DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XD282

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to a Wharf Construction Project

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed incidental harassment authorization; request for comments.

SUMMARY: NMFS has received a request from the U.S. Navy (Navy) for authorization to take marine mammals incidental to construction activities as part of a wharf construction project. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an incidental harassment authorization (IHA) to the Navy to incidentally take marine mammals, by Level B Harassment only, during the specified activity.

DATES: Comments and information must be received no later than July 7, 2014.

ADDRESSES: Comments on the application should be addressed to Jolie Harrison, Supervisor, Incidental Take Program, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service. Physical comments should be sent to 1315 East-West Highway, Silver Spring, MD 20910 and electronic comments should be sent to *ITP.Laws@noaa.gov*.

Instructions: NMFS is not responsible for comments sent by any other method, to any other address or individual, or received after the end of the comment period. Comments received electronically, including all attachments, must not exceed a 25-megabyte file size. Attachments to electronic comments will be accepted in Microsoft Word or Excel or Adobe PDF file formats only. All comments received are a part of the public record and will generally be posted to the Internet at *www.nmfs.noaa.gov/pr/permits/incidental.htm* without change. All personal identifying information (e.g., name, address) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.

FOR FURTHER INFORMATION CONTACT: Ben Laws, Office of Protected Resources, NMFS, (301) 427–8401.

SUPPLEMENTARY INFORMATION:

Availability

An electronic copy of the Navy's application and supporting documents, as well as a list of the references cited in this document, may be obtained by visiting the Internet at: *www.nmfs.noaa.gov/pr/permits/incidental.htm*. In case of problems accessing these documents, please call the contact listed above (see **FOR FURTHER INFORMATION CONTACT**).

National Environmental Policy Act (NEPA)

The Navy prepared an Environmental Impact Statement (EIS) for this project. We acted as a cooperating agency on development of that analysis and subsequently adopted the EIS and issued our own Record of Decision (ROD; 2012), prior to issuing the first IHA for this project, in accordance with NEPA and the regulations published by the Council on Environmental Quality. We reaffirmed the existing 2012 ROD before issuing an IHA in 2013 for the second year of project construction. Information in the Navy's application, the Navy's EIS (2012), and this notice collectively provide the environmental information related to proposed issuance of this IHA for public review and comment. All documents are available at the aforementioned Web site, with the exception of the Navy's EIS, which is publicly available at *www.nbkeis.com* (accessed May 2, 2014). We will review all comments submitted in response to this notice as we complete the NEPA process, including a decision of whether to reaffirm the existing ROD, prior to a final decision on the incidental take authorization request.

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce to allow, upon request by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified area, the incidental, but not intentional, taking of small numbers of marine mammals, providing that certain findings are made and the necessary prescriptions are established.

The incidental taking of small numbers of marine mammals may be allowed only if NMFS (through authority delegated by the Secretary) finds that the total taking by the specified activity during the specified time period will (i) have a negligible impact on the species or stock(s) and (ii) not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant). Further, the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such taking must be set forth, either in specific regulations or in an authorization.

The allowance of such incidental taking under section 101(a)(5)(A), by harassment, serious injury, death, or a combination thereof, requires that regulations be established. Subsequently, a Letter of Authorization may be issued pursuant to the prescriptions established in such regulations, providing that the level of taking will be consistent with the findings made for the total taking allowable under the specific regulations. Under section 101(a)(5)(D), NMFS may authorize such incidental taking by harassment only, for periods of not more than one year, pursuant to requirements and conditions contained within an IHA. The establishment of prescriptions through either specific regulations or an authorization requires notice and opportunity for public comment.

NMFS has defined ''negligible impact'' in 50 CFR 216.103 as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival. Except with respect to certain activities not pertinent here, section 3(18) of the MMPA defines ''harassment'' as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild; or 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. The former is termed Level A harassment and the latter is termed Level B harassment.

Summary of Request

On January 10, 2014, we received a request from the Navy for authorization to take marine mammals incidental to pile driving associated with the construction of an explosives handling wharf (EHW–2) in the Hood Canal at Naval Base Kitsap in Bangor, WA (NBKB). The Navy submitted a revised version of the request on April 11, 2014, which we deemed adequate and complete. The Navy proposes to continue this multi-year project, involving impact and vibratory pile driving conducted within the approved in-water work window. This IHA would cover only the third year (in-water work window) of the project, from July 16, 2014, through February 15, 2015.

The use of both vibratory and impact pile driving is expected to produce underwater sound at levels that have the potential to result in behavioral harassment of marine mammals. Species with the expected potential to be present during all or a portion of the in-water work window include the Steller sea lion (*Eumetopias jubatus monteriensis*), California sea lion (*Zalophus californianus*), harbor seal (*Phoca vitulina richardii*), killer whale (transient only; *Orcinus orca*), and harbor porpoise (*Phocoena phocoena vomerina*). These species may occur year-round in the Hood Canal, with the exception of the Steller sea lion, which is present only from fall to late spring (approximately late September to early May), and the California sea lion, which is only present from late summer to late spring (approximately late August to early June).

This would be the third such IHA, if issued. The Navy received IHAs, effective from July 16–February 15, in 2012–13 (77 FR 42279) and 2013–14 (78 FR 43148). Additional IHAs were issued to the Navy in recent years for marine construction projects on the NBKB waterfront. These projects include the Test Pile Project (TPP), conducted in 2011–12 in the proposed footprint of the EHW–2 to collect geotechnical data and test methodology in advance of EHW–2 (76 FR 38361); a two-year maintenance project on the existing explosives handling wharf (EHW–1) conducted in 2011–12 and 2012–13 (76 FR 30130 and 77 FR 43049); and a minor project to install a new mooring for an existing research barge, conducted in 2013–14 (78 FR 43165). In-water work associated with all projects was conducted only during the approved in-water work window (July 16–February 15). Monitoring reports for all of these projects are available on the Internet at *www.nmfs.noaa.gov/pr/permits/incidental.htm* and provide environmental information related to proposed issuance of this IHA for public review and comment.

Description of the Specified Activity

Overview

NBKB provides berthing and support services to Navy submarines and other fleet assets. The Navy proposes to continue construction of the EHW–2 facility at NBKB in order to support future program requirements for submarines berthed at NBKB. The Navy has determined that construction of EHW–2 is necessary because the existing EHW alone will not be able to support future program requirements. All piles would be driven with a vibratory hammer for their initial embedment depths, while select piles may be finished with an impact hammer for proofing, as necessary. A maximum of three vibratory drivers and one impact driver may be used simultaneously. Proofing involves striking a driven pile with an impact hammer to verify that it provides the required load-bearing capacity, as indicated by the number of hammer blows per foot of pile advancement. Sound attenuation measures (i.e., bubble curtain) would be used during all impact hammer operations.

Dates and Duration

The allowable season for in-water work, including pile driving, at NBKB is July 16 through February 15, a window established by the Washington Department of Fish and Wildlife in coordination with NMFS and the U.S. Fish and Wildlife Service (USFWS) to protect juvenile salmon. Under the proposed action—which includes only the portion of the project that would be completed under this proposed IHA—a maximum of 195 pile driving days would occur. Pile driving may occur on any day during the in-water work window.

Impact pile driving during the first half of the in-water work window (July 16 to September 15) may only occur between two hours after sunrise and two hours before sunset to protect breeding marbled murrelets (an Endangered Species Act [ESA]-listed bird under the jurisdiction of USFWS). Vibratory driving during the first half of the window, and all in-water work conducted between September 16 and February 15, may occur during daylight hours (sunrise to sunset). Other construction (not in-water) may occur between 7:00 a.m. and 10:00 p.m., year-round. Therefore, in-water work is restricted to daylight hours (at minimum) and there is at least a nine-hour break during the 24-hour cycle from all construction activity.

Specific Geographic Region

NBKB is located on the Hood Canal approximately 32 km west of Seattle, Washington (see Figures 2–1 through 2–4 in the Navy's application). The Hood Canal is a long, narrow fjord-like basin of the western Puget Sound. Throughout its 108-km length, the width of the canal varies from 1.6–3.2 km and exhibits strong depth/elevation gradients and irregular seafloor topography in many areas. Although no official boundaries exist along the waterway, the northeastern section extending from the mouth of the canal at Admiralty Inlet to the southern tip of Toandos Peninsula is referred to as northern Hood Canal. NBKB is located within this region. Please see Section 2 of the Navy's application for detailed information about the specific geographic region, including physical and oceanographic characteristics.

Detailed Description of Activities

Development of necessary facilities for handling of explosive materials is part of the Navy's sea-based strategic deterrence mission. The EHW–2 consists of two components: (1) The wharf proper (or Operations Area), including the warping wharf; and (2) two access trestles. Please see Figures 1–1 and 1–2 of the Navy's application for conceptual and schematic representations of the EHW–2.

The wharf proper will lie approximately 183 m offshore at water depths of 18–30 m, and will consist of the main wharf, a warping wharf, and lightning protection towers, all pile-supported. It will include a slip (docking area) for submarines, surrounded on three sides by operational wharf area. The access trestles will connect the wharf to the shore. There will be an entrance trestle and an exit trestle; these will be combined over shallow water to reduce overwater area. The trestles will be pile-supported on 24-in steel pipe piles driven approximately 9 m into the seafloor. Spacing between bents (rows of piles) will be 8 m. Concrete pile caps will be cast in place and will support pre-cast concrete deck sections.

For the entire project, a total of up to 1,250 permanent piles ranging in size between 24–48 inches in diameter will be driven in-water to construct the wharf. Construction also requires temporary installation of up to 150 falsework piles used as an aid to guide permanent piles to their proper locations. Falsework piles, which are removed upon installation of the permanent piles, are usually steel pipe piles and are driven and removed using a vibratory driver. It has not been determined exactly what parts or how much of the project will be constructed in any given year; however, a maximum of 195 days of pile driving may occur per in-water work window. The analysis contained herein is based upon the maximum of 195 pile driving days, rather than any specific number of piles driven. Table 1 summarizes the number and nature of piles required for the entire project, rather than what subset of piles may be expected to be driven during the third year of construction proposed for this IHA.

TABLE 1—SUMMARY OF PILES REQUIRED FOR WHARF CONSTRUCTION

[in total]

Feature	Quantity
Total number of permanent in-water piles.	Up to 1,250.
Size and number of main wharf piles.	24-in: 140. 36-in: 157. 48-in: 263.
Size and number of warping wharf piles.	24-in: 80. 36-in: 190.
Size and number of lightning tower piles.	24-in: 40. 36-in: 90.
Size and number of trestle piles.	24-in: 57. 36-in: 233.
Falsework piles	Up to 150, 18- to 24-in.
Maximum pile driving duration.	195 days (under one-year IHA).

Pile installation will utilize vibratory pile drivers to the greatest extent possible, and the Navy anticipates that most piles will be able to be vibratory driven to within several feet of the required depth. Pile drivability is, to a large degree, a function of soil conditions and the type of pile hammer. The soil conditions encountered during geotechnical explorations at NBKB indicate existing conditions generally consist of fill or sediment of very dense glacially overridden soils. Recent experience at other construction locations along the NBKB waterfront indicates that most piles should be able to be driven with a vibratory hammer to proper embedment depth. However, difficulties during pile driving may be encountered as a result of obstructions, such as rocks or boulders, which may exist throughout the project area. If difficult driving conditions occur, increased usage of an impact hammer will occur.

Unless difficult driving conditions are encountered, an impact hammer will only be used to proof the load-bearing capacity of approximately every fourth or fifth pile. The industry standard is to proof every pile with an impact hammer; however, in an effort to reduce blow counts from the impact hammer, the engineer of record has agreed to only proof every fourth or fifth pile. A maximum of 200 strikes would be required to proof each pile. Pile production rates are dependent upon required embedment depths, the potential for encountering difficult driving conditions, and the ability to drive multiple piles without a need to relocate the driving rig. Under best-case scenarios (i.e., shallow piles, driving in optimal conditions, using multiple driving rigs), it may be possible to install enough pilings with the vibratory hammer that proofing may be required for up to five piles in a day. Under this scenario, with a single impact hammer used to proof up to five piles per day at 200 strikes per pile, it is estimated that up to a maximum of 1,000 strikes from an impact hammer would be required per day.

If difficult subsurface driving conditions (e.g., cobble/boulder zones) are encountered that cause refusal with the vibratory equipment, it may be necessary to use an impact hammer to drive some piles for the remaining portion of their required depth. The worst-case scenario is that a pile would be driven for its entire length using an impact hammer. Given the uncertainty regarding the types and quantities of boulders or cobbles that may be encountered, and the depth at which they may be encountered, the number of strikes necessary to drive a pile its entire length could be approximately 1,000 to 2,000 strikes per pile. The Navy estimates that a possible worst-case daily scenario would require driving three piles full length (at a worst-case of 2,000 strikes per pile) after the piles have become hung on large boulders early in the installation process, with proofing of an additional two piles (at 200 strikes each) that were able to be installed primarily via vibratory means. This worst-case scenario would therefore result in a maximum of 6,400 strikes per day. All piles driven or struck with an impact hammer would be surrounded by a bubble curtain over the full water column to minimize in-water sound. Up to three vibratory rigs and one impact rig may be used at a time. Pile production rate (number of piles driven per day) is affected by many factors: Size, type (vertical versus angled), and location of piles; weather; number of driver rigs operating; equipment reliability; geotechnical (subsurface) conditions; and work stoppages for security or environmental reasons (such as presence of marine mammals).

Description of Work Accomplished—During the first in-water work season, the contractor completed installation of 184 piles to support the main segment of the access trestle. Driven piles ranged in size from 24- to 36-in at depths ranging from 0 to 15 m. A maximum of two vibratory pile drivers and one impact hammer were operated concurrently.

During the second season, installation of 411 total piles was completed, including all 315 of the wharf deck plumb piles (non-fender) and 24 of the 34 total wharf deck Lead Rubber Bearing (LRB) dolphins (clusters of four piles per dolphin). Installed piles ranged in size from 36- to 48-in at depths ranging from 12–29 m. As before, a maximum two vibratory pile drivers and one impact hammer were operated concurrently.

During the third season, the Navy expects to complete installation of the wharf deck LRBs, piling support for the warping wharf, lightning towers, and trestle deck closure as well as all fender piles. The Navy expects to complete the project in January 2016. The amount of progress made under this proposed IHA, if issued, would determine necessity of a fourth IHA for the 2015–16 in-water work window.

Description of Marine Mammals in the Area of the Specified Activity

There are eight marine mammal species with recorded occurrence in the Hood Canal during the past fifteen years, including five cetaceans and three pinnipeds. The harbor seal resides year-round in Hood Canal, while the Steller sea lion and California sea lion inhabit Hood Canal during portions of the year. Harbor porpoises may transit through the project area and occur regularly in Hood Canal, while transient killer whales could be present in the project area but do not have regular occurrence in the Hood Canal. The Dall's porpoise (*Phocoenoides dalli dalli*), humpback whale (*Megaptera novaeangliae*), and gray whale (*Eschrichtius robustus*) have been observed in Hood Canal, but their presence is sufficiently rare that we do not believe there is a reasonable likelihood of their occurrence in the project area during the proposed period of validity for this IHA. The latter three species are not carried forward for further analysis beyond this section.

We have reviewed the Navy's detailed species descriptions, including life history information, for accuracy and completeness and refer the reader to Sections 3 and 4 of the Navy's application instead of reprinting the information here. Please also refer to NMFS' Web site (*www.nmfs.noaa.gov/pr/species/mammals*) for generalized species accounts and to the Navy's Marine Resource Assessment for the Pacific Northwest, which documents and describes the marine resources that occur in Navy operating areas of the Pacific Northwest, including Puget Sound (DoN, 2006). The document is publicly available at *www.navfac.navy.mil/products_and_services/ev/products_and_services/marine_resources/marine_resource_assessments.html* (accessed May 2, 2014).

Table 2 lists the marine mammal species with expected potential for occurrence in the vicinity of NBKB during the project timeframe and summarizes key information regarding stock status and abundance. Taxonomically, we follow Committee on Taxonomy (2014). Please see NMFS' Stock Assessment Reports (SAR), available at *www.nmfs.noaa.gov/pr/sars,* for more detailed accounts of these stocks' status and abundance. The harbor seal, California sea lion and harbor porpoise are addressed in the Pacific SARs (e.g., Carretta *et al.,* 2013a), while the Steller sea lion and transient killer whale are treated in the Alaska SARs (e.g., Allen and Angliss, 2013a).

In the species accounts provided here, we offer a brief introduction to the species and relevant stock as well as available information regarding population trends and threats, and describe any information regarding local occurrence.

TABLE 2—MARINE MAMMALS POTENTIALLY PRESENT IN THE VICINITY OF NBKB

Species	Stock	ESA/MMPA status; strategic (Y/N) [1]	Stock abundance (CV, N_{min}, most recent abundance survey) [2]	PBR [3]	Annual M/SI [4]	Relative occurrence in Hood Canal; season of occurrence
Order Cetartiodactyla—Cetacea—Superfamily Odontoceti (toothed whales, dolphins, and porpoises)						
Family Delphinidae						
Killer whale	West coast transient.[5 6]	—;N	243 (n/a; 2006).	2.4	0	Rare; year-round (but last observed in 2005).
Family Phocoenidae (porpoises)						
Harbor porpoise	Washington inland waters.[7]	—;N	10,682 (0.38; 7,841; 2003).	63	≥2.2	Possible regular presence; year-round.
Order Carnivora—Superfamily Pinnipedia						
Family Otariidae (eared seals and sea lions)						
California sea lion	U.S.	—; N	296,750 (n/a; 153,337; 2008).	9,200	≥431	Seasonal/common; Fall to late spring (Aug to Jun).
Steller sea lion	Eastern U.S.[5]	—; N [8]	63,160–78,198 (n/a; 57,966; 2008–11) [9].	[10] 1,552	65.1	Seasonal/occasional; Fall to late spring (Sep to May).
Family Phocidae (earless seals)						
Harbor seal	Washington inland waters.[7]	—; N	14,612 (0.15; 12,844; 1999).	771	13.4	Common; Year-round resident.

[1] ESA status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). A dash (—) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR (see footnote 3) or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.

[2] CV is coefficient of variation; N_{min} is the minimum estimate of stock abundance. In some cases, CV is not applicable. For killer whales, the abundance values represent direct counts of individually identifiable animals; therefore there is only a single abundance estimate with no associated CV. For certain stocks of pinnipeds, abundance estimates are based upon observations of animals (often pups) ashore multiplied by some correction factor derived from knowledge of the specie's (or similar species') life history to arrive at a best abundance estimate; therefore, there is no associated CV. In these cases, the minimum abundance may represent actual counts of all animals ashore.

[3] Potential biological removal, defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population size (OSP).

[4] These values, found in NMFS' SARs, represent annual levels of human-caused mortality plus serious injury from all sources combined (e.g., commercial fisheries, subsistence hunting, ship strike). Annual M/SI often cannot be determined precisely and is in some cases presented as a minimum value. All values presented here are from the draft 2013 SARs (*www.nmfs.noaa.gov/pr/sars/draft.htm*).

[5] Abundance estimates (and resulting PBR values) for these stocks are new values presented in the draft 2013 SARs. This information was made available for public comment and is currently under review and therefore may be revised prior to finalizing the 2013 SARs. However, we consider this information to be the best available for use in this document.

[6] The abundance estimate for this stock includes only animals from the "inner coast" population occurring in inside waters of southeastern Alaska, British Columbia, and Washington—excluding animals from the "outer coast" subpopulation, including animals from California—and therefore should be considered a minimum count. For comparison, the previous abundance estimate for this stock, including counts of animals from California that are now considered outdated, was 354.

[7] Abundance estimates for these stocks are greater than eight years old and are therefore not considered current. PBR is considered undetermined for these stocks, as there is no current minimum abundance estimate for use in calculation. We nevertheless present the most recent abundance estimates and PBR values, as these represent the best available information for use in this document.

[8] The eastern distinct population segment of the Steller sea lion, previously listed under the ESA as threatened, was delisted on December 4, 2013 (78 FR 66140; November 4, 2013). Because this stock is not below its OSP size and the level of direct human-caused mortality does not exceed PBR, this delisting action implies that the stock is no longer designated as depleted or as a strategic stock under the MMPA.

[9] Best abundance is calculated as the product of pup counts and a factor based on the birth rate, sex and age structure, and growth rate of the population. A range is presented because the extrapolation factor varies depending on the vital rate parameter resulting in the growth rate (i.e., high fecundity or low juvenile mortality).

[10] PBR is calculated for the U.S. portion of the stock only (excluding animals in British Columbia) and assumes that the stock is not within its OSP. If we assume that the stock is within its OSP, PBR for the U.S. portion increases to 2,069.

Although present in Washington inland waters in small numbers (Falcone *et al.,* 2005), primarily in the Strait of Juan de Fuca and San Juan Islands but also occasionally in Puget Sound, the humpback whale is not typically present in Hood Canal. Archived sighting records show no confirmed observations from 2001–11 (*www.orcanetwork.org;* accessed May 5, 2014), and no records are found in the literature. In January–February 2012, one individual was observed in Hood Canal repeatedly over a period of several weeks. No sightings have been recorded since that time.

Gray whales generally migrate southbound past Washington in late December and January, and transit past Washington on the northbound return in March to May. Gray whales do not generally make use of Washington inland waters, but have been observed in certain portions of those waters in all months of the year, with most records occurring from March through June (Calambokidis *et al.,* 2010; *www.orcanetwork.org*) and associated with regular feeding areas. Usually fewer than twenty gray whales visit the inner marine waters of Washington and British Columbia beginning in about January, and six to ten of these are individual whales that return most years to feeding sites in northern Puget Sound. The remaining individuals occurring in any given year generally appear unfamiliar with feeding areas, often arrive emaciated, and commonly die of starvation (WDFW, 2012). Gray whales have been sighted in Hood Canal on six occasions since 1999 (including a stranded whale), with the most recent report in November 2010 (*www.orcanetwork.org*).

In Washington, Dall's porpoises are most abundant in offshore waters where they are year-round residents, although interannual distribution is highly variable (Green *et al.,* 1992). In inland waters, Dall's porpoises are most frequently observed in the Strait of Juan de Fuca and Haro Strait between San Juan Island and Vancouver Island (Nysewander *et al.,* 2005), but are seen occasionally in southern Puget Sound and may also occasionally occur in Hood Canal. Only a single Dall's porpoise has been observed at NBKB, in deeper water during a 2008 summer survey conducted by the Navy (Tannenbaum *et al.,* 2009). On the basis of this single observation, we previously assumed it appropriate to authorize incidental take of this species. However, there have been no subsequent observations of Dall's porpoises in Hood Canal during either dedicated vessel line-transect surveys or project-specific monitoring and we no longer believe that the species may be reasonably expected to be present in the action area.

Steller Sea Lion

Steller sea lions are distributed mainly around the coasts to the outer continental shelf along the North Pacific rim from northern Hokkaido, Japan through the Kuril Islands and Okhotsk Sea, Aleutian Islands and central Bering Sea, southern coast of Alaska and south to California (Loughlin *et al.,* 1984). Based on distribution, population response, and phenotypic and genotypic data, two separate stocks of Steller sea lions are recognized within U.S. waters, with the population divided into western and eastern distinct population segments (DPS) at 144°W (Cape Suckling, Alaska) (Loughlin, 1997). The eastern DPS extends from California to Alaska, including the Gulf of Alaska, and is the only stock that may occur in the Hood Canal.

According to NMFS' recent status review (NMFS, 2013), the best available information indicates that the overall abundance of eastern DPS Steller sea lions has increased for a sustained period of at least three decades while pup production has also increased significantly, especially since the mid-1990s. Johnson and Gelatt (2012) provided an analysis of growth trends of the entire eastern DPS from 1979–2010, indicating that the stock increased during this period at an annual rate of 4.2 percent (90% CI 3.7–4.6). Most of the overall increase occurred in the northern portion of the range (southeast Alaska and British Columbia), but pup counts in Oregon and California also increased significantly (e.g., Merrick *et al.,* 1992; Sease *et al.,* 2001; Olesiuk and Trites, 2003; Fritz *et al.* 2008; Olesiuk, 2008; NMFS, 2008, 2013). In Washington, Pitcher *et al.* (2007) reported that Steller sea lions, presumably immature animals and non-breeding adults, regularly used four haul-outs, including two ''major'' haul-outs (>50 animals). The same study reported that the numbers of sea lions counted between 1989 and 2002 on Washington haul-outs increased significantly (average annual rate of 9.2 percent) (Pitcher *et al.,* 2007). Although the stock size has increased, its status relative to OSP size is unknown. However, the consistent long-term estimated annual rate of increase may indicate that the stock is reaching OSP size (Allen and Angliss, 2013a).

Data from 2005–10 show a total mean annual mortality rate of 5.71 (CV = 0.23) sea lions per year from observed fisheries and 11.25 reported takes per year that could not be assigned to specific fisheries, for an approximate total from all fisheries of 17 eastern Steller sea lions (Allen and Angliss, 2013a). In addition, opportunistic observations and stranding data indicate that an additional 32 animals are killed or seriously injured each year through interaction with commercial and recreational troll fisheries and by entanglement (Allen and Angliss, 2013b). The annual average take for subsistence harvest in Alaska was 11.9 individuals in 2004–08 (Allen and Angliss, 2013a). Data on community subsistence harvests is no longer being collected, and this average is retained as an estimate for current and future subsistence harvest. Sea lion deaths are also known to occur because of illegal shooting, vessel strikes, or capture in research gear and other traps, totaling 4.2 animals per year from 2007–11 (Allen and Angliss, 2013b). The total annual human-caused mortality is a minimum estimate because takes via fisheries interactions and subsistence harvest in Canada are poorly known, although are believed to be small.

The eastern stock breeds in rookeries located in southeast Alaska, British Columbia, Oregon, and California. There are no known breeding rookeries in Washington (Allen and Angliss, 2013a) but eastern stock Steller sea lions are present year-round along the outer coast of Washington, including immature animals or non-breeding adults of both sexes. In 2011, the minimum count for Steller sea lions in Washington was 1,749 (Allen and Angliss, 2013b), up from 516 in 2001 (Pitcher *et al.,* 2007).

In Washington, Steller sea lions primarily occur at haul-out sites along the outer coast from the Columbia River to Cape Flattery and in inland waters sites along the Vancouver Island coastline of the Strait of Juan de Fuca (Jeffries *et al.,* 2000; Olesiuk and Trites, 2003; Olesiuk, 2008). Numbers vary seasonally in Washington waters with peak numbers present during the fall and winter months (Jeffries *et al.,* 2000). Beginning in 2008, Steller sea lions have been observed at NBKB hauled out on submarines at Delta Pier (located approximately 1.25 km south of the project site) during fall through spring months, with September 26 as the earliest documented arrival. When Steller sea lions are present, there are typically one to four individuals, with a maximum observed group size of eleven.

Harbor Seal

Harbor seals inhabit coastal and estuarine waters and shoreline areas of the northern hemisphere from temperate to polar regions. The eastern North Pacific subspecies is found from Baja California north to the Aleutian Islands and into the Bering Sea. Multiple lines of evidence support the existence of geographic structure among harbor seal populations from California to Alaska (e.g., O'Corry-Crowe *et al.,* 2003; Temte, 1986; Calambokidis *et al.,* 1985; Kelly, 1981; Brown, 1988; Lamont, 1996; Burg, 1996). Harbor seals are generally non-migratory, and analysis of genetic information suggests that genetic differences increase with geographic distance (Westlake and O'Corry-Crowe, 2002). However, because stock boundaries are difficult to meaningfully draw from a biological perspective, three separate harbor seal stocks are recognized for management purposes along the west coast of the continental U.S.: (1) Inland waters of Washington (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.,* 2013a). Multiple stocks are recognized in Alaska. Samples from Washington, Oregon, and California demonstrate a high level of genetic diversity and indicate that the harbor seals of Washington inland waters possess unique haplotypes not found in seals from the coasts of Washington, Oregon, and California (Lamont *et al.,* 1996). Only the Washington inland waters stock may be found in the project area.

Recent genetic evidence suggests that harbor seals of Washington inland waters may have sufficient population structure to warrant division into multiple distinct stocks (Huber *et al.,* 2010, 2012). Based on studies of pupping phenology, mitochondrial DNA, and microsatellite variation, Carretta *et al.* (2013b) suggest division of the Washington inland waters stock into three new populations, and present these as prospective stocks: (1) Southern Puget Sound (south of the Tacoma Narrows Bridge); (2) Washington northern inland waters (including Puget Sound north of the Tacoma Narrows Bridge, the San Juan Islands, and the Strait of Juan de Fuca); and (3) Hood Canal. Until this stock structure is accepted, we consider a single Washington inland waters stock.

The best available abundance estimate was derived from aerial surveys of harbor seals in Washington conducted during the pupping season in 1999, during which time the total numbers of hauled-out seals (including pups) were counted (Jeffries *et al.,* 2003). Radio-tagging studies conducted at six locations collected information on harbor seal haul-out patterns in 1991–92, resulting in a pooled correction factor (across three coastal and three inland sites) of 1.53 to account for animals in the water which are missed during the aerial surveys (Huber *et al.,* 2001), which, coupled with the aerial survey counts, provides the abundance estimate (see Table 2).

Harbor seal counts in Washington State increased at an annual rate of six percent from 1983–96, increasing to ten percent for the period 1991–96 (Jeffries *et al.,* 1997). The population is thought to be stable, and the Washington inland waters stock is considered to be within its OSP size (Jeffries *et al.,* 2003).

Data from 2007–11 indicate that a minimum of four harbor seals are killed annually in Washington inland waters commercial fisheries, while mean annual mortality for recreational fisheries is one seal (Carretta *et al.,* 2013b). Animals captured east of Cape Flattery are assumed to belong to this stock. The estimate is considered a minimum because there are likely additional animals killed in unobserved fisheries and because not all animals stranding as a result of fisheries interactions are likely to be recorded. Another 8.4 harbor seals per year are estimated to be killed as a result of various non-fisheries human interactions (Carretta *et al.,* 2013b). Tribal subsistence takes of this stock may occur, but no data on recent takes are available.

Harbor seals are the most abundant marine mammal in Hood Canal, where they can occur anywhere year-round and are considered resident, and are the only pinniped that breeds in inland Washington waters (Jeffries *et al.,* 2003). They are year-round, non-migratory residents, pup (i.e., give birth) in Hood Canal, and the population is considered closed, meaning that they do not have much movement outside of Hood Canal (London, 2006). Surveys in the Hood Canal from the mid-1970s to 2000 show a fairly stable population between 600–1,200 seals, and the abundance of harbor seals in Hood Canal has likely stabilized at its carrying capacity of approximately 1,000 seals (Jeffries *et al.,* 2003). Harbor seals have been consistently sighted during Navy surveys, found in all marine habitats including nearshore waters and deeper water, and have been observed hauled out on manmade objects such as buoys (Agness and Tannenbaum, 2009; Tannenbaum *et al.,* 2009, 2011). Harbor seals were commonly observed in the water during monitoring conducted for other projects at NBKB in 2011–13 (HDR, 2012a, 2012b; Hart Crowser, 2013).

There are no known pupping or regular haul-out sites in the project area, as harbor seals in Hood Canal prefer river deltas and exposed tidal areas (London, 2006). The closest haul-out to the project area is approximately 16 km southwest of NBKB at Dosewallips River mouth, outside the potential area of effect for this project (see Figure 4–1 of the Navy's application). During most of the year, all age and sex classes (except neonates) occur in the project area throughout the period of construction activity. Because there are no known regular pupping sites in the vicinity of the project area, harbor seal neonates would not generally be expected to be present during pile driving. However, pupping has been observed on the NBKB waterfront at Carderock Pier and Service Pier (both locations over a mile south of the project site), and a harbor seal neonate was observed on a small floating dock near the project site in 2013.

California Sea Lion

California sea lions range from the Gulf of California north to the Gulf of Alaska, with breeding areas located in the Gulf of California, western Baja California, and southern California. Five genetically distinct geographic populations have been identified: (1) Pacific temperate, (2) Pacific subtropical, and (3–5) southern, central, and northern Gulf of California (Schramm *et al.,* 2009). Rookeries for the Pacific temperate population are found within U.S. waters and just south of the U.S.-Mexico border, and animals belonging to this population may be found from the Gulf of Alaska to

Mexican waters off Baja California. For management purposes, a stock of California sea lions comprising those animals at rookeries within the U.S. is defined (i.e., the U.S. stock of California sea lions) (Carretta *et al.,* 2013a). Pup production at the Coronado Islands rookery in Mexican waters is considered an insignificant contribution to the overall size of the Pacific temperate population (Lowry and Maravilla-Chavez, 2005).

Trends in pup counts from 1975 through 2008 have been assessed for four rookeries in southern California and for haul-outs in central and northern California. During this time period counts of pups increased at an annual rate of 5.4 percent, excluding six El Nino years when pup production declined dramatically before quickly rebounding (Carretta *et al.,* 2013a). The maximum population growth rate was 9.2 percent when pup counts from the El Niño years were removed. There are indications that the California sea lion may have reached or is approaching carrying capacity, although more data are needed to confirm that leveling in growth persists (Carretta *et al.,* 2013a).

Data from 2003–09 indicate that a minimum of 337 (CV = 0.56) California sea lions are killed annually in commercial fisheries. In addition, a summary of stranding database records for 2005–09 shows an annual average of 65 such events, which is likely a gross underestimate because most carcasses are not recovered. California sea lions may also be removed because of predation on endangered salmonids (seventeen per year, 2008–10) or incidentally captured during scientific research (three per year, 2005–09) (Carretta *et al.,* 2013a). Sea lion mortality has also been linked to the algal-produced neurotoxin domoic acid (Scholin *et al.,* 2000). Future mortality may be expected to occur, due to the sporadic occurrence of such harmful algal blooms. There is currently an Unusual Mortality Event (UME) declaration in effect for California sea lions. Beginning in January 2013, elevated strandings of California sea lion pups have been observed in southern California, with live sea lion strandings nearly three times higher than the historical average. Findings to date indicate that a likely contributor to the large number of stranded, malnourished pups was a change in the availability of sea lion prey for nursing mothers, especially sardines. The causes and mechanisms of this UME remain under investigation (*www.nmfs.noaa.gov/pr/health/mmume/californiasealions2013.htm;* accessed May 8, 2014).

An estimated 3,000 to 5,000 California sea lions migrate northward along the coast to central and northern California, Oregon, Washington, and Vancouver Island during the non-breeding season from September to May (Jeffries *et al.,* 2000) and return south the following spring (Mate, 1975; Bonnell *et al.,* 1983). Peak numbers of up to 1,000 California sea lions occur in Puget Sound (including Hood Canal) during this time period (Jeffries *et al.,* 2000).

California sea lions are present in Hood Canal during much of the year with the exception of mid-June through August, and occur regularly at NBKB, as observed during Navy waterfront surveys conducted from April 2008 through December 2013 (DoN, 2013). They are known to utilize a diversity of man-made structures for hauling out (Riedman, 1990) and, although there are no regular California sea lion haul-outs known within the Hood Canal (Jeffries *et al.,* 2000), they are frequently observed hauled out at several opportune areas at NBKB (e.g., submarines, floating security fence, barges). All documented instances of California sea lions hauling out at NBKB have been on submarines docked at Delta Pier, where a maximum of 122 California sea lions have been observed at any one time (DoN, 2013), and on pontoons of the NBKB floating security fence.

Killer Whale

Killer whales are one of the most cosmopolitan marine mammals, found in all oceans with no apparent restrictions on temperature or depth, although they do occur at higher densities in colder, more productive waters at high latitudes and are more common in nearshore waters (Leatherwood and Dahlheim, 1978; Forney and Wade, 2006). Killer whales are found throughout the North Pacific, including the entire Alaska coast, in British Columbia and Washington inland waterways, and along the outer coasts of Washington, Oregon, and California. On the basis of differences in morphology, ecology, genetics, and behavior, populations of killer whales have largely been classified as ''resident'', ''transient'', or ''offshore'' (e.g., Dahlheim *et al.,* 2008). Several studies have also provided evidence that these ecotypes are genetically distinct, and that further genetic differentiation is present between subpopulations of the resident and transient ecotypes (e.g., Barrett-Lennard, 2000). The taxonomy of killer whales is unresolved, with expert opinion generally following one of two lines: Killer whales are either (1) a single highly variable species, with locally differentiated ecotypes representing recently evolved and relatively ephemeral forms not deserving species status, or (2) multiple species, supported by the congruence of several lines of evidence for the distinctness of sympatrically occurring forms (Krahn *et al.,* 2004). Resident and transient whales are currently considered to be unnamed subspecies (Committee on Taxonomy, 2014).

The resident and transient populations have been divided further into different subpopulations on the basis of genetic analyses, distribution, and other factors. Recognized stocks in the North Pacific include Alaska residents; northern residents; southern residents; Gulf of Alaska, Aleutian Islands, and Bering Sea transients; and west coast transients, along with a single offshore stock. See Allen and Angliss (2013a) for more detail about these stocks. West coast transient killer whales, which occur from California through southeastern Alaska, are the only type expected to potentially occur in the project area.

It is thought that the stock grew rapidly from the mid-1970s to mid-1990s as a result of a combination of high birth rate, survival, as well as greater immigration of animals into the nearshore study area (DFO, 2009). The rapid growth of the population during this period coincided with a dramatic increase in the abundance of the whales' primary prey, harbor seals, in nearshore waters. Population growth began slowing in the mid-1990s and has continued to slow in recent years (DFO, 2009). Population trends and status of this stock relative to its OSP level are currently unknown. Analyses in DFO (2009) estimated a rate of increase of about six percent per year from 1975 to 2006, but this included recruitment of non-calf whales into the population.

Although certain commercial fisheries are known to have potential for interaction with killer whales and other mortality, resulting from shooting, ship strike, or entanglement, has been of concern in the past, the estimated level of human caused mortality and serious injury is currently considered to be zero for this stock (Allen and Angliss, 2013a). However, this could represent an underestimate as regards total fisheries-related mortality due to a lack of data concerning marine mammal interactions in Canadian commercial fisheries known to have potential for interaction with killer whales. Any such interactions are thought to be few in number (Allen and Angliss, 2013a). No ship strikes have been reported for this stock, and shooting of transients is thought to be minimal because their diet is based on marine mammals rather than fish. There are no reports of a subsistence harvest of killer whales in Alaska or Canada.

Transient occurrence in inland waters appears to peak during August and September, which is the peak time for harbor seal pupping, weaning, and post-weaning (Baird and Dill, 1995). The number of transient killer whales in Washington waters at any one time is probably fewer than twenty individuals (Wiles, 2004). In 2003 and 2005, small groups of transient killer whales (eleven and six individuals, respectively) were present in Hood Canal for significant periods of time (59 and 172 days, respectively) between the months of January and July. While present, the whales preyed on harbor seals in the subtidal zone of the nearshore marine and inland marine deeper water habitats (London, 2006).

Harbor Porpoise

Harbor porpoises are found primarily in inshore and relatively shallow coastal waters (<100 m) from Point Barrow (Alaska) to Point Conception (California). Various genetic analyses and investigation of pollutant loads indicate a low mixing rate for harbor porpoises along the west coast of North America and likely fine-scale geographic structure along an almost continuous distribution from California to Alaska (e.g., Calambokidis and Barlow, 1991; Osmek *et al.,* 1994; Chivers *et al.,* 2002, 2007). However, stock boundaries are difficult to draw because any rigid line is generally arbitrary from a biological perspective. On the basis of genetic data and density discontinuities identified from aerial surveys, eight stocks have been identified in the eastern North Pacific, including northern Oregon/Washington coastal and inland Washington stocks (Carretta *et al.,* 2013a). The Washington inland waters stock includes individuals found east of Cape Flattery and is the only stock that may occur in the project area.

Although long-term harbor porpoise sightings in southern Puget Sound declined from the 1940s through the 1990s, sightings and strandings have increased in Puget Sound and northern Hood Canal in recent years and harbor porpoise are now considered to regularly occur year-round in these waters (Carretta *et al.,* 2013a). Reasons for the apparent decline, as well as the apparent rebound, are unknown. Recent observations 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). The status of harbor porpoises in Washington inland waters relative to OSP is not known (Carretta *et al.,* 2013a).

Data from 2005–09 indicate that a minimum of 2.2 Washington inland waters harbor porpoises are killed annually in U.S. commercial fisheries (Carretta *et al.,* 2013a). Animals captured in waters east of Cape Flattery are assumed to belong to this stock. This estimate is considered a minimum because the Washington Puget Sound Region salmon set/drift gillnet fishery has not been observed since 1994, and because of a lack of knowledge about the extent to which harbor porpoise from U.S. waters frequent the waters of British Columbia and are, therefore, subject to fishery-related mortality. However, harbor porpoise takes in the salmon drift gillnet fishery are unlikely to have increased since the fishery was last observed, when few interactions were recorded, due to reductions in the number of participating vessels and available fishing time. Fishing effort and catch have declined throughout all salmon fisheries in the region due to management efforts to recover ESA-listed salmonids (Carretta *et al.,* 2013a). In addition, an estimated 0.4 animals per year are killed by non-fishery human causes (e.g., ship strike, entanglement). In 2006, a UME was declared for harbor porpoises throughout Oregon and Washington, and a total of 114 strandings were reported in 2006–07. The cause of the UME has not been determined and several factors, including contaminants, genetics, and environmental conditions, are still being investigated (Carretta *et al.,* 2013a).

Prior to recent construction projects conducted by the Navy at NBKB, harbor porpoises were considered to have only occasional occurrence in the project area. A single harbor porpoise had been sighted in deeper water at NBKB during 2010 field observations (Tannenbaum *et al.,* 2011). However, while implementing monitoring plans for work conducted from July–October, 2011, the Navy recorded multiple sightings of harbor porpoise in the deeper waters of the project area (HDR, 2012). Following these sightings, the Navy conducted dedicated line transect surveys, recording multiple additional sightings of harbor porpoises, and have revised local density estimates accordingly.

Potential Effects of the Specified Activity on Marine Mammals

This section includes a summary and discussion of the ways that components of the specified activity may impact marine mammals. This discussion also includes reactions that we consider to rise to the level of a take and those that we do not consider to rise to the level of a take (for example, with acoustics, we may include a discussion of studies that showed animals not reacting at all to sound or exhibiting barely measurable avoidance). This section is intended as a background of potential effects and does not consider either the specific manner in which this activity will be carried out or the mitigation that will be implemented, and how either of those will shape the anticipated impacts from this specific activity. The ''Estimated Take by Incidental Harassment'' section later in this document will include a quantitative analysis of the number of individuals that are expected to be taken by this activity. The ''Negligible Impact Analysis'' section will include the analysis of how this specific activity will impact marine mammals and will consider the content of this section, the ''Estimated Take by Incidental Harassment'' section, the ''Proposed Mitigation'' section, and the ''Anticipated Effects on Marine Mammal Habitat'' section to draw conclusions regarding the likely impacts of this activity on the reproductive success or survivorship of individuals and from that on the affected marine mammal populations or stocks. In the following discussion, we provide general background information on sound and marine mammal hearing before considering potential effects to marine mammals from sound produced by vibratory and impact pile driving.

Description of Sound Sources

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in hertz (Hz) or cycles per second. Wavelength is the distance between two peaks of a sound wave; lower frequency sounds have longer wavelengths than higher frequency sounds and attenuate (decrease) more rapidly in shallower water. Amplitude is the height of the sound pressure wave or the 'loudness' of a sound and is typically measured using the decibel (dB) scale. A dB is the ratio between a measured pressure (with sound) and a reference pressure (sound at a constant pressure, established by scientific standards). It is a logarithmic unit that accounts for large variations in amplitude; therefore, relatively small changes in dB ratings correspond to large changes in sound pressure. When referring to sound pressure levels (SPLs;

the sound force per unit area), sound is referenced in the context of underwater sound pressure to 1 microPascal (μPa). One pascal is the pressure resulting from a force of one newton exerted over an area of one square meter. The source level (SL) represents the sound level at a distance of 1 m from the source (referenced to 1 μPa). The received level is the sound level at the listener's position. Note that all underwater sound levels in this document are referenced to a pressure of 1 μPa and all airborne sound levels in this document are referenced to a pressure of 20 μPa.

Root mean square (rms) is the quadratic mean sound pressure over the duration of an impulse. Rms is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick, 1983). Rms accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper, 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in all directions away from the source (similar to ripples on the surface of a pond), except in cases where the source is directional. The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones.

Even in the absence of sound from the specified activity, the underwater environment is typically loud due to ambient sound. Ambient sound is defined as environmental background sound levels lacking a single source or point (Richardson *et al.,* 1995), and the sound level of a region is defined by the total acoustical energy being generated by known and unknown sources. These sources may include physical (e.g., waves, earthquakes, ice, atmospheric sound), biological (e.g., sounds produced by marine mammals, fish, and invertebrates), and anthropogenic sound (e.g., vessels, dredging, aircraft, construction). A number of sources contribute to ambient sound, including the following (Richardson *et al.,* 1995):

- Wind and waves: The complex interactions between wind and water surface, including processes such as breaking waves and wave-induced bubble oscillations and cavitation, are a main source of naturally occurring ambient noise for frequencies between 200 Hz and 50 kHz (Mitson, 1995). In general, ambient sound levels tend to increase with increasing wind speed and wave height. Surf noise becomes important near shore, with measurements collected at a distance of 8.5 km from shore showing an increase of 10 dB in the 100 to 700 Hz band during heavy surf conditions.
- Precipitation: Sound from rain and hail impacting the water surface can become an important component of total noise at frequencies above 500 Hz, and possibly down to 100 Hz during quiet times.
- Biological: Marine mammals can contribute significantly to ambient noise levels, as can some fish and shrimp. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz.
- Anthropogenic: Sources of ambient noise related to human activity include transportation (surface vessels and aircraft), dredging and construction, oil and gas drilling and production, seismic surveys, sonar, explosions, and ocean acoustic studies. Shipping noise typically dominates the total ambient noise for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz and, if higher frequency sound levels are created, they attenuate rapidly (Richardson *et al.,* 1995). Sound from identifiable anthropogenic sources other than the activity of interest (e.g., a passing vessel) is sometimes termed background sound, as opposed to ambient sound.

The sum of the various natural and anthropogenic sound sources at any given location and time—which comprise ''ambient'' or ''background'' sound—depends not only on the source levels (as determined by current weather conditions and levels of biological and shipping activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor, and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10–20 dB from day to day (Richardson *et al.,* 1995). The result is that, depending on the source type and its intensity, sound from the specified activity may be a negligible addition to the local environment or could form a distinctive signal that may affect marine mammals.

Underwater ambient noise was measured at approximately 113 dB rms between 50 Hz and 20 kHz during the recent TPP project, approximately 1.85 mi from the project area (Illingworth & Rodkin, 2012). In 2009, the average broadband ambient underwater noise levels were measured at 114 dB 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 noted in the 125 Hz band. In the 300 Hz to 5 kHz range, average levels ranged between 83 and 99 dB. Wind-driven wave noise dominated the background noise environment at approximately 5 kHz and above, and ambient noise levels flattened above 10 kHz. Known sound levels and frequency ranges associated with anthropogenic sources similar to those that would be used for this project are summarized in Table 3. Details of the source types are described in the following text.

TABLE 3—REPRESENTATIVE SOUND LEVELS OF ANTHROPOGENIC SOURCES

Sound source	Frequency range (Hz)	Underwater sound level	Reference
Small vessels	250–1,000	151 dB rms at 1 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 72-in steel pipe pile	10–1,500	180 dB rms at 10 m	Reyff, 2007.
Impact driving of 36-in steel pipe pile	10–1,500	195 dB rms at 10 m	Laughlin, 2007.
Impact driving of 66-in cast-in-steel-shell (CISS) pile.	10–1,500	195 dB rms at 10 m	Reviewed in Hastings and Popper, 2005.

In-water construction activities associated with the project would include impact pile driving and vibratory pile driving. The sounds produced by these activities fall into one of two general sound types: Pulsed and non-pulsed (defined in the following). The distinction between these two sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (e.g., Ward, 1997 in Southall *et al.,* 2007). Please see Southall *et al.,* (2007) for an in-depth discussion of these concepts.

Pulsed sound sources (e.g., explosions, gunshots, sonic booms, impact pile driving) produce signals that are brief (typically considered to be less than one second), broadband, atonal transients (ANSI, 1986; Harris, 1998; NIOSH, 1998; ISO, 2003; ANSI, 2005) and occur either as isolated events or repeated in some succession. Pulsed sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features.

Non-pulsed sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or non-continuous (ANSI, 1995; NIOSH, 1998). Some of these non-pulsed sounds can be transient signals of short duration but without the essential properties of pulses (e.g., rapid rise time). Examples of non-pulsed sounds include those produced by vessels, aircraft, machinery operations such as drilling or dredging, vibratory pile driving, and active sonar systems (such as those used by the U.S. Navy). The duration of such sounds, as received at a distance, can be greatly extended in a highly reverberant environment.

Impact hammers operate by repeatedly dropping a heavy piston onto a pile to drive the pile into the substrate. Sound generated by impact hammers is characterized by rapid rise times and high peak levels, a potentially injurious combination (Hastings and Popper, 2005). Vibratory hammers install piles by vibrating them and allowing the weight of the hammer to push them into the sediment. Vibratory hammers produce significantly less sound than impact hammers. Peak SPLs may be 180 dB or greater, but are generally 10 to 20 dB lower than SPLs generated during impact pile driving of the same-sized pile (Oestman *et al.,* 2009). Rise time is slower, reducing the probability and severity of injury, and sound energy is distributed over a greater amount of time (Nedwell and Edwards, 2002; Carlson *et al.,* 2005).

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals, and exposure to sound can have deleterious effects. To appropriately assess these potential effects, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (e.g., Richardson *et al.,* 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on measured or estimated hearing ranges on the basis of available behavioral data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. The lower and/or upper frequencies for some of these functional hearing groups have been modified from those designated by Southall *et al.* (2007). The functional groups and the associated frequencies are indicated below (note that these frequency ranges do not necessarily correspond to the range of best hearing, which varies by species):

- Low-frequency cetaceans (mysticetes): Functional hearing is estimated to occur between approximately 7 Hz and 30 kHz (extended from 22 kHz; Watkins, 1986; Au *et al.,* 2006; Lucifredi and Stein, 2007; Ketten and Mountain, 2009; Tubelli *et al.,* 2012);
- Mid-frequency cetaceans (larger toothed whales, beaked whales, and most delphinids): Functional hearing is estimated to occur between approximately 150 Hz and 160 kHz;
- High-frequency cetaceans (porpoises, river dolphins, and members of the genera *Kogia* and *Cephalorhynchus;* now considered to include two members of the genus *Lagenorhynchus* on the basis of recent echolocation data and genetic data [May-Collado and Agnarsson, 2006; Kyhn *et al.* 2009, 2010; Tougaard *et al.* 2010]): Functional hearing is estimated to occur between approximately 200 Hz and 180 kHz; and
- Pinnipeds in water: Functional hearing is estimated to occur between approximately 75 Hz to 100 kHz for Phocidae (true seals) and between 100 Hz and 40 kHz for Otariidae (eared seals), with the greatest sensitivity between approximately 700 Hz and 20 kHz. The pinniped functional hearing group was modified from Southall *et al.* (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä *et al.,* 2006; Kastelein *et al.,* 2009; Reichmuth *et al.,* 2013).

There are five marine mammal species (two cetacean and three pinniped [two otariid and one phocid] species) with expected potential to co-occur with Navy construction activities. Please refer to Table 2. Of the two cetacean species that may be present, the killer whale is classified as a mid-frequency cetacean and the harbor porpoise is classified as a high-frequency cetacean.

Acoustic Effects, Underwater

Potential Effects of Pile Driving Sound—The effects of sounds from pile driving might result in one or more of the following: Temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, and masking (Richardson *et al.,* 1995; Gordon *et al.,* 2004; Nowacek *et al.,* 2007; Southall *et al.,* 2007). The effects of pile driving on marine mammals are dependent on several factors, including the size, type, and depth of the animal; the depth, intensity, and duration of the pile driving 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 driving activities 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 that are soft (e.g., sand) would absorb or attenuate the sound more readily than hard substrates (e.g., 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.

In the absence of mitigation, impacts to marine species would be expected to result from physiological and behavioral responses to both the type and strength of the acoustic signature (Viada *et al.,* 2008). The type and severity of behavioral impacts are more difficult to define due to limited studies addressing the behavioral effects of impulsive sounds on marine mammals. Potential effects from impulsive sound sources can range in severity from effects such as behavioral disturbance or tactile perception to physical discomfort, slight injury of the internal organs and the auditory system, or mortality (Yelverton *et al.,* 1973).

Hearing Impairment and Other Physical Effects—Marine mammals exposed to high intensity sound repeatedly or for prolonged periods can experience hearing threshold shift (TS), which is the loss of hearing sensitivity at certain frequency ranges (Kastak *et al.,* 1999; Schlundt *et al.,* 2000; Finneran *et al.,* 2002, 2005). TS can be permanent (PTS), in which case the loss of hearing sensitivity is not recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall *et al.,* 2007). Marine mammals depend on acoustic cues for vital biological functions, (e.g., orientation, communication, finding prey, avoiding predators); thus, TTS may result in reduced fitness in survival and reproduction. However, this depends on the frequency and duration of TTS, as well as the biological context in which it occurs. TTS of limited duration, occurring in a frequency range that does not coincide with that used for recognition of important acoustic cues, would have little to no effect on an animal's fitness. Repeated sound exposure that leads to TTS could cause PTS. PTS constitutes injury, but TTS does not (Southall *et al.,* 2007). The following subsections discuss in somewhat more detail the possibilities of TTS, PTS, and non-auditory physical effects.

Temporary Threshold Shift—TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises, and a sound must be stronger in order to be heard. In terrestrial mammals, TTS can last from minutes or hours to days (in cases of strong TTS). For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the sound ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the published data concern TTS elicited by exposure to multiple pulses of sound. Available data on TTS in marine mammals are summarized in Southall *et al.* (2007).

Given the available data, the received level of a single pulse (with no frequency weighting) might need to be approximately 186 dB re 1 μPa^2-s (i.e., 186 dB sound exposure level [SEL] or approximately 221–226 dB p-p [peak]) in order to produce brief, mild TTS. Exposure to several strong pulses that each have received levels near 190 dB rms (175–180 dB SEL) might result in cumulative exposure of approximately 186 dB SEL and thus slight TTS in a small odontocete, assuming the TTS threshold is (to a first approximation) a function of the total received pulse energy.

The above TTS information for odontocetes is derived from studies on the bottlenose dolphin (*Tursiops truncatus*) and beluga whale (*Delphinapterus leucas*). There is no published TTS information for other species of cetaceans. However, preliminary evidence from a harbor porpoise exposed to pulsed sound suggests that its TTS threshold may have been lower (Lucke *et al.,* 2009). As summarized above, data that are now available imply that TTS is unlikely to occur unless odontocetes are exposed to pile driving pulses stronger than 180 dB re 1 μPa rms.

Permanent Threshold Shift—When PTS occurs, there is physical damage to the sound receptors in the ear. In severe cases, there can be total or partial deafness, while in other cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985). There is no specific evidence that exposure to pulses of sound can cause PTS in any marine mammal. However, given the possibility that mammals close to a sound source might incur TTS, there has been further speculation about the possibility that some individuals might incur PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS.

Relationships between TTS and PTS thresholds have not been studied in marine mammals but are assumed to be similar to those in humans and other terrestrial mammals. PTS might occur at a received sound level at least several decibels above that inducing mild TTS if the animal were exposed to strong sound pulses with rapid rise time. Based on data from terrestrial mammals, a precautionary assumption is that the PTS threshold for impulse sounds (such as pile driving pulses as received close to the source) is at least 6 dB higher than the TTS threshold on a peak-pressure basis and probably greater than 6 dB (Southall *et al.,* 2007). On an SEL basis, Southall *et al.* (2007) estimated that received levels would need to exceed the TTS threshold by at least 15 dB for there to be risk of PTS. Thus, for cetaceans, Southall *et al.* (2007) estimate that the PTS threshold might be an M-weighted SEL (for the sequence of received pulses) of approximately 198 dB re 1 μPa^2-s (15 dB higher than the TTS threshold for an impulse). Given the higher level of sound necessary to cause PTS as compared with TTS, it is considerably less likely that PTS could occur.

Measured source levels from impact pile driving can be as high as 214 dB rms. Although no marine mammals have been shown to experience TTS or PTS as a result of being exposed to pile driving activities, captive bottlenose dolphins and beluga whales exhibited changes in behavior when exposed to strong pulsed sounds (Finneran *et al.,* 2000, 2002, 2005). The animals tolerated high received levels of sound before exhibiting aversive behaviors. Experiments on a beluga whale showed that exposure to a single watergun impulse at a received level of 207 kPa (30 psi) p-p, which is equivalent to 228 dB p-p, resulted in a 7 and 6 dB TTS in the beluga whale at 0.4 and 30 kHz, respectively. Thresholds returned to within 2 dB of the pre-exposure level within four minutes of the exposure (Finneran *et al.,* 2002). Although the source level of pile driving from one hammer strike is expected to be much lower than the single watergun impulse cited here, animals being exposed for a prolonged period to repeated hammer strikes could receive more sound exposure in terms of SEL than from the single watergun impulse (estimated at 188 dB re 1 μPa^2-s) in the aforementioned experiment (Finneran *et al.,* 2002). However, in order for marine mammals to experience TTS or PTS, the animals have to be close enough to be exposed to high intensity sound levels for a prolonged period of time. Based on the best scientific information available, these SPLs are far below the thresholds that could cause TTS or the onset of PTS.

Non-auditory Physiological Effects—Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox *et al.,* 2006; Southall *et al.,* 2007). Studies examining such effects are limited. In general, little is known about the potential for pile driving to cause auditory impairment or other physical effects in marine mammals. Available data suggest that such effects, if they occur at all, would presumably be limited to short distances from the sound source and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.,* 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. Marine mammals that show behavioral avoidance of pile driving, including some odontocetes and some pinnipeds, are especially unlikely to incur auditory impairment or non-auditory physical effects.

Disturbance Reactions

Disturbance includes a variety of effects, including subtle changes in behavior, more conspicuous changes in activities, and displacement. Behavioral responses to sound are highly variable and context-specific and reactions, if any, depend on species, state of maturity, experience, current activity, reproductive state, auditory sensitivity, time of day, and many other factors (Richardson *et al.,* 1995; Wartzok *et al.,* 2003; Southall *et al.,* 2007).

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al.,* 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. Behavioral state may affect the type of response as well. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (Richardson *et al.,* 1995; NRC, 2003; Wartzok *et al.,* 2003).

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, but also including pile driving) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds, 2002; Thorson and Reyff, 2006; see also Gordon *et al.,* 2004; Wartzok *et al.,* 2003; Nowacek *et al.,* 2007). Responses to continuous sound, such as vibratory pile installation, have not been documented as well as responses to pulsed sounds.

With both types of pile driving, it is likely that the onset of pile driving could result in temporary, short term changes in an animal's typical behavior and/or avoidance of the affected area. These behavioral changes may include (Richardson *et al.,* 1995): Changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where sound sources are located; and/or flight responses (e.g., pinnipeds flushing into water from haul-outs or rookeries). Pinnipeds may increase their haul-out time, possibly to avoid in-water disturbance (Thorson and Reyff, 2006).

The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, the consequences of behavioral modification could be expected to be biologically significant if the change affects growth, survival, or reproduction. Significant behavioral modifications that could potentially lead to effects on growth, survival, or reproduction include:

• Drastic changes in diving/surfacing patterns (such as those thought to cause beaked whale stranding due to exposure to military mid-frequency tactical sonar);
• Habitat abandonment due to loss of desirable acoustic environment; and
• Cessation of feeding or social interaction.

The onset of behavioral disturbance from anthropogenic sound depends on both external factors (characteristics of sound sources and their paths) and the specific characteristics of the receiving animals (hearing, motivation, experience, demography) and is difficult to predict (Southall *et al.,* 2007).

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. Chronic exposure to excessive, though not high-intensity, sound could cause masking at particular frequencies for marine mammals that utilize sound for vital biological functions. Masking can interfere with detection of acoustic signals such as communication calls, echolocation sounds, and environmental sounds important to marine mammals. Therefore, under certain circumstances, marine mammals whose acoustical sensors or environment are being severely masked could also be impaired from maximizing their performance fitness in survival and reproduction. If the coincident (masking) sound were man-made, it could be potentially harassing if it disrupted hearing-related behavior. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs during the sound exposure. Because masking (without resulting in TS) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

The frequency range of the potentially masking sound is important in determining any potential behavioral impacts. Because sound generated from in-water pile driving is mostly concentrated at low frequency ranges, it may have less effect on high frequency echolocation sounds made by porpoises. However, lower frequency man-made sounds are more likely to affect detection of communication calls and other potentially important natural sounds such as surf and prey sound. It may also affect communication signals when they occur near the sound band and thus reduce the communication space of animals (e.g., Clark *et al.,* 2009) and cause increased stress levels (e.g., Foote *et al.,* 2004; Holt *et al.,* 2009).

Masking has the potential to impact species at the population or community levels as well as at individual levels. Masking affects both senders and receivers of the signals and can potentially have long-term chronic effects on marine mammal species and populations. Recent research suggests that low frequency ambient sound levels have increased by as much as 20 dB (more than three times in terms of SPL) in the world's ocean from pre-industrial periods, and that most of these increases are from distant shipping (Hildebrand, 2009). All anthropogenic sound sources, such as those from vessel traffic, pile driving, and dredging activities, contribute to the elevated ambient sound levels, thus intensifying masking.

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 marine mammals present in the project area. Impact pile driving activity is relatively short-term, with rapid pulses occurring for approximately fifteen 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 likely to be negligible. Vibratory pile driving is also relatively short-term, with rapid oscillations occurring for approximately one and a half hours 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 insignificant impacts 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.

Acoustic Effects, Airborne

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 pile driving activities. Airborne pile driving sound would have less impact on cetaceans than pinnipeds because sound from atmospheric sources does not transmit well underwater (Richardson *et al.,* 1995); thus, airborne sound would only be an issue for pinnipeds either hauled-out or looking with heads above water in the project area. Most likely, airborne sound would cause behavioral responses similar to those discussed above in relation to underwater sound. 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.

Anticipated Effects on Habitat

The proposed activities at NBKB would not result in permanent impacts to habitats used directly by marine mammals, such as haul-out sites, but may have potential short-term impacts to food sources such as forage fish and salmonids. There are no rookeries or major haul-out sites within 16 km or ocean bottom structure of significant biological importance to marine mammals that may be present in the marine waters in the vicinity of the project area. Therefore, the main impact associated with the proposed activity would be temporarily elevated sound levels and the associated direct effects on marine mammals, as discussed previously in this document. The most likely impact to marine mammal habitat occurs from pile driving effects on likely marine mammal prey (i.e., fish) near NBKB and minor impacts to the immediate substrate during installation and removal of piles during the wharf construction project.

Pile Driving Effects on Potential Prey

Construction activities would produce both pulsed (i.e., impact pile driving) and continuous (i.e., vibratory pile driving) sounds. Fish react to sounds which 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) identified several studies that suggest fish may relocate to avoid certain areas of sound energy. Additional studies have documented effects of pile driving on fish, although several are based on studies in support of large, multiyear bridge construction projects (e.g., Scholik and Yan, 2001, 2002; Popper and Hastings, 2009). Sound pulses at received levels of 160 dB may cause subtle changes in fish behavior. SPLs of 180 dB may cause noticeable changes in behavior (Pearson *et al.,* 1992; Skalski *et al.,* 1992). SPLs of sufficient strength have been known to cause injury to fish and fish mortality. The most likely impact to fish from pile driving activities at the project area would be temporary behavioral 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 timeframe for the wharf construction project. However, adverse impacts may occur to a few species of rockfish and salmon which may still be present in the project area despite operating in a reduced work window in an attempt to avoid important fish spawning time periods. Impacts to these species could result from potential impacts to their eggs and larvae.

Pile Driving Effects on Potential Foraging Habitat

The area likely impacted by the project is relatively small compared to the available habitat in the Hood Canal. 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 driving 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.

In summary, given the short daily duration of sound associated with individual pile driving events and the relatively small areas being affected, pile driving activities associated with the proposed action are not likely to have a permanent, adverse effect on any fish habitat, or populations of fish species. Thus, any impacts to marine mammal habitat are not expected to cause significant or long-term consequences for individual marine mammals or their populations.

Proposed Mitigation

In order to issue an IHA under Section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses.

Measurements from similar pile driving events were coupled with practical spreading loss to estimate zones of influence (ZOI; see ''Estimated Take by Incidental Harassment''). These values were then refined based on in situ measurements performed during the TPP, for similar pile driving activity and within the EHW–2 project footprint, to develop mitigation measures for EHW–2 pile driving activities. The ZOIs effectively represent the mitigation zone that would be established around each pile to prevent Level A harassment to marine mammals, while providing estimates of the areas within which Level B harassment might occur. While the ZOIs vary between the different diameter piles and types of installation methods, the Navy is proposing to establish mitigation zones for the maximum ZOI for all pile driving conducted in support of the wharf construction project. In addition to the measures described later in this section, the Navy would employ the following standard mitigation measures:

(a) Conduct briefings between construction supervisors and crews, marine mammal 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.

(b) For in-water heavy machinery work other than pile driving (using, e.g., standard barges, tug boats, barge-mounted excavators, or clamshell equipment used to place or remove material), if a marine mammal comes within 10 m, operations shall cease and vessels shall reduce speed to the minimum level required to maintain steerage and safe working conditions. This type of work could include the following activities: (1) Movement of the barge to the pile location; (2) positioning of the pile on the substrate via a crane (i.e., stabbing the pile); (3) removal of the pile from the water column/substrate via a crane (i.e., deadpull); or (4) the placement of sound attenuation devices around the piles. For these activities, monitoring would take place from 15 minutes prior to initiation until the action is complete.

Monitoring and Shutdown for Pile Driving

The following measures would apply to the Navy's mitigation through shutdown and disturbance zones:

Shutdown Zone—For all pile driving activities, the Navy will establish a shutdown zone intended to contain the area in which SPLs equal or exceed the 180/190 dB rms acoustic injury criteria. The purpose of a shutdown zone is to define an area within which shutdown of activity would occur upon sighting of a marine mammal (or in anticipation of an animal entering the defined area), thus preventing injury of marine mammals. Modeled distances for shutdown zones are shown in Table 8. However, during impact pile driving, the Navy would implement a minimum shutdown zone of 85 m radius for cetaceans and 20 m radius for pinnipeds around all pile driving activity. The modeled injury threshold distances are approximately 22 m and 5 m, respectively, but the distances are increased based on in-situ recorded sound pressure levels during the TPP. During vibratory driving, the shutdown zone would be 10 m distance from the source for all animals. These precautionary measures are intended to further reduce any possibility of acoustic injury, as well as to account for any undue reduction in the modeled zones stemming from the assumption of 10 dB attenuation from use of a bubble curtain (see discussion later in this section).

Disturbance Zone—Disturbance zones are the areas in which SPLs equal or exceed 160 and 120 dB rms (for pulsed and non-pulsed continuous sound, respectively). Disturbance zones provide utility for monitoring conducted for mitigation purposes (i.e., shutdown zone monitoring) by establishing monitoring protocols for areas adjacent to the shutdown zones. Monitoring of disturbance zones enables observers to be aware of and communicate the presence of marine mammals in the project area but outside the shutdown zone and thus prepare for potential shutdowns of activity. However, the primary purpose of disturbance zone monitoring is for documenting incidents of Level B harassment; disturbance zone monitoring is discussed in greater detail later (see ''Proposed Monitoring and Reporting''). Nominal radial distances for disturbance zones are shown in Table 8. Given the size of the disturbance zone for vibratory pile driving, it is impossible to guarantee that all animals would be observed or to make comprehensive observations of fine-scale behavioral reactions to sound, and only a portion of the zone (e.g., what may be reasonably observed by visual observers stationed within the water front restricted area [WRA]) will be monitored.

In order to document observed incidents of harassment, monitors record all marine mammal observations, regardless of location. The observer's location, as well as the location of the pile being driven, is known from a GPS. The location of the animal is estimated as a distance from the observer, which is then compared to the location from the pile. The received level may be estimated on the basis of past or subsequent acoustic monitoring. It may then be determined whether the animal was exposed to sound levels constituting incidental harassment in post-processing of observational data, and a precise accounting of observed incidents of harassment created. Therefore, although the predicted distances to behavioral harassment thresholds are useful for estimating harassment for purposes of authorizing levels of incidental take, actual take may be determined in part through the use of empirical data. That information may then be used to extrapolate observed takes to reach an approximate understanding of actual total takes.

Monitoring Protocols—Monitoring would be conducted before, during, and after pile driving activities. In addition, observers shall record all incidents of marine mammal occurrence, regardless of distance from activity, and shall document any behavioral reactions in concert with distance from piles being driven. Observations made outside the shutdown zone will not result in shutdown; that pile segment would be completed without cessation, unless the animal approaches or enters the shutdown zone, at which point all pile driving activities would be halted. Monitoring will take place from fifteen minutes prior to initiation through thirty minutes post-completion of pile driving activities. Pile driving activities include the time to remove a single pile or series of piles, as long as the time elapsed between uses of the pile driving equipment is no more than thirty minutes. Please see the Marine Mammal Monitoring Plan (available at *www.nmfs.noaa.gov/pr/permits/incidental.htm*), developed by the Navy with our approval, for full details of the monitoring protocols.

The following additional measures apply to visual monitoring:

(1) Monitoring will be conducted by qualified observers, who will be placed at the best vantage point(s) practicable to monitor for marine mammals and implement shutdown/delay procedures when applicable by calling for the shutdown to the hammer operator. Qualified observers are trained biologists, with the following minimum qualifications:

- Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with ability to estimate target size and distance; use of binoculars may be necessary to correctly identify the target;
- Advanced education in biological science or related field (undergraduate degree or higher required);
- Experience and ability to conduct field observations and collect data according to assigned protocols (this may include academic experience);
- Experience or training in the field identification of marine mammals, including the identification of behaviors;
- Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations;
- Writing skills sufficient to prepare a report of observations including but not limited to the number and species of marine mammals observed; dates and times when in-water construction activities were conducted; dates and

times when in-water construction activities were suspended to avoid potential incidental injury from construction sound of marine mammals observed within a defined shutdown zone; and marine mammal behavior; and

• Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary.

(2) Prior to the start of pile driving activity, the shutdown zone will be monitored for fifteen minutes to ensure that it is clear of marine mammals. Pile driving will only commence once observers have declared the shutdown zone clear of marine mammals; animals will be allowed to remain in the shutdown zone (i.e., must leave of their own volition) and their behavior will be monitored and documented. The shutdown zone may only be declared clear, and pile driving started, when the entire shutdown zone is visible (i.e., when not obscured by dark, rain, fog, etc.). In addition, if such conditions should arise during impact pile driving that is already underway, the activity would be halted.

(3) If a marine mammal approaches or enters the shutdown zone during the course of pile driving operations, activity will be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or fifteen minutes have passed without re-detection of the animal. Monitoring will be conducted throughout the time required to drive a pile.

Sound Attenuation Devices

Sound levels can be greatly reduced during impact pile driving using sound attenuation devices. There are several types of sound attenuation devices including bubble curtains, cofferdams, and isolation casings (also called temporary noise attenuation piles [TNAP]), and cushion blocks. The Navy proposes to use bubble curtains, which create a column of air bubbles rising around a pile from the substrate to the water surface. The air bubbles absorb and scatter sound waves emanating from the pile, thereby reducing the sound energy. Bubble curtains may be confined or unconfined. An unconfined bubble curtain may consist of a ring seated on the substrate and emitting air bubbles from the bottom. An unconfined bubble curtain may also consist of a stacked system, that is, a series of multiple rings placed at the bottom and at various elevations around the pile. Stacked systems may be more effective than non-stacked systems in areas with high current and deep water (Oestman *et al.,* 2009).

A confined bubble curtain contains the air bubbles within a flexible or rigid sleeve made from plastic, cloth, or pipe. Confined bubble curtains generally offer higher attenuation levels than unconfined curtains because they may physically block sound waves and they prevent air bubbles from migrating away from the pile. For this reason, the confined bubble curtain is commonly used in areas with high current velocity (Oestman *et al.,* 2009).

Both environmental conditions and the characteristics of the sound attenuation device may influence the effectiveness of the device. According to Oestman *et al.* (2009):

• In general, confined bubble curtains attain better sound attenuation levels in areas of high current than unconfined bubble curtains. If an unconfined device is used, high current velocity may sweep bubbles away from the pile, resulting in reduced levels of sound attenuation.

• Softer substrates may allow for a better seal for the device, preventing leakage of air bubbles and escape of sound waves. This increases the effectiveness of the device. Softer substrates also provide additional attenuation of sound traveling through the substrate.

• Flat bottom topography provides a better seal, enhancing effectiveness of the sound attenuation device, whereas sloped or undulating terrain reduces or eliminates its effectiveness.

• Air bubbles must be close to the pile; otherwise, sound may propagate into the water, reducing the effectiveness of the device.

• Harder substrates may transmit ground-borne sound and propagate it into the water column.

The literature presents a wide array of observed attenuation results for bubble curtains (e.g., Oestman *et al.,* 2009; Coleman, 2011; see Table 6–5 of the Navy's application). The variability in attenuation levels is due to variation in design, as well as differences in site conditions and difficulty in properly installing and operating in-water attenuation devices. As a general rule, reductions of greater than 10 dB cannot be reliably predicted. The TPP reported a range of measured values for realized attenuation mostly within 6 to 12 dB (Illingworth & Rodkin, 2012). For 36-in 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. For 48-in 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 Tables 6–6 and 6–7 of the Navy's application.

To avoid loss of attenuation from design and implementation errors, the Navy has required 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. We considered TPP measurements (approximately 7 dB overall) and other monitored projects (typically at least 8 dB realized attenuation), and consider 8 dB as potentially the best estimate of average SPL (rms) reduction, assuming appropriate deployment and no problems with the equipment. In looking at other monitored projects prior to completion of the TPP, the Navy determined with our concurrence that an assumption of 10 dB realized attenuation was realistic. Therefore, a 10 dB reduction was used in the Navy's analysis of pile driving noise in the initial environmental analyses for the EHW–2 project. The Navy's analysis is retained here. While acknowledging that empirical evidence from the TPP indicates that the 10 dB target has not been consistently achieved, we did not require the Navy to revisit their acoustic modeling because (1) shutdown and disturbance zones for the second and third construction years are based on in situ measurements rather than the original modeling that assumed 10 dB attenuation from a bubble curtain and (2) take estimates are not affected because they are based on a combined modeled sound field (i.e., concurrent operation of impact and vibratory drivers) rather than there being separate take estimates for impact and vibratory pile driving.

Bubble curtains shall be used during all impact pile driving. The device will distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column, and the lowest bubble ring shall be in contact with the mudline for the full circumference of the ring. Testing of the device by comparing attenuated and unattenuated strikes is not possible because of requirements in place to protect marbled murrelets (an ESA-listed bird species under the jurisdiction of the USFWS). However, in order to avoid loss of attenuation from design and implementation errors in the absence of such testing, a performance test of the device shall be conducted prior to initial use. The performance test shall confirm the calculated pressures and flow rates at each manifold ring. In addition, the contractor shall also train personnel in the proper balancing of air flow to the bubblers and shall submit an inspection/performance report to the Navy within 72 hours following the performance test.

Timing Restrictions

In Hood Canal, designated timing restrictions exist for pile driving activities to avoid in-water work when salmonids and other spawning forage fish are likely to be present. The in-water work window is July 16–February 15. Until September 23, impact pile driving will only occur starting two hours after sunrise and ending two hours before sunset due to marbled murrelet nesting season. After September 23, in-water construction activities will occur during daylight hours (sunrise to sunset).

Soft Start

The use of a soft-start procedure is believed to provide additional protection to marine mammals by warning or providing a chance to leave the area prior to the hammer operating at full capacity, and typically involves a requirement to initiate sound from vibratory hammers for fifteen seconds at reduced energy followed by a thirty-second waiting period. This procedure is repeated two additional times.

However, implementation of soft start for vibratory pile driving during previous pile driving work for the EHW–2 project at NBKB has led to equipment failure and serious human safety concerns. Project staff have reported that, during power down from the soft start, the energy from the hammer is transferred to the crane boom and block via the load fall cables and rigging resulting in unexpected damage to both the crane block and crane boom. This differs from what occurs when the hammer is powered down after a pile is driven to refusal in that the rigging and load fall cables are able to be slacked prior to powering down the hammer, and the vibrations are transferred into the substrate via the pile rather than into the equipment via the rigging. One dangerous incident of equipment failure has already occurred, with a portion of the equipment shearing from the crane and falling to the deck. Subsequently, the crane manufacturer has inspected the crane booms and discovered structural fatigue in the boom lacing and main structural components, which will ultimately result in a collapse of the crane boom. All cranes were new at the beginning of the job. In addition, the vibratory hammer manufacturer has attempted to install dampers to mitigate the problem, without success.

It is the Navy's contention that this situation is unique to the EHW–2 project, in comparison with other common marine construction projects requiring pile driving. The design specifications of the wharf, which require relatively large-diameter piles to be driven to embedment in relatively deep water through stiff glacial soil, mean that relatively greater driving energy, and therefore a larger hammer, is required for successful embedment. The Marine Mammal Commission previously recommended that we require the Navy to consult with the Washington State Department of Transportation and/or the California Department of Transportation to determine whether soft start procedures can be used safely with the vibratory hammers that the Navy plans to use. We agreed with that recommendation and are still working to facilitate such a consultation in order to determine whether the potentially significant human safety issue is inherent to implementation of the measure or is due to operator error. However, our interest in examining this issue is related to our need to understand the conditions under which vibratory soft start may be advisable from an engineering perspective for future projects.

For this proposed IHA and for the remainder of the EHW–2 project, as a result of this potential risk to human safety, we have determined vibratory soft start to not currently be practicable. Therefore, the measure will not be required. We have further determined this measure unnecessary to providing the means of effecting the least practicable impact on marine mammals and their habitat.

For impact driving, soft start will be required, and contractors will provide an initial set of strikes from the impact hammer at reduced energy, followed by a thirty-second waiting period, then two subsequent reduced energy strike sets. The reduced energy of an individual hammer cannot be quantified because of variation in individual drivers. The actual number of strikes at reduced energy will vary because operating the hammer at less than full power results in ''bouncing'' of the hammer as it strikes the pile, resulting in multiple ''strikes.'' Soft start for impact driving will be required at the beginning of each day's pile driving work and at any time following a cessation of impact pile driving of thirty minutes or longer.

We have carefully evaluated the Navy's proposed mitigation measures and considered their effectiveness in past implementation to preliminarily determine whether they are likely to effect the least practicable impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another: (1) The manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals, (2) the proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and (3) the practicability of the measure for applicant implementation.

Any mitigation measure(s) we prescribe should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the general goals listed below:

(1) Avoidance or minimization of injury or death of marine mammals wherever possible (goals 2, 3, and 4 may contribute to this goal).

(2) A reduction in the number (total number or number at biologically important time or location) of individual marine mammals exposed to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing takes by behavioral harassment only).

(3) A reduction in the number (total number or number at biologically important time or location) of times any individual marine mammal would be exposed to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing takes by behavioral harassment only).

(4) A reduction in the intensity of exposure to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing the severity of behavioral harassment only).

(5) Avoidance or minimization of adverse effects to marine mammal habitat, paying particular attention to the prey base, blockage or limitation of passage to or from biologically important areas, permanent destruction of habitat, or temporary disturbance of habitat during a biologically important time.

(6) For monitoring directly related to mitigation, an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation.

Based on our evaluation of the Navy's proposed measures, including information from monitoring of the Navy's implementation of the mitigation measures as prescribed under previous IHAs for this and other projects in the Hood Canal, we have preliminarily determined that the proposed mitigation measures provide the means of effecting the least practicable impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to issue an IHA for an activity, Section 101(a)(5)(D) of the MMPA states that NMFS must set forth ''requirements pertaining to the monitoring and reporting of such taking''. The MMPA implementing regulations at 50 CFR 216.104(a)(13) indicate that requests for incidental take authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area.

Any monitoring requirement we prescribe should accomplish one or more of the following general goals:

1. An increase in the probability of detecting marine mammals, both within defined zones of effect (thus allowing for more effective implementation of the mitigation) and in general to generate more data to contribute to the analyses mentioned below;

2. An increase in our understanding of how many marine mammals are likely to be exposed to stimuli that we associate with specific adverse effects, such as behavioral harassment or hearing threshold shifts;

3. An increase in our understanding of how marine mammals respond to stimuli expected to result in incidental take and how anticipated adverse effects on individuals may impact the population, stock, or species (specifically through effects on annual rates of recruitment or survival) through any of the following methods:

• Behavioral observations in the presence of stimuli compared to observations in the absence of stimuli (need to be able to accurately predict pertinent information, e.g., received level, distance from source);

• Physiological measurements in the presence of stimuli compared to observations in the absence of stimuli (need to be able to accurately predict pertinent information, e.g., received level, distance from source);

• Distribution and/or abundance comparisons in times or areas with concentrated stimuli versus times or areas without stimuli;

4. An increased knowledge of the affected species; or

5. An increase in our understanding of the effectiveness of certain mitigation and monitoring measures.

The Navy submitted a marine mammal monitoring plan as part of the IHA application for year two of this project. It will be applied to year three of this project and can be found on the Internet at *www.nmfs.noaa.gov/pr/permits/incidental.htm.* The plan has been successfully implemented by the Navy under the previous IHA and may be modified or supplemented based on comments or new information received from the public during the public comment period.

Visual Marine Mammal Observations

The Navy will collect sighting data and behavioral responses to construction for marine mammal species observed in the region of activity during the period of activity. All observers will be trained in marine mammal identification and behaviors and are required to have no other construction-related tasks while conducting monitoring. The Navy will monitor the shutdown zone and disturbance zone before, during, and after pile driving, with observers located at the best practicable vantage points. Based on our requirements, the Marine Mammal Monitoring Plan would implement the following procedures for pile driving:

• MMOs would be located at the best vantage point(s) in order to properly see the entire shutdown zone and as much of the disturbance zone as possible.

• During all observation periods, observers will use binoculars and the naked eye to search continuously for marine mammals.

• If the shutdown zones are obscured by fog or poor lighting conditions, pile driving at that location will not be initiated until that zone is visible. Should such conditions arise while impact driving is underway, the activity would be halted.

• The shutdown and disturbance zones around the pile will be monitored for the presence of marine mammals before, during, and after any pile driving or removal activity.

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

Data Collection

We require that observers use approved data forms. Among other pieces of information, the Navy will record detailed information about any implementation of shutdowns, including the distance of animals to the pile and description of specific actions that ensued and resulting behavior of the animal, if any. In addition, the Navy will attempt to distinguish between the number of individual animals taken and the number of incidents of take. We require that, at a minimum, the following information be collected on the sighting forms:

• Date and time that monitored activity begins or ends;

• Construction activities occurring during each observation period;

• Weather parameters (e.g., percent cover, visibility);

• Water conditions (e.g., sea state, tide state);

• Species, numbers, and, if possible, sex and age class of marine mammals;

• Description of any observable marine mammal behavior patterns, including bearing and direction of travel and distance from pile driving activity;

• Distance from pile driving activities to marine mammals and distance from the marine mammals to the observation point;

• Locations of all marine mammal observations; and

• Other human activity in the area.

Reporting

A draft report would be submitted within ninety calendar days of the completion of the in-water work window. The report will include marine mammal observations pre-activity, during-activity, and post-activity during pile driving days, and will also provide descriptions of any problems encountered in deploying sound attenuating devices, any behavioral responses to construction activities by marine mammals and a complete description of all mitigation shutdowns and the results of those actions and an extrapolated total take estimate based on the number of marine mammals observed during the course of construction. A final report must be submitted within thirty days following resolution of comments on the draft report.

Monitoring Results From Previously Authorized Activities

The Navy complied with the mitigation and monitoring required under the previous authorizations for this project. Marine mammal monitoring occurred before, during, and after each pile driving event. During the course of these activities, the Navy did not exceed the take levels authorized under the IHAs.

In accordance with the 2012 IHA, the Navy submitted a Year 1 Marine Mammal Monitoring Report (2012–2013), covering the period of July 16 through February 15. Due to delays in beginning the project the first day of monitored pile driving activity occurred on September 28, 2012, and a total of 78 days of pile driving occurred between then and February 14, 2013. That total included 56 days of vibratory driving only, three days of only impact driving, and 19 days where both vibratory and impact driving occurred, with a maximum concurrent deployment of two vibratory drivers and one impact driver.

Monitoring was conducted in two areas: (1) Primary visual surveys within the disturbance and shutdown zones in the WRA (approximately 500-m radius), (2) boat surveys outside the WRA but within the disturbance zone. The latter occurred only during acoustic monitoring accomplished at the outset of the work period, which required a small vessel be deployed outside the WRA. Marine mammal observers were placed on construction barges, the construction pier, and vessels located in near-field (within the WRA) and far-field (outside the WRA) locations, in accordance with the Marine Mammal Monitoring Plan.

Monitoring for the second year of construction was conducted throughout the 2013–14 work window (i.e., mid-July to mid-February). The monitoring was conducted in the same manner as the first year, but was limited to within the WRA as no acoustic monitoring was conducted during the second year. At the time of this writing, the Navy has provided a draft of the Year 2 Marine Mammal Report and it is under review. We have made the draft report available for public review and comment prior to any final decision regarding this proposed authorization.

Table 3 summarizes monitoring results from years one and two of the EHW–2 project, including observations from all monitoring effort (including while pile driving was not actively occurring) and records of unique observations during active pile driving (seen in the far right column). Primary surveys refer to observations by stationary and vessel-based monitors within the WRA. Boat surveys refer to vessel-based surveys conducted outside the WRA (Year 1 only). No Steller sea lions have been observed within defined ZOIs during active pile driving, and no killer whales have been observed during any project monitoring at NBKB. For more detail, including full monitoring results and analysis, please see the monitoring reports at *www.nmfs.noaa.gov/pr/permits/incidental.htm.*

TABLE 3—SUMMARY MARINE MAMMAL MONITORING RESULTS, EHW–2 YEARS 1–2

Activity [1]	Species	Total number groups observed	Total number individuals observed	Maximum group size	Total individuals observed (active pile driving and within disturbance zone only)
Primary surveys, Y1	California sea lion	30	30	1	4
	Harbor seal	939	984	4	214
Boat surveys, Y1	California sea lion	21	126	20	22
	Steller sea lion	3	3	1	0
	Harbor seal	73	76	2	22
	Harbor porpoise	10	57	10	36
Primary surveys, Y2	California sea lion	77	83	3	10
	Harbor seal	3,046	3,229	5	713

[1] Total observation effort during active pile driving: Year 1—530 hours, 50 minutes on eighty construction days; Year 2—1,247 hours, 27 minutes on 162 construction days.

Acoustic Monitoring—During the first year of construction for EHW–2, the Navy conducted acoustic monitoring as required under the IHA. During year one, 24- to 36-in diameter piles were primarily driven, by vibratory and impact driving. Only one 48-in pile was driven, so no data are provided for that pile size. All piles were steel pipe piles. Primary objectives for the acoustic monitoring were to characterize underwater and airborne source levels for each pile size and hammer type and to verify distances to relevant threshold levels by characterizing site-specific transmission loss. Measurements of impact driving for 24-in piles showed a high degree of variation (SD = 24.1) because many of these piles were driven either on land or in extremely shallow water, while others were driven in deeper water more characteristic of typical driving conditions for EHW–2. Select results are reproduced here (Tables 4–5); the interested reader may find the entire report posted at *www.nmfs.noaa.gov/pr/permits/incidental.htm.* Acoustic monitoring was also conducted during the TPP and during year one of the EHW–1 project. Those reports may be found at the same address. Acoustic measurements from NBKB are discussed further below in ''Estimated Take by Incidental Harassment.''

TABLE 4—ACOUSTIC MONITORING RESULTS FROM 2012–13 ACTIVITIES AT EHW–2 (YEAR 1)

Pile size (in)	Hammer type [1]	n [2]	Underwater			Airborne	
			RL [3]	SD [4]	TL [5]	RL [6]	SD
24	Impact	41	179	24.1	18.6	103	1.0
36	Impact	26	188	5.0	14.9	102	2.2
24	Vibratory	71	163	8.3	15.3	95	3.7
36	Vibratory	113	169	4.3	16.8	103	3.2

[1] All data for impact driving include use of bubble curtain; [2] n = sample size, or number of measured pile driving events; [3] Received level at 10 m, presented in dB rms; [4] Standard deviation; [5] Transmission loss (log_{10}); [6] Received level at 15 m, presented in dB rms (Z-weighted L_{eq}).

For vibratory driving, measured source levels were below the 180-dB threshold. Calculation of average distances to the 120-dB threshold was complicated by variability in propagation of sound at greater distances, variability in measured sounds from event to event, and the difficulty of making measurements, given noise from wind and wave action, in the far field (Table 5). Also, as observed during previous monitoring events at NBKB, measured levels in shallower water at the far side of Hood Canal are sometimes louder than measurements made closer to the source in the deeper open channel. These events are unexplained. Estimated radial distances to the 120-dB threshold were highly variable, but typically less than the maximum distance as constrained by land (i.e., 13,800 m; Table 9). The topography of Hood Canal realistically constrains distances to 7,000 m to the south of the project area.

TABLE 5—MEASURED VALUES FROM TPP AND EHW–2 ACOUSTIC MONITORING, INCLUDING DISTANCES TO RELEVANT THRESHOLDS

Project	Type	Source level (dB rms)	Transmission loss	Measured distances to relevant thresholds (rms)			
				120-dB [1]	160-dB	180-dB	190-dB
TPP	Impact; 36-in	181 (avg)/183 (max)	16.4	n/a	425 m	35 m	<10 m.
TPP	Impact; 48-in	187 (avg)/188 (max)	13.4	n/a	1,300 m	60 m	15 m.
TPP	Vibratory; 36- to 48-in			1,200–8,000+ m	n/a	n/a	n/a.
EHW–2 (Y1).	Impact; 36-in	188 dB (avg)/191 dB (max).	14.9	n/a	670 m	45 m	12 m.
EHW–2 (Y1).	Vibratory; 36-in			4,400 m (avg)/10,250 m (max).	n/a	n/a	n/a.

[1] Distances to 120-dB threshold are estimated from measured source level and transmission loss values. The distances themselves are not measured.

Sound levels during soft starts were typically lower than those levels at the initiation and completion of continuous vibratory driving. However, levels during continuous driving varied considerably and were at times lower than those produced during the soft starts. It is difficult to assign a level that describes how much lower the soft start sound levels were than continuous levels. Similarly inconclusive results were seen from monitoring associated with the TPP.

Estimated Take by Incidental Harassment

Except with respect to certain activities not pertinent here, section 3(18) of the MMPA defines ''harassment'' as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild; or 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. The former is termed Level A harassment and the latter is termed Level B harassment.

All anticipated takes would be by Level B harassment resulting from vibratory and impact pile driving and involving temporary changes in behavior. The proposed mitigation and monitoring measures are expected to minimize the possibility of injurious or lethal takes such that take by Level A harassment, serious injury, or mortality is considered discountable. However, it is unlikely that injurious or lethal takes would occur even in the absence of the planned mitigation and monitoring measures.

If a marine mammal responds to a stimulus by changing its behavior (e.g., through relatively minor changes in locomotion direction/speed or vocalization behavior), the response may or may not constitute taking at the individual level, and is unlikely to affect the stock or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on animals or on the stock or species could potentially be significant (e.g., Lusseau and Bejder, 2007; Weilgart, 2007). Given the many uncertainties in predicting the quantity and types of impacts of sound on marine mammals, it is common practice to estimate how many animals are likely to be present within a particular distance of a given activity, or exposed to a particular level of sound.

This practice potentially overestimates the numbers of marine mammals taken. For example, during the past fifteen years, killer whales have been observed within the project area twice. On the basis of that information, an estimated amount of potential takes for killer whales is presented here. However, while a pod of killer whales could potentially visit again during the project timeframe, and thus be taken, it is more likely that they will not. Although incidental take of killer whales and Dall's porpoises was authorized for 2011–12 and 2012–13 activities at NBKB on the basis of past observations of these species, no such takes were recorded and no individuals of these species were observed. Similarly, estimated actual take levels (observed takes extrapolated to the remainder of unobserved but ensonified area) were significantly less than authorized levels of take for the remaining species. In addition, it is often difficult to distinguish between the individuals harassed and incidences of harassment. In particular, for stationary activities, it is more likely that some smaller number of individuals may accrue a number of incidences of harassment per individual than for each incidence to accrue to a new individual, especially if those individuals display some degree of residency or site fidelity and the impetus to use the site (e.g., because of foraging opportunities) is stronger than the deterrence presented by the harassing activity.

The project area is not believed to be particularly important habitat for marine mammals, nor is it considered an area frequented by marine mammals, although harbor seals are year-round residents of Hood Canal and sea lions are known to haul-out on submarines and other man-made objects at the NBKB waterfront (although typically at a distance of a mile or greater from the project site). Therefore, behavioral disturbances that could result from anthropogenic sound associated with these activities are expected to affect only a relatively small number of individual marine mammals, although those effects could be recurring over the life of the project if the same individuals remain in the project vicinity.

The Navy has requested authorization for the incidental taking of small numbers of Steller sea lions, California sea lions, harbor seals, transient killer whales, and harbor porpoises in the Hood Canal that may result from pile driving during construction activities associated with the wharf construction project described previously in this document. In order to estimate the potential incidents of take that may occur incidental to the specified activity, we must first estimate the extent of the sound field that may be produced by the activity and then consider in combination with information about marine mammal density or abundance in the project area. We first provide information on applicable sound thresholds for determining effects to marine mammals before describing the information used in estimating the sound fields, the available marine mammal density or abundance information, and the method of estimating potential incidences of take.

Sound Thresholds

We use generic sound exposure thresholds to determine when an activity that produces sound might result in impacts to a marine mammal such that a take by harassment might occur. To date, no studies have been conducted that explicitly examine impacts to marine mammals from pile driving sounds or from which empirical sound thresholds have been established. These thresholds should be considered guidelines for estimating when harassment may occur (i.e., when an animal is exposed to levels equal to or exceeding the relevant criterion) in specific contexts; however, useful contextual information that may inform our assessment of effects is typically lacking and we consider these thresholds as step functions. NMFS is currently revising these acoustic guidelines; for more information on that process, please visit *www.nmfs.noaa.gov/pr/acoustics/guidelines.htm.* Vibratory pile driving produces continuous noise and impact pile driving produces impulsive noise.

TABLE 6—CURRENT ACOUSTIC EXPOSURE CRITERIA

Criterion	Definition	Threshold
Level A harassment (underwater)	Injury (PTS—any level above that which is known to cause TTS).	180 dB (cetaceans)/190 dB (pinnipeds) (rms).
Level B harassment (underwater)	Behavioral disruption	160 dB (impulsive source)/120 dB (continuous source) (rms).
Level B harassment (airborne)*	Behavioral disruption	90 dB (harbor seals)/100 dB (other pinnipeds) (unweighted).

* NMFS has not established any formal criteria for harassment resulting from exposure to airborne sound. However, these thresholds represent the best available information regarding the effects of pinniped exposure to such sound and NMFS' practice is to associate exposure at these levels with Level B harassment.

Distance to Sound Thresholds

Underwater Sound Propagation Formula—Pile driving generates underwater noise that can potentially result in disturbance to marine mammals in the project area. Transmission loss (TL) is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, and bottom composition and topography. The general formula for underwater TL is:

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

where

R_1 = the distance of the modeled SPL from the driven pile, and

R_2 = the distance from the driven pile of the initial measurement.

This formula neglects loss due to scattering and absorption, which is assumed to be zero here. The degree to which underwater sound propagates away from a sound source is dependent on a variety of factors, most notably the water bathymetry and presence or absence of reflective or absorptive conditions including in-water structures and sediments. Spherical spreading occurs in a perfectly unobstructed (free-field) environment not limited by depth or water surface, resulting in a 6 dB reduction in sound level for each doubling of distance from the source (20*log[range]). Cylindrical spreading occurs in an environment in which sound propagation is bounded by the water surface and sea bottom, resulting in a reduction of 3 dB in sound level for each doubling of distance from the source (10*log[range]). A practical spreading value of fifteen is often used under conditions, such as Hood Canal, where water increases with depth as the receiver moves away from the shoreline, resulting in an expected propagation environment that would lie between spherical and cylindrical spreading loss conditions. Practical spreading loss (4.5 dB reduction in sound level for each doubling of distance) is assumed here.

Underwater Sound—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. A large quantity of literature regarding SPLs recorded from pile driving projects is available for consideration. In order to determine reasonable SPLs and their associated effects on marine mammals that are likely to result from pile driving at NBKB, studies with similar properties to the specified activity were evaluated, including measurements conducted for driving of steel piles at NBKB as part of the TPP (Illingworth & Rodkin, 2012). During the TPP, SPLs from driving of 24-, 36-, and 48-in piles by impact and vibratory hammers were measured. Overall, studies which met the following parameters were considered: (1) Pile size and materials: Steel pipe piles (30- to 72-in diameter); (2) Hammer machinery: Vibratory and impact hammer; and (3) Physical environment: shallow depth (less than 30 m).

TABLE 7—UNDERWATER SPLS FROM MONITORED CONSTRUCTION ACTIVITIES USING IMPACT HAMMERS

Project and location	Pile size and type	Water depth (m)	Measured SPLs
Eagle Harbor Maintenance Facility, WA[1]	30-in steel pipe	10	192 dB (rms) at 10 m.
Friday Harbor Ferry Terminal, WA[2]	30-in steel pipe	10	196 dB (rms) at 10 m.
Humboldt Bay Bridges, CA[3]	36-in CISS pipe	10	193 dB (rms) at 10 m.
Mukilteo Test Piles, WA[4]	36-in steel pipe	7.3	195 dB (rms) at 10 m.
Anacortes Ferry, WA[5]	36-in steel pipe	12.8	199 dB (rms) at 10 m.
Test Pile Program, NBKB[6]	36-in steel pipe	13.7–26.8	196 dB (rms) at 10 m.
EHW–2, Year 1, NBKB[7]	36-in steel pipe	13.7–26.8	194 dB (rms) at 10 m.[9]
Carderock Pier, NBKB[8]	42-in steel pipe	14.6–21.3	195 dB (rms) at 10 m.[10]
Russian River, CA[3]	48-in CISS pipe	2	195 dB (rms) at 10 m.
Test Pile Program, NBKB[6]	48-in steel pipe	26.2–28	194 dB (rms) at 10 m.
California[3]	60-in CISS pipe	10	195 dB (rms) at 10 m.[11]
Richmond-San Rafael Bridge, CA[3]	66-in cast-in-drilled-hole steel pipe	4	195 dB (rms) at 10 m.

Sources: [1] MacGillivray and Racca, 2005; [2] Laughlin, 2005; [3] Caltrans, 2012; [4] MacGillivray, 2007; [5] Sexton, 2007; [6] Illingworth & Rodkin, 2012; [7] Illingworth & Rodkin, 2013; [8] DoN, 2009.

[9] Bubble curtain in place for all measurements.

[10] Source level at 10 m estimated based on measurements at distances of 48–387 m.

[11] Specific location/project unknown. Summary value possibly comprising multiple events rather than a single event.

The tables presented here detail representative pile driving SPLs that have been recorded from similar construction activities in recent years. Due to the similarity of these actions and the Navy's proposed action, these values represent reasonable SPLs which could be anticipated, and which were used in the acoustic modeling and analysis. Table 7 displays SPLs measured during pile installation using an impact hammer and Table 8 displays SPLs measured during pile installation using a vibratory hammer. For impact driving, a source value of 195 dB rms at 10 m was the average value reported from the listed studies, and is consistent with measurements from the TPP and Carderock Pier pile driving projects at NBKB, which had similar pile materials (48- and 42-inch hollow steel piles, respectively), water depth, and substrate type as the EHW–2 project site. For vibratory pile driving, the Navy selected the most conservative value (72-in piles; 180 dB rms at 10 m) available when initially assessing EHW–2 project impacts, prior to the first year of the project. Since then, data have become available that indicate, on average, a lower source level for vibratory pile driving (e.g., 172 dB rms for 48-in steel piles). However, for consistency we have maintained the initial conservative assumption regarding source level for vibratory driving.

TABLE 8—UNDERWATER SPLS FROM MONITORED CONSTRUCTION ACTIVITIES USING VIBRATORY HAMMERS

Project and location	Pile size and type	Water depth	Measured SPLs
Vashon Terminal, WA[1]	30-in steel pipe	6 m	165 dB (rms) at 11 m.
Keystone Terminal, WA[2]	30-in steel pipe	8 m	165 dB (rms) at 10 m.
Edmonds Ferry Terminal, WA[3]	36-in steel pipe	5.8 m	162–163 dB (rms) at 10 m.
Anacortes Ferry Terminal, WA[4]	36-in steel pipe	12.7 m	168–170 dB (rms) at 10 m.
California[5]	36-in steel pipe	5 m	170 dB/175 dB (rms) at 10 m.[8]
Test Pile Program, NBKB[6]	36-in steel pipe	13.7–26.8 m	154–169 dB (rms) at 10 m.
EHW–2, Year 1, NBKB[7]	36-in steel pipe	Avg of mid- and deep-depth	169 dB (rms) at 10 m.
Test Pile Program, NBKB[6]	48-in steel pipe	13.7–26.8 m	172 dB (rms) at 10 m.
California[3]	72-in steel pipe	5 m	170 dB/180 dB (rms) at 10 m.[8]

Sources: [1] Laughlin, 2010a; [2] Laughlin, 2010b; [3] Loughlin, 2011; [4] Loughlin, 2012; [5] Caltrans, 2012; [6] Illingworth & Rodkin, 2012; [7] Illingworth & Rodkin, 2013.

[8] Specific location/project unknown. Summary value possibly comprising multiple events rather than a single event. Average and maximum values presented.

All calculated distances to and the total area encompassed by the marine mammal sound thresholds are provided in Table 9. The Navy used source values of 185 dB rms for impact driving (the mean SPL of the values presented in Table 7, less 10 dB of sound attenuation from use of a bubble curtain) and 180 dB rms for vibratory driving (the worst-case value from Table 8). Under the worst-case construction scenario, up to three vibratory drivers would operate simultaneously with one impact driver. Although radial distance and area associated with the zone ensonified to 160 dB (the behavioral harassment threshold for pulsed sounds, such as those produced by impact driving) are presented in Table 9, this zone would be subsumed by the 120-dB zone produced by vibratory driving. Thus, behavioral harassment of marine mammals associated with impact driving is not considered further here. Since the 160-dB threshold and the 120-dB threshold both indicate behavioral harassment, pile driving effects in the two zones are equivalent. Although not considered as a likely construction scenario, if only the impact driver was operated on a given day incidental take on that day would likely be lower because the area ensonified to levels producing Level B harassment would be smaller (although actual take would be determined by the numbers of marine mammals in the area on that day). The use of multiple vibratory rigs at the same time would result in a small additive effect with regard to produced SPLs; however, because the sound field produced by vibratory driving would be truncated by land in the Hood Canal, no increase in actual sound field produced would occur. There would be no overlap in the 190/180-dB sound fields produced by rigs operating simultaneously.

TABLE 9—CALCULATED DISTANCE(S) TO AND AREA ENCOMPASSED BY UNDERWATER MARINE MAMMAL SOUND THRESHOLDS DURING PILE INSTALLATION

Threshold	Distance [1] (m)	Area (km²)
Impact driving, pinniped injury (190 dB)	4.9.	0.0001
Impact driving, cetacean injury (180 dB)	22.	0.002
Impact driving, disturbance (160 dB)[2]	724.	1.65
Vibratory driving, pinniped injury (190 dB)	2.1.	< 0.0001
Vibratory driving, cetacean injury (180 dB)	10.	0.0003
Vibratory driving, disturbance (120 dB)[3]	13,800.	41.4

[1] SPLs used for calculations were: 185 dB for impact and 180 dB for vibratory driving.
[2] Area of 160-dB zone presented for reference. Estimated incidental take calculated on basis of larger 120-dB zone.
[3] Hood Canal average width at site is 2.4 km, and is fetch limited from N to S at 20.3 km. Calculated range (over 222 km) is greater than actual sound propagation through Hood Canal due to intervening land masses. The greatest line-of-sight distance from pile driving locations unimpeded by land masses is 13.8 km (i.e., the maximum possible distance for propagation of sound).

Hood Canal does not represent open water, or free field, conditions. Therefore, sounds would attenuate as they encounter land masses or bends in the canal. As a result, the calculated distance and areas of impact for the 120-dB threshold cannot actually be attained at the project area. See Figure 6–1 of the Navy's application for a depiction of the size of areas in which each underwater sound threshold is predicted to occur at the project area due to pile driving.

Airborne Sound—Pile driving can generate airborne sound that could potentially result in disturbance to marine mammals (specifically, 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 NBKB to be exposed to airborne SPLs that could result in Level B behavioral harassment. A spherical spreading loss model (i.e., 6 dB reduction in sound level for each doubling of distance from the source), in which there is a perfectly unobstructed (free-field) environment not limited by depth or water surface, is appropriate for use with airborne sound and was used to estimate the distance to the airborne thresholds.

As was discussed for underwater 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 SPLs and their associated effects on marine mammals that are likely to result from pile driving at NBKB, studies with similar properties to the proposed action, as described previously, were evaluated. Table 10 details representative pile driving activities that have occurred in recent years. Due to the similarity of these actions and the Navy's proposed action, they represent reasonable SPLs which could be anticipated. Measured values from the TPP and EHW–2 (Year 1) are generally lower than those assumed for Navy's initial analysis for impact driving and generally equivalent to what was assumed for vibratory driving (see values for Northstar Island and Keystone Ferry Terminal in Table 10; note that these equate to approximately 118 dB and 96 dB when standardized to 15 m). However, these values were retained for impact assessment because they either result in a more conservative distance to threshold (impact driving) or are equivalent (vibratory driving). Please see Illingworth & Rodkin (2012, 2013) for details of the TPP and EHW–2 measurements.

TABLE 10—AIRBORNE SPLS FROM SIMILAR CONSTRUCTION ACTIVITIES

Project and location	Pile size and type	Method	Measured SPLs [5]
Northstar Island, AK [1]	42-in steel pipe	Impact	97 dB rms at 160 m.
TPP, NBKB [2]	36-in steel pipe	Impact	109 dB Lmax at 15 m.
TPP, NBKB [2]	48-in steel pipe	Impact	107 dB at 15 m.
EHW–2, Year 1, NBKB [3]	24-in steel pipe	Impact	111 dB Lmax at 15 m.
EHW–2, Year 1, NBKB [3]	36-in steel pipe	Impact	111 dB at 15 m.
EHW–2, Year 1, NBKB [3]	24-in steel pipe	Vibratory	95 dB Leq at 15 m.
Keystone Ferry Terminal, WA [4]	30-in steel pipe	Vibratory	98 dB rms at 11 m.
TPP, NBKB [2]	36-in steel pipe	Vibratory	93 dB Leq at 15 m.
EHW–2, Year 1, NBKB [3]	36-in steel pipe	Vibratory	103 Leq dB at 15 m.
TPP, NBKB [2]	48-in steel pipe	Vibratory	94 dB Leq at 15 m.

Sources: [1] Blackwell *et al.,* 2004; [2] Illingworth & Rodkin, 2012; [3] Illingworth & Rodkin, 2013; [4] Laughlin, 2010b.
[5] Lmax = maximum level; Leq = equivalent level.

Based on these values and the assumption of spherical spreading loss, distances to relevant thresholds and associated areas of ensonification under the multi-rig scenario (i.e., combined impact and vibratory driving) are presented in Table 11. See Figure 6–2 of the Navy's application for a depiction of the size of areas in which each airborne sound threshold is predicted to occur at the project area due to pile driving.

TABLE 11—DISTANCES TO RELEVANT SOUND THRESHOLDS AND AREAS OF ENSONIFICATION, AIRBORNE SOUND

Group	Threshold (dB)	Distance to threshold (m) and associated area of ensonification (km^2); combined rig scenario (worst-case)
Harbor seals	90 dB	361, 0.07
Sea lions ...	100 dB	114, 0.005

Marine Mammal Densities

The Navy has developed, with input from regional marine mammal experts, estimates of marine mammal densities in Washington inland waters for the Navy Marine Species Density Database (NMSDD). A technical report (Hanser *et al.,* 2014) describes methodologies and available information used to derive these densities, which are generally considered the best available information for Washington inland waters, except where specific local abundance information is available. Initial impact assessment for the EHW–2 project relied on data available at the time the application was submitted, including survey efforts conducted in the project area. Here, we rely on NMSDD density information for the harbor seal, killer whale, and harbor porpoise and use local abundance data for the California sea lion and Steller sea lion. This approach is the same as that taken for estimating take for Year 2 of the EHW–2 project, which represented a departure from the approach taken for Year 1 of EHW–2 for certain species. Please see Appendix A of the Navy's application for more information on the NMSDD information.

For all species, the most appropriate information available was used to estimate the number of potential incidences of take. For harbor seals, this involved published literature describing harbor seal research conducted in Washington and Oregon, including counts from Hood Canal (Huber *et al.,* 2001; Jeffries *et al.,* 2003). Killer whales are known from two periods of occurrence (2003 and 2005) and are not known to preferentially use any specific portion of the Hood Canal. Therefore, density was calculated as the maximum number of individuals expected to be present at a given time (Houghton *et al.,* in prep.), divided by the area of Hood Canal. The best information available for the remaining species in Hood Canal came from surveys conducted by the Navy at the NBKB waterfront or in the vicinity of the project area.

Beginning in April 2008, Navy personnel have recorded sightings of marine mammals occurring at known haul-outs along the NBKB waterfront, including docked submarines or other structures associated with NBKB docks and piers 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 whenever possible during a typical work week (i.e., Monday through Friday), but inclement weather, holidays, or security constraints often precluded surveys. These sightings took place frequently, although without a formal survey protocol. During the surveys, staff visited each of the above-mentioned locations and recorded observations of marine mammals. Surveys were conducted using binoculars and the naked eye from shoreline locations or the piers/wharves themselves. Because these surveys consist of opportunistic sighting data from shore-based observers, largely of hauled-out animals, there is no associated survey area appropriate for use in calculating a density from the abundance data. Data were compiled for the period from April 2008 through December 2013 for analysis here, and these data provide the basis for take estimation for Steller and California sea lions. Other information, including sightings data from other Navy survey efforts at NBKB, is available for these two species, but these data provide the most conservative (i.e., highest) local abundance estimates (and thus the highest estimates of potential take). These data are also most appropriate for these two species because they are attracted to the NBKB waterfront due to the availability of suitable haul-out sites. The cetaceans and (to a lesser extent) the harbor seal are not specifically attracted to any attribute of the project area and are assumed to occur uniformly throughout the project area.

In addition, vessel-based marine wildlife surveys were conducted according to established survey protocols during July through September 2008 and November through May 2009–10 (Tannenbaum *et al.,* 2009, 2011). Eighteen complete surveys of the nearshore area resulted in observations of four marine mammal species (harbor seal, California sea lion, harbor porpoise, and Dall's porpoise). These surveys operated along pre-determined transects parallel to the shoreline from the nearshore out to approximately 550 m from shoreline, at a spacing of 100 yd, and covered the entire NBKB waterfront (approximately 3.9 km^2 per survey) at a speed of 5 kn 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 haul-out 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 to produce coordinates of the locations of all animals detected. These surveys resulted in the only observation of a Dall's porpoise near NBKB, but these surveys do not afford any information used in take estimation here.

The Navy also conducted vessel-based line transect surveys in Hood Canal on non-construction days during the 2011 TPP in order to collect additional data for species present in Hood Canal. These surveys detected three marine mammal species (harbor seal, California sea lion, and harbor porpoise), and included surveys conducted in both the main body of Hood Canal, near the project area, and baseline surveys conducted for comparison in Dabob Bay, an area of Hood Canal that is not affected by sound from Navy actions at the NBKB waterfront. The surveys operated along pre-determined transects that followed a double saw-tooth pattern to achieve uniform coverage of the entire NBKB waterfront. The vessel traveled at a speed of approximately 5 kn 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 to produce coordinates of the locations of all animals detected. Sighting information for harbor porpoises was corrected for detectability ($g(0) = 0.54$; Barlow, 1988; Calambokidis *et al.,* 1993; Carretta *et al.,* 2001).

Distance sampling methodologies were used to estimate densities of animals for the data. This information provides the best information for harbor porpoises.

The cetaceans, as well as the harbor seal, appear to range throughout Hood Canal; therefore, this analysis assumes that harbor seal, transient killer whale, and harbor porpoise are uniformly distributed in the project area. However, it should be noted that there have been no observations of cetaceans within the floating security barriers at NBKB; these barriers thus appear to effectively prevent cetaceans from approaching the shutdown zones. Although the Navy will implement a precautionary shutdown zone for cetaceans, anecdotal evidence suggests that cetaceans are not at risk of Level A harassment at NBKB even from louder activities (e.g., impact pile driving). 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. The sea lions appear to be attracted to the man-made haul-out opportunities along the NBKB waterfront while dispersing for foraging opportunities elsewhere in Hood Canal. California sea lions were not reported during aerial surveys of Hood Canal (Jeffries *et al.,* 2000), and Steller sea lions have been documented almost solely at the NBKB waterfront.

Description of Take Calculation

The take calculations presented here rely on the best data currently available for marine mammal populations in the Hood Canal. The formula was developed for calculating take due to pile driving activity and applied to each group-specific sound impact threshold. The formula is founded on the following assumptions:

- All marine mammal individuals potentially available are assumed to be present within the relevant area, and thus incidentally taken;
- An individual can only be taken once during a 24-h period;
- There were will be 195 total days of activity and the largest ZOI equals 41.4 km^2;
- Exposure modeling assumes that one impact pile driver and three vibratory pile drivers are operating concurrently; and,
- Exposures to sound levels above the relevant thresholds equate to take, as defined by the MMPA.

The calculation for marine mammal takes is estimated by:

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

Where:

n = density estimate used for each species/season

ZOI = sound threshold ZOI area; the area encompassed by all locations where the SPLs equal or exceed the threshold being evaluated

n * ZOI produces an estimate of the abundance of animals that could be present in the area for exposure, and is rounded to the nearest whole number before multiplying by days of total activity.

The ZOI impact area is the estimated range of impact to the sound criteria. The relevant distances specified in Table 9 were used to calculate ZOIs around each pile. The ZOI impact area took into consideration the possible affected area of the Hood Canal from the pile driving site furthest from shore with attenuation due to land shadowing from bends in the canal. Because of the close proximity of some of the piles to the shore, the narrowness of the canal at the project area, and the maximum fetch, the ZOIs for each threshold are not necessarily spherical and may be truncated.

While pile driving can occur any day throughout the in-water work window, and the analysis is conducted on a per day basis, only a fraction of that time (typically a matter of hours on any given day) is actually spent pile driving. Acoustic monitoring conducted as part of the TPP and year one of EHW–2 demonstrated that Level B harassment zones for vibratory pile driving are likely to be smaller than the zones estimated through modeling based on measured source levels and practical spreading loss. Also of note is the fact that the effectiveness of mitigation measures in reducing takes is typically not quantified in the take estimation process. In addition, equating exposure with response (i.e., a behavioral response meeting the definition of take under the MMPA) is a simplistic and conservative assumption. For these reasons, these take estimates are likely to be conservative. See Table 14 for total estimated incidents of take.

Airborne Sound—No incidences of incidental take resulting solely from airborne sound are likely, as distances to the harassment thresholds would not reach areas where pinnipeds may haul out. Harbor seals can haul out at a variety of natural or manmade locations, but the closest known harbor seal haul-out is at the Dosewallips River mouth (London, 2006) and Navy waterfront surveys and boat surveys have found it rare for harbor seals to haul out along the NBKB waterfront (Agness and Tannenbaum, 2009; Tannenbaum *et al.,* 2009, 2011; DoN, 2013). Individual seals have occasionally been observed hauled out on pontoons of the floating security fence within the restricted areas of NBKB, but this area is not within the airborne disturbance ZOI. Nearby piers are elevated well above the surface of the water and are inaccessible to pinnipeds, and seals have not been observed hauled out on the adjacent shoreline. Sea lions typically haul out on submarines docked at Delta Pier, approximately one mile from the project site.

We recognize that pinnipeds in the water could be exposed to airborne sound that may result in behavioral harassment when looking with heads above water. However, these animals would previously have been 'taken' as a result of exposure to underwater sound above the behavioral harassment thresholds, which are in all cases larger than those associated with airborne sound. Thus, the behavioral harassment of these animals is already accounted for in these estimates of potential take. Multiple incidents of exposure to sound above NMFS' thresholds for behavioral harassment are not believed to result in increased behavioral disturbance, in either nature or intensity of disturbance reaction. Therefore, we do not believe that authorization of incidental take resulting from airborne sound for pinnipeds is warranted, and airborne sound is not discussed further here.

California Sea Lion—California sea lions occur regularly in the vicinity of the project site, with the exception of approximately mid-June through mid-August, as determined by Navy waterfront surveys conducted from April 2008 through December 2013 (Table 12). With regard to the range of this species in Hood Canal and the project area, we assume on the basis of waterfront observations (Agness and Tannenbaum, 2009; Tannenbaum *et al.,* 2009, 2011; HDR 2012a, 2012b; Hart Crowser, 2013) that the opportunity to haul out on submarines docked at Delta Pier is a primary attractant for California sea lions in Hood Canal, as they are not typically observed elsewhere in Hood Canal. Abundance is calculated as the monthly average of the maximum number observed in a given month, as opposed to the overall average (Table 12). That is, the maximum number of animals observed on any one day in a given month was averaged for 2008–13, providing a monthly average of the maximum daily number observed. The largest monthly average (71 animals) was recorded in November, as was the largest single daily count (122 animals). The first California sea lion was observed at NBKB in August 2009, and their occurrence has been increasing since that time (DoN, 2013).

TABLE 12—CALIFORNIA SEA LION SIGHTING INFORMATION FROM NBKB, APRIL 2008–DECEMBER 2013

Month	Number of surveys	Number of surveys with animals present	Frequency of presence [2]	Abundance [3]
January	47	36	0.77	31.0
February	51	44	0.86	39.2
March	47	45	0.96	53.3
April	69	57	0.83	43.2
May	73	58	0.79	24.5
June	73	17	0.23	7.4
July	67	1	0.01	0.5
August	67	12	0.18	2.2
September	58	34	0.59	22.8
October	69	65	0.94	57.8
November	65	65	1	70.5
December	54	44	0.81	49.6
Total or average (in-water work season only) [1]	478	301	0.63	33.9

[1] Totals (number of surveys) and averages (frequency and abundance) presented for in-water work season (July–February) only. Information from March–June presented for reference.

[2] Frequency is the number of surveys with California sea lions present/number of surveys conducted.

[3] Abundance is calculated as the monthly average of the maximum daily number observed in a given month.

California sea lion density for Hood Canal was calculated to be 0.28 animals/km^2 for purposes of the NMSDD (Hanser *et al.,* 2014). Jeffries *et al.* (2003) split the Washington inland waters area into five regions, including Hood Canal as a discrete region. To determine density, the number of California sea lions known to use haul-outs in the Hood Canal was identified and then divided by the area of the Hood Canal to give a total density estimate. However, this density was derived by averaging data collected year-round. This project will occur during the designated in-water work window, so it is more appropriate to use data collected at the NBKB waterfront during those months (July–February). The average of the monthly averages for maximum daily numbers observed (in a given month, during the in-water work window) is 33.9 animals (see Table 12). Exposures were calculated assuming 34 individuals could be present, and therefore exposed to sound exceeding the behavioral harassment threshold, on each day of pile driving. This methodology is conservative in that it assumes that all individuals present potentially would be taken on any given day of activity.

Steller Sea Lion

Steller sea lions were first documented at the NBKB waterfront in November 2008, while hauled out on submarines at Delta Pier, and have been periodically observed from October to April since that time, as determined by Navy waterfront surveys conducted from April 2008 through December 2013 (Table 13). Steller sea lions are occasionally observed in early May or late September, but have never been observed from approximately mid-May through mid-September. We assume, on the basis of waterfront observations (Agness and Tannenbaum, 2009; Tannenbaum *et al.,* 2009, 2011; HDR 2012a, 2012b; Hart Crowser, 2013), that Steller sea lions use available haul-outs and foraging habitat similarly to California sea lions. On occasions when Steller sea lions are observed, they typically occur in mixed groups with California sea lions also present, allowing observers to confirm their identifications based on discrepancies in size and other physical characteristics. (DoN, 2013)

TABLE 13—STELLER SEA LION SIGHTING INFORMATION FROM NBKB, APRIL 2008–DECEMBER 2013

Month	Number of surveys	Number of surveys with animals present	Frequency of presence [2]	Abundance [3]
January	47	12	0.26	1.5
February	51	7	0.14	1.4
March	47	12	0.26	1.8
April	69	21	0.30	2.3
May	73	6	0.08	1.5
June	73	0	0	0
July	67	0	0	0
August	67	0	0	0
September	58	2	0.03	0.8
October	69	30	0.43	3.7
November	65	37	0.57	5.7
December	54	18	0.33	2.6
Total or average (in-water work season only) [1]	478	106	0.22	2.0

[1] Totals (number of surveys) and averages (frequency and abundance) presented for in-water work season (July–February) only. Information from March–June presented for reference.

[2] Frequency is the number of surveys with Steller sea lions present/number of surveys conducted.

[3] Abundance is calculated as the monthly average of the maximum daily number observed in a given month.

Abundance is calculated in the same manner described for California sea lions (Table 13). That is, the maximum number of animals observed on any one day in a given month was averaged for 2008–13, providing a monthly average of the maximum daily number observed. The largest monthly average (six animals) was recorded in November, as was the largest single daily count (eleven animals). NMSDD density for Steller sea lions was also calculated in a similar manner as that for California sea lions (0.03 animals/km^2; Hanser *et al.,* 2014) and, as for California sea lions, local abundance data specific to the in-water work window is the most appropriate information for use in estimating take. The average of the monthly averages for maximum daily numbers observed (in a given month, during the in-water work window) is two animals (see Table 13). However, in recognition that numbers of Steller sea lions have been increasing every year and reflecting a more typical group size when Steller sea lions have been observed, the Navy has requested a precautionary assumption that three individuals could be present, and therefore exposed to sound exceeding the behavioral harassment threshold, on each day of pile driving.

Harbor Seal—The harbor seal density used here is the same as that in the NMSDD (Hanser *et al.,* 2014). Jeffries *et al.* (2003) conducted aerial surveys of harbor seals in 1999 for the Washington Department of Fish and Wildlife, dividing the survey areas into seven strata (including five in inland waters and two in coastal waters). Survey effort in the Hood Canal stratum yielded a count of 711 harbor seals hauled out. To account for animals in the water and not observed during survey counts, a correction factor of 1.53 was applied (Huber *et al.,* 2001) to derive a total Hood Canal population of 1,088 seals. The correction factor (1.53) was based on the proportion of time seals spend on land versus in the water over the course of a day, and was derived by dividing one by the percentage of time harbor seals spent on land. These data came from tags (VHF transmitters) applied to harbor seals at six areas (Grays Harbor, Tillamook Bay, Umpqua River, Gertrude Island, Protection/Smith Islands, and Boundary Bay, BC) within two different harbor seal stocks (the coastal stock and the Washington inland waters stock) over four survey years. Although the sampling areas included both coastal and inland waters, with pooled correction factors of 1.50 and 1.57, respectively, Huber *et al.* (2001) found no significant difference in the proportion of seals ashore among the six sites and no interannual variation at one site studied across years. Therefore, we retain the total pooled correction factor of 1.53 here. The Hood Canal population is part of the inland waters stock, and while not specifically sampled, Jeffries *et al.* (2003) found the VHF data to be broadly applicable to the entire Washington harbor seal population. Using this information and the area of the Hood Canal stratum yields a density estimate of 3.04 animals/km^2.

However, to determine an instantaneous in-water density estimate, a secondary correction must be applied to account for harbor seals that are hauled out at any given moment. The tagging research in 1991 and 1992 conducted by Huber *et al.* (2001) was repeated for two sites by Jeffries *et al.* (2003), using the same methods for the 1999 and 2000 survey years. These surveys indicated that approximately 35 percent of harbor seals are in the water versus hauled out on a daily basis (Huber *et al.,* 2001; Jeffries *et al.,* 2003). A corrected density was derived from the number of harbor seals that are present in the water at any one time (35 percent of 1,088, or approximately 381 individuals), divided by the area of the Hood Canal, yielding an estimate of 1.06 animals/km^2.

We recognize 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 (i.e., it is probable that greater than 35 percent of seals will enter the water at some point during the day). Therefore, an instantaneous estimate of animals in the water at a given time may not produce an accurate assessment of the number of individuals that enter the water over the daily duration of the activity. However, no data exist regarding fine-scale harbor seal movements within the project area on time durations of less than a day, thus precluding an assessment of ingress or egress of different animals through the action area. As such, it is impossible, given available data, to determine exactly what number of individuals above 35 percent may potentially be exposed to underwater sound. Therefore, we are left to make a decision, on the basis of limited available information, regarding which of these two scenarios (i.e., 100 percent versus 35 percent of harbor seals are in the water and exposed to sound) produces a more accurate estimate of the potential incidents of take.

First, we understand that hauled-out harbor seals are necessarily at haul-outs. No significant harbor seal haul-outs are located within or near the action area. Harbor seals observed in the vicinity of the NBKB shoreline are rarely hauled-out (for example, in formal surveys during 2007–08, approximately 86 percent of observed seals were swimming), and when hauled-out, they do so opportunistically (i.e., on floating booms rather than established haul-outs). Harbor seals are typically unsuited for using manmade haul-outs at NBKB, which are used by the larger sea lions. Primary harbor seal haul-outs in Hood Canal are generally located at significant distance (20 km or more) from the action area in Dabob Bay or further south (see Figure 4–1 in the Navy's application), meaning that animals casually entering the water from haul-outs or flushing due to some disturbance at those locations would not be exposed to underwater sound from the project; rather, only those animals embarking on foraging trips and entering the action area may be exposed.

Second, we know that harbor seals in Hood Canal are not likely to have a uniform distribution as is assumed through use of a density estimate, but are likely to be relatively concentrated near areas of interest such as the haul-outs found in Dabob Bay or foraging areas. The majority of the action area consists of the Level B harassment zone in deeper waters of Hood Canal; past observations from surveys and required monitoring have confirmed that harbor seals are less abundant in these waters.

Third, a typical pile driving day (in terms of the actual time spent driving) is somewhat shorter than may be assumed (i.e., 8–15 hours) as a representative pile driving day based on daylight hours. Construction scheduling and notional production rates in concert with typical delays mean that hammers are active for only some fraction of time on pile driving ''days''. During the first two years of construction for EHW–2, pile driving occurred over approximately 1,778 hours on 242 days, for an approximate average of seven hours per pile driving day.

What we know tells us that (1) the turnover of harbor seals (in and out of the water) is occurring primarily outside the action area and would not be expected to result in a greater number of individuals entering the action area within a given day and being harassed than is assumed; (2) there are likely to be significantly fewer harbor seals in the majority of the action area than would be indicated by the uncorrected density; and (3) pile driving actually occurs over a limited timeframe on any given day (i.e., less total time per day than would be assumed based on daylight hours and non-continuously), reducing the amount of time over which new individuals might enter the action area within a given day. These factors lead us to believe that the corrected density is likely to more closely approximate the number of seals that may be found in the action area than does the uncorrected density, and there are no existing data that would indicate that the proportion of individuals entering the water within the predicted area of effect during pile driving would be dramatically larger than 35 percent. Therefore, using 100 percent of the population to estimate density would likely result in a gross exaggeration of potential take. Moreover, because the Navy is typically unable to determine from field observations whether the same or different individuals are being exposed, each observation is recorded as a new take, although an individual theoretically would only be considered as taken once in a given day.

Finally, we note that during the course of four previous IHAs over two years (2011–12), the Navy was authorized for 6,725 incidents of incidental harassment (corrected for actual number of pile driving days). The total estimate of actual incidents of take (observed takes and observations extrapolated to unobserved area) was 868. This is almost certainly negatively biased, but the huge disparity does provide confirmation that we are not significantly underestimating takes.

Killer Whales—Transient killer whales are uncommon visitors to Hood Canal, and may be present anytime during the year. Transient pods (six to eleven individuals per event) were observed in Hood Canal for lengthy periods of time (59–172 days) in 2003 (January–March) and 2005 (February–June), feeding on harbor seals (London, 2006). These whales used the entire expanse of Hood Canal for feeding. The NMSDD used monthly unique sightings data collected over the period 2004–2010 and an average group size of 5.16 (Houghton *et al.,* in prep.) to calculate densities on a seasonal basis for each of five geographic strata (Hanser *et al.,* 2014). Densities for the Hood Canal stratum range from 0–0.0006 animals/km² across all seasons, which would result in a prediction that zero animals would be harassed by the project activities.

However, while transient killer whales are rare in the Hood Canal, it is possible that a pod of animals could be present. In the event that this occurred in a similar manner to prior occurrences (e.g., 59–172 days) and incidental take were not authorized appropriately, there could be significant project delays. In estimating potential incidences of take here, we make three assumptions: (1) Transient killer whales have a reasonable likelihood of occurrence in the project area; (2) if whales were present, they would occur in a pod of six animals (the minimum pod size seen in the 2003/2005 events but equivalent to the average pod size reported by Houghton et al. [in prep.]); and (3) the pod would be present for thirty days. This last assumption represents only half of the minimum time killer whales were present during the 2003/2005 events; however, we believe that it is unlikely the whales would remain in the area for a longer period in the presence of a harassing stimulus (i.e., pile driving). In the absence of any overriding contextual element (e.g., NBKB is not important as a breeding area, and provides no unusual concentration of prey), it is reasonable to assume that whales would leave the area if exposed to potentially harassing levels of sound on each day that they were present. In summary, we assume here that, if killer whales occurred in the project area, a pod of six whales would be present—and could potentially be harassed—for thirty days.

Harbor Porpoise—During vessel-based line transect surveys on non-construction days during the TPP, 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 NBKB waterfront on the far side of Toandos Peninsula. Harbor porpoise presence in the immediate vicinity of the base (i.e., within one kilometer) remained low. These data 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 (e.g., boat speed, number of observers) (Barlow, 1988; Calambokidis *et al.,* 1993; Carretta *et al.,* 2001), the Navy determined the effective strip width for the surveys to be one kilometer, or a perpendicular distance of 500 m from the transect to the left or right of the vessel. The effective strip width was set at the distance at which the detection probability for harbor porpoises was equivalent to one, which assumes that all individuals on a transect are detected. Only sightings occurring within the effective strip width were used in the density calculation. By multiplying the trackline length of the surveys by the effective strip width, the total area surveyed during the surveys was 471.2 km². Thirty-eight individual harbor porpoises were sighted within this area, resulting in a density of 0.0806 animals/km². To account for availability bias, 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 animals/km².

TABLE 14—NUMBER OF POTENTIAL INCIDENTAL TAKES OF MARINE MAMMALS WITHIN VARIOUS ACOUSTIC THRESHOLD ZONES

Species	Density	Underwater		Total proposed authorized takes [2]
		Level A	Level B 120 dB) [1]	
California sea lion	[3] 34	0	6,630	6,630
Steller sea lion	[3] 2	0	585	585
Harbor seal	1.06	0	8,580	8,580
Killer whale (transient)	n/a	0	180	[4] 180
Harbor porpoise	0.149	0	1,170	1,170

[1] The 160-dB acoustic harassment zone associated with impact pile driving would always be subsumed by the 120-dB harassment zone produced by vibratory driving. Therefore, takes are not calculated separately for the two zones.

[2] For species with associated density, density was multiplied by largest ZOI (i.e., 41.4 km). The resulting value was rounded to the nearest whole number and multiplied by the 195 days of activity. For species with abundance only, that value was multiplied directly by the 195 days of activity. We assume for reasons described earlier that no takes would result from airborne noise.

[3] Figures presented are abundance numbers, not density, and are calculated as the average of average daily maximum numbers per month (see Tables 12–13). Abundance numbers are rounded to the nearest whole number for take estimation. The Steller sea lion abundance was increased to three for take estimation purposes.

[4] We assumed that a single pod of six killer whales could be present for as many as 30 days of the duration.

Analyses and Preliminary Determinations

Negligible Impact Analysis

NMFS has defined ''negligible impact'' in 50 CFR 216.103 as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival. A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (i.e., population-level effects). An estimate of the number of Level B harassment takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be ''taken'' through behavioral harassment, we consider other factors, such as the likely nature of any responses (e.g., intensity, duration), the context of any responses (e.g., critical reproductive time or location, migration), as well as the number and nature of estimated Level A harassment takes, the number of estimated mortalities, and effects on habitat.

Pile driving activities associated with the wharf construction project, as outlined previously, have the potential to disturb or displace marine mammals. Specifically, the specified activities may result in take, in the form of Level B harassment (behavioral disturbance) only, from underwater sounds generated from pile driving. Potential takes could occur if individuals of these species are present in the ensonified zone when pile driving is happening, which is likely to occur because (1) harbor seals, which are frequently observed along the NBKB waterfront, are present within the WRA; (2) sea lions, which are less frequently observed, transit the WRA en route to haul-outs to the south at Delta Pier; or (3) cetaceans or pinnipeds transit the larger Level B harassment zone outside of the WRA.

No injury, serious injury, or mortality is anticipated given the methods of installation and measures designed to minimize the possibility of injury to marine mammals. The potential for these outcomes is minimized through the construction method and the implementation of the planned mitigation measures. Specifically, vibratory hammers will be the primary method of installation, and this activity does not have significant potential to cause injury to marine mammals due to the relatively low source levels produced (likely less than 180 dB rms) and the lack of potentially injurious source characteristics. Impact pile driving produces short, sharp pulses with higher peak levels and much sharper rise time to reach those peaks. When impact driving is necessary, required measures (use of a sound attenuation system, which reduces overall source levels as well as dampening the sharp, potentially injurious peaks, and implementation of shutdown zones) significantly reduce any possibility of injury. Given sufficient ''notice'' through use of soft start (for impact driving), marine mammals are expected to move away from a sound source that is annoying prior to its becoming potentially injurious. The likelihood that marine mammal detection ability by trained observers is high under the environmental conditions described for Hood Canal further enables the implementation of shutdowns to avoid injury, serious injury, or mortality.

Effects on individuals that are taken by Level B harassment, on the basis of reports in the literature as well as monitoring from past projects at NBKB, will likely be limited to reactions such as increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring). Most likely, individuals will simply move away from the sound source and be temporarily displaced from the areas of pile driving, although even this reaction has been observed primarily only in association with impact pile driving. In response to vibratory driving, harbor seals (which may be somewhat habituated to human activity along the NBKB waterfront) have been observed to orient towards and sometimes move towards the sound. Repeated exposures of individuals to levels of sound that may cause Level B harassment are unlikely to result in hearing impairment or to significantly disrupt foraging behavior. Thus, even repeated Level B harassment of some small subset of the overall stock is unlikely to result in any significant realized decrease in fitness to those individuals, and thus would not result in any adverse impact to the stock as a whole. Level B harassment will be reduced to the level of least practicable impact through use of mitigation measures described herein and, if sound produced by project activities is sufficiently disturbing, animals are likely to simply avoid the project area while the activity is occurring.

For pinnipeds, no rookeries are present in the project area, there are no haul-outs other than those provided opportunistically by man-made objects, and the project area is not known to provide foraging habitat of any special importance (other than is afforded by the known migration of salmonids generally along the Hood Canal shoreline). No cetaceans are expected within the WRA. The pile driving activities analyzed here are similar to other nearby construction activities within the Hood Canal, including recent projects conducted by the Navy at the same location (TPP and EHW–1 pile replacement project, Years 1–2 of EHW–2; barge mooring project) as well as work conducted in 2005 for the Hood Canal Bridge (SR–104) by the Washington State Department of Transportation, which have taken place with no reported injuries or mortality to marine mammals, and no known long-term adverse consequences from behavioral harassment.

In summary, this negligible impact analysis is founded on the following factors: (1) The possibility of injury, serious injury, or mortality may reasonably be considered discountable; (2) the anticipated incidences of Level B harassment consist of, at worst, temporary modifications in behavior; (3) the absence of any major rookeries and only a few isolated and opportunistic haul-out areas near or adjacent to the project site; (4) the absence of cetaceans within the WRA and generally sporadic occurrence outside the WRA; (5) the absence of any other known areas or features of special significance for foraging or reproduction within the project area; and (6) the presumed efficacy of the planned mitigation measures in reducing the effects of the specified activity to the level of least practicable impact. In addition, none of these stocks are listed under the ESA or designated as depleted under the MMPA. All of the stocks for which take is authorized are thought to be increasing or to be within OSP size. In combination, we believe that these factors, as well as the available body of evidence from other similar activities, including those conducted at the same time of year and in the same location, demonstrate that the potential effects of the specified activity will have only short-term effects on individuals. The specified activity is not expected to impact rates of recruitment or survival and will therefore not result in population-level impacts. Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, we preliminarily find that the total marine mammal take from Navy's wharf construction activities will have a negligible impact on the affected marine mammal species or stocks.

Small Numbers Analysis

The numbers of animals authorized to be taken for Steller and California sea lions would be considered small relative to the relevant stocks or populations (less than one percent for Steller sea lions and less than three percent for California sea lions) even if each estimated taking occurred to a new individual—an extremely unlikely scenario. For pinnipeds occurring at the NBKB waterfront, there will almost certainly be some overlap in individuals present day-to-day. Further, for the pinniped species, these takes could potentially occur only within some small portion of the overall regional stock. For example, of the estimated 296,500 California sea lions, only certain adult and subadult males—believed to number approximately 3,000–5,000 by Jeffries *et al.* (2000)—travel north during the non-breeding season. That number has almost certainly increased with the population of California sea lions—the 2000 SAR for California sea lions reported an estimated population size of 204,000–214,000 animals—but likely remains a relatively small portion of the overall population.

For harbor seals, animals found in Hood Canal belong to a closed, resident population estimated at approximately 1,000 animals by Jeffries *et al.* (2003), and takes are likely to occur only within some portion of that closed population, rather than to animals from the Washington inland waters stock as a whole. The animals that are resident to Hood Canal, to which any incidental take would accrue, represent only seven percent of the best estimate of regional stock abundance. For transient killer whales, we estimate take based on an assumption that a single pod of whales, comprising six individuals, is present in the vicinity of the project area for the entire duration of the project. These six individuals represent a small number of transient killer whales, for which a conservative minimum estimate of 243 animals is given in the draft 2013 SAR.

Little is known about harbor porpoise use of Hood Canal, and prior to monitoring associated with recent pile driving projects at NBKB, it was believed that harbor porpoises were infrequent visitors to the area. It is unclear from the limited information available what relationship harbor porpoise occurrence in Hood Canal may hold to the regional stock or whether similar usage of Hood Canal may be expected to be recurring. It is unknown how many unique individuals are represented by sightings in Hood Canal, although it is unlikely that these animals represent a large proportion of the overall stock. While we believe that the authorized numbers of incidental take would be likely to occur to a much smaller number of individuals, the number of incidents of take relative to the stock abundance (approximately eleven percent) remains within the bounds of what we consider to be small numbers.

As summarized here, the estimated numbers of potential incidents of harassment for these species are likely much higher than will realistically occur. This is because (1) we use the maximum possible number of days (195) in estimating take, despite the fact that multiple delays and work stoppages are likely to result in a lower number of actual pile driving days; (2) sea lion estimates rely on the averaged maximum daily abundances per month, rather than simply an overall average which would provide a much lower abundance figure; and (3) the estimates for transient killer whales use sparse information to attempt to account for the potential presence of species that have not been observed in Hood Canal since 2005. In addition, potential efficacy of mitigation measures in terms of reduction in numbers and/or intensity of incidents of take has not been quantified. Therefore, these estimated take numbers are likely to be precautionary. Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the mitigation and monitoring measures, we preliminarily find that small numbers of marine mammals will be taken relative to the populations of the affected species or stocks.

Impact on Availability of Affected Species for Taking for Subsistence Uses

There are no relevant subsistence uses of marine mammals implicated by this action. Therefore, we have determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act (ESA)

No marine mammal species listed under the ESA are expected to be affected by these activities. Therefore, we have determined that a section 7 consultation under the ESA is not required.

National Environmental Policy Act (NEPA)

In compliance with the NEPA of 1969 (42 U.S.C. 4321 *et seq.*), as implemented by the regulations published by the Council on Environmental Quality (CEQ; 40 CFR parts 1500–1508), the Navy prepared an Environmental Impact Statement (EIS) and issued a Record of Decision (ROD) for this project. We acted as a cooperating agency in the preparation of that document, and reviewed the EIS and the public comments received and determined that preparation of additional NEPA analysis was not necessary. In compliance with NEPA, the CEQ regulations, and NOAA Administrative Order 216–6, we subsequently adopted the Navy's EIS and issued our own ROD for the issuance of the first IHA on July 6, 2012, and reaffirmed the ROD before issuing a second IHA in 2013.

We have reviewed the Navy's application for a renewed IHA for ongoing construction activities for 2014–15 and the 2013–14 monitoring report. Based on that review, we have determined that the proposed action is very similar to that considered in the previous IHAs. In addition, no significant new circumstances or information relevant to environmental concerns have been identified. Thus, we have determined preliminarily that the preparation of a new or supplemental NEPA document is not necessary, and will, after review of public comments determine whether or not to reaffirm our 2012 ROD. The 2012 NEPA documents are available for review at *http://www.nmfs.noaa.gov/pr/permits/incidental.htm.*

Proposed Authorization

As a result of these preliminary determinations, we propose to issue an IHA to the Navy for conducting the described wharf construction activities in the Hood Canal, from July 16, 2014 through February 15, 2015, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. The proposed IHA language is provided next.

This section contains a draft of the IHA itself. The wording contained in this section is proposed for inclusion in the IHA (if issued).

1. This Incidental Harassment Authorization (IHA) is valid from July 16, 2014 through February 15, 2015.

2. This IHA is valid only for pile driving and removal activities associated with construction of Explosive Handling Wharf #2 (EHW–2) in the Hood Canal, Washington.

3. General Conditions

(a) A copy of this IHA must be in the possession of the Navy, its designees, and work crew personnel operating under the authority of this IHA.

(b) The species authorized for taking are the harbor seal (*Phoca vitulina*), California sea lion (*Zalophus californianus*), killer whale (transient only; *Orcinus orca*), Steller sea lion (*Eumetopias jubatus*), and the harbor porpoise (*Phocoena phocoena*).

(c) The taking, by Level B harassment only, is limited to the species listed in condition 3(b). See Table 1 (attached) for numbers of take authorized.

(d) The taking by injury (Level A harassment), serious injury, or death of any of the species listed in condition 3(b) of the Authorization or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA.

(e) The Navy shall conduct briefings between construction supervisors and crews, marine mammal 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.

4. Mitigation Measures

In order to ensure the least practicable impact on the species listed in condition 3(b), the holder of this Authorization is required to implement the following mitigation measures:

(a) During impact pile driving, the Navy shall implement a minimum shutdown zone of 20 m radius around the pile, to be effective for all species of pinniped, and a minimum shutdown zone of 85 m radius around the pile, to be effective for all species of cetacean. If a marine mammal comes within the relevant zone, such operations shall cease. No marine mammal shall be exposed to sound pressure levels equaling or exceeding 180/190 dB rms (re 1 μPa) for cetaceans and pinnipeds, respectively, in order to prevent unauthorized Level A harassment.

(b) During vibratory pile driving and removal, the Navy shall implement a minimum shutdown zone of 10 m radius around the pile for marine mammals. If a marine mammal comes within this zone, such operations shall cease. No marine mammal shall be exposed to sound pressure levels equaling or exceeding 180/190 dB rms (re 1 μPa) for cetaceans and pinnipeds, respectively, in order to prevent unauthorized Level A harassment.

(c) The Navy shall similarly avoid direct interaction with marine mammals during in-water heavy machinery work other than pile driving that may occur in association with the wharf construction project. If a marine mammal comes within 10 m of such activity, operations shall cease and vessels shall reduce speed to the minimum level required to maintain steerage and safe working conditions, as appropriate.

(d) The Navy shall establish monitoring locations as described in the Marine Mammal Monitoring Plan (Monitoring Plan; attached). For all pile driving activities, a minimum of one observer shall be assigned to each active pile driving rig in order to monitor the shutdown zones, while at least two additional observers shall be positioned for optimal monitoring of the surrounding waters within the Waterfront Restricted Area (WRA). These observers shall record all observations of marine mammals, regardless of distance from the pile being driven, as well as behavior and potential behavioral reactions of the animals.

(e) Monitoring shall take place from 15 minutes prior to initiation of pile driving activity through 30 minutes post-completion of pile driving activity. Pre-activity monitoring shall be conducted for 15 minutes to ensure that the shutdown zone is clear of marine mammals, and pile driving may commence when observers have declared the shutdown zone clear of marine mammals. In the event of a delay or shutdown of activity resulting from marine mammals in the shutdown zone, animals shall be allowed to remain in the shutdown zone (i.e., must leave of their own volition) and their behavior shall be monitored and documented. Monitoring shall occur throughout the time required to drive a pile. The shutdown zone must be determined to be clear during periods of good visibility (i.e., the entire shutdown zone and surrounding waters within the WRA must be visible to the naked eye).

(f) If a marine mammal approaches or enters the shutdown zone, all pile driving activities at that location shall be halted (i.e., implementation of shutdown at one pile driving location may not necessarily trigger shutdown at other locations when pile driving is occurring concurrently). If pile driving is halted or delayed at a specific location due to the presence of a marine mammal, the activity may not commence or resume until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal.

(g) Monitoring shall be conducted by qualified observers, as described in the Monitoring Plan. Trained observers shall be placed from the best vantage point(s) practicable to monitor for marine mammals and implement shutdown or delay procedures when applicable through communication with the equipment operator.

(h) Approved sound attenuation devices shall be used during impact pile driving operations. The Navy shall implement the necessary contractual requirements to ensure that such devices are capable of achieving optimal performance, and that deployment of the device is implemented properly such that no reduction in performance may be attributable to faulty deployment.

(i) The Navy shall use soft start techniques recommended by NMFS for impact pile driving. The soft start requires contractors to provide an initial set of strikes from the impact hammer at reduced energy, followed by a 30-second waiting period, then two subsequent reduced energy strike sets. Soft start shall be implemented at the start of each day's impact pile driving and at any time following cessation of impact pile driving for a period of 30 minutes or longer.

(j) Pile driving shall only be conducted during daylight hours.

5. Monitoring

The holder of this Authorization is required to conduct marine mammal monitoring during pile driving activity. Marine mammal monitoring and reporting shall be conducted in accordance with the Monitoring Plan.

(a) The Navy shall collect sighting data and behavioral responses to pile driving for marine mammal species observed in the region of activity during the period of activity. All observers shall be trained in marine mammal identification and behaviors, and shall have no other construction related tasks while conducting monitoring.

(b) For all marine mammal monitoring, the information shall be recorded as described in the Monitoring Plan.

6. Reporting

The holder of this Authorization is required to:

(a) Submit a draft report on all marine mammal monitoring conducted under the IHA within 90 calendar days of the end of the in-water work period. A final report shall be prepared and submitted within 30 days following resolution of comments on the draft report from NMFS. This report must contain the informational elements described in the Monitoring Plan, at minimum (see attached).

(b) Reporting injured or dead marine mammals:

i. In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by this IHA, such as an injury (Level A harassment), serious injury, or mortality, Navy shall immediately cease the specified activities and report the incident to the Office of Protected Resources (301–427–8425), NMFS, and the West Coast Regional Stranding Coordinator (206–526–6550), NMFS. The report must include the following information:

A. Time and date of the incident;

B. Description of the incident;

C. Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);

D. Description of all marine mammal observations in the 24 hours preceding the incident;

E. Species identification or description of the animal(s) involved;

F. Fate of the animal(s); and

G. Photographs or video footage of the animal(s).

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with Navy to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. Navy may not resume their activities until notified by NMFS.

i. In the event that Navy discovers an injured or dead marine mammal, and the lead observer determines that the cause of the injury or death is unknown and the death is relatively recent (e.g., in less than a moderate state of decomposition), Navy shall immediately report the incident to the Office of Protected Resources, NMFS, and the West Coast Regional Stranding Coordinator, NMFS.

The report must include the same information identified in 6(b)(i) of this IHA. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with Navy to determine whether additional mitigation measures or modifications to the activities are appropriate.

ii. In the event that Navy discovers an injured or dead marine mammal, and the lead observer determines that the injury or death is not associated with or related to the activities authorized in the IHA (e.g., previously wounded animal, carcass with moderate to advanced decomposition, scavenger damage), Navy shall report the incident to the Office of Protected Resources, NMFS, and the West Coast Regional Stranding Coordinator, NMFS, within 24 hours of the discovery. Navy shall provide photographs or video footage or other documentation of the stranded animal sighting to NMFS.

7. This Authorization may be modified, suspended or withdrawn if the holder fails to abide by the conditions prescribed herein, or if the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals.

Request for Public Comments

We request comment on our analysis, the draft authorization, and any other aspect of this Notice of Proposed IHA for Navy's wharf construction activities. Please include with your comments any supporting data or literature citations to help inform our final decision on Navy's request for an MMPA authorization.

Dated: May 27, 2014.

Perry F. Gayaldo,

Deputy Director, Office of Protected Resources, National Marine Fisheries Service.

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