastal Oregon/Washington waters and inland Washington/British Columbia waters (Calambokidis et al. 1993), although a specific stock boundary line cannot be identified based upon biological or genetic differences. Since harbor porpoise movements and rates of intermixing within the eastern North Pacific are restricted, and there was a significant decline in harbor porpoise sightings within southern Puget Sound from the 1940s until recently (Calambokidis 2010, personal communication), NMFS conservatively recognizes two stocks in Washington waters: the Oregon/Washington Coast stock and the Washington Inland Waters stock (Carretta et al. 2011). Individuals from the Washington Inland Waters stock are expected to occur in the project area.

Harbor porpoise sightings have increased in Puget Sound and northern Hood Canal in recent years and are now considered to occur year-round in these waters (Calambokidis 2010, personal communication). This may represent a return to historical conditions, when harbor porpoises were considered one of the most common cetaceans in Puget Sound (Scheffer and Slipp 1948).

Population Abundance

Aerial surveys of the inland waters of Washington and southern British Columbia were conducted during August of 2002 and 2003 (J. Laake, unpublished data in Carretta et al. 2011). These aerial surveys included the Strait of Juan de Fuca, San Juan Islands, Gulf Islands, and Strait of Georgia, which includes waters inhabited by the Washington Inland Waters stock of harbor porpoise as well as harbor porpoises from British Columbia. An average of the 2002 and 2003 estimates of abundance in U.S. waters resulted in an uncorrected abundance of 3,123 (CV=0.10) harbor porpoises in Washington inland waters (J. Laake, unpublished data in Carretta et al. 2011). When corrected for availability and perception bias, using a correction factor of 3.42 (1/g(0); g(0)=0.292, CV=0.366) (Laake et al. 1997), the estimated abundance for the Washington Inland Waters stock of harbor porpoise is 10,682 (CV=0.38) animals (Carretta et al. 2011).

3.3 Marine Mammal Modeling Parameters

3.3.1 Spatial Distribution and Project-Area Survey Efforts

Density assumes that marine mammals are uniformly distributed within a given area, although this is rarely the case. Marine mammals are usually clumped in areas of greater importance, for example, areas of high prey abundance, safe calving or haulout, areas with lower predation risk, etc. Available data on marine mammal populations in Hood Canal are sparse, with the exception of surveys of harbor seal haulouts (Jeffries et al. 2000) and recent surveys on NAVBASE Kitsap, Bangor (Agness and Tannenbaum 2009; Tannenbaum et al. 2009, 2011; Navy 2010b; Navy 2011), some of which covered a very limited area.

Beginning in April 2008, Navy personnel have recorded sightings of marine mammals including California sea lion, Steller sea lion, and harbor seal at known sea lion haulouts along the Bangor waterfront on NAVBASE Kitsap, including Delta Pier, Marginal Wharf, Service Pier, K/B Dock, and the nearshore pontoons of the floating security fence. Sightings of marine mammals within the waters adjoining these locations were also recorded. Sightings were attempted during a typical workweek (i.e., Monday through Friday), but inclement weather, holidays, or security constraints often precluded surveys. These sightings took place frequently (average 14 per month) although without a formal protocol. During the surveys, staff visited each of the above-mentioned locations and recorded observations of marine mammals on data collection forms, noting date, time, location, number, and species of marine mammals (by location), and other relevant notes. Surveys were conducted using binoculars and the naked eye from shoreline locations or the piers/wharves themselves. Data were compiled for the period from April 2008 through December 2011 for analysis in this IHA application.

Boat-based opportunistic sightings along portions of the Bangor waterfront on NAVBASE Kitsap 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 2009). In these surveys, seals and sea lions were noted in a field notebook, as well as date, time, location, number of individuals, species, and other relevant notes. 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. 2009, 2011) detected four marine mammal species (harbor seal, California sea lion, harbor porpoise, and Dall's porpoise). These protocol surveys operated along pre-determined transects parallel to the shoreline from the nearshore out to approximately 1,800 feet from shoreline, at a spacing of 100 yards, and covered the entire Bangor waterfront on NAVBASE Kitsap (approximately 3.9 sq km) at a speed of 5 knots or less. Two observers recorded sightings of marine mammals both in the water and hauled out, including date, time, species, number of individuals, age (juvenile, adult), behavior (swimming, diving, hauled out, avoidance dive), and haulout location. Positions of marine mammals were obtained by recording distance and bearing to the animal with a rangefinder and compass, noting the concurrent location of the boat with GPS, and, subsequently, analyzing these data with the coordinate geometry application available in ArcInfo to produce coordinates of the locations of all animals detected.

Marine mammal monitoring was conducted near the explosive's Handling Wharf during September and October of 2011 on construction days as part of the mitigation for the Test Pile Program. In addition, on days where no pile driving activities occurred due to construction delays, security restrictions, or other factors, the Navy conducted vessel-based line transect surveys in Hood Canal and Dabob Bay to collect additional density data for species present in Hood Canal. The primary impetus for these surveys was observational data during construction monitoring, which indicated an unexpected abundance of harbor porpoise within Hood Canal. The surveys in Hood Canal detected four marine mammal species (Steller sea lion, harbor seal, California sea lion, and harbor porpoise). The surveys operated along pre-determined transects that followed a double saw-tooth pattern to achieve uniform coverage of the entire Bangor waterfront. The vessel traveled at a speed of approximately 5 knots when transiting along the transect lines. Two observers recorded sightings of marine mammals both in the water and hauled out, including the date, time, species, number of individuals, and behavior (swimming, diving, etc.). Positions of marine mammals were obtained by recording the distance and bearing to the animal(s), noting the concurrent location of the boat with GPS, and subsequently analyzing these data with the coordinate geometry application available in ArcInfo to produce coordinates of the locations of all animals detected. Distance sampling methodologies were used to estimate densities of animals for the data.

The cetacean species and the harbor seal appear to range throughout Hood Canal; therefore, the analysis in this IHA application assumes that harbor seal, transient killer whale, harbor porpoise, and Dall's porpoise are uniformly distributed in the project area. The remaining species that occur in the project area, Steller sea lion and California sea lion, do not appear to utilize most of Hood Canal. As described in Sections 4.1.1, Steller Sea Lion, and 4.2.1, California Sea Lion, these species appear attracted to the manmade haulout opportunities along the waterfront on NAVBASE Kitsap, Bangor and forage in the nearby waters. They have been seen leaving the submarines and security fence pontoons and swimming south of the base towards the large river mouth areas on the west side of Hood Canal. The California sea lion was not reported during aerial surveys of Hood Canal (Jeffries et al. 2000), and the Steller sea lion has only been documented on NAVBASE Kitsap, Bangor (although NMFS [1997b] stated that the species is present in Hood Canal without providing numbers, locations, or sighting dates). Therefore, it is assumed in this IHA application that sea lion species are either hauled out on NAVBASE Kitsap, Bangor or are transiting or foraging from this area northward, and density calculations utilize the project impact area defined as the maximum area in which underwater noise disturbance would affect pinnipeds.

3.3.2 Submergence

Cetaceans spend their entire lives in the water and spend most of their time (>90% for most species) entirely submerged below the surface. When at the surface, cetacean bodies are almost entirely below the water's surface, with only the blowhole exposed to allow breathing. This makes cetaceans difficult to locate visually and exposes them to underwater noise, both natural and anthropogenic, essentially 100 percent of the time because their ears are nearly always below the water's surface.

Seals and sea lions (pinnipeds) spend significant amounts of time out of the water during breeding, molting, and hauling out periods. Seals and sea lions have been sighted hauling out on structures along the NAVBASE Kitsap, Bangor waterfront. In the water, pinnipeds spend varying amounts of time underwater. California sea lions are known to rest at the surface in large groups for long amounts of time. When not actively diving, pinnipeds at the surface often orient their bodies vertically in the water column and often hold their heads above the water surface. Consequently, pinnipeds may not be exposed to underwater sounds to the same extent as cetaceans.

For the purpose of assessing impacts from underwater sound on NAVBASE Kitsap, Bangor, the Navy assumed that that three cetacean species and two pinniped species found in the vicinity of NAVBASE Kitsap, Bangor (Steller sea lion, California sea lion, killer whale, Dall's porpoise, and harbor porpoise) spend 100 percent of the time underwater. This approach could be considered conservative because sea lions spend a portion of their time hauled out and therefore are expected to be exposed to less sound than is estimated by this approach. The harbor seal was the only species for which detailed information regarding the percentage of time spent underwater, in-water but at the surface, and hauled out was available (Jeffries et al. 2003, Huber et al. 2001). The application of these results to exposure calculations for harbor seals in this IHA application is described in detail in Section 6.7.3.

4 STATUS AND DISTRIBUTION OF MARINE MAMMAL SPECIES OR STOCKS THAT COULD POTENTIALLY BE AFFECTED

A description of the status, distribution, and seasonal distribution (when applicable) of the affected species or stocks of marine mammals likely to be affected by such activities.

There are seven marine mammal species within the marine waters adjacent to NAVBASE Kitsap, Bangor with confirmed or historic occurrence in the Project Area. Only two of these species, the humpback whale and Steller sea lion, are listed as threatened or endangered under the ESA.

4.1 ESA-Listed Marine Mammals

4.1.1 Humpback Whale (*Megaptera novaeangliae*)

Status and Management

Humpback whales were listed as endangered under the Endangered Species Preservation Act of 1966 (35 FR 1222) due to commercial whaling. This protection was transferred to the ESA in 1973. For the MMPA stock assessment reports, the CA/ OR/WA Stock is defined to include humpback whales that feed off the west coast of the continental U.S. Because the species is listed as endangered under the ESA, the CA/OR/WA stock is automatically listed as "depleted" and "strategic" under the MMPA. The recovery plan for humpback whales was finalized in November 1991 (NMFS 1991).

Critical habitat has not been designated for this species.

Distribution

Humpback whales were one of the most common large cetaceans in the inland waters of Washington in the early 1900s (Scheffer and Slipp 1948). Humpback whale sightings were infrequent in Puget Sound and the Georgia Basin through the late 1990s, and prior to 2003, the presence of only three individual humpback whales was confirmed (Falcone et al. 2005). However, in 2003 and 2004, 13 individuals were sighted in the inland waters of Washington, mainly during the fall (Falcone et al. 2005). Records available for April 2001 to February 2012 include observations in the Strait of Juan de Fuca, the Gulf Islands and the vicinity of Victoria, British Columbia, Admiralty Inlet, the San Juan Islands, Hood Canal, and Puget Sound (Orca Network 2012). For the areas listed above, Orca Network records shows humpback whale presence in one of the areas listed above in all months from May through November in 2009; in all months but January, March, April , May, and August in 2010; and from March through November in 2011.

In Hood Canal, humpback whale sightings occurred several times in January and February 2012 (Orca Network 2012). Review of the sightings information indicated they were of one individual (Calambokidis pers. comm. 2012). Prior to these sightings, there were no confirmed reports of humpback whales entering Hood Canal (Calambokidis pers. comm. 2012). No other reports of humpback whales in the

Hood Canal were found in the Orca Network database, the scientific literature, or agency reports. Construction of the Hood Canal Bridge occurred in 1961 and could have contributed to the lack of historical sightings (Calambokidis pers. comm. 2010). Only a few records of humpback whales near Hood Canal (but north of the Hood Canal Bridge) are in the Orca Network database. Two were from the northern tip of Kitsap Peninsula (Foulwater Bluff/Point No Point) and a few others from Port Madison Bay in Puget Sound.

Behavior and Ecology

In the summer, most humpback whales are found in high latitude feeding grounds eating crustaceans, plankton, and small fish. During the summer months, they spend the majority of their time building up blubber to live off in the winter. Humpback whales can consume up to 1,360 kg of food per day (NMFS 2012). In the winter, they congregate in subtropical or tropical waters for mating. The CA/OR/WA stock winters in coastal Central America and Mexico, and the stock migrates to areas ranging from the coast of California to southern British Columbia in summer and fall (NMFS 2012).

4.1.2 Steller Sea Lion (*Eumetopias jubatus*), Eastern U.S. Stock

Status and Management

The Steller sea lion was originally listed as threatened under the ESA in 1990. In 1997, the NMFS reclassified Steller sea lions as two subpopulations, listing the Western Stock as endangered under the ESA, and maintaining threatened status for the Eastern stock (NMFS 1997). There is a final revised species recovery plan that addresses both stocks (NMFS 2008a).

Critical habitat has been designated for the Steller sea lion (NMFS 1993). Critical habitat includes so-called “aquatic zones” that extend 3,000 feet (1 km) seaward in state and federally managed waters from the baseline or base point of each major rookery in Oregon and California (NMFS 2008a). Three major rookery sites in Oregon (Rogue Reef, Pyramid Rock; and Long Brown Rock and Seal Rock on Orford Reef at Cape Blanco) and three rookery sites in California (Ano Nuevo I; Southeast Farallon I; and Sugarloaf Island and Cape Mendocino) are designated critical habitat (NMFS 1993). There is no designated critical habitat for the species in Washington.

Distribution

Steller sea lions are found along the coasts of Washington, Oregon, and northern California where they occur at breeding rookeries and numerous haulout locations along the coastline (Jeffries et al. 2000; Scordino 2006). From breeding rookeries in northern California (St. George Reef) and southern Oregon (Rogue Reef), male Steller sea lions often disperse widely outside of the breeding season (Scordino 2006). Based on mark recapture sighting studies, males migrate back into these Oregon and California locations from winter-feeding areas in Washington, British Columbia, and Alaska (Scordino 2006).

In Washington, Steller sea lions use haulout sites primarily along the outer coast from the Columbia River to Cape Flattery, as well as along the Vancouver Island side of the Strait of Juan de Fuca (Jeffries et al. 2000). Numbers vary seasonally in Washington with peak numbers present during the fall and winter months (Jeffries et al. 2000). Steller Sea lions are occasionally present in the Puget Sound at the Toliva Shoals haulout site in south Puget Sound (Jeffries et al. 2000) and at a rock 3 miles south of Marrowstone Island (NMFS 2010). On NAVBASE Kitsap, Bangor, Steller sea lions were observed hauled out on submarines at Delta Pier, approximately 0.85 miles north of the project area, on several occasions from 2008 through 2011 from the end of September through May.

Behavior and Ecology

Steller sea lions are gregarious animals that often travel or haul out in large groups of up to 45 individuals (Keple 2002). At sea, groups usually consist of female and subadult males; adult males are usually solitary while at sea (Loughlin 2002). In the Pacific Northwest, breeding rookeries are located in British Columbia, Oregon, and northern California. Steller sea lions form large rookeries during late spring when adult males arrive and establish territories (Pitcher and Calkins 1981). Large males aggressively defend territories while non-breeding males remain at peripheral sites or haulouts. Females arrive soon after and give birth. Most births occur from mid-May through mid-July, and breeding takes place shortly thereafter. Most pups are weaned within a year. Non-breeding individuals may not return to rookeries during the breeding season but remain at other coastal haulouts (Scordino 2006).

Steller sea lions are opportunistic predators, feeding primarily on fish and cephalopods, and their diet varies geographically and seasonally (Bigg 1985; Merrick et al. 1997; Bredesen et al. 2006; Guénette et al. 2006). Foraging habitat is primarily shallow, nearshore and continental shelf waters; freshwater rivers; and deep waters (Reeves et al. 2008; Scordino 2010). Their prey in inland Washington waters is not well documented, but their expected prey, based on studies in British Columbia and Alaska, would include schooling fish such as herring, hake, sand lance, salmon, flounder, rockfish, squid, and octopus (Bigg 1985; Merrick and Loughlin 1997). Foraging habitats in Hood Canal would likely include nearshore and deeper waters.

4.2 Non-ESA Listed Marine Mammals

4.2.1 California Sea Lion (*Zalophus californianus*), U.S. Stock

Status and Management

California sea lions are protected under the MMPA, but they are not listed under the ESA. Individuals that may occur in the Project Area belong to the U.S. stock.

Distribution

The geographic distribution of California sea lions includes a breeding range from Baja California to southern California. During the summer, California sea lions breed on islands from the Gulf of California to the Channel Islands and seldom travel more than about 31 miles (50 km) from the islands (Bonnell et al. 1983). The primary rookeries are located on the California Channel Islands of San Miguel, San Nicolas, Santa Barbara, and San Clemente (Le Boeuf and Bonnell 1980; Bonnell and Dailey 1993). Their distribution shifts to the northwest in fall and to the southeast during winter and spring, probably in response to changes in prey availability (Bonnell and Ford 1987).

The non-breeding distribution extends from Baja California north to Alaska for males and encompasses the waters of California and Baja California for females (Reeves et al. 2008; Maniscalco et al. 2004). In the non-breeding season, an estimated 3,000 to 5,000 adult and sub-adult males migrate northward along the coast to central and northern California, Oregon, Washington, and Vancouver Island from September to May (Jeffries et al. 2000) and return south the following spring (Mate 1975; Bonnell et al. 1983). Along their migration, they are occasionally sighted hundreds of miles (kilometers) offshore (Jefferson et al. 1993). Females and juveniles tend to stay closer to the rookeries (Bonnell et al. 1983).

Peak abundance in the Puget Sound is September to May. California sea lion are known to haul out on structures such as piers, jetties, offshore buoys, and oil platforms (Riedman 1990). During the most recent aerial survey population counts conducted by WDWF for California sea lion within the inland waters of Washington State, no regular haulouts were documented within the Hood Canal; however, five navigational buoys near the entrance to Hood Canal were documented as potential haulouts, each capable of supporting three adult California sea lions (Jeffries et al. 2000).

Although haulouts were not documented in Hood Canal during the WDFW surveys, as many as 40 California sea lions have been observed hauled on submarines, the floating security fence, and barges on NAVBASE Kitsap, Bangor (Agness and Tannenbaum 2009a; Tannenbaum et al 2009; Walters 2009, personal communication). More recent dedicated surveys on NAVBASE Kitsap, Bangor have reported as many as 81 California sea lions hauled out daily from late August through early June on submarines, buoys, pontoons of the floating security fence, and barges on NAVBASE Kitsap, Bangor (Agness and Tannenbaum 2009; Tannenbaum et al. 2009; Navy 2011) (see detailed discussion in Section 6.6.2). All documented haulouts of California sea lions along NAVBASE Kitsap, Bangor have been on submarines docked at Delta Pier, approximately 0.85 miles north of the Project Area, and on pontoons of the security fence. California sea lions were also observed swimming 1.85 miles north of the project near the Explosives Handling Wharf (EHW-1) on several occasions (Tannenbaum et al. 2009; Navy 2010) and likely forage in both nearshore marine and inland marine deeper water habitats in the vicinity.

Behavior and Ecology

California sea lions are gregarious during the breeding season and social at haulout sites during other times. They prefer to breed on sandy, remote beaches (Le Boeuf 2002) near productive upwelling zones where prey is easily available to lactating females (Heath 2002). Females give birth in May and June, and mating follows. Within their geographic range, California sea lions have been known to utilize manmade structures such as piers, jetties, offshore buoys, oil platforms, and navigational buoys (Riedman 1990; Jeffries et al. 2000).

California sea lions feed on a wide variety of prey, including many species of fish and squid (Everitt et al. 1981; Roffe and Mate 1984; Antonelis et al. 1990; Lowry et al. 1991). In the Puget Sound region, they feed primarily on fish such as hake, walleye pollock, herring, and spiny dogfish (Calambokidis and Baird 1994). In some locations where sea lions and salmon runs exist, California sea lions also feed on returning adult and out-migrating juvenile salmonids (London 2006). Sexual maturity occurs at around four to five years of age for California sea lions (Heath 2002).

4.2.2 Harbor Seal (*Phoca vitulina*), WA Inland Waters Stock

Status and Management

Harbor seals are protected under the MMPA, but they are not listed under the ESA. In the state of Washington, they have a “State Monitored” status, meaning they require management, survey or data emphasis.

Distribution

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. 2007b). The harbor seal is the only pinniped species that breeds in inland Washington waters, including Hood Canal, and is consistently abundant and widespread (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, and the population may have reached carrying capacity in the mid-1990s (approximate abundance in Hood Canal is 1,000 harbor seals) (Jeffries et al. 2003). The mean population size in 1999 for harbor seals in all inland waters of Washington was estimated from 9,550 to 14,612 harbor seals (Jeffries et al. 2003). Thus, up to 10 percent of the Puget Sound harbor seal population occurs in Hood Canal. The abundance of harbor seals in Hood Canal may have been influenced by the recent occurrences of transient killer whales in Hood Canal, which feed on harbor seals; however, no change in abundance was detected in subsequent survey efforts (Jeffries et al. 2003; London 2006).

The main dedicated haulout locations for harbor seals in Hood Canal (Figure 4–1) are located on river delta and tidal exposed areas at Quilcene, Dosewallips, Duckabush, Hamma Hamma, and Skokomish

River mouths, with the closest haulout area 10 miles southwest of NAVBASE Kitsap, Bangor at the Dosewallips River mouth (London 2006).

Harbor seals have been observed swimming in the waters along NAVBASE Kitsap, Bangor in every month of surveys conducted from 2007 to 2010 (Agness and Tannenbaum 2009; Tannenbaum et al. 2009, 2011). Harbor seals were commonly seen in the water during monitoring conducted in 2011 as part of the mitigation for EHW-1 repairs and the Test Pile program. These projects occurred approximately 1.85 miles north of the Service Pier. Baseline transect surveys of Hood Canal conducted during this time also resulted in frequent sightings of harbor seals (Navy 2012).

During 2007, harbor seals were seen hauled out on manmade floating structures near K/B Dock and Delta Pier. On two occasions, the group size was four to six individuals near Delta Pier. It is unknown if these structures are still present.

During the 2008 survey, 10 harbor seals were seen hauled out at specific locations. The largest group size was two animals and the majority of the sightings were solitary animals. The animals were seen on the port security barrier, on small manmade structures near Delta Pier that are not necessarily present any longer, and on a log that is no longer present. There was one individual sighted one time on a buoy.

During the 2009-2010 survey, only four individuals were hauled out and they were solitary animals at the time of the sightings. The locations include a small manmade float between the Service Pier and the shoreline. The remaining three individuals were solitary animals, but seen on the port security barrier floats (two south of Service Pier and one offshore of EHW-1). A few of the documented occurrences were of harbor seals opportunistically hauling out along the Bangor waterfront were on pontoons of the security fence close to Delta Pier.

Behavior and Ecology

Although generally solitary in the water, harbor seals come ashore at communal haulout sites for resting, thermoregulation, birthing, and nursing pups. Major haulout sites are relatively consistent from year to year. Haulout areas can include intertidal and subtidal rock outcrops, mudflats, sandbars, sandy beaches, peat banks in salt marshes, and manmade structures such as log booms, docks, and recreational floats (Wilson 1978; Prescott 1982; Gilbert and Guldager 1998; Jeffries et al. 2000). Harbor seals mate at sea and females in most areas give birth during the spring and summer, although the “pupping season” varies considerably in the Pacific Northwest. The Hood Canal population has the latest pupping season in the region: pupping typically extends from mid-July through December (Ferrero and Fowler 1992). 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 wave screen dock at Carderock Pier, 0.15 miles (0.2 kilometers) south of the Service Pier project site. This was the first documented birth on NAVBASE Kitsap, Bangor. Harbor seal pups were regularly seen during the Test Pile Program and during EHW-1 repairs in 2011.

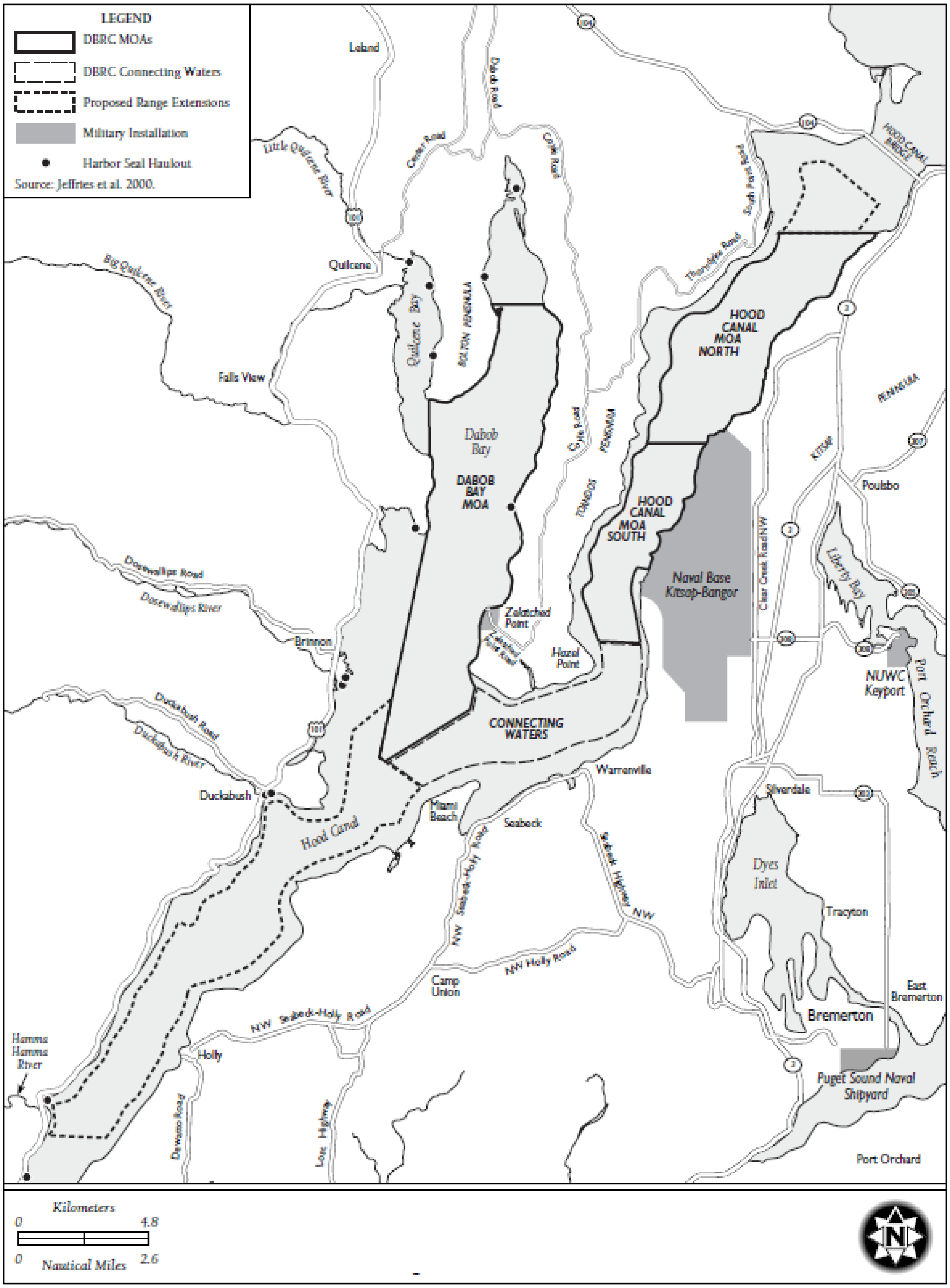

Figure 4-1: Harbor Seal Haulouts within the Vicinity of NAVBASE Kitsap, Bangor

Harbor seals are opportunistic feeders that adjust their patterns to take advantage of locally and seasonally abundant prey (Payne and Selzer 1989; Baird 2001; Bjørge 2002). Diet consists of fish and invertebrates (Bigg 1981; Roffe and Mate 1984; Orr et al. 2004). In the Puget Sound region, the diet is diverse but primarily consists of Pacific hake, walleye pollock, and Pacific herring (Lance and Jeffries 2007; London 2006; Luxa 2008). In some locations harbor seals feed on returning adult and out-migrating juvenile salmonids (London et al. 2002; Lance and Jeffries 2006, 2007; London 2006; Scordino 2010). Harbor seals in Hood Canal feed on returning adult salmon, including threatened summer-run chum salmon (London et al. 2002); the other top prey species found in Hood Canal harbor seal scats were Pacific hake and Pacific herring (London 2006). Telemetry studies in the San Juan Islands showed no consistent diurnal or nocturnal pattern for foraging behavior (Suryan and Harvey 1998), and observations in Hood Canal at river mouths indicated that feeding on fish occurred during both day and night, and was most influenced by tidal stage (London 2006).

4.2.3 Killer whale (*Orcinus orca*), West Coast Transient Stock

Status and Management

The West Coast transient stock is a genetically distinct assemblage of killer whales in the northeastern Pacific. Killer whales belonging to the West Coast transient stock are protected under the MMPA, but not listed under the ESA.

Distribution

The geographical range of transient killer whales includes the northeast Pacific, with preference for coastal waters of southern Alaska and British Columbia (Krahn et al. 2002). Transient killer whales in the eastern North Pacific spend most of their time along the outer coast, but visit Hood Canal and the Puget Sound in search of harbor seals, sea lions, and other prey. Transient occurrence in inland waters appears to peak during August and September (Morton 1990; Baird and Dill 1995, Ford and Ellis 1999) which is the peak time for harbor seal pupping, weaning, and post-weaning (Baird and Dill 1995).

In 2003 and 2005, small groups of transient killer whales (11 and 6 individuals, respectively) visited Hood Canal to feed on harbor seals and remained in the area for significant periods of time (59 and 172 days, respectively) between the months of January and July.

Behavior and Ecology

Transient killer whales show great variability in habitat use, with some groups spending most of their time foraging in shallow waters close to shore while others hunt almost entirely in open water (Felleman et al. 1991; Baird and Dill 1995; Matkin and Saulitis 1997). West Coast transient killer whales feed on marine mammals and some seabirds, and do not consume fish (Morton 1990; Baird and Dill 1996; Ford et al. 1998, 2005; Ford and Ellis 1999). While present in Hood Canal in 2003 and 2005, 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 they prefer to forage on pinnipeds in shallow, protected waters (Heimlich-Boran 1988; Saulitis et al. 2000). Transient killer whales travel in small matrilineal groups, but they typically contain six or fewer animals and their social organization generally is more fluid than the resident killer whale (Morton 1990; Ford and Ellis 1999). Differences in social organization may be adaptations to differences in feeding specializations (Ford and Ellis 1999; Baird and Whitehead 2000). There is no information on the reproductive behavior of transient killer whales in this area.

4.2.4 Dall's Porpoise (*Phocoenoides dalli*), CA/OR/WA Stock

Status and Management

Dall's porpoises are protected under the MMPA, but not listed under the ESA. Those potentially occurring in the vicinity of the Barge Mooring project are from the California / Oregon / Washington stock (NMFS 2011).

Distribution

The Dall's porpoise is found from northern Baja California, Mexico, north to the northern Bering Sea and south to southern Japan (Jefferson et al. 1993). The species is only common between 32°N and 62°N in the eastern North Pacific (Morejohn 1979; Houck and Jefferson 1999). North-south movements in California, Oregon, and Washington have been suggested. Dall's porpoises shift their distribution southward during cooler-water periods (Forney and Barlow 1998). Norris and Prescott (1961) reported finding Dall's porpoise in southern California waters only in the winter, generally when the water temperature was less than 15°C. Seasonal movements have also been noted off Oregon and Washington, where higher densities of Dall's porpoises were sighted offshore in winter and spring and inshore in summer and fall (Green et al. 1992).

In Washington, they are most abundant in offshore waters. They are year-round residents in Washington (Green et al. 1992), but their distribution is highly variable between years likely due to changes in oceanographic conditions (Forney and Barlow 1998). Dall's porpoise are observed throughout the year in the Puget Sound north of Seattle (Osborne et al. 1988) and are seen occasionally in southern Puget Sound. Dall's porpoises may also occasionally occur in Hood Canal (Jeffries 2006, personal communication). Nearshore habitats used by Dall's porpoise could include the marine habitats found in the inland marine waters of the Hood Canal. A Dall's porpoise was observed in the deeper water on NAVBASE Kitsap, Bangor in summer 2008 (Tannenbaum et al. 2009).

Behavior and Ecology

Groups of Dall's porpoises generally include fewer than 10 individuals and are fluid, 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 10-12 months. Breeding and calving 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 1989). Resident Dall's porpoise breed in Puget Sound from August to September.

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).

4.2.5 Harbor Porpoise (*Phocoena phocoena*), WA Inland Waters Stock

<u>Status and Management</u>

Harbor porpoises are protected under the MMPA, but not listed under the ESA. NMFS conservatively recognizes two stocks in Washington waters: the Oregon/Washington Coast stock and the Washington Inland Waters stock (Carretta et al. 2011). Individuals from the Washington Inland Waters stock may occur in the vicinity of the Barge Mooring Project.

<u>Distribution</u>

Harbor porpoises are generally found in cool temperature to subarctic waters over the continental shelf in both the North Atlantic and North Pacific (Read 1999). This species is seldom found in waters warmer than 17°C (Gaskin et al. 1993) or south of Point Conception (Barlow and Hanan 1995). Harbor porpoises can be found year-round primarily in the shallow coastal waters including harbors, bays, and river mouths (Green et al. 1992). Along the Pacific coast, harbor porpoises occur from Monterey Bay, California, to the Aleutian Islands and west to Japan (Reeves et al. 2008). Harbor porpoises are known to occur in Puget Sound year-round (Osmek et al. 1996, 1998; Carretta et al. 2007b); indeed, harbor porpoise observations in Puget Sound including northern Hood Canal have increased in recent years (Calambokidis 2010, personal communication). A harbor porpoise was seen in deeper water on NAVBASE Kitsap, Bangor during 2010 field observations (Tannenbaum et al. 2011). During line transect surveys conducted as part of the Test Pile Program, harbor porpoises were seen commonly sighted in the deeper waters of the Hood Canal adjacent to the Bangor waterfront (Navy 2012).

<u>Behavior and Ecology</u>

Harbor porpoises are usually seen in small groups of 2 to 5 animals. Little is known about their social behavior. Studies of harbor porpoises 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, harbor porpoises primarily feed on Pacific herring (Clupea pallasii), market squid, and smelts (Gearin et al. 1994).

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5 HARASSMENT AUTHORIZATION REQUESTED

The type of incidental taking authorization that is being requested (i.e., takes by harassment only, takes by harassment, injury and/or death), and the method of incidental taking.

Under Section 101 (a)(5)(D) of the MMPA, the Navy requests an IHA for the take of small numbers of marine mammals, by Level B behavioral harassment only, incidental to conducting pile installation operations associated with the Barge Mooring Project on NAVBASE Kitsap, Bangor, Washington. The Navy requests an IHA for incidental take of marine mammals described within this application commencing in July 2013 (or the issuance date, whichever is later) until September 30, 2013. All in-water activities are scheduled to be completed by September 30, 2013, which is within the timeframe of the requested IHA.

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 C.F.R, Part 216, Subpart A, Section 216.3-Definitions).

Level A is the more severe form of harassment because it may result in injury, whereas Level B only results in disturbance without the potential for injury (Norberg pers. comm. 2007a).

5.1 Take Authorization Request

Under Section 101 (a)(5)(D) of the MMPA, the Navy requests an IHA from NMFS for: Level B take (behavioral harassment) of small numbers of marine mammals described within this application because of in-water pile installation activities. The take authorizations requested for each species are shown below in Table 5-1. The Navy requests the IHA to begin coverage on July 16, 2013.

The exposure assessment methodology in this IHA application attempts to quantify potential exposures to marine mammals resulting from pile installation. Section 6 presents a detailed description of the acoustic exposure assessment methodology. Results from this approach overestimate exposures because all animals are assumed to be available to be exposed 100 percent of the time, and the formulas used to estimate transmission loss used idealized parameters, which are unrealistic in nature.

The analysis for the Barge Mooring Project predicts 1,161 potential exposures (see Section 6 for estimates of exposures by species from pile installation and removal that could be classified as Level B harassment as defined under MMPA). The Navy's mitigation procedures, presented in Section 11, include monitoring of mitigation zones prior to the initiation of vibratory and steel pile driving, the use of a sound attenuation device during impact installation, and the use of a shutdown zone to prevent injury.

The Navy does not anticipate that 1,161 actual harassment incidents will result from activities during the Barge Mooring Project. However, to allow for scientific uncertainty regarding the exact mechanisms of the physical and behavioral effects, and as a conservative approach, the Navy is requesting authorization for take (Level B harassment) of 1,161 marine mammals over the course of the project in this IHA application.

Table 5-1: Take Authorization Requested during the Barge Mooring Project

Species	Take Authorization Requested
Humpback Whale	0
Steller Sea Lion	0
California Sea Lion	660
Harbor Seal	341
Transient Killer Whale	120
Dall's Porpoise	0
Harbor Porpoise	40
Total	**1,161**

5.2 Method of Incidental Taking

Construction activities associated with the Barge Mooring Project as outlined in Sections 1 and 2 have the potential to disturb or displace small numbers of marine mammals. Specifically, underwater sounds generated from pile installation activities that produce underwater noise above the 120 dB rms threshold level for continuous noise (vibratory pile installation) and 160 dB rms threshold level for pulsed sound (impact pile driving) may result in "take" in the form of Level B harassment (behavioral disturbance). Level B harassment is not anticipated from airborne sounds generated during pile installation or during other construction activities. Level A harassment is not anticipated to result from any of the construction activities, and measures designed to minimize the possibility of injury to marine mammals. Specifically, vibratory hammers will be the primary method of installation, which are not expected to cause injury to marine mammals due to the relatively low source levels (<190 dB). In addition, no impact pile driving will occur without the use of a noise attenuation system *(*e.g., bubble curtain), and pile driving will either not start or be halted if marine mammals approach the shutdown zone. See Section 11 for more details on the impact reduction and mitigation measures proposed.

6 NUMBERS AND SPECIES EXPOSED

By age, sex, and reproductive condition (if possible), the number of marine mammals (by species) that may be taken by each type of taking identified in [Section 5], and the number of times such takings by each type of taking are likely to occur.

6.1 Introduction

The NMFS application for IHAs requires applicants to determine the number of marine mammals that are expected to be incidentally harassed by an action and the nature of the harassment (Level A or Level B). Section 5 defines MMPA Level A and Level B . Section 6 below presents how these definitions were relied on to develop the quantitative analyses used to assess the potential for the proposed action to incidentally harass marine mammals. The project construction and operation as outlined in Sections 1 and 2 have the potential to take marine mammals by harassment only, primarily through noise produced by pile driving. Other activities are not expected to result in take as defined under the MMPA.

In-water pile installation/extraction activities would temporarily increase the local underwater and airborne noise environment near the Project Area. Research suggests that increased noise may affect marine mammals in several ways and depends on many factors. This will be discussed in more detail in Section 7. The following text provides a background on underwater sound, description of noise sources in the Project Area, applicable noise criteria, and the basis for the calculation of take by Level B harassment. Level A harassment of cetaceans and pinnipeds for this project is not expected to occur; therefore, Level A harassment is not discussed in this application.

6.2 Fundamentals of Sound

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water. Sound is generally characterized by several factors, including frequency and intensity. Frequency describes the sound's pitch and is measured in hertz (Hz), while intensity describes the sound's loudness. Due to the wide range of pressure and intensity encountered during measurements of sound, a logarithmic scale is used. In acoustics, the word "level" denotes a sound measurement in decibels. A decibel (dB) expresses the logarithmic strength of a signal relative to a reference. Because the decibel is a logarithmic measure, each increase of 20 dB reflects a ten-fold increase in signal amplitude (whether expressed in terms of pressure or particle motion), i.e., 20 dB means ten times the amplitude, 40 dB means one hundred times the amplitude, 60 dB means one thousand times the amplitude, and so on. Because the decibel is a relative measure, any value expressed in decibels is meaningless without an accompanying reference. In describing underwater sound pressure, the reference amplitude is usually 1 microPascal (μPa, or 10^{-6} Pascals), and is expressed as "dB re 1 μPa." For in-air sound pressure, the reference amplitude is usually 20 μPa and is expressed as "dB re 20 μPa."

The method commonly used to quantify airborne sounds consists of evaluating all frequencies of a sound according to a weighting system that reflects that human hearing is less sensitive at low frequencies and extremely high frequencies than at mid-range frequencies. This is called A-weighting, and the decibel level measured is called the A-weighted sound level (dBA). A filtering method that reflects hearing of marine mammals has not yet been developed. Therefore, underwater sound levels are not weighted and measure the entire frequency range of interest. In the case of marine construction work, the frequency range of interest is 10 to 10,000 Hz.

Table 6-1 summarizes commonly used terms to describe underwater sounds. Two common descriptors are the peak sound pressure level (SPL) and the root mean square (rms) SPL (dB rms) during the pulse or over a defined averaging period. The peak pressure is the maximum absolute value of the instantaneous pressure observed during each pulse or sound event and is presented in Pascals (Pa) or dB referenced to a pressure of one microPascal (dB re 1 µPa). The rms level is the square root of the energy divided by a defined time period. All underwater sound levels throughout the remainder of this application are presented in dB re 1 µPa unless otherwise noted.

Table 6-1: Definitions of Acoustical Terms

Term	Definition
Decibel, dB	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for water is 1 microPascal (µPa) and for air is 20 µPa (approximate threshold of human audibility).
Sound Pressure Level, SPL	Sound pressure is the force per unit area, usually expressed in microPascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure. Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	Frequency is expressed in terms of oscillations, or cycles, per second. Cycles per second are commonly referred to as hertz (Hz). Typical human hearing ranges from 20 Hz to 20,000 Hz.
Peak Sound Pressure (unweighted), dB re 1 µPa	Peak sound pressure level is based on the largest absolute value of the instantaneous sound pressure over the frequency range from 20 Hz to 20,000 Hz. This pressure is expressed in this application as dB re 1 µPa.
Root-Mean-Square (rms), dB re 1 µPa	The rms level is the square root of the energy divided by a defined time period. For pulses, the rms has been defined as the average of the squared pressures over the time that comprise that portion of waveform containing 90 percent of the sound energy for one impact pile driving impulse.[5]

[5] Underwater sound measurement results obtained by Illingworth & Rodkin (2001) for the Pile Installation Demonstration Project in San Francisco Bay indicated that most impact pile driving impulses occurred over a 50 to 100 millisecond (ms) period. Most of the energy was contained in the first 30 to 50 ms. Analyses of that underwater acoustic data for various pile strikes at various distances demonstrated that the acoustic signal measured using the standard “impulse exponential time-weighting” on the sound level meter (35-ms rise time) correlated to the rms level measured over the duration of the pulse.

Term	Definition
Sound Exposure Level (SEL), dB re 1 µPa^2 sec	Sound exposure level is a measure of energy. Specifically, it is the dB level of the time integral of the squared-instantaneous sound pressure, normalized to a 1-second period. It can be an extremely useful metric for assessing cumulative exposure because it enables sounds of differing duration, to be compared in terms of total energy.
Waveforms, µPa over time	A graphical plot illustrating the time history of positive and negative sound pressure of individual pile strikes shown as a plot of µPa over time (i.e., seconds).
Frequency Spectra, dB over frequency range	A graphical plot illustrating the 6 to 12 Hz band-center frequency sound pressure over a frequency range (e.g., 10 to 5,000 Hz in this application).
A-Weighting Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A- or C-weighting filter network. The A-weighting filter de-emphasizes the low and high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective human reactions to noise.
Ambient Noise Level	The background sound level, which is a composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.

6.3 Description of Noise Sources

Underwater sound levels are comprised of multiple sources, including physical noise, biological noise, and anthropogenic noise. Physical noise includes waves at the surface, earthquakes, ice, and atmospheric noise. Biological noise includes sounds produced by marine mammals, fish, and invertebrates. Anthropogenic noise consists of vessels (small and large), dredging, aircraft over flights, and construction noise. Known noise levels and frequency ranges associated with anthropogenic sources similar to those that will be used for this project are summarized in Table 6-2. Details of each of the sources are described in the following text.

Table 6-2: Representative Noise Levels of Anthropogenic Sources

Noise Source	Frequency Range (Hz)	Underwater Noise Level (dB re 1 µPa)	Reference
Small vessels	250 – 1,000	151 dB rms at 1 meter (m)	Richardson et al. 1995
Tug docking gravel barge	200 – 1,000	149 dB rms at 100 m	Blackwell and Greene 2002
Vibratory driving of 30-inch Steel Pipe pile	10 – 1,500	~168 dB rms at 10m	WSDOT 2010a, 2010b
Impact driving of 30-inch Steel Pipe pile	10 – 1,500	~193 dB rms at 10m	WSDOT 2005, 2008; Caltrans 2007;

In-water construction activities associated with the Barge Mooring Project will include impact and vibratory pile driving. The sounds produced by these activities fall into one of two sound types: pulsed and non-pulsed (defined below). Impact pile driving produces pulsed sounds, while vibratory pile driving produces non-pulsed (or continuous) sounds. The distinction between these two general sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (e.g., Ward 1997 as cited in Southall et al. 2007).

Pulsed sounds (e.g., explosions, gunshots, sonic booms, seismic air gun pulses, and impact pile driving) are brief, broadband, atonal transients (ANSI 1986; Harris 1998) and occur as isolated events or repeated in some succession (Southall et al. 2007). Pulsed sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a decay period that may include a period of diminishing, oscillating maximal and minimal pressures (Southall et al. 2007). Pulsed sounds generally have an increased capacity to induce physical injury as compared with sounds that lack these features (Southall et al. 2007).

Non-pulse (intermittent or continuous sounds) can be tonal, broadband, or both (Southall et al. 2007). Some of these non-pulse sounds can be transient signals of short duration but without the essential properties of pulses (e.g., rapid rise time) (Southall et al. 2007). Examples of non-pulse sounds include vessels, aircraft, machinery operations such as drilling or dredging, vibratory pile driving, pneumatic chipping, and active sonar systems (Southall et al. 2007). The duration of such sounds, as received at a distance, can be greatly extended in highly reverberant environments (Southall et al. 2007).

6.4 Vocalization and Hearing of Marine Mammals

All marine mammals that have been studied can produce sounds and use sounds to forage; orient; detect and respond to predators; and socially interact with others. Measurements of marine mammal sound production and hearing capabilities provide some basis for assessing whether exposure to a particular sound source may affect a marine mammal behaviorally or physiologically. Marine mammal hearing abilities are quantified using live animals either via behavioral audiometry or electrophysiology (see Schusterman 1981; Au 1993; Wartzok and Ketten 1999; Nachtigall 2007). Behavioral audiograms, which are plots of animals' exhibited hearing threshold versus frequency, are obtained from captive, trained live animals using standard testing procedures with appropriate controls, and are considered to be a more accurate representation of a subject's hearing abilities. Behavioral audiograms of marine mammals are difficult to obtain because many species are too large, too rare, and too difficult to acquire and maintain for experiments in captivity. Consequently, our understanding of a species' hearing ability may be based on the behavioral audiogram of a single individual or small group of animals. In addition, captive animals may be exposed to local ambient sounds and other environmental factors that may impact their hearing abilities and may not accurately reflect the hearing abilities of free-swimming animals. For animals not available in captive or stranded settings (including large whales and rare species), estimates of hearing capabilities are made based on physiological structures, vocal characteristics, and extrapolations from related species.

Electrophysiological audiometry measures small electrical voltages produced by neural activity when the auditory system is stimulated by sound. The technique is relatively fast, does not require a conscious response, and is routinely used to assess the hearing of newborn humans. For both methods of evaluating hearing ability, hearing response in relation to frequency is a generalized U-shaped curve or audiogram showing the frequency range of best sensitivity (lowest hearing threshold) and frequencies above and below with higher threshold values.

Direct measurement of hearing sensitivity exists for approximately 25 of the nearly 130 species of marine mammals. Table 6-3 provides a summary of sound production and hearing capabilities for marine mammal species in the Study Area. For purposes of this analysis, marine mammals are arranged into the following functional hearing groups based on their generalized hearing sensitivities: high-frequency cetaceans, mid-frequency cetaceans, low-frequency cetaceans (mysticetes), phocid pinnipeds (true seals), otariid pinnipeds (sea lions and fur seals).

Table 6-3: Hearing and Vocalization Ranges for Marine Mammal Functional Hearing Groups and Species Potentially within the Study Area

Functional Hearing Group	Species	Sound Production		General Hearing Ability Frequency Range
		Frequency Range	Source Level (dB re 1 µPa @ 1 m)	
High-Frequency Cetaceans	Harbor Porpoise, Dall's Porpoise	100 Hz to 200 kHz	120 to 205	200 Hz to 180 kHz
Mid-Frequency Cetaceans	Killer Whale, Pacific White-sided Dolphin	100 Hz to 100kHz	137 to 236	150 Hz to 160 kHz
Low-Frequency Cetaceans	Gray Whale, Humpback Whale, Minke Whale	10 Hz to 20 kHz	137 to 192	7 Hz to 22 kHz
Phocidae	Northern Elephant Seal, Harbor Seal	100 Hz to 120 kHz	103 to 180	In-water: 75 Hz to 75 kHz In-air: 75 Hz to 30 kHz
Otariidae	Steller Sea Lion, California Sea Lion	250 Hz to 6 kHz	120	In-water: 100 Hz to 20 kHz In-air: 200 Hz to 75 kHz

Adapted and derived from Southall et al. (2007)
dB re 1 µPa @ 1 m: decibels (dB) referenced to (re) 1 micro (µ) Pascal (Pa) at 1 meter; Hz: Hertz; kHz: kilohertz

6.5 Sound Exposure Criteria and Thresholds

Under the MMPA, NMFS has defined levels of harassment for marine mammals. Level A harassment is defined as "Any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is defined as "Any act of pursuit, torment, or annoyance which 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."

Since 1997, 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 that a take by harassment might occur (NMFS 2005b). No studies have been conducted that examine impacts to marine mammal from pile driving sounds. Current NMFS practice regarding exposure of marine mammals to sounds is that cetaceans and pinnipeds exposed to impulsive sounds of 180 and 190 dB rms or above, respectively, are considered to have been taken by Level A (i.e., injurious) harassment.

Behavioral harassment (Level B) is considered to have occurred when marine mammals are exposed to underwater sounds ≥ 160 dB rms for impulse sounds (e.g., impact pile driving) and 120 dB rms for continuous noise (e.g., vibratory pile driving), but below injurious thresholds. Level A (injury) and Level B (disturbance) thresholds are provided in Table 6–4.

As described above for underwater sound injury and harassment thresholds, NMFS uses generic sound exposure thresholds to determine when an activity in the ocean that produces airborne sound might result in impacts to a marine mammal (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 project locations. NMFS has identified behavioral harassment threshold criteria for airborne noise generated by pile driving for pinnipeds regulated under the MMPA. Level A injury threshold criteria for airborne noise have not been established. The Level B behavioral harassment threshold for harbor seals is 90 dB rms (unweighted) and for all other pinnipeds is 100 dB rms (unweighted).

Table 6-4: Injury and Disturbance Thresholds for Underwater and Airborne Sounds

Marine Mammals	**Airborne Marine Construction Criteria** (Impact & Vibratory Pile Driving) **(re 20 µPa)**	**Underwater Vibratory Driving Criteria** (e.g., non-pulsed/continuous sounds) **(re 1 µPa)**		**Underwater Impact Pile Driving Criteria** (e.g., pulsed sounds) **(re 1 µPa)**	
	Disturbance Guideline Threshold (Haulout)[1]	**Level A Injury Threshold**	**Level B Disturbance Threshold**	**Level A Injury Threshold**	**Level B Disturbance Threshold**
Cetaceans (whales, dolphins, porpoises)	N/A	180 dB rms	120 dB rms	180 dB rms	160 dB rms
Pinnipeds (seals, sea lions, walrus; except harbor seal)	100 dB rms (unweighted)	190 dB rms	120 dB rms	190 dB rms	160 dB rms
Harbor seal	90 dB rms (unweighted)	190 dB rms	120 dB rms	190 dB rms	160 dB rms

[1]Sound level at which pinniped haulout disturbance has been documented. Not an official threshold, but used as a guideline. dB = decibel; N/A = not applicable; rms = root mean square

6.5.1 Limitations of Existing Noise Criteria

The application of the 120 dB rms threshold can sometimes be problematic because this threshold level can be either at or below the ambient noise level of certain locations. As a result, this threshold level is subject to ongoing discussion (NMFS 2009 74 FR 41684). NMFS is developing new science-based thresholds to improve and replace the current generic exposure level thresholds, but the criteria have not been finalized (Southall et al. 2007). The 120 dB rms threshold level for continuous noise originated from research conducted by Malme et al. (1984, 1988) for California gray whale response to continuous industrial sounds such as drilling operations. The 120 dB *continuous* sound threshold should not be confused with the 120 dB *pulsed* sound criterion established for migrating bowhead whales in the Arctic as a result of research in the Beaufort Sea (Richardson et al. 1995; Miller et al. 1999).

To date, there is no research or data supporting a response by pinnipeds or odontocetes to continuous sounds from vibratory pile driving as low as the 120 dB threshold. Southall et al. (2007) reviewed studies conducted to document behavioral responses of harbor seals and northern elephant seals to continuous sounds under various conditions, and concluded that those limited studies suggest that exposures between 90 dB and 140 dB rms re 1µPa generally do not appear to induce strong behavioral responses.

6.5.2 Auditory Masking

Natural and artificial sounds can disrupt behavior by masking, or interfering with a marine mammal's ability to hear other sounds. Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher levels. If the second sound were anthropogenic, it could be potentially harassing (according to the MMPA) if it disrupted hearing-related behavior such as communications or echolocation. It is important to distinguish temporary threshold shift (TTS) and permanent threshold shift (PTS), which persist after the sound exposure, from masking, which occurs during the sound exposure. Because masking (without a resulting in a threshold shift [TS]) is not associated with abnormal physiological function, it is not considered a physiological effect in this IHA application, but rather a potential behavioral effect.

The most intense underwater sounds in the proposed action are those produced by impact pile driving. Given that the energy distribution of pile driving covers a broad frequency spectrum, sound from these sources would likely be within the audible range of Steller sea lions, California sea lions, harbor seals, transient killer whales, harbor porpoise, and Dall's porpoise. Impact pile driving activity is relatively short-term, with rapid pulses occurring for approximately 15 minutes per pile. The probability for impact pile driving resulting from this proposed action masking acoustic signals important to the behavior and survival of marine mammal species is therefore negligible. Vibratory pile driving is also relatively short-term, with rapid oscillations occurring for a few minutes to approximately an hour per pile. It is possible that vibratory pile driving resulting from this proposed action may mask acoustic signals important to the behavior and survival of marine mammal species, but the short-term duration and limited affected area would result in a negligible impact from masking. Any masking event that could possibly rise to Level B harassment under the MMPA would occur concurrently within the zones of behavioral harassment already estimated for vibratory and impact pile driving, and which have already been taken into account in the exposure analysis.

6.6 Distance to Sound Thresholds

6.6.1 Underwater Sound Propagation Formula

Pile driving would generate underwater noise that could potentially result in disturbance to marine mammals swimming by the project area. Transmission loss underwater is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source. Transmission loss parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, and bottom composition and topography. A practical sound propagation modeling technique was used to estimate the range from the pile driving activity to various expected sound pressure levels 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 sound pressure level at some distance away from the source (e.g., driven pile) is governed by a measured source level, minus the transmission loss of the energy as it dissipates with distance. The formula for underwater transmission loss is:

$TL = 15 * \log_{10}(R_1/R_2)$,

Where: TL = Transmission loss

R_1 = the distance of the modeled sound pressure level from the driven pile, and
R_2 = the distance from the driven pile of the initial measurement.

The degree to which underwater noise propagates away from a noise source is dependent on a variety of factors, most notably by the water bathymetry and presence or absence of reflective or absorptive conditions including in-water structures and sediments. In a perfectly unobstructed (free-field) environment not limited by depth or water surface, noise follows the spherical spreading law, resulting in a 6 dB reduction in noise level for each doubling of distance from the source [20*log(range)]. Cylindrical spreading occurs in an environment wherein noise propagation is bounded by the water surface and sea bottom. In this case, a 3 dB reduction in noise level is observed for each doubling of distance from the source [10*log(range)].

The propagation environment along the Bangor waterfront on NBK is neither free-field nor cylindrical; as the receiver moves away from the shoreline, the water increases in depth, resulting in an expected propagation environment that would lie between spherical and cylindrical spreading loss conditions. The practical spreading loss method uses a 4.5 dB reduction in noise level for each doubling of distance from the source [15*log(range)], and has been accepted by NMFS and U.S. Fish and Wildlife Service (USFWS).

6.6.2 Underwater Noise from Pile Driving

The intensity of pile driving sounds, is greatly influenced by factors such as the type of piles, hammers, and the physical environment in which the activity takes place. The source levels obtained for steel piles during the Test Pile Program were in similar substrate (silty sand) and shallow depth environment (<100 ft [30 m]) as the current project.

Table 6-5 details representative pile driving sound pressure levels from the Test Pile Program. Due to the similarity of this action and the Navy's proposed action, they represent reasonable sound pressure levels that are expected during the vibratory and impact installation of the 24-inch, 36-inch, and 48-inch piles and vibratory removal of the 24-inch steel pipe pile. Since 20-inch piles were not measured during the Test Pile Program, the Barge Mooring Project sound analysis uses the sound pressure levels from the 24-inch piles as a conservative estimate.

Table 6-5: Summary of Underwater Sound Pressure Levels during the Test Pile Program

Installation Method	Steel Pipe Pile Size	Peak dB[1]	RMS dB[1]	Singe Strike SEL[2]
Impact	24-inch	193	180	167
	36-inch	210	196	177
	48-inch	209	194	180
Vibratory	24-inch	-	160	-
	36-inch	-	169	-
	48-inch	-	172	-

[1]Measured at 10 m; referenced to 1 μPa. [2]Measured at 10 m; referenced to 1 μPa^2*sec. Source: Illingsworth and Rodkin 2012.

A bubble curtain will be used to minimize the noise generated by impact pile driving. The Test Pile Program reported a range of measured values mostly within 6 to 12 dB reduction (Illingworth & Rodkin, Inc. 2012). The sole 24-inch pile in this project was struck a total of 3 times with the bubble curtain turned on; therefore, the results are unlikely to be indicative of values that would be obtained on this site with more extensive measurements. For 36-inch piles the average peak and RMS reduction with use of the bubble curtain was 8 dB, where the averages of all bubble-on and bubble-off data were compared (see Table 6-6 below). For 48-inch piles, the average SPL reduction with use of a bubble curtain was 6 dB for average peak values and 5 dB for RMS values (see Table 6-7 below).

Table 6-6. Reduction in Average Noise Values for Impact Pile Driving of 36-inch Steel Piles with a Bubble Curtain, Measured at 10 meters (dB re 1µPa) combining mid-depth and deep-depth data. Measurements obtained during Bangor Naval Base Test Pile Program.

	Sound Level (RMS)[1]	**Sound Level (Peak)[2]**	**Sound Level (SEL)[3]**
Bubble Curtain On			
Maximum	190	208	180
Average	181	195	172
Standard deviation	5.45	6.09	5.07
Bubble Curtain Off			
Maximum	196	210	184
Average	189	203	177
Standard deviation	4.71	5.82	4.57

Source: Illingworth & Rodkin 2012[1] Values are the averages of all bubble-on data and the averages of all bubble-off data, based on the average impulse RMS (RMS_{imp}) levels over the entire pile driving event. [2] Values are average peak levels of all bubble-on data and all bubble-off data. [3] Values are the average single strike SEL of all bubble-on data and all bubble-off data.

Table 6-7. Reduction in Average Noise Values for Impact Pile Driving of 48-inch Steel Piles with a Bubble Curtain, Measured at 10 meters (dB re 1µPa) combining mid-depth and deep-depth data. Measurements obtained during Bangor Naval Base Test Pile Program.

	Sound Level (RMS)[1]	Sound Level (Peak)[2]	Sound Level (SEL)[3]
Bubble Curtain On			
Maximum	191	209	181
Average	187	201	177
Standard deviation	4.43	5.90	4.17
Bubble Curtain Off			
Maximum	194	209	181
Average	192	207	180
Standard deviation	1.83	1.71	1.41

Source: Illingworth & Rodkin 2012 [1] Values are the averages of all bubble-on data and the averages of all bubble-off data, based on the average impulse RMS (RMS_{imp}) levels over the entire pile driving event. [2] Values are average peak levels of all bubble-on data and all bubble-off data. [3] Values are the average single strike SEL of all bubble-on data and all bubble-off data.

We also reviewed attenuation rates from other available reports from projects in Washington, California, and Oregon that impact drove steel pipe piles up to 48-inches in diameter using unconfined bubble curtains. Table 6-8 contains a summary of the attenuation levels reported. Several studies were reviewed, but not included in the summary because they were not considered representative. Excluded studies were:

- Willamette River Bridge Project (Caltrans 2012). Bubble curtain was poorly designed and deployed in a river with a high current. No RMS SPLs reported.
- South Umpqua River (Caltrans 2012). Current conditions resulted in little coverage of piles by bubble curtain. No RMS SPLs reported.
- Ten Mile River Bridge Porject (Caltrans 2012). 30-inch piles driven with bubble curtain, but inside of cofferdam.

Of the remaining studies reviewed, significant variability in attenuation occurred; however, an average of at least 8 dB of peak SPL attenuation was achieved on ten of the twelve projects (Table 6-9). Some of the lower attenuation levels reported were attributed to the bottom ring not seated on the substrate, poor airflow, or currents that resulted in an uneven distribution of bubbles (WSDOT 2005a, WSDOT 2005b, Caltrans 2012).

To avoid loss of attenuation from design and implementation errors, our project has specific bubble curtain design specifications, including testing requirements for air pressure and flow prior to initial impact hammer use, and a requirement for placement on the substrate. Therefore, we believe 8 dB is a realistic, but conservative estimate of average SPL reduction.

Table 6-8. Summary of Attenuation Levels with Use of an Unconfined Bubble Curtain During Impact Driving of Steel Pipe Piles up to 40-inches Diameter

Project/Location	**Steel Pipe Pile Diameter**	**Range (dB)**	**Mean Peak dB re 1µPa @ 10 m**	**Standard Deviation (dB)**
Friday Harbor Ferry Terminal Restoration/ San Juan Island marine waters, WA[1]	24-inch, 30-inch	0-5	2	2.2
Bainbridge Island Ferry Terminal Preservation/ Puget Sound marine waters, WA[1]	24-inch	3-14	7	4.7
Cape Disappointment Boat Launch Facility, Wave Barrier Project/ Columbia River, Illwaco, WA[1]	12-inch (n=5[*])	6-17	11	4.9
Mukilteo Ferry Terminal Test Pile/Puget Sound marine waters, WA[1]	36-inch (n=2)	7-22	15	10.6
Anacortes Ferry Terminal Dolphin Replacement/Puget Sound marine waters, WA[1]	36-inch (n=7)	3-11	8	3.1
SR 520 Test Pile Project/Lake Washington/Portage Bay (freshwater), WA[1, 2]	24-inch (n=4) 30-inch (n=2)	3-32	20	11.1
Columbia River Crossing Test Pile Program/Columbia River, WA/OR[3]	24-inch (n=1)	---	10	---
Tesoro's Amorco Wharf/San Francisco Bay, Martinez, CA[2]	24-inch (n =18 battered and n =18 vertical)	---	~10 dB (not well seated, stated capable of up to 15 dB and strong currents present at times and poor positioning on some piles)*	---

Deep Water-tongue Point Facility Pier Repairs/Columbia River, Astoria, OR[2]	24-inch (n = 10)	5-22	14	---
Portland-Milwaukie Light Rail Project/Willamette River, Portland, OR[2]	24-inch (n=5)	8-27	---	---
Bay Ship and Yacht Dock/San Francisco Bay, Almeda, CA[2]	40-inch (n = 2)	---	~10-15 (Not installed at the substrate at start of drive. Performance from part of drive when bubble curtain properly situated).	---
Richmond-San Rafael Bridge Project/San Francisco Bay, CA[2]	30-inch (n=2)	---	9	---

Sources: [1]WSDOT 2013, Also, see individual report references below for WSDOT; [2]Caltrans 2012; [3]CRC 2011. Also, see individual report references below for WSDOT projects.*Includes rate from 4 winged-piles driven with a U-shaped bubble curtain.**Attenuation level derived from poorly attenuated piles.

Table 6-9 presents the calculated distance to and areas encompassed by the underwater marine mammal thresholds during pile driving 48-inch piles during the Barge Mooring Project. Since it is unknown what size piles may be driven on any given day during the project, the distances were conservatively calculated using the 48-inch piles, which would provide the largest potential areas exceeding the thresholds. The predicted area exceeding the threshold assumes a field free of obstruction, which is unrealistic; however, because Hood Canal does not represent open water conditions (free field) and therefore, sounds would attenuate as they encountered land masses or bends in the canal. As a result, some of the distances and areas of impact calculated cannot actually be attained at the project area. The actual distance to the behavioral disturbance thresholds for pile driving may be shorter than the calculated distance due to the irregular contour of the waterfront, the narrowness of the canal, and the maximum fetch (furthest distance sound waves travel without obstruction [i.e., line of site]) at the project area. This distance is presented in Table 6-6. Figures 6-1 and 6-2 graphically depict the representative areas of each underwater sound threshold for marine mammals (cetaceans and pinnipeds) that are predicted to occur at the project area due to pile driving 48-inch piles during the Barge Mooring Project.

Table 6-9: Calculated Distance(s) to and Area(s) Encompassed by the Underwater Marine Mammal Noise Thresholds during Steel Pile Driving

Species	Threshold	Distance in (m)	Distance in (km)	Actual Area in (km^2)
Pinnipeds	Vibratory Driving Injury (190 dB rms)	1	0.001	0.00000314
Cetaceans	Vibratory Driving Injury (180 dB rms)	3	0.003	0.0000283
All Marine Mammals	Vibratory Driving Disturbance (120 dB rms)	29,286*	29.286	16.1
Pinnipeds	Impact Driving Injury (190 dB rms)	7	0.007	0.000154
Cetaceans	Impact Driving Injury (180 dB rms)	34	0.034	.00363
All Marine Mammals	Impact Driving Disturbance (160 dB rms)	736	0.736	1.702

All sound levels expressed in dB re 1 µPa rms. dB = decibel; rms = root-mean-square; µPa = microPascal; Practical spreading loss (15 log, or 4.5 dB per doubling of distanced) used for calculations. Sound pressure levels used for calculations were: 196 dB rms re1 µPa @ 10m for impact and 172 dB rms re1 µPa @ 10m for vibratory. Since the sound pressure levels measured during the TPP were higher for the 36" piles than for the 48" piles he source level data for 36"piles was used in the analysis to provide a conservative estimate. 8 db of attenuation was applied to source sound pressure levels. *Range calculated is greater than what would be realistic. Hood Canal average width at site is 2.4 km, and is fetch limited from N to S at 20.3 km.

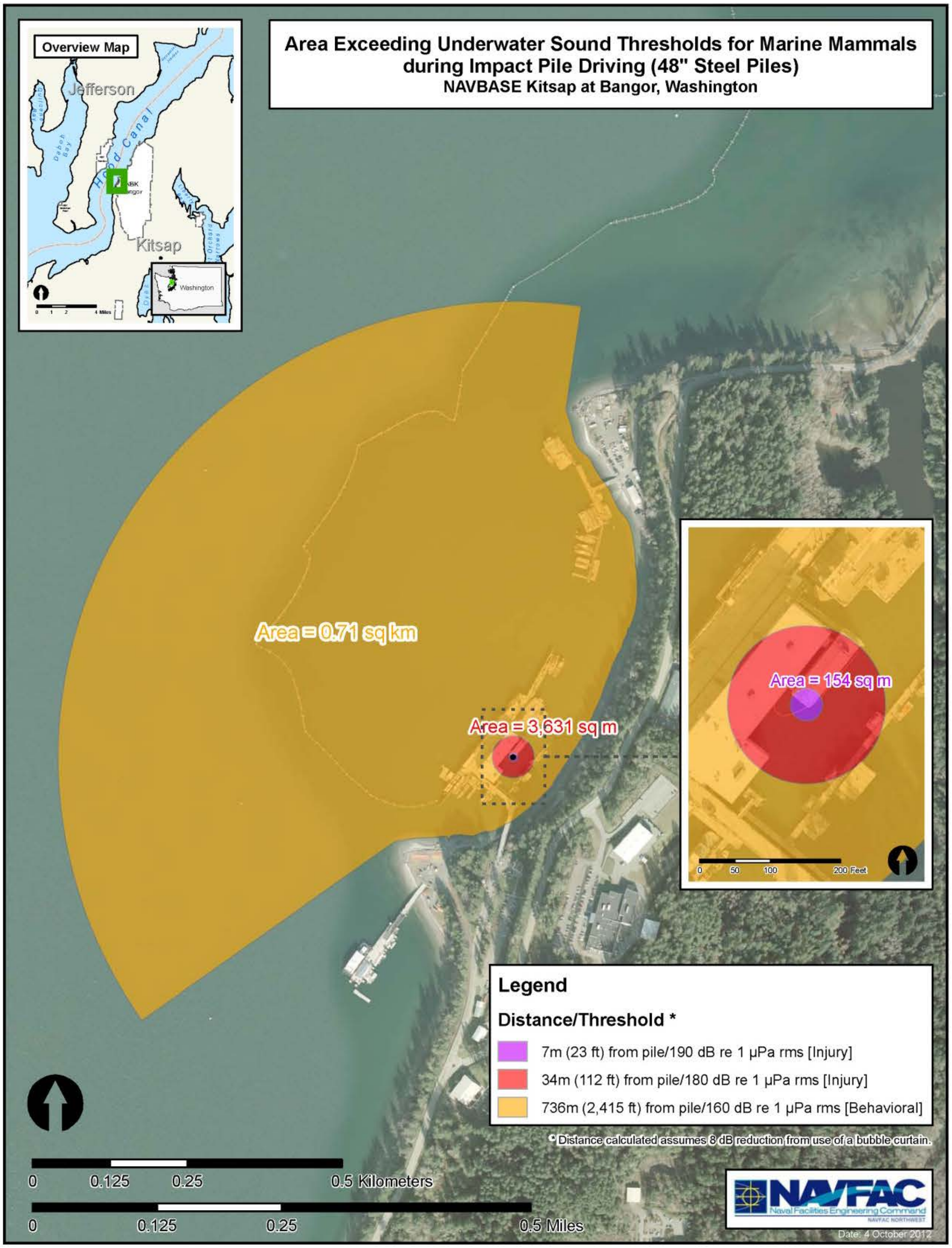

Figure 6-1: Representative Distance to Marine Mammal Underwater Thresholds during Impact Pile Driving 48-inch Piles

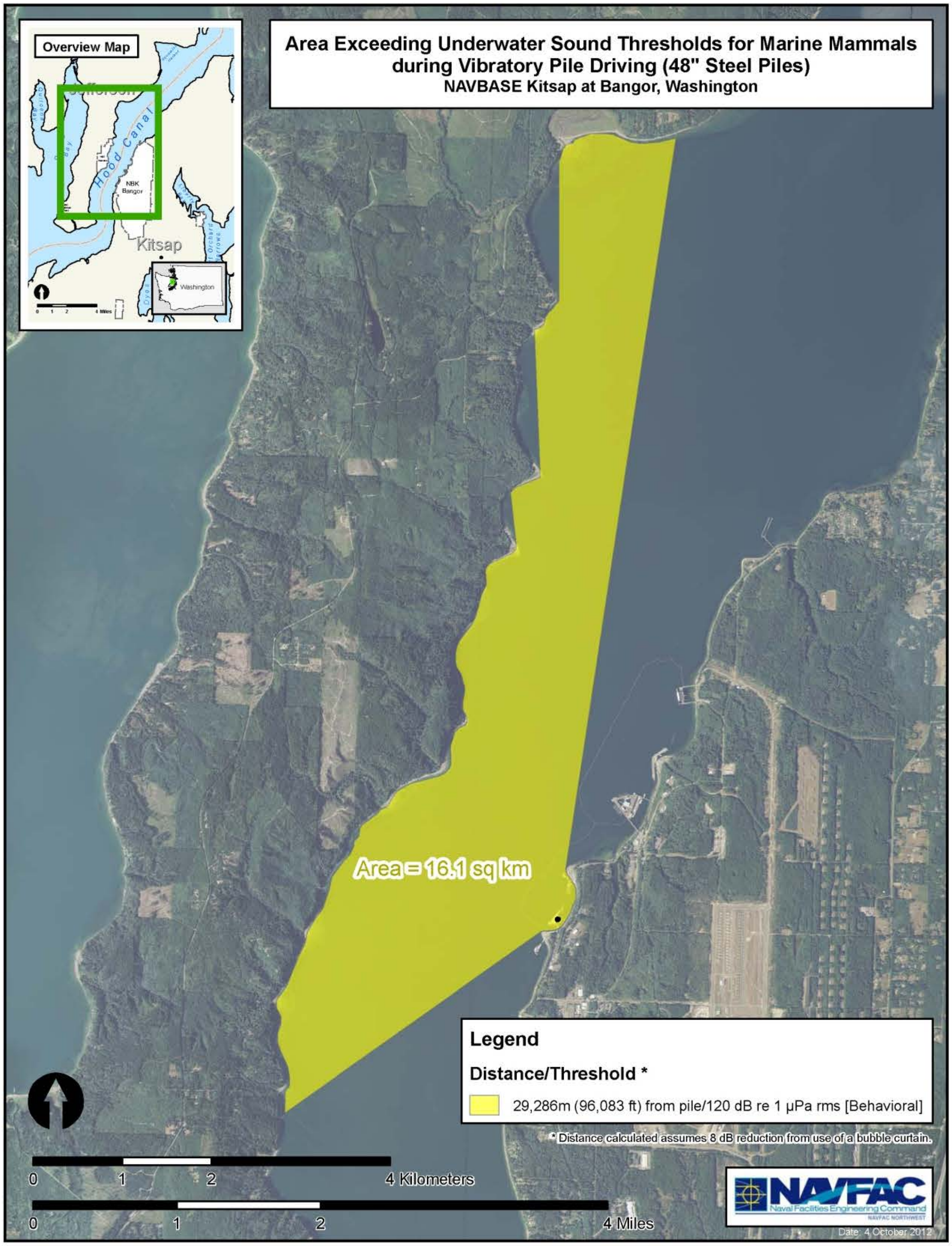

Figure 6-2: Representative Distance to Marine Mammal Underwater Disturbance Thresholds during Vibratory Pile Driving 48-inch Piles

6.6.3 Airborne Sound Propagation Formula

Pile driving can generate airborne noise that could potentially result in disturbance to marine mammals (pinnipeds) which are hauled out or at the water's surface. As a result, the Navy analyzed the potential for pinnipeds hauled out or swimming at the surface near the NAVBASE Kitsap, Bangor to be exposed to airborne sound pressure levels that could result in Level B behavioral harassment. The appropriate airborne noise thresholds for behavioral disturbance for all pinnipeds, except harbor seals is 100 dB re 20 µPa rms (unweighted) and for harbor seals is 90 dB re 20 µPa rms (unweighted) (see Table 6-3). Construction noise behaves as point-source, and thus propagates in a spherical manner, with a 6 dB decrease in sound pressure level over water ("hard-site" condition) per doubling of distance (WSDOT 2010c). A spherical spreading loss model, assuming average atmospheric conditions, was used to estimate the distance to the 100 dB and 90 dB rms re 20 µPa (unweighted) airborne thresholds. The formula for calculating spherical spreading loss is:

$$TL = 20 * \log_{10}(R1/R2),$$

Where: TL = Transmission loss in dB
R1 = the distance of the modeled sound pressure level from the source, and
R2 = the distance from the source of the initial measurement.

6.6.4 Airborne Sound from Pile Driving

The intensity of pile driving sounds is greatly influenced by factors such as the type of piles, hammers, and the physical environment in which the activity takes place. In order to determine reasonable airborne sound pressure levels and their associated affects on marine mammals that are likely to result from pile driving on NAVBASE Kitsap, Bangor, studies with similar properties to the proposed action were evaluated.

Airborne pile driving sound pressure levels documented during the Test Pile Program are shown in Table 6-10. Due to the similarity to the Barge Mooring Project, they represent reasonable sound pressure levels that could be anticipated and these values were used in the acoustic modeling and analysis. The 36-inch pile data from the Test Pile Program was the loudest measurement during driving the 24-inch to 48-inch piles. This is the most reliable and representative unweighted measurement; therefore, this data was used for all pile sizes in this analysis and provides a conservative estimate.

Table 6-10: Airborne Sound Pressure Levels during the Test Pile Program

Pile Size &Type	Method	Measured Sound Pressure Levels
24-inch, 36-inch and 48-inch Steel Pipe	Vibratory	102 dB re 20 µPa rms at 15 m
24-inch, 36-inch and 48-inch Steel Pipe	Impact	109 dB re 20 µPa rms at 15 m

Source: Illingworth&Rodkin, INC. 2012

The distances to the airborne thresholds were calculated with the airborne transmission loss formula presented in section 6.6.3. The calculated distances to and the total area encompassed by the marine mammal airborne thresholds are provided in Table 6-11. All airborne distances are less than those calculated for underwater sound thresholds. All construction noise associated with the project would not extend beyond the buffer zone that would be established to protect seals and sea lions during impact installation. Figures 6-3 through 6-4 depict representative distances for each airborne pinniped sound threshold that is predicted to be exceeded due to pile driving.

Table 6-11: Calculated Distances (m) to and the Area(s) Encompassed by the Marine Mammal Airborne Noise Thresholds duringPile Driving 48-inch Steel Piles.

Species	Threshold	Airborne Behavioral Disturbance		
		Distance (m)	Distance (km)	Area (km^2)
Pinnipeds (except harbor seal)	100 dB rms (vibratory disturbance)	19	0.019	0.001134
Harbor seal	90 dB rms (vibratory disturbance)	60	0.06	0.01131
Pinnipeds (except harbor seal)	100dB rms (impact disturbance)	42	0.042	0.005542
Harbor seal	90 dB rms (impact disturbance)	134	0.134	0.05641

All sound pressure levels are reported re 20 µPa rms (unweighted). Airborne ranges based on a spherical spreading model

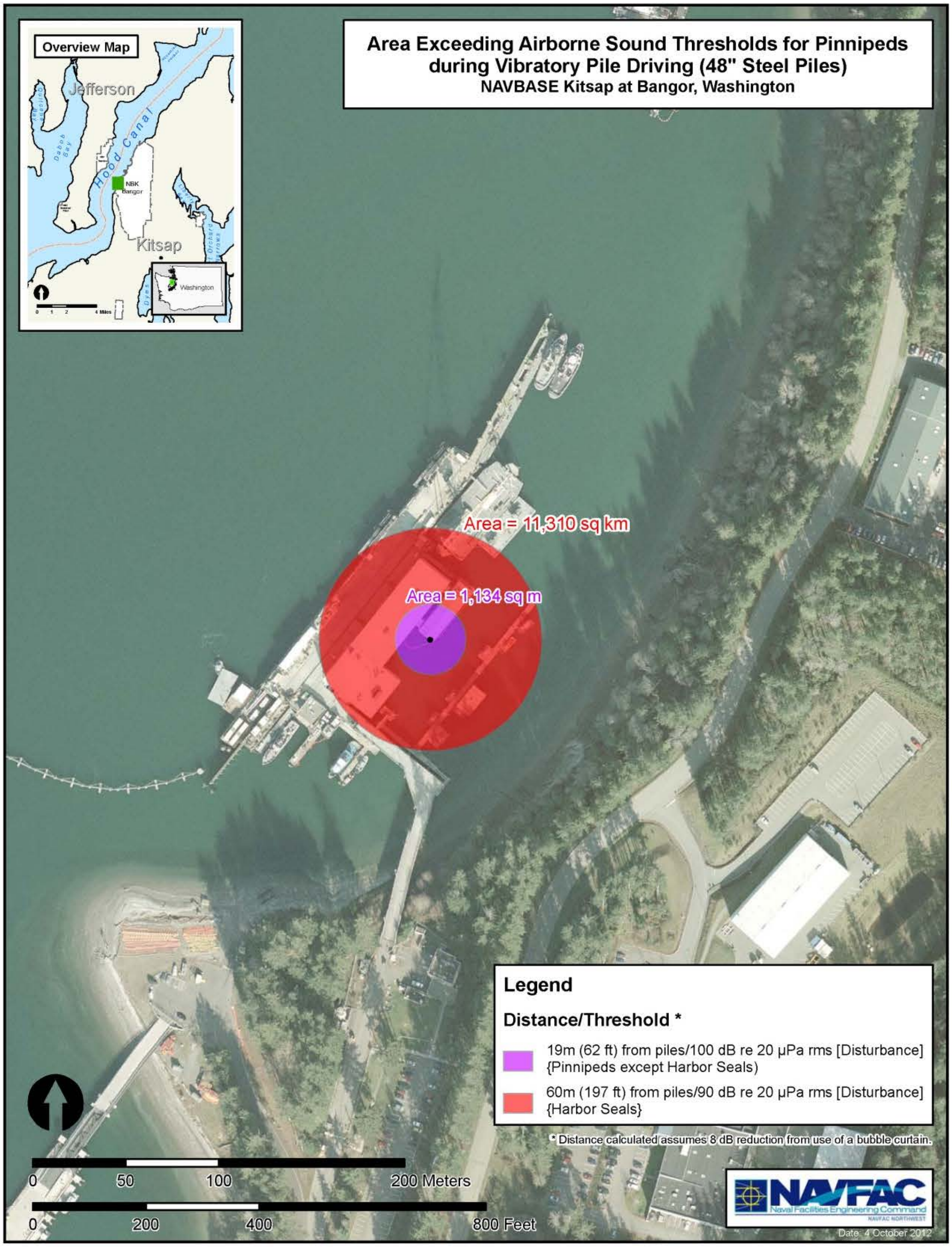

Figure 6-3: Representative Area (km^2) Exceeding Airborne Sound Thresholds for Pinnipeds during Vibratory Pile Driving

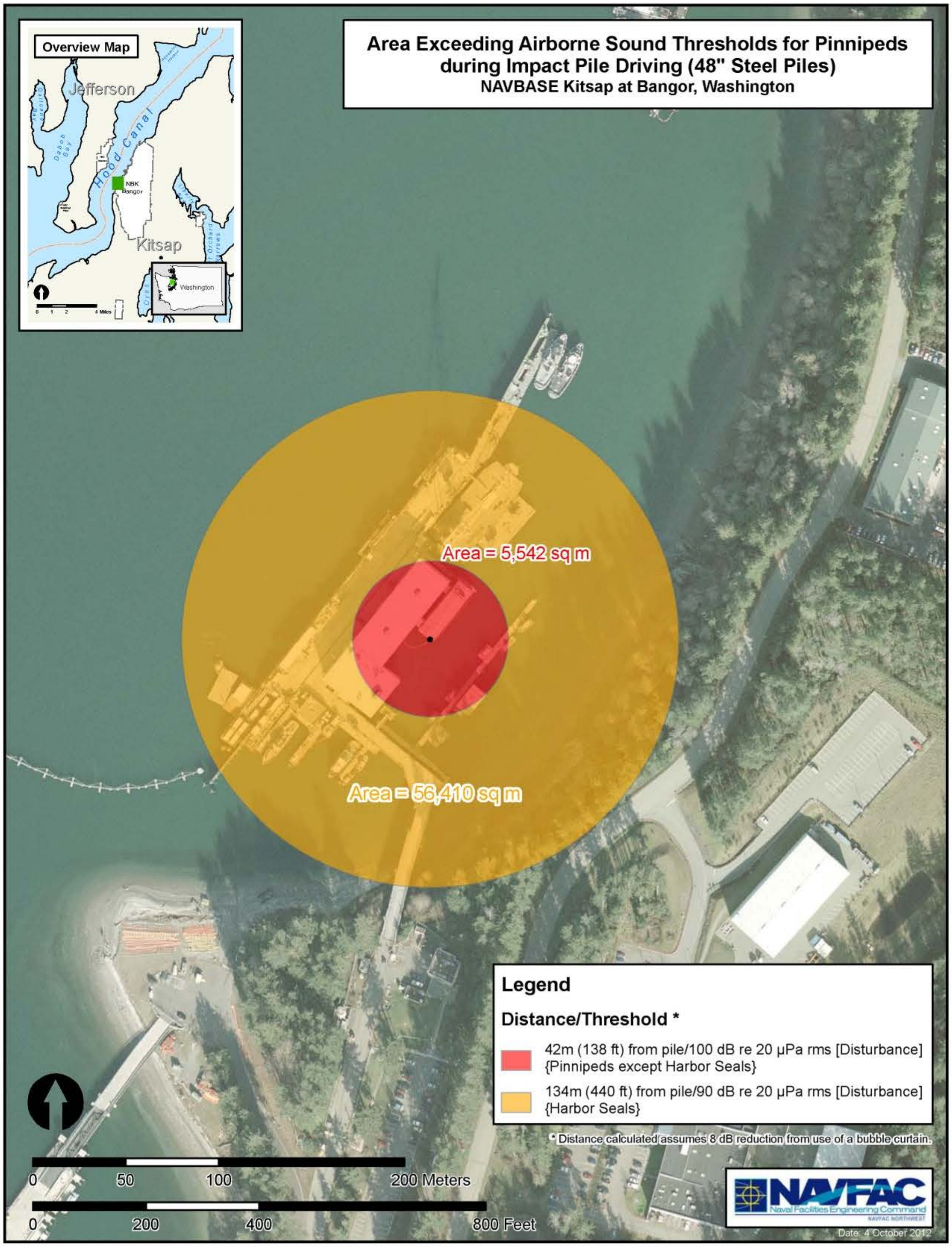

Figure 6-4. Representative Area (km^2) exceeding Airborne Sound Thresholds for Pinnipeds during Impact Pile Driving

6.7 Marine Mammal Species Quantitatively Assessed

The marine mammal density data used for this analysis come from the Navy Marine Species Density Database (NMSDD) (Navy 2013). The density data were derived from the best available data published in the literature or from survey efforts. The maximum density value for each species for each site was used in the marine mammal take assessment calculation.

All of the pinniped derived abundances assumed that pinnipeds would be both in the water 100% of the time during pile driving activities for underwater calculations and out of water 100% of the time for the airborne calculations. This approach could be considered conservative because pinnipeds spend a portion of their time hauled out and therefore are expected to be exposed to less sound than is estimated by this approach since the in-air Zone of Influence (ZOI), or area affected by the noise criteria, is much smaller that the underwater ZOIs.

When pile driving is under way, exposure to increased sound pressure levels would likely involve individuals that that are moving through the area during foraging trips. Pinnipeds may also be exposed en route to haulout sites or returning to Puget Sound. If exposure were to occur, both pinnipeds and cetaceans could exhibit behavioral changes such as increased swimming speeds, increased surfacing time, or decreased foraging. Most likely, individuals affected by elevated underwater or airborne noise would move away from the sound source and be temporarily displaced from the areas of pile installation and extraction. Any effects experienced by individual marine mammals are anticipated to be limited to short-term disturbance of normal behavior or temporary displacement of animals near the source of the noise. Therefore, the exposures requested are expected to have no more than a minor effect on individual animals and no effect on the populations of these species.

6.8 Description of Exposure Calculation

The exposure calculations presented here rely on the best data currently available for marine mammal populations in the Puget Sound, where animal densities were specific to each project location. The method for calculating potential exposures to impact and vibratory pile driving noise for each specific threshold, and includes 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 one potential taking per individual 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 largest pile furthest from shore).
- Pile driving could potentially occur every day of the in-water work window; however, no more than a couple hours pile driving are estimated to occur per day (one hour of vibratory, and 25-40 minutes of impact). The total number of days for steel pile installation and removal are estimated to be 20 (21 piles total with no more than four piles installed each day).

The calculation for marine mammal exposures is estimated by:

Exposure estimate = (n * ZOI) * X days of total activity,

Where:

n = density estimate used for each species/season

X = number of days of pile vibratory extraction or pneumatic chipping, estimated based on the total number of piles and the average number of piles that the contractor can remove per day.

ZOI[6] = noise threshold zone of influence (ZOI) impact area[7]

The ZOI impact area is the estimated range of impact to the noise criteria. The formula for determining the area of a circle ($\pi * radius^2$) was used to calculate the ZOI around each pile, for each threshold. The distances specified in Tables 6–8 and 6–9 were used to calculate the overwater areas that would be encompassed within the threshold distances for injury or disturbance harassment. As described in Section 6.5.2 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 along the Bangor shoreline on NAVBASE Kitsap and the Toandos Peninsula on the opposite shoreline, which would dissipate sound pressure waves (WSDOT 2010c).

The exposure assessment methodology is an estimate of the numbers of individuals exposed to the effects of pile driving activities exceeding NMFS established thresholds. Table 6-12 shows the exposures expected for each species. Results from acoustic impact exposure assessments should be regarded as conservative estimates that are strongly influenced by limited marine mammal population data. While the numbers generated from the pile driving exposure calculations provide conservative overestimates of marine mammal exposures, the short duration and limited geographic extent of Barge Mooring Project would further limit actual exposures.

[6] Zone of Influence (ZOI) is the area encompassed by all locations where the sound pressure levels equal or exceed the threshold being evaluated.

[7] 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.

Table 6-12: Total Number of Potential Exposures for All Species During the Barge Mooring Project Pile Driving (July 16 through September 30)

Species	Underwater	Airborne	
	Vibratory[1] Disturbance Threshold (120dB re 1 µPa rms)	Vibratory/Impact Disturbance Threshold (100dB re 20 µPa rms)	Vibratory/Impact Disturbance Threshold (90dB re 20 µPa rms)
Humpback Whale	0	N/A	N/A
Steller Sea Lion	0	0[2]	N/A
California Sea Lion	660	0[2]	N/A
Harbor Seal	341	N/A	0[2]
Transient Killer Whale	120[3]	N/A	N/A
Dall's Porpoise	0	N/A	N/A
Harbor Porpoise	40	N/A	N/A
Total	**1,161**		

No injury exposures of any species are expected. [1]The impact disturbance ZOI is within the larger vibratory ZOI. [2]Both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance threshold. No haulouts are located within the area exceeding the airborne thresholds. Therefore, it is expected that pinniped takes would occur as a result of underwater exposures rather than in-air exposures. The modeling indicated that zero killer whales were likely to be exposed to sounds that would qualify as behavioral harassment during impact pile driving (160 dB zone). However, the Navy is requesting 120 behavioral takes of Transient killer whales – based on the average size of pods seen previously in the Hood Canal and their residence times - by pile driving over the course of the project.

6.8.1 Humpback Whale

One individual humpback whale has been documented in Hood Canal with sightings in January and February 2012. Although known to be historically abundant in the inland waters of Washington, no other documentation of humpback whales in Hood Canal is available. Their presence has likely not occurred in several decades.

The density for humpback whales in the Hood Canal is 0.000001/km^2 (Navy 2013). A seasonal use trend in Hood Canal was not possible to discern from one occurrence. However, humpback whales occur intermittently in all months in other Washington inland waters; therefore, we assumed that humpback whales could occur year-round. Exposure calculated using the formula presented in Section 6.7 is estimated at zero. With the absence of any regular occurrence adjacent to the project site and only 20 days estimated for pile driving with short durations per day, the Navy believes the likelihood of exposure is discountable and is not requesting take for this species.

6.8.2 Steller Sea Lion

Steller sea lions are present in the Hood Canal, but are only expected in the project area during October through May. The earliest documented occurrence of Steller sea lions along NAVBASE Kitsap, Bangor occurred on September 30, 2010 when 5 individuals were observed at Delta Pier during daily surveys. During monitoring during the Test Pile Program, Steller sea lions were documented arriving on October 8, 2011 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.

The proposed project will occur between July 16 and September 30. It is anticipated that pile driving will begin July 16, or shortly after, and last 20 work days; pile driving will be completed by September 30. Since Steller sea lions are not likely to be present in the project area during this time, no exposure to acoustic impacts from pile-driving operations are expected, and the Navy is not requesting take for this species.

6.8.3 California Sea Lion

California sea lions are present in Hood Canal during much of the year with the exception of mid-June and July. California sea lions occur regularly near the project site from August through mid-June, as determined by Navy waterfront surveys conducted from April 2008 through December 2011 (Navy 2011). The largest monthly average (58 animals) was recorded in November, as was the largest daily count (81 in 2011). A California sea lion was observed arriving on the NAVBASE Kitsap, Bangor waterfront for the first time in August in 2009 (Navy 2012).

The likelihood of California sea lions being present on NAVBASE Kitsap, Bangor is greatest from October through May, when the frequency of attendance in surveys was at least 0.70. Table 6–13 reports the frequency of California sea lion presence at survey sites and the monthly average of the maximum number of California sea lions observed during the Navy's surveys.

Table 6-13. California Sea Lions (CSL) Observed on NAVBASE Kitsap, Bangor, April 2008 - December 2011

	Number of Surveys with CSL present	Number of Surveys	Frequency of CSL presence at survey sites[1]	Monthly Average of Maximum Number Observed
January	26	37	0.70	27.0
February	34	41	0.83	34.6
March	37	39	0.95	43.6
April	43	54	0.80	43.75
May	49	61	0.80	32.25
June	13	56	0.23	8.3
July	0	54	0.00	0.0
August	9	55	0.16	2.0
September	22	43	0.51	22.8
October	46	50	0.92	47.3
November	45	45	1.00	57.8
December	36	46	0.78	44.8
Totals	360	581	Average all Months: 0.64 Average during Project Duration: 0.22	Average Within Project Duration: 8.3

1. Frequency is the number of surveys with California sea lions present/number of surveys conducted.

The largest daily number of California sea lions hauled out along the waterfront on NAVBASE Kitsap, Bangor during previous months within the project timeframe was 0 in July (all years), 4 in August (2011), and 33 in September (2010)(Navy 2011). During construction monitoring and baseline surveys conducted from late August through October 2011, the largest daily attendance averaged for each month ranged from 24 individuals to 54 individuals.

The density for California sea lions was calculated to be 0.28 animals per sq km (Navy 2013). However, this density was derived by averaging data collected year-round. The Barge Mooring Project will occur during the months when California sea lions are the least abundant in Hood Canal and the NMSDD density does not allow for this level of seasonal variation. Therefore, a more accurate approach to calculating exposures during the project would be to use data collected at the Bangor waterfront during the months in which the project will occur, July-September. The highest number of individual California sea lions observed hauled on NAVBASE Kitsap, Bangor during this time was 33, which occurred at the end of September in 2010. Exposures were calculated assuming 33 individuals could be present in the behavioral ZOI per day for the 20 days during which pile driving will occur resulting in 660 behavioral exposures. However, if all pile driving were to occur July or August, the number of takes would be reduced.

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 California sea lions in Hood Canal. Their haulout sites, submarines docked at Delta Pier (approximately one mile north of the Barge Mooring Project location) and the pontoons of the security fence within this area, are not within the underwater distance threshold for behavioral harassment due to vibratory pile installation since sound would encounter land before reaching the haulout site (Figure 6-2). This area is also outside the airborne ZOI (Figure 6-3 and 6-4). California sea lions have also been sighted on the port security fence west of the Service Pier. This area is within the vibratory underwater disturbance ZOI but not within the airborne disturbance ZOI (Figures 6-2, 6-3 and 6-4). Therefore, it is assumed that animals swimming to and from the submarines or floating security fences may be exposed to disturbing noise levels resulting from pile driving.

Based on 20 days of piling driving and the maximum number of individuals observed at the project site during July-September, the Navy has determined that up to 660 individual California sea lions may experience sound pressure levels exceeding the behavioral threshold (Level B take) during pile driving. Due to the small size of the injury ZOI and the implementation of a NMFS approved monitoring plan, California sea lions are not expected to experience elevated noise levels that would result in injury (Level A take).

California sea lions would typically be present in the project area during a portion (September) of the in-water construction period (mid-July through the end of September). California sea lions that are taken could exhibit behavioral changes such as increased swimming speeds, increased surfacing time, or decreased foraging. Most likely, California sea lions may move away from the sound source and be temporarily displaced from the areas of pile driving. With the absence of any major rookeries and only a few isolated haulout areas near or adjacent to the project site, potential takes by disturbance will have a negligible short-term effect on individual California sea lions and would not result in population-level impacts.

6.8.4 Harbor Seal

Harbor seals are the most abundant marine mammal in Hood Canal, where they can occur anywhere in Hood Canal waters year-round. The Navy detected harbor seals during marine mammal boat surveys of the waterfront area from July to September 2008 (Tannenbaum et al. 2009) and November to May 2010 (Tannenbaum et al. 2011), and August through October 2011 (Navy 2012), as described in Section 4.2.2. Harbor seals were sighted during every survey and were found in all marine habitats including nearshore waters and deeper water, and hauled out on manmade objects such as piers and buoys. Three to five individuals were detected in most boat surveys, which encompassed the entire waterfront out to a distance of at least 1,800 feet from shore on NAVBASE Kitsap, Bangor. Although there are no known pupping sites near the project site, pups have been seen on NAVBASE Kitsap, Bangor during monitoring events. Therefore, some harbor seal neonates could potentially be present during pile driving. Otherwise, during most of the year, all age and sex classes could occur in the project area throughout the period of construction activity.

Jeffries et al. (2003) completed a more comprehensive stock assessment of the Hood Canal in 1999 and counted 711 harbor seals hauled out. This abundance was adjusted using a correction factor of 1.53 to account for seals in the water and not counted to provide a population estimate of 1,088 harbor seals in the Hood Canal (Jeffries et al. 2003). In order to estimate the underwater exposures from pile driving operations, the Navy determined the proportion of the Hood Canal population that could be in the water and susceptible to exposure on a daily basis. Jeffries et al. (2003) applied the correction factor on an annual basis, thereby assuming that the proportion of harbor seals on land versus in-water was consistent on a daily basis for the entire year. Similarly, 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 1,088 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 and airborne 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 (35 percent of 1,088 animals, or approximately 381 individuals), divided by the area of Hood Canal (358.44 sq km, or 138.4 sq miles) (Huber et al. 2001; Jeffries et al. 2003). The density of harbor seals calculated in this manner is 1.06 animals/sq km. Exposures were calculated using this density in the formula described in Section 6.8.

In order to analyze the potential for harbor seals to be disturbed by airborne noise associated with pile driving, the Navy looked at the likelihood for harbor seals in the project area to be hauled out and/or swimming with their heads out of the water. Harbor seals' typical haulout locations include intertidal or sub-tidal 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 closest known harbor seal haulout is 10 miles southwest of NAVBASE Kitsap, Bangor at the Dosewallips River mouth (London 2006). The Navy's waterfront surveys and boat surveys (Agness and Tannenbaum 2009; Tannenbaum et al. 2009, 2011; Navy 2010) found that it is rare for harbor seals to haul out along the Bangor waterfront on NAVBASE Kitsap. Individual harbor seals have occasionally been sighted hauled out on pontoons of the floating security fence within the restricted areas of NAVEBASE Kitsap (see Section 4.2.2). This area is within the vibratory underwater disturbance ZOI but not with the airborne disturbance ZOI (Figures 6-2, 6-3 and 6-4). Therefore, it is assumed that animals potentially present on the floats would not be exposed to disturbing in-air noise levels resulting from pile driving. The Service Pier is elevated at least 20 feet above the surface of the water and is inaccessible to pinnipeds. Harbor Seals have not been observed hauled out on the floating Port Operations pier sections or on the shoreline adjacent to the Service Pier.

Therefore, on NAVBASE Kitsap, 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. Harbor seals present in the area would also likely be within the larger underwater vibratory ZOI and it is assumed harbor seals exposed to the airborne sound pressure levels above the threshold would be accounted for in the underwater vibratory behavioral takes. Additionally, marine mammal observers will be monitoring the shutdown and buffer zones (see Section 11 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 seals in or near the shutdown and buffer zones, reducing the potential for acoustic harassment. Based on the exposure analysis, no harbor seals are anticipated to experience airborne sound pressure levels that would qualify as harassment.

Based on 20 days of piling driving and the density within the ZOI , an average of 341 individual harbor seals may experience sound pressure levels exceeding the behavioral threshold (Level B take) during pile driving. Due to the small size of the injury ZOI and the implementation of a NMFS approved monitoring plan, harbor seals are not expected to experience elevated noise levels that would result in injury (Level A take).

6.8.5 Transient Killer Whale

Transients may be present in the Hood Canal anytime during the year and may traverse as far as the project site. 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.

West Coast Transient killer whales most often travel in small pods of up to four individuals (Baird and Dill 1996). Houghton (pers. comm. 2012) reported that the group size most often observed in the Salish Sea was four whales for 2004-2010, is larger than the size most often observed from 1987-1993, and that group size appeared to be increasing in the 2004-2010 time period. According to Houghton unpublished data, the most commonly observed group size in Puget Sound (defined as from Admiralty Inlet south and up through Skagit Bay) from 2004-2010 data is 6 whales (mode = 6, mean = 6.88) (Houghton pers. comm. 2012). Occasionally larger groups may occur (OrcaNetwork 2012). A group of up to 27 animals was observed in Puget Sound in 2010 (Houghton pers. comm. 2012).

The density used in the sound exposure analysis was calculated using densities provided in Navy Marine Species Density Database (Navy 2013).The calculated density of transient killer whales is 0.001914 animals per sq km. Zero exposures were calculated using this density in the formula described in Section 6.8.

However, while transient killer whales are rare in the Hood Canal, when these animals are present they occur in pods, so their density in the project area is unlikely to be uniform, as was modeled. If they are present during impact pile driving it is possible that one or more individuals within a pod could travel through the behavioral harassment zone. Therefore, the Navy is requesting 120 behavioral takes of transient killer whales – based on the average size of pods seen previously in the Hood Canal and their residence time - by pile driving over the course of the proposed action.

Pile driving is expected to occur for 20 days with short durations per day; therefore, the likelihood of exposure is small. However, if a transient killer whale was exposed to increased sound pressure levels, disturbance is not expected to be significant because exposure would likely be brief as they transited through the zone. Furthermore, each pile driving event is not expected to be long in duration (approximately 15 minutes per pile for vibratory pile driving), and exposure would be short in duration. Therefore, exposure to underwater noise impacts would have a negligible short-term effect on individual killer whales and would not result in population-level impacts because it is estimated that only a small number of killer whales may be affected by acoustic harassment.

6.8.6 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. 2009) and November 2009 to May 2010 (Tannenbaum et al. 2011). During one of the surveys a single Dall's porpoise was sighted in August 2009 in the deeper waters off Carlson Spit. During line transect surveys conducted in the Hood Canal in September and October 2011, as part of the Test Pile Program, no Dall's porpoises were sighted (Navy 2012).

The calculated density of Dall's porpoise in Hood Canal is 0.000001 animals per sq km (Navy 2013). Zero Dall's porpoise exposures were calculated using this density in the formula described in Section 6.8, and the Navy is not requesting any takes of this species.

6.8.7 Harbor Porpoise

Harbor porpoises may be present anywhere in Hood Canal year-round. The Navy conducted nearshore marine mammal boat surveys of the Bangor waterfront area from July to September 2008 (Tannenbaum et al. 2009) and from November to May 2010 (Tannenbaum et al. 2011), as described in Section 3.3.1. During one of these surveys, a harbor porpoise was sighted in May in the deeper waters within the WRA near the existing EHW-1. 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 near NAVBASE Kitsap, Bangor is much more robust than anticipated from existing surveys and anecdotal evidence. During these surveys, while harbor porpoise presence in the immediate vicinity of the base (i.e., within 1 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 from the Bangor waterfront on the far side of Toandos Peninsula. Based on observations during track line transect surveys conducted from September through October 2011, harbor porpoises have been seen commonly during surveys with the number of individuals sighted in the deeper water of Hood Canal ranging from 0 to 11 individuals, with an average of approximately six animals sighted per day (Navy 2012.). The maximum group size per sighting was six individuals (mean 1.8) (Navy 2012).

Density of harbor porpoises was estimated from the 2011 trackline surveys. Sightings of harbor porpoises during these surveys were used to generate a density for Hood Canal. Based on guidance from other line transect surveys conducted for harbor porpoises using similar monitoring parameters (i.e., boat speed, number of observers, etc.) (Barlow 1988; Calambokidis et al. 1993; Caretta et al. 2001), the Navy determined the effective strip width for the surveys to be one kilometer 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 the sightings occurring within the effective strip width were used in the density calculation. Based on the data collected during the line transect surveys conducted as part of the Test Pile Program, a total of 38 individual harbor porpoises were sighted within the required perpendicular distance from the survey vessel. The total trackline length of all the surveys conducted during the Test Pile Program (September and October) was 471.2 km (Navy 2012). By multiplying the trackline length of the surveys by the effective strip width, in this case one kilometer, the total area surveyed during the surveys was 471.2 square kilometers. Dividing the number of individual harbor porpoises sighted (38) by the area surveyed (471.2 sq. km) results in a density of 0.0806 harbor porpoises per sq. km. To account for availability bias [g(0)] or the animals which are unavailable to be detected because they are submerged, the Navy utilized a g(0) value of 0.54, derived from other similar line transect surveys (Barlow 1988; Calambokidis et al. 1993; Carretta et al. 2001). This resulted in a corrected density of 0.149 harbor porpoises per sq. km.

Exposures were calculated using the formula in Section 6.8 and the 0.149 density estimate. Based on the density analysis above, up to 2 individual harbor porpoises may experience sound pressure levels on a given day that would qualify as harassment. The total number of exposures is calculated to be 40 due to behavioral harassment. Harbor porpoises that are exposed to acoustic harassment could exhibit short-term behavioral changes. Disturbance from underwater noise impacts is not expected to be significant at the population level because it is estimated that only a small number of harbor porpoises may be affected by acoustic harassment relative to the size of the entire stock.

6.9 Effects of Other Construction Activities

Several non-pile construction activities will also occur at the project area as part of the proposed action. Among them are the non-vibratory extraction of steel piles, removal of the concrete pile cap, and pier reconfiguration. Each of these activities could involve the generation of low levels of noise from the operation of associated installation machinery (i.e., hydraulic shears, bolt gun, welder, etc.). While no empirical data exists for these construction activities, they are expected to be significantly lower than those estimated for pile installation and removal using an impact/vibratory pile driver. As a result, disturbance is not anticipated for any marine mammal species and the Navy is not requesting any additional takes from construction activities other than pile driving.

6.10 Summary

The total numbers of exposures the Navy is requesting for the marine mammals species that may occur within the Project Area are presented in Table 6-14. All exposures will be Level B disturbance takes from noise levels exceeding the 120 dB rms underwater threshold for continuous noise from vibratory driving. No additional exposures are requested for exposure to airborne noise levels because these will be encompassed in the larger ZOI being monitored.

Table 6-14: Total Number of Exposures Requested Per Species during the Barge Mooring Project

	Underwater	In-Air
Species	**Level B**	**Level B**
Humpback whale	0	N/A
Transient killer whale	120	N/A
Harbor porpoise	40	N/A
Dall's porpoise	0	N/A
Steller sea lion	0	N/A
California sea lion	660	0
Harbor seal	341	0
Total	**1,161**	**0**

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7 IMPACTS TO MARINE MAMMAL SPECIES OR STOCKS

The anticipated impact of the activity upon the species or stock of marine mammals

7.1 Potential Effects of Pile Driving on Marine Mammals

7.1.1 Underwater Noise Effects

The effects of pile driving on marine mammals are dependent on several factors, including the size, type, and depth of both the animal; the depth, intensity, and duration of the sound; the depth of the water column; the substrate of the habitat; the standoff distance between the pile and the animal; and the sound propagation properties of the environment. Impacts to marine mammals from pile installation and removal are expected to result primarily from acoustic pathways. As such, the degree of effect is intrinsically related to the received level and duration of the sound exposure, which are in turn influenced by the distance between the animal and the source. The further away from the source, the less intense the exposure should be. The substrate and depth of the habitat affect the sound propagation properties of the environment. Shallow environments are typically more structurally complex which leads to rapid sound attenuation. In addition, substrates which are soft (e.g., sand) will absorb or attenuate the sound more readily than hard substrates (rock) which may reflect the acoustic wave. Soft porous substrates would also likely require less time to drive the pile and possibly less forceful equipment, which would ultimately decrease the intensity of the acoustic source.

Impacts to marine species are expected to be the result of physiological responses to both the type and strength of the acoustic signature (Viada et al. 2008). Behavioral impacts are also expected, though the type and severity of these effects are more difficult to define due to limited studies addressing the behavioral effects of continuous sounds on marine mammals. Potential effects from continuous sound sources are expected to be temporary behavioral disturbance.

Physiological Responses

Direct tissue responses to impact/impulsive sound stimulation may range from mechanical vibration or compression with no resulting injury to tissue trauma (injury). Because the ears are the most sensitive organ to pressure, they are the organs most sensitive to injury (Ketten 2000). Sound related trauma can be lethal or sub-lethal. Lethal impacts are those that result in immediate death or serious debilitation in or near an intense source (Ketten 1995). Sub-lethal impacts include hearing loss, which is caused by exposure to perceptible sounds. Severe damage from a pressure wave to the ear can include rupture of the tympanum, fracture of the ossicles, damage to the cochlea, hemorrhage, and cerebrospinal fluid leakage into the middle ear (NMFS 2008b). Moderate injury implies partial hearing loss. Permanent hearing loss can occur when the hair cells are damaged by one very loud event, as well as prolonged exposure to noise. Instances of temporary threshold shifts (TTS) and/or auditory fatigue are well documented in marine mammal literature as being one of the primary avenues of acoustic impact. Temporary loss of hearing sensitivity (TTS) has been documented in controlled settings using captive marine mammals exposed to strong sound exposure levels 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. While injuries to other sensitive organs are possible, they are less likely since pile driving impacts are almost entirely acoustically mediated, versus explosive sounds, which also include a shock wave that can result in damage.

No physiological responses are expected from pile driving operations occurring during the Barge Mooring Project within the Project Area for several reasons. Firstly, vibratory pile driving which is being utilized as the primary installation method, does not generate high enough peak sound pressure levels that are commonly associated with physiological damage. Any use of non-pulsed pile driving will only occur from a short period of time (~15 min per pile). Additionally, the mitigation measures that the Navy will be employing (see Section 11) will greatly reduce the chance that a marine mammal may be exposed to sound pressure levels that could cause physical harm. During impact pile driving the Navy will employ a sound attenuation system (e.g., bubble curtain) to attenuate initial sound pressure levels (-8 dB reduction assumed). Furthermore, the Navy will have trained biologists monitoring a shutdown zone equivalent to the Level A Harassment zone (inclusive of the 180 dB re 1 µ Pa (cetaceans) and 190 dB re 1 µ Pa (pinnipeds) isopleths) to ensure no marine mammals are injured.

Behavioral Responses

An individual's behavioral response to sound is 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.

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. 2003, 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 or differences in individual tolerance levels 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 that are highly motivated to remain in an area for feeding (Richardson et al. 1995; NRC 2003; Wartzok et al. 2003/2004). 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 haulout time, possibly to avoid in-water disturbance.

The type and severity of behavioral effects are difficult to define due to limited studies addressing the behavioral effects of sounds on marine mammals. 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 pulsed sound sources (typically seismic guns or acoustic harassment devices, and also including pile driving) 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. 2003/2004; 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 dB rms range tolerated this noise level and did not seem unwilling to dive. One individual was as close as 63 meters 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 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 of the pile driving barge during pile driving. Several sea lions, however, were observed at distances of 500 to 1,000 meters 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 proposed in this application, are limited. Marine mammal monitoring during two lengthy construction seasons at the Port of Anchorage marine terminal found no response by marine mammals swimming within the threshold distances to noise impacts from construction activities including pile driving (both impact hammer and vibratory driving) (Integrated Concepts & Research Corporation 2009). Most marine mammals observed were beluga whales, harbor seals, harbor porpoises, and small numbers of Steller sea lions were observed in smaller numbers. Background noise levels at this port are typically at 125 dB.

A comprehensive review of acoustic and behavioral responses to noise exposure by Nowacek et al. (2007) 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.

Marine mammals encountering pile driving operations over the 20 days of pile driving during the Barge Mooring Project 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. Avoidance of the affected area during pile driving operations would reduce the likelihood of injury impacts but would reduce access to foraging areas. Noise-related disturbance may also inhibit some marine mammals from transiting the area. A marine mammal may also show signs that it is startled by the noise and/or may swim further away from the sound source and avoid the area. Other potential behavioral changes could include increased swimming speed, increased surfacing time, and decreased foraging in the affected area. Since vibratory pile driving will occur for only one hour maximum per day, over a short period of time, permanent displacement is unlikely. In addition, 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. Individual marine mammals could experience potential impacts from pile driving, but would not cause population level impacts, or affect the long-term fitness of a species.

7.1.2 Airborne Noise Effects

Marine mammals that occur in the Project Area could be exposed to airborne sounds associated with pile driving that have the potential to cause harassment, depending on their distance from activities. Airborne noise would have less impact on cetaceans than pinnipeds because noise from atmospheric sources does not transmit well underwater (Richardson et al. 1995); thus airborne noise would only be an issue for hauled-out pinnipeds within the Project Area. 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 habitat and move further from the source. Studies by Blackwell et al. (2004) and Moulton et al. (2005) indicate a tolerance or lack of response to unweighted airborne sounds as high as 112 dB peak and 96 dB rms. Based on these observations marine mammals could exhibit temporary behavioral reactions to airborne noise, however, exposure is not likely to result in population level impacts.

Despite taking into consideration all known and incidental haulout locations nearby the Project Area, the exposure modeling indicated that no pinniped species would be exposed to airborne noise levels at sound pressure levels that would constitute Level B behavioral harassment during either impact or vibratory pile driving (see Section 6 for modeling results). Injury or Level A harassment is not expected to occur from airborne noise. In conclusion, this is a negligible impact.

7.2 Conclusions Regarding Impacts to Species or Stocks

Individual marine mammals may be exposed to sound pressure levels during pile driving operations during the Barge Mooring Project that would result in Level B Behavioral harassment. Any marine mammals that are taken (harassed) may change their normal behavior patterns (i.e., swimming speed, foraging habits, etc.) or be temporarily displaced from the area of construction. Any takes would likely have only a minor effect on individuals and no effect on the population. The sound generated from vibratory pile driving is non-pulsed (e.g., continuous) which is not known to cause injury to marine mammals. Mitigation is likely to avoid most potential adverse underwater impacts to marine mammals from impact pile driving. Nevertheless, some level of impact is unavoidable. The expected level of unavoidable impact (defined as an acoustic or harassment “take”) is described in Sections 6. This level of effect is not anticipated to have any detectable adverse impact on population recruitment, survival or recovery.

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8 IMPACT ON SUBSISTENCE USE

The anticipated impact of the activity on the availability of the species or stock of marine mammals for subsistence uses.

8.1 Subsistence Harvests by Northwest Treaty Indian Tribes

Historically, Pacific Northwest treaty Indian tribes were known to utilize (hunt) several species of marine mammals including, but not limited to: harbor seals, Steller sea lions, northern fur seals, gray whales, and humpback whales (Norberg pers. comm. 2007b). Several Pacific Northwest treaty Indian tribes have promulgated[8] tribal regulations allowing tribal members to exercise treaty rights for subsistence harvest of California sea lions and harbor seals (Carretta et al. 2007). There are no known active ceremonial and/or subsistence hunts for marine mammals in Hood Canal, Puget Sound, or the San Juan Islands (Norberg pers. comm. 2007b). Carretta et al. (2007) estimated annual subsistence takes of zero to two California sea lions. No data are available for the number of annual harbor seal subsistence takes (Carretta et al. 2011).

8.2 Summary

Potential impacts resulting from the Barge Mooring Project will be limited to individuals of marine mammal species located in the marine waters near NAVBASE Kitsap, Bangor and will be limited to Level B harassment. Therefore, no impacts on the availability of species or stocks for subsistence use were found.

[8] To make known by open declaration; publish; proclaim formally or put into operation (a law, decree of a court, etc.).

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9 IMPACTS TO THE MARINE MAMMAL HABITAT AND THE LIKELIHOOD OF RESTORATION

The anticipated impact of the activity upon the habitat of the marine mammal populations, and the likelihood of restoration of the affected habitat.

The proposed activities on NAVBASE Kitsap, Bangor may have potential short-term impacts to food sources such as forage fish, but would not result in any permanent impacts on habitats used by marine mammals. Pinnipeds haul out on structures such as submarines and floating security barriers within NAVBASE Kitsap, Bangor. However, there are no rookeries or major haulout sites within 10 km, foraging hotspots, or other ocean bottom structure of significant biological importance to marine mammals that may be present in the marine waters near the Project Area. The primary potential impact of concern associated with the proposed activity will be temporarily elevated noise levels and the associated direct effects on marine mammals, as discussed in Sections 6 and 7. The most likely impact to marine mammal habitat occurs from temporary noise disturbance to marine mammal prey (i.e., fish) and minor impacts to the immediate substrate during installation and removal of piles. The new barge will be larger than the existing barge, however the replacement barge and the piles installed to support it will be within the existing footprint of the current Service Pier facility will not affect marine mammal habitat.

9.1 Pile Driving Effects on Potential Prey (Fish)

Construction activities will produce both pulsed (i.e., impact pile driving) and continuous sounds (i.e., vibratory pile driving). Fish react to sounds that are especially strong and/or intermittent low-frequency sounds. Short duration, sharp sounds can cause overt or subtle changes in fish behavior and local distribution. Hastings and Popper (2005, 2009) identified several studies that suggest fish may relocate to avoid certain areas of noise energy. Additional studies have documented effects of pile driving (or other types of continuous sounds) on fish, although several are based on studies in support of large, multiyear bridge construction projects (Scholik and Yan 2001, 2002, Govoni et al. 2003, Hawkins 2005, Hastings 1990, 2007, Popper et al. 2006, Popper and Hastings 2009). Sound pulses at received levels of 160 dB re 1 µPa may cause subtle changes in fish behavior. SPLs of 180 dB may cause noticeable changes in behavior (Chapman and Hawkins 1969; Pearson et al. 1992; Skalski et al. 1992). SPLs of sufficient strength have been known to cause injury to fish and fish mortality (CALTRANS 2001; Longmuir and Lively 2001).

Fish that occur in the immediate project area would be exposed to underwater noise that could injure or disturb fish during pile driving activity. Because vibratory pile driving is the primary installation and removal methodology, the most likely impact to fish from pile driving activities at the project area would be temporary behavioral disturbance or avoidance of the area. The duration of fish avoidance of this area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. In general, impacts to marine mammal prey species are expected to be minor and temporary due to the short-time frame for the Barge Mooring Project. Fish may still be present in the project area despite operating in a reduced work-window to minimize impacts to fish.

9.2 Pile Driving Effects on Potential Foraging Habitat

The area likely impacted by the Barge Mooring Project is relatively small compared to the available habitat in the Hood Canal. Potentially a small area surrounding a pile may have decreased foraging value as each pile is installed and/or removed. Avoidance by potential prey (i.e., fish) of the immediate area due to the temporary loss of this foraging habitat is also possible. The duration of fish avoidance of this area after pile removal stops is unknown, but a rapid return to normal recruitment, distribution, and behavior is anticipated. Any behavioral avoidance by fish of the disturbed area would still leave significantly large areas of fish and marine mammal foraging habitat in the Hood Canal and nearby vicinity.

9.3 Summary of Impacts to Marine Mammal Habitat

Given the short daily duration of noise associated with pile driving, the short duration of the entire Barge Mooring Project, and the relatively small area affected, in-water activities associated with the proposed action are not likely to have a permanent, adverse effect on any marine habitat or population of fish species.

10 IMPACTS TO MARINE MAMMALS FROM LOSS OR MODIFICATION OF HABITAT

The anticipated impact of the loss or modification of the habitat on the marine mammal populations involved.

The Barge Mooring Project is not expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or their populations, since all pile driving activities will be temporary and the use of the Service Pier will remain at the current level. The new barge will be larger than the existing barge, however the replacement barge and the piles installed to support it will be in the within the existing footprint of the current Service Pier facility. Based on the discussions in Section 9, there will be no impacts to marine mammals resulting from loss or modification of marine mammal habitat.

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11 MEANS OF EFFECTING THE LEAST PRACTICABLE ADVERSE IMPACTS – MITIGATION MEASURES

The availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

The Navy will employ the minimization measures listed in this section to avoid and minimize impacts to marine mammals, their habitats, and forage species. Best Management Practices (BMPs) are intended to avoid and minimize potential environmental impacts. Additional minimization measures have been developed to protect ESA-listed species, designated critical habitats, and marine mammals.

BMPs and minimization measures are included in the construction contract plans and must be agreed upon by the contractor prior to any construction activities. Upon signing the contract, it becomes a legal agreement between the contractor and the Navy. Failure to follow the prescribed BMPs and minimization measures is a contract violation.

11.1 General Construction Best Management Practices

- All work will adhere to performance requirements of the Clean Water Act, Section 404 permit and Section 401 Water Quality Certification. No in-water work will begin until after issuance of regulatory authorizations.
- All work will comply with water quality restrictions imposed by Washington Department of Ecology (Chapter 173-201A Washington Administrative Code [WAC]), which specify a mixing zone beyond which water quality standards cannot be exceeded. Compliance with WDOE's standards is intended to ensure protection of fish and aquatic life to the extent feasible and practicable.
- The construction contractor is responsible for preparation of an Environmental Protection Plan. The plan will be submitted and implemented prior to the commencement of any construction activities and is a binding component of the overall contract. The plan shall identify construction elements and recognize spill sources at the site. The plan shall outline BMPs, responsive actions in the event of a spill or release, and notification and reporting procedures. The plan shall also outline contractor management elements such as personnel responsibilities, project site security, site inspections, and training.
- No petroleum products, fresh cement, lime, fresh concrete, chemicals, or other toxic or harmful materials shall be allowed to enter surface waters.
- Washwater resulting from washdown of equipment or work areas shall be contained for proper disposal, and shall not be discharged unless authorized.

- Equipment that enters surface waters shall be maintained to prevent any visible sheen from petroleum products.
- No oil, fuels, or chemicals shall be discharged to surface waters, or onto land where there is a potential for re-entry into surface waters will occur. Fuel hoses, oil drums, oil or fuel transfer valves, fittings, etc. shall be checked regularly for leaks and will be maintained and stored properly to prevent spills.
- No cleaning solvents or chemicals used for tools or equipment cleaning shall be discharged to ground or surface waters.
- Construction materials will not be stored where high tides, wave action, or upland runoff could cause materials to enter surface waters.
- Barge operations will be restricted to tidal elevations adequate to prevent grounding of a barge.
- Where eelgrass is present in the work area, the Navy shall provide the contractor with plan sheets showing eelgrass boundaries. The following restrictions shall apply to areas designated as eelgrass:
    - No derrick spudding or anchoring will occur.
    - No scouring of sediments or significant sediment contamination will occur within eelgrass beds.

11.2 Pile Repair, Removal and Installation Best Management Practices

- Oil-absorbent materials will be used in the event of a spill if any oil product is observed in the water.
- Removed piles and associated sediments (if any) shall be contained on a barge. If a barge is not utilized, piles and sediments may be stored in a containment area near the construction site.
- Piling that break or are already broken below the waterline may be removed by wrapping the piles with a cable or chain and pulling them directly from the sediment with a crane. If this is not possible, they will be removed with a clamshell bucket. To minimize disturbance to bottom sediments and splintering of piling, the contractor will use the minimum size bucket required to pull out piling based on pile depth and substrate. The clam shell bucket will be emptied of piling and debris on a contained barge before it is lowered into the water. If the bucket contains only sediment, the bucket will remain closed and be lowered to the mudline and opened to redeposit the sediment. In some cases (depending on access, location, etc.), piles may be cut below the mudline and the resulting hole backfilled with clean sediment.
- Any floating debris generated during installation will be retrieved. Any debris in a containment boom will be removed by the end of the work day or when the boom is removed, whichever occurs first. Retrieved debris will be disposed of at an upland disposal site.

- If steel piles are filled with concrete, the tube used to fill steel piles with concrete will be placed toward the bottom of the pile to prevent splashing and overflow.
- Whenever activities that generate sawdust, drill tailings, or wood chips from treated timbers are conducted, tarps or other containment material will be used to prevent debris from entering the water.
- All piles, lumber, and other materials treated with preservatives shall be sufficiently cured to minimize leaching into the water or sediment.
- If excavation around piles to be repaired or replaced is necessary, hand tools or a siphon dredge will be used to excavate around piles to be replaced.

11.3 Timing Restrictions

- To minimize the number of fish exposed to underwater noise and other construction disturbance, in-water work will occur between 16 July – 30 September when ESA-listed salmonids and spawning forage fish are less likely to be present.
- All in-water construction activities will occur during daylight hours (sunrise to sunset[9]) except during the marbled murrelet nesting season, July 16 to September 23, when impact pile driving will only occur starting 2 hours after sunrise and ending 2 hours before sunset. Non in-water construction activities could occur between 7:00 AM and 10:00 PM during any time of the year.

11.4 Additional Minimization Measures for Marine Mammals

The following mitigation measures will be implemented during pile driving to avoid marine mammal exposure to Level A injurious noise levels generated from impact pile driving and to reduce to the lowest extent practicable exposure to Level B disturbance noise levels.

Coordination

- The Navy shall conduct briefings between construction supervisors and crews, marine mammal monitoring team, acoustical monitoring team, and Navy staff prior to the start of all pile driving activity, and when new personnel join the work, in order to explain responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures.

Acoustic Minimization Measures

[9] Sunrise and sunset are to be determined based on the National Oceanic and Atmospheric Administration data which can be found at http://www.srrb.noaa.gov/highlights/sunrise/sunrise.html.

- Vibratory installation will be used to the extent possible to drive steel piles to minimize higher sound pressure levels associated with impact pile driving.
- A bubble curtain or other noise attenuation device will be employed during impact installation or proofing of steel pipe piles where water depths are greater than 0.67 meter (2 feet). A noise attenuation device is not required during vibratory pile driving.
- If a bubble curtain or similar measure is used, it will distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column. Any other attenuation measure must provide 100 percent coverage in the water column for the full depth of the pile. The lowest bubble ring shall be in contact with the mudline for the full circumference of the ring. The weights attached to the bottom ring shall ensure the 100% mudline contact. No parts of the ring or other objects shall prevent full mudline contact.
- A performance test of the noise attenuation device shall be conducted prior to initial use during impact pile driving. The performance test shall confirm the calculated pressures and flow rates at each manifold ring. The Contractor shall also train personnel in the proper balancing of air flow to the bubblers. The Contractor shall submit an inspection/performance report to the Navy within 72 hours following the performance test.

Soft Start

The objective of a soft-start is to provide a warning and/or give animals in close proximity to pile driving a chance to leave the area prior to a vibratory or impact driver operating at full capacity; thereby, exposing fewer animals to loud underwater and airborne sounds.

- A soft start procedure will be used at the beginning of each day's in-water pile driving or if pile driving has ceased for more than 1 hour.
- For impact pile driving, the following soft-start procedures will be conducted:
  - The Contractor will start the bubble curtain prior to the initiation of impact pile driving in order to flush pinnipeds and fish from the injury zone near the pile.
  - The Contractor will provide an initial set of strikes from the impact hammer at reduced energy, followed by a 30-second waiting period, then two subsequent sets. (The reduced energy of an individual hammer cannot be quantified because they vary by individual drivers. Also, the number of strikes will vary at reduced energy because raising the hammer at less than full power and then releasing it results in the hammer "bouncing" as it strikes the pile resulting in multiple "strikes").

- For vibratory pile driving, the Contractor will initiate noise from vibratory hammers for 15 seconds at reduced energy followed by a 30-second waiting period. The procedure shall be repeated two additional times. [10]
  - If additional marine mammal monitoring data indicates that there is no change in behavior of pinnipeds during vibratory pile driving or soft start procedures and the NMFS concurs, then the soft start procedure would no longer be required.

11.5 Visual Monitoring and Shutdown Procedure

A marine mammal monitoring plan will be approved by NMFS prior to commencement of project activities. At a minimum the plan will include the following:

- For all impact and vibratory pile driving, a shutdown and disturbance zone will be monitored.
  - Monitoring will take place from 15 minutes prior to initiation through 15 minutes post-completion of pile driving.
  - The shutdown zone shall include all areas where the underwater sound pressure levels (SPLs) are anticipated to equal or exceed the Level A (injury) criteria for marine mammals (180 dB isopleth for cetaceans; 190 dB isopleth for pinnipeds). The shutdown zone will always be a minimum of 10 meters (33 feet) to prevent injury from physical interaction of marine mammals with construction equipment.
  - The disturbance zone shall include all areas where the underwater or airborne sound pressure levels are anticipated to equal or exceed the Level B (disturbance) criteria for marine mammals (160 dB or 120 dB re 1µPa or 90 dB re 20 µPa isopleths). However, due to the extreme area of this zone at some of the project's locations, this zone may be reduced to a practicable monitoring area in final approved monitoring plan.
- Visual monitoring will be conducted by qualified, trained marine mammal observers (hereafter "observer"). An observer is a biologist with prior training and experience conducting marine mammal monitoring or surveys, and who has the ability to identify marine mammal species and describe relevant behaviors that may occur in proximity to in-water construction activities.

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[10] 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 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.

- A trained observer will be placed at the best vantage point(s) practicable (e.g. from a small boat, construction barges, on shore, or any other suitable location) to monitor for marine mammals and implement shutdown / delay procedures when applicable by calling for the shutdown to the hammer operator. If a boat is used for monitoring, the boat will remain 100 yards from marine mammals in accordance with NMFS marine mammal viewing guidelines (available at http://www.bewhalewise.org/marine-wildlife-guidelines) and 200 yards from Southern resident killer whales in accordance with Federal and Washington State law (50 CFR 224.103; Revised Code of Washington 77.15.740).If the shutdown zone is obscured by fog or poor lighting conditions, pile driving will not be initiated until the entire shutdown zone is visible.
- Prior to the start of pile driving, the shutdown zone will be monitored for 15 minutes to ensure that the shutdown zone is clear of marine mammals. Pile driving will only commence once observers have declared the shutdown zone clear of marine mammals.
- If a humpback whale, Southern Resident killer whale, or Steller sea lion approaches or enters a disturbance zone during pile impact or vibratory driving, work will be halted and delayed until either the animal has voluntarily left and has been visually confirmed beyond the disturbance zone or 30 minutes have passed without re-detection of the animal.
- If a marine mammal(s) is observed in the disturbance zone, but not approaching or entering the shutdown zone, a "take" will be recorded and the work will be allowed to proceed without cessation. Marine mammal behavior will be monitored and documented.
- If a marine mammal(s) approaches or enters a shutdown zone during pile impact or vibratory driving, work will be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or 30 minutes have passed without re-detection of the animal.

11.6 Data Collection

NMFS requires that a minimum, the following information be collected on the sighting forms:

- Date and time that pile removal begins or ends;
- Construction activities occurring during each observation period;
- Weather parameters identified in the acoustic monitoring (e.g., percent cover, visibility);
- Water conditions (e.g., sea state, tidal state [incoming, outgoing, slack, low, and high]);
- Species, numbers, and if possible sex and age class of marine mammals;
- Marine mammal behavior patterns observed, including bearing and direction of travel and, if possible, the correlation to sound pressure levels;
- Distance from pile removal activities to marine mammals and distance from the marine mammal to the observation point;
- Locations of all marine mammal observations;

- Other human activity in the area.

The Navy will note in behavioral observations, to the extent practicable, if an animal has remained in the area during construction activities. Therefore, it may be possible to identify if the same animal or a different individuals are being taken.

11.7 Mitigation Effectiveness

All observers utilized for mitigation activities will be experienced biologists with training in marine mammal detection and behavior. Due to their specialized training, the Navy expects that visual mitigation will be highly effective. The observers will be positioned in locations, which provide the best vantage point(s) for monitoring. This will probably be an elevated position as they provide a better range of viewing angles. In addition, the small radius of the Level A shutdown zone makes the likelihood of detecting a marine mammal in this zone extremely high.

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12 MINIMIZATION OF ADVERSE EFFECTS ON SUBSISTENCE USE

Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, the applicant must submit either a plan of cooperation or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses. A plan must include the following:

(i) A statement that the applicant has notified and provided the affected subsistence community with a draft plan of cooperation;

(ii) A schedule for meeting with the affected subsistence communities to discuss proposed activities and to resolve potential conflicts regarding any aspects of either the operation or the plan of cooperation;

(iii) A description of what measures the applicant has taken an/or will take to ensure that proposed activities will not interfere with subsistence whaling or sealing; and

(iv) What plans the applicant has to continue to meet with the affected communities, both prior to and while conducting activity, to resolve conflicts and to notify the communities of any changes in the operation.

Subsistence use is the traditional exploitation of marine mammals by native peoples for their own consumption. Based on the discussions in Section 8, there are no adverse effects on the availability of species or stocks for subsistence use.

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13 MONITORING AND REPORTING MEASURES

The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding.

13.1 Monitoring Plan

The following monitoring measures will be implemented along with the mitigation measures (Section 11) in order to reduce impacts to marine mammals to the lowest extent practicable. A marine mammal monitoring plan will be developed further and submitted to NMFS for approval prior to the start of construction.

13.1.1Visual Marine Mammal Observations

Marine mammal observers will collect sighting data and behavioral responses to construction activities for marine mammal species observed in the region of activity during the period of construction. All observers will be experienced biologists trained in marine mammal identification and behaviors, as described in Section 11. NMFS requires that the observers have no other construction related tasks while conducting monitoring.

13.1.2 Methods of Monitoring

The Navy will monitor the shutdown zone and buffer zone before, during, and after pile driving. Based on NMFS requirements, the Marine Mammal Monitoring Plan will include the following:

- Observers would be located at the best vantage point(s) in order to properly see the entire shutdown zone and safety zone. This may require the use of a small boat to monitor certain areas while also monitoring from one or more land based vantage points. At least one observer would be assigned to monitor the shutdown zone.
- During all observation periods, observers would use binoculars and the naked eye to search continuously for marine mammals.
- If the shutdown zone is obscured by fog or poor lighting conditions, pile driving would not be initiated until the shutdown zone is visible.
- The shutdown and buffer zones around the pile will be monitored for the presence of marine mammals before, during, and after any pile driving.
- Pre-Activity Monitoring:
  - The shutdown and buffer zones will be monitored for 15 minutes prior to initiating vibratory piles driving or the soft start for impact pile installation. If a marine

mammal(s) is present within the shutdown zone prior to start of these activities or during the soft start, the start of pile driving would be delayed until the animal(s) leave the shutdown zone. Pile driving would resume only after the observer has determined, through visual observation or by waiting approximately 15 minutes, the animal(s) has moved outside the shutdown zone.

- During Activity Monitoring:
  - The shutdown and buffer zones will also be monitored throughout the time required to install or remove a pile or complete other in-water construction activities. If a marine mammal is observed entering the buffer zone, an exposure would be recorded and behaviors documented. However, that pile segment or other in-water construction activities would be completed without cessation, unless the animal enters or approaches the shutdown zone, at which point all pile driving activities will be halted. However, the shutdown provision may be waived in situations where shutdown would create an imminent concern for human safety. Pile driving can only resume once the animal has left the shutdown zone of its own volition or has not been re-sighted for a period of 15 minutes.
- Post-Activity Monitoring:
  - Monitoring of the shutdown and buffer zones would continue for 30 minutes following the completion of pile removal.

The individuals that implement the monitoring protocol will assess its effectiveness using an adaptive approach. Monitoring biologists will use their best professional judgment throughout implementation and will seek improvements to these methods when deemed appropriate. Any modifications to protocol will be coordinated between the U.S. Navy and NMFS.

13.1.3 Data Collection

NMFS requires that at a minimum, the following information be collected on the sighting forms:

- Date and time that pile installation/removal begins or ends;
- Construction activities occurring during each observation period;
- Weather parameters identified in the acoustic monitoring (e.g., percent cover, visibility);
- Water conditions (e.g., sea state, tidal state [incoming, outgoing, slack, low, and high]);
- Species, numbers, and if possible sex and age class of marine mammals;
- Marine mammal behavior patterns observed, including bearing and direction of travel, and if possible, the correlation to sound pressure levels;
- Distance from pile driving activities to marine mammals and distance from the marine mammal to the observation point;
- Locations of all marine mammal observations;
- Other human activity in the area.

Additionally, based on recent discussions with NMFS Headquarters, they request that the Navy record behavioral observations such that, if possible, the Navy can attempt to determine whether animals can be (or are) "taken" by more than one sound source in a day's operations. For instance, the Navy has agreed to "Note in behavioral observations, to the extent practicable, if an animal has remained in the area during construction activities. Therefore, it may be possible to identify if the same animal or a different individuals are being taken."

13.2 Reporting

A draft monitoring report will be submitted to NMFS within 90 work days of the completion of marine mammal monitoring. A final monitoring report would be prepared and submitted to the NMFS within 30 work days following receipt of comments on the draft report from the NMFS. At a minimum, the report shall include:

- General data:
  - Date and time of activities.
  - Water conditions (e.g., sea-state, tidal state).
  - Weather conditions (e.g., percent cover, visibility).
- Pre-activity observational survey-specific data:
  - Dates and time survey is initiated and terminated.
  - Description of any observable marine mammal behavior in the immediate area during monitoring.
  - If possible, the correlation to underwater sound levels occurring at the time of the observable behavior.
  - Actions performed to minimize impacts to marine mammals.
- During-activity observational survey-specific data:
- Description of any observable marine mammal behavior within monitoring zones or in the immediate area surrounding the monitoring zones, including the following:
    - Distance from animal to pile driving sound source
    - Reason why/why not shutdown implemented
    - If a shutdown was implemented, behavioral reactions noted and if they occurred before or after implementation of the shutdown
    - If a shutdown is implemented, the distance from animal to sound source at the time of the shutdown
    - Behavioral reactions noted during soft starts and if they occurred before or after implementation of the soft start
    - Distance to the animal from the sound source during soft start

- Post-activity observational survey-specific data:

- Results, which include the detections of marine mammals, species and numbers observed, sighting rates and distances, behavioral reactions within and outside of safety zones.
- A refined take estimate based on the number of marine mammals observed during the course of construction.

14 RESEARCH

Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects.

To minimize the likelihood that impacts will occur to the species, stocks and subsistence use of marine mammals, all construction activities will be conducted in accordance with all federal, state, and local regulations and minimization measures proposed by the Navy will be implemented to protect marine mammals. The Navy will coordinate all activities with the relevant federal and state agencies. These include, but are not limited to: the NMFS, USFWS, U.S. Coast Guard, Federal Energy Regulatory Commission, the U.S. Army Corps of Engineers, and the Washington Department of Fish and Wildlife. The Navy will share field data and behavioral observations on all marine mammals that occur in the project area. Draft results of the monitoring effort will be provided to NMFS in summary reports. This information could be made available to regional, state and federal resource agencies, scientists, professors, and other interested private parties upon written request to NMFS.

Additionally the Navy provides a significant amount of funding and support for marine research. The Navy provided $26 million in Fiscal Year 2008 and $22 million in Fiscal Year 2009 to universities, research institutions, federal laboratories, private companies, and independent researchers around the world to study marine mammals. The Navy has funded has provided more than $100 million over the past five years to universities, research institutions, federal laboratories, private companies, and independent researchers around the world to increase the understanding of marine species physiology and behavior, with several projects ongoing in Washington.

The Navy sponsors 70% of all U.S. research concerning the effects of human-generated sound on marine mammals and 50% of such research conducted worldwide. Major topics of Navy-supported research include the following:

- Gaining a better understanding of marine species distribution and important habitat areas,
- Developing methods to detect and monitor marine species before and during training,
- Understanding the effects of sound on marine mammals, and
- Developing tools to model and estimate potential effects of sound.

The Navy has sponsored several workshops to evaluate the current state of knowledge and potential for future acoustic monitoring of marine mammals. The workshops brought together acoustic experts and marine biologists from the Navy and other research organizations to present data and information on current acoustic monitoring research efforts and to evaluate the potential for incorporating similar technology and methods in Navy activities. The Navy supports research efforts on acoustic monitoring and will continue to investigate the feasibility of passive acoustics as a potential monitoring tool. Overall, the Navy will continue to research and contribute to university/external research to improve the state of the science regarding marine species biology and acoustic effects. These efforts include monitoring programs; data sharing with NMFS from research and development efforts; and future research as described previously.

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