Naval Base Kitsap at Bangor
EHW-1 Pile Replacement Project

Final Marine Mammal Monitoring Report

BANGOR, WASHINGTON

30 April 2012

NAVFAC
Naval Facilities Engineering Command

Prepared by:

HDR

Suggested Citation

NAVFAC. 2012. Naval Base Kitsap at Bangor EHW-1 Pile Replacement Project, Bangor, Washington. Final Marine Mammal Monitoring Report. Prepared by HDR, Inc., San Diego, CA. April 2012.

Table of Contents

Appendices

Figures

Tables

Acronyms and Abbreviations

dB	decibel(s)
dB re 1 µPa	dB referenced to 1 micropascal
DON	Department of the Navy
EC	exclusion zone
EHW	Explosives Handling Wharf
EHW-1 PRP	Explosives Handling Wharf #1 Pile Replacement Program
EA	Environmental Assessment
ESA	Endangered Species Act
ft	foot/feet
GPS	Global Positioning System
HQ	Headquarters
ICMP	Integrated Comprehensive Monitoring Program
IHA	Incidental Harassment Authorization
km	kilometer(s)
km^2	square kilometer(s)
m	meter(s)
mi^2	square miles
MC	Monitoring Coordinator
MMO	Marine Mammal Observer
MMPA	Marine Mammal Protection Act
NBK	Naval Base Kitsap
NMFS	National Marine Fisheries Service
NWR	Northwest Region
nm	nautical mile(s)
nm^2	square nautical mile(s)
OD	outside diameter
RMS	root mean square
SLM	sound level meter
SPL	sound pressure level
SSP	Strategic Systems Programs
SSV	vibratory soft start
TPP	Test Pile Program
TRIDENT	TRIDENT Fleet Ballistic Missile
U.S.	United States
USFWS	United States Fish and Wildlife Service
USCG	United States Coast Guard
V	vibratory
VHF	very high frequency
WRA	Waterfront Restricted Area
ZOI	zone of influence

THIS PAGE INTENTIONALLY LEFT BLANK

Section 1 Introduction

This report summarizes the marine mammal monitoring effort implemented for the Explosives Handling Wharf #1 Pile Replacement Project (EHW-1 PRP) which occurred from 4 October through 27 October 2011. The purpose of the EHW-1 PRP was to remove and install piles and associated structures to maintain the structural integrity of the wharf (DoN 2011). As part of the United States (U.S.) Navy's sea-based strategic deterrence mission, the U.S. Navy Strategic Systems Programs (SSP) directs research, development, manufacturing, test, evaluation, and operational support of the TRIDENT Fleet Ballistic Missile (TRIDENT) program. SSP currently utilizes the existing EHW-1 to accomplish its mission. Repairs and maintenance were needed so that the operational requirements of the TRIDENT program could continue to be met. The EHW-1 PRP occurred concurrently with a portion of another U.S. Navy project, the Test Pile Program (TPP). Marine mammal monitoring for the EHW-1 PRP overlapped with Phases 2 and 3 of TPP monitoring. The marine mammal monitoring results from the TPP are presented in a separate report (HDR 2012).

The marine mammal monitoring performed for this project was conducted to be in compliance with the Marine Mammal Protection Act (MMPA) permit and Endangered Species Act (ESA) consultations for the EHW-1 PRP. This report was prepared by HDR on behalf of the U.S. Navy as part of the monitoring requirements mandated in the EHW-1 PRP Incidental Harassment Authorization (IHA) issued by the National Marine Fisheries Service (NMFS) Headquarters (HQ) office and the ESA Biological Opinion issued by NMFS Northwest Region (NWR). The results from this monitoring project are a part of a long-term monitoring effort under the U.S. Navy's Marine Species Monitoring Program (Contract # N62470-10-D-3011) issued to HDR. Data collected under this contract will be incorporated with information from other monitoring efforts, which the U.S. Navy has conducted, and compiled under the Integrated Comprehensive Monitoring Program (ICMP). The ICMP was initially developed by the U.S. Navy to assist in meeting the regulatory requirements for monitoring established under the Final Rules for U.S. Navy training ranges. The ICMP serves as the overarching structure to coordinate the collection and synthesis of monitoring data from U.S. Navy training, construction, and research and development projects.

Section 2 Methods

Project Area

Naval Base Kitsap (NBK) at Bangor, Washington is located on the eastern shoreline of Hood Canal approximately 20 miles (32.19 kilometers [km]) due west of Seattle, Washington (**Figure 1**). NBK at Bangor provides berthing and support services to U.S. Navy submarines and other fleet assets. EHW-1 is located within the northern portion of NBK at Bangor's Waterfront Restricted Area (WRA) (**Figure 2**). The entire NBK at Bangor waterfront, as well as the adjacent water areas in the Hood Canal, is restricted to the general public.

Map Courtesy of NAVFAC NW

Figure 1. Vicinity Map

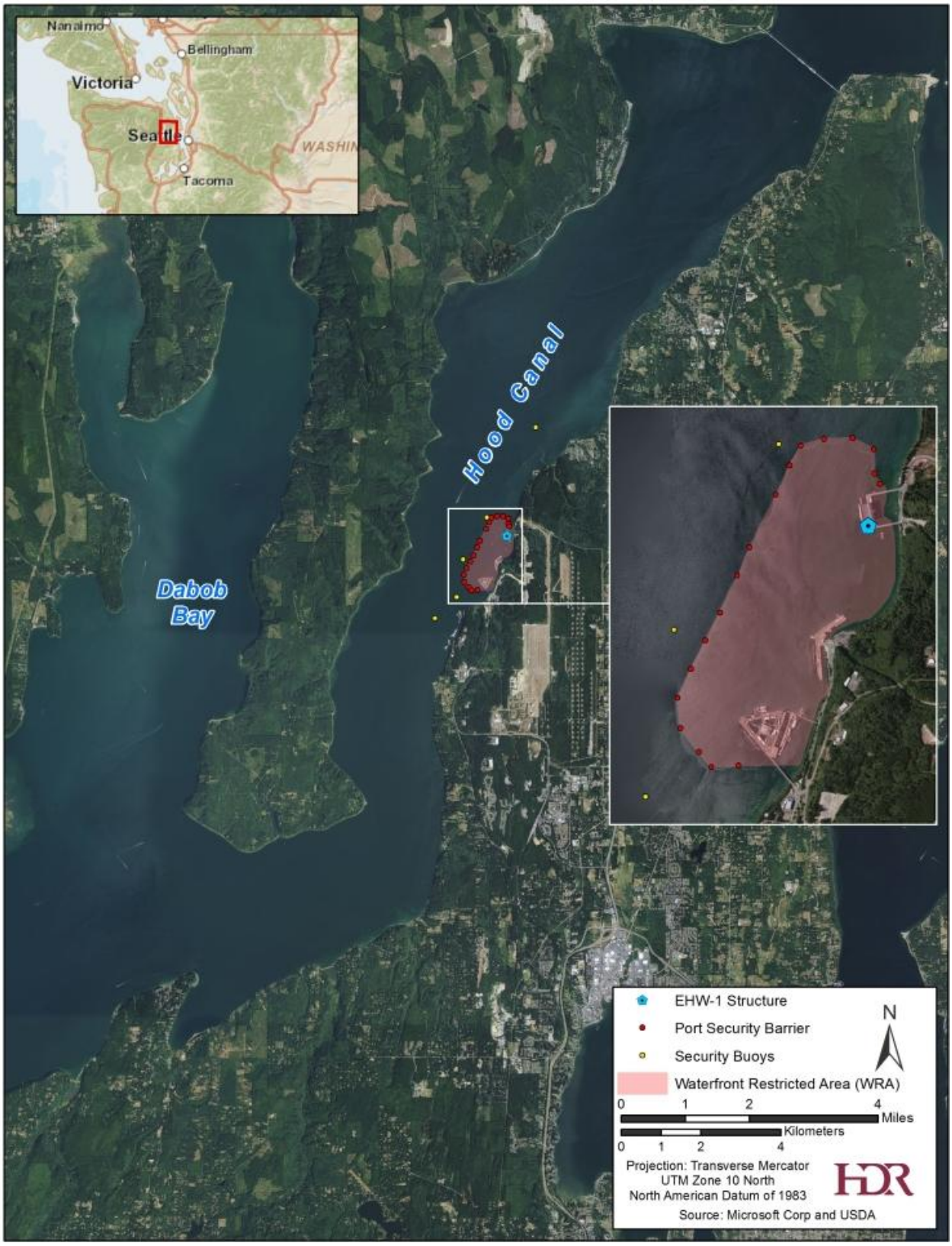


Figure 2. Project Area

The wharf is a U-shaped concrete structure built in 1977 for ordnance handling operations in support of the Trident Submarine squadron home ported at NBK at Bangor (DoN 2011). EHW-1 consists of two 100-foot (ft) (30.5 meters [m]) access trestles and a main pier deck, which measures approximately 700 ft (213 m) in length and is approximately 500 ft (183 m) wide. The wharf is supported by both 16-inch and 24-inch diameter hollow, octagonal, pre-cast concrete piles (approximately 130 ft [40 m] in length) (DON 2011). Marine mammal monitoring was focused in the immediate vicinity of the structure within the WRA, and in the waters immediately adjacent, where sound pressure levels (SPL) associated with pile installation and removal activities could potentially be transmitted.

Project Staffing

Staff for the EHW-1 PRP included the project manager, the monitoring coordinator (MC), marine mammal observers (MMOs), and acoustic technicians (**Table 1**). MMOs were experienced in marine mammal identification and had extensive knowledge of the biology and behavior of locally-occurring species. Acoustic technicians had prior experience conducting acoustic monitoring during pile driving construction projects. All MMOs were dedicated to observation of marine mammals and served no other function while conducting observations.

Marine Mammal Monitoring Platforms

Vessel-based Monitoring

Four vessels served as observation platforms and marine transportation. These boats included three 21- to 24-ft (6.4- to 7.3-m) aluminum-hulled jet boats and one 32-ft (9.8-m) fiberglass monohull boat (leased from Tetra Tech EC, Inc). Vessels were equipped with Global Positioning Systems (GPS), very high frequency (VHF) radios and depth sounders, and all captains were United States Coast Guard (USCG)-certified. All captains were familiar with Puget Sound waterways and the unique characteristics of the region. Vessels were equipped with elevated observation platforms which provided maximum viewing capability. The jet boats observation platforms were approximately 2 to 3 ft (0.6 to 0.9 m) above the water line, while the larger boat had an observation platform that was approximately 8 ft (2.4 m) above the water line.

EHW-1 was originally intended to start at the opening of the fish window and occur concurrently with TPP. This would allow a sharing of monitoring assets between the two projects which were located next to each other. However, materials and operational delays prevented EHW-1 repairs from being initiated on time. As a result, by the time it started, several weeks of far-field recordings had been conducted for the TPP and sufficient data had already been collected to characterize small to large piles and determine propagation characteristics. Therefore for EHW-1, it was determined that one far-field vessel, versus the initial three vessels, would be sufficient to continue with acoustic recordings and would not substantially affect the effectiveness of marine mammal monitoring. This was consistent with the language in the EHW-1 Acoustic Plan which stated that "if the acoustic recordings indicate the actual zone of influence is significantly smaller than the modeled area, some far-field monitoring locations may be removed or consolidated if they are unnecessary for effective marine mammal monitoring."

Table 1. Project Staff

Name	Role(s)	Company
Kristen Ampela	Project Manager	HDR
Jeff Barrett	Monitoring Coordinator	Hart Crowser
Jason Stutes	Monitoring Coordinator	Hart Crowser
Steve Olson	Marine Mammal Observer Coordinator	HDR
Todd McConchie	Marine Mammal Observer	HDR
Cathy Bacon	Marine Mammal Observer	HDR
Stefanie Hawks-Johnson	Marine Mammal Observer	HDR
Brian McNamara	Marine Mammal Observer	HDR
Paula von Weller	Marine Mammal Observer	HDR
Mike Witter	Marine Mammal Observer	HDR
Brad Dawe	Marine Mammal Observer	HDR
Hans Hurn	Marine Mammal Observer	Hart Crowser
Andrew Kaparos	Acoustician/Marine Mammal Observer	Hart Crowser
Emily Duncanson	Acoustician/Marine Mammal Observer	Hart Crowser
Brian Payne	Acoustician	Hart Crowser
Colleen Rust	Acoustician	Hart Crowser
Jim Starkes	Acoustician	Hart Crowser
Chris Martin	Acoustician	Hart Crowser
Jason Miles	Acoustician	Hart Crowser
James Reyff	Acoustician	Illingworth & Rodkin
Keith Pommerenck	Acoustician	Illingworth & Rodkin
Jared McDaniel	Acoustician	Illingworth & Rodkin
Jordan Roberts	Acoustician	Illingworth & Rodkin
Christopher Peters	Acoustician	Illingworth & Rodkin
Carrie Janelle	Acoustician	Illingworth & Rodkin
Michael Thill	Acoustician	Illingworth & Rodkin
Robert Miner	Acoustician	Robert Miner Dynamic Testing Inc.
Andrew Banas	Acoustician	Robert Miner Dynamic Testing Inc.

Pier- and Barge-based Monitoring

After the appearance of ESA-listed Steller sea lions (*Eumetopias jubatus*) at the work site in early October, two MMOs were stationed at Delta Pier (one at Delta Pier South, the other at Delta Pier North) on all construction days. These MMOs had the sole task of making detailed Steller sea lion observations and of notifying the MC if a Steller sea lion moved toward, or entered, the water during pile driving activities. The MC was typically located on the construction barge, and served as an added marine species observer from that relatively stationary location. The MC was typically 5 to 10 m (16 to 33 ft) from the pile, and at all times had a full view of the shutdown zone (also referred to as the exclusion zone [EZ]). The MC was positioned in close proximity to the construction foreman, and each pile-driving event was communicated between the foreman and MC. The MC would transmit the pile specifications and other details to the observers, vessel captains, and acoustic personnel, all of whom monitored the same radio channel.

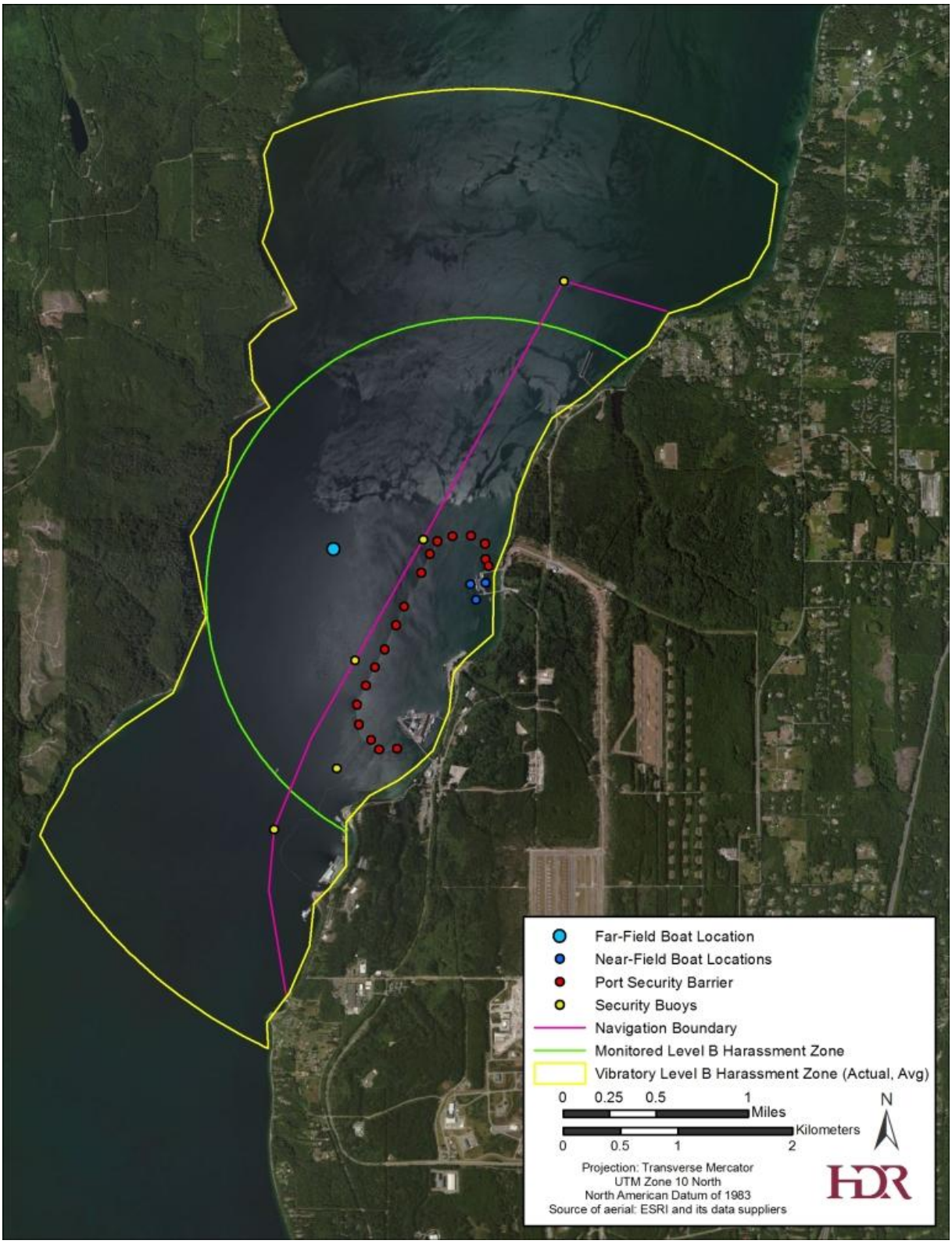
Construction Monitoring

During construction monitoring, several vessel-based monitoring locations were used to monitor for marine mammals to ensure the animals' safety outside the shutdown zone and to collect observational data regarding their behavioral responses to pile installation and removal activities (refer to the U.S. Navy's Marine Mammal Monitoring Plan, **Appendix A**). Vessels were semi-stationary during construction monitoring. In the near-field (inside the WRA), vessels only moved occasionally to maintain adequate visual coverage or to collect acoustic recordings. Within the far-field (outside the WRA), the vessels moved more frequently. The vessel stationed at approximately mid-channel outside the WRA occasionally moved to the north and south to collect acoustic recordings relative to the extent of the 120 decibel (dB) root mean square (RMS) isopleth during vibratory pile driving. During acoustic recordings, the vessel remained stationary with the engines off to ensure the engine noise did not contaminate the recordings. This vessel also communicated with the nearshore observers regarding animals that were transiting the area or approaching the WRA. The general positions of vessel-based monitoring locations during the EHW-1 PRP are depicted in **Figure 3**.

Construction monitoring was performed over a period from 4 October through 27 October 2011 (**Table 2**). The area monitored on any given day ranged from 1.4 to 7 square miles (mi^2; 3.6 to 18.1 square kilometers [km^2]), with an average of 3 mi^2 (7.7 km^2) (**Table 2**). Vessel tracks varied with construction activities and monitoring requirements, but were focused within and around the WRA near NBK at Bangor.

Table 2. Summary of Monitoring Effort for the Hood Canal EHW-1 Pile Driving Project

Date	Approximate Area Covered (km^2)	Start Time (hh:mm)	End Time (hh:mm)	Total Time (hh:mm)
4-Oct-2011	8.0	07:50	16:42	08:52
5-Oct-2011	7.0	07:06	17:23	10:17
6-Oct-2011	18.1	07:50	17:35	09:45
7-Oct-2011	8.3	07:25	18:19	10:54
8-Oct-2011	3.6	08:05	17:00	08:55
10-Oct-2011	5.0	11:15	17:23	06:08
11-Oct-2011	6.2	07:50	18:19	10:29
12-Oct-2011	4.8	07:45	18:45	11:00
13-Oct-2011	4.8	07:45	15:45	08:00
14-Oct-2011	5.6	11:03	17:45	06:42
15-Oct-2011	9.8	08:09	13:42	05:33
17-Oct-2011	17.7	08:09	17:15	09:06
19-Oct-2011	5.4	07:48	16:41	08:53
21-Oct-2011	5.3	13:26	16:53	03:27
27-Oct-2011	5.3	08:00	14:43	06:43
TOTAL				**124:44**



Note: The boat depicted to be inside the u-shape of the wharf was actually inside the EHW-1 facility, under the building roof, near the pile driving barge.

Figure 3. Boat Locations Relative to the 1.5 miles (2.4 km) Monitored Level B (Behavioral Disturbance) Harassment Zone

During the duration of EHW-1 PRP construction activities, TPP was occurring concurrently at the waterfront at NBK at Bangor. The TPP work area was located immediately to the south the existing EHW-1 facility in the open water area between EHW-1 and Marginal Wharf. EHW-1 overlapped with the later two phases (Phases 2 and 3) of TPP. Construction for the EHW-1 PRP and TPP overlapped on 4, 5, 8, 17 and 19 October 2011. On all five of these days, construction activities for each project were separated sufficiently in space and time to assign sightings (and therefore any takes) to one project or the other. Two hammers were never operated at the same time at any point during either project. In one instance, on 17 October 2011, a hammer was positioned over an EHW-1 pile (pile EHW-14) in preparation for pile driving at the same time a pile was being driven for TPP (pile TP#3). Therefore, there was minimal observer coverage for this hammer positioning event. Observers remained at the TPP work site for the duration of that drive, and then repositioned at the EHW-1 structure (approximately 656 ft [200 m] away) for the subsequent EHW-1 drive.

As part of the TPP, during days in which in-water construction work did not occur, baseline surveys were conducted in Hood Canal and/or Dabob Bay to collect additional data regarding marine mammal abundance and occurrence within the waters nearby NBK at Bangor. The details regarding these surveys and their results are included in the TPP marine mammal monitoring report. They are discussed briefly within the main body of that report and in more detail in Appendix E.

Monitoring Zones

The acoustic modeling results presented within the Environmental Assessment (EA), Biological Assessment, and the Incidental Harassment Authorization (IHA) (DoN 2011, NMFS 2011), were used to develop the shutdown and buffer zones for pile installation and removal activities associated with the EHW-1 PRP. While the acoustic zones of influence (ZOIs) varied among the different diameter piles and types of installation and removal methodologies, shutdown and buffer zones were based on the modeled maximum ZOI for all pile installation and removal activities. The monitoring zones (i.e., shutdown and buffer) were created to delineate areas that are important to species that inhabit the area around the Proposed Action. Monitoring of the shutdown and buffer zones and the implementation of other minimization measures, such as the use of sound attenuation devices, were designed to reduce the potential impacts of underwater and airborne sound from pile installation and removal activities on marine mammals.

Shutdown Zone. The shutdown zone included all areas where the underwater SPLs were anticipated to equal or exceed the Level A (injury) Harassment criteria for marine mammals (180 dB referenced to 1 micropascal [dB re 1µPa]) isopleth for cetaceans; 190 dB re 1µPa isopleth for pinnipeds). For vibratory pile installation and removal, monitoring was conducted for a 50 m (164 ft)[1] radius shutdown zone (Level A Harassment) surrounding each pile for the presence of marine mammals before, during, and after pile operations.

[1] Based on coordination with NMFS Headquarters, a minimum shutdown zone of 50 m (164 ft) was initially recommended to standardize monitoring activities at the NBK at Bangor waterfront, even though this zone is slightly larger than the modeled Level A harassment zone. This measure was implemented for vibratory pile installation and removal activities. This mitigation measure only applies to marine mammals.

Buffer Zone. The buffer zone included all areas where the underwater or airborne SPLs generated by vibratory pile driving were anticipated to equal or exceed the Level B (behavioral disturbance) Harassment criteria for marine mammals (120 dB re 1µPa - underwater noise; 90 or 100 dB re 20µPa – airborne noise thresholds for the harbor seal, and all other seals and sea lions, respectively). For vibratory pile installation and removal activities, modeling predicted a 120 dB threshold distance of 8.6 miles (13.8 km) to the north in Hood Canal, and 4.2 miles (6.8 km) to the south, for an affected area of 40.3 km^2. The distance to the 100 dB threshold during vibratory installation and removal was modeled at 30 ft (9 m) from the pile, and the 90 dB threshold was modeled to extend 95 ft (29 m) from the pile. Measured threshold distances are described in the Acoustic Results section.

Due to the difficulty of effectively monitoring such a large area, the U.S. Navy and NMFS agreed that the monitored zone would include the area north, south, and west of the construction area equivalent to the width of the Hood Canal 1.5 miles (2.4 km) (**Figure 4**). This area was monitored for the presence of marine mammals before, during, and after pile installation and removal activities. Boat captains and MMOs were equipped with vessel-mounted and hand-held GPS units in order to ensure correct positioning and effective coverage of shutdown and buffer zones.

Observer Monitoring Locations

In order to properly monitor shutdown and buffer zones, MMOs were positioned at various vessel- and land-based vantage points, taking into consideration security, safety, and space limitations at the NBK at Bangor waterfront. Three monitoring vessels were positioned inside the WRA in addition to the construction-related vessels (e.g., barges, tugs, etc.). One monitoring vessel was also stationed outside the WRA. Inside the WRA, MMOs were occasionally placed on the construction barge when: (1) complete MMO coverage could not be accomplished any other way, and/or (2) when the hydrophones located on the barge needed to be repositioned or otherwise maintained. As described previously, the MC was stationed on or near the construction barge, and served as an additional MMO when needed. When an MMO was on a barge, appropriate protective gear was required and worn at all times. After the appearance of ESA-listed Steller sea lions in the WRA in early October, two MMOs were stationed at Delta Pier (one at Delta Pier South, the other at Delta Pier North, **Figure 5**) on all construction days in order to monitor the behavior, number, and position of these animals during construction activities.

The following boat locations (**Figure 3**) were identified to provide adequate visual coverage during all construction activities:

Near-field Boat Locations:

- *North Monitoring Boat:* Small boat vantage point within the WRA that monitored the injury zone and behavioral disturbance zone to the north of each pile location. This boat accommodated one MMO and two marbled murrelet observers and was also used as a monitoring platform for the TPP. When being used to conduct EHW-1 PRP monitoring, during vibratory installation and removal activities, the boat was stationary and positioned at a location to provide the best vantage point.

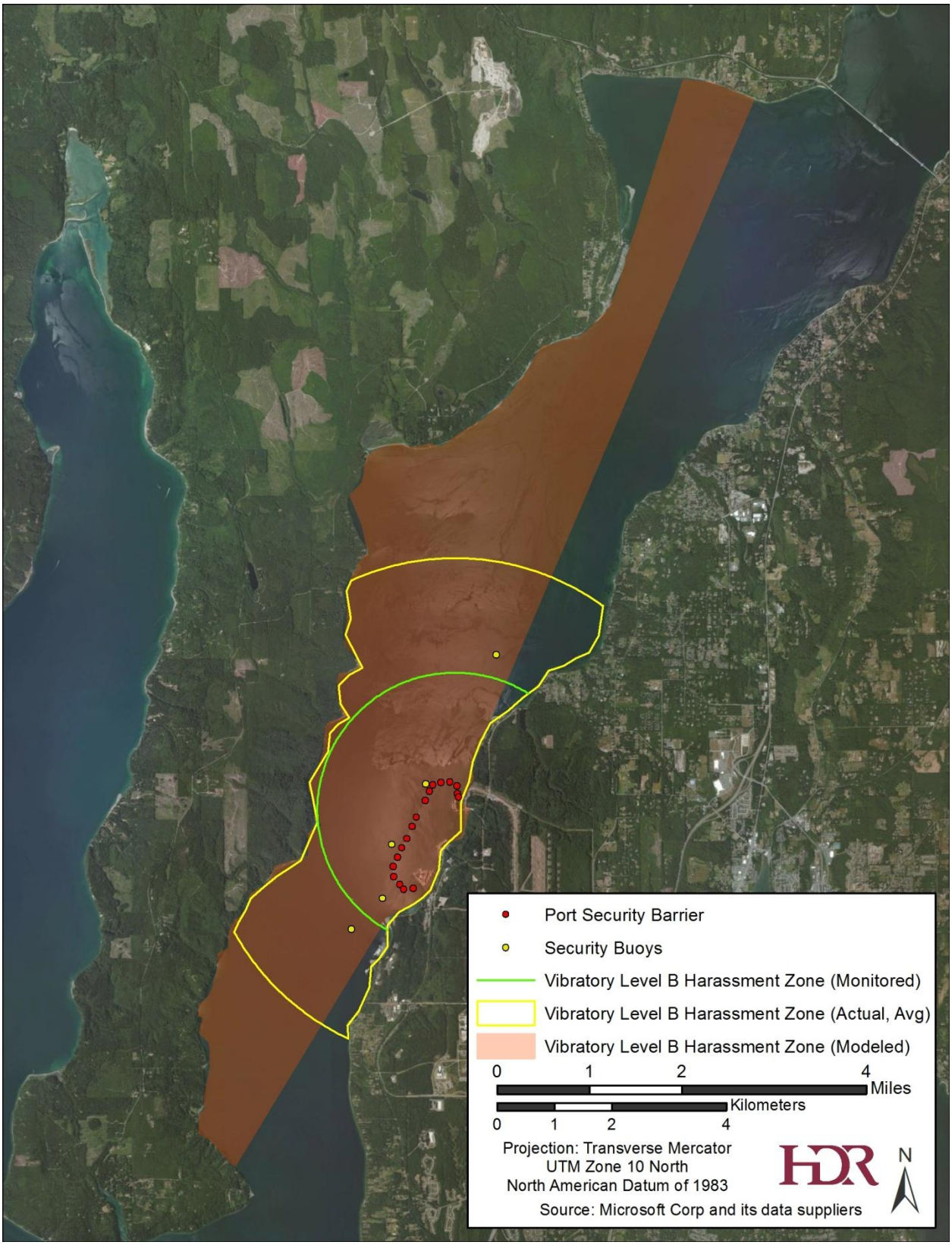


Figure 4. Modeled, Monitored, and Actual Level B Harassment Zones

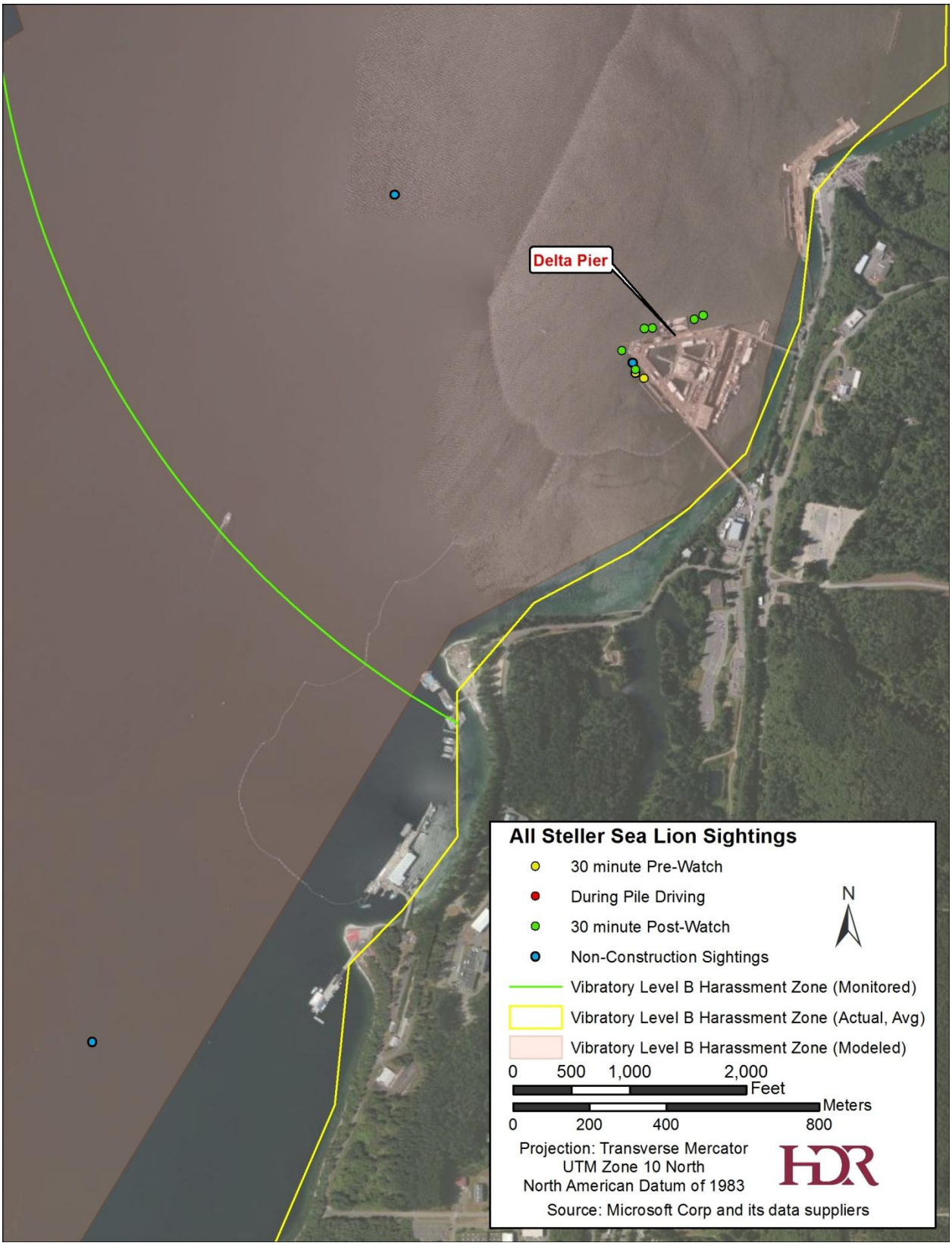


Figure 5. All Steller Sea Lion Sightings. Points may represent more than one individual.

- *South Monitoring Boat:* Small boat vantage point within the WRA that monitored the injury zone and behavioral disturbance zone to the south of each pile location. This boat accommodated one MMO and two marbled murrelet observers and was also used as a monitoring platform for the TPP. When being used to conduct EHW-1 PRP monitoring, during vibratory installation and removal activities, the boat was stationary and positioned at a location to provide the best vantage point.
- *West Monitoring Boat:* Small boat vantage point within the WRA that monitored the injury zone and behavioral disturbance zone to the west of each pile location. This boat was used for acoustic monitoring and also accommodated one MMO. During EHW-1 PRP monitoring the vessel was generally stationary.

Far-Field Boat Locations:

- *Mid-Channel Boat*: Small boat vantage point located in the middle of the Hood Canal due west of the EHW-1 location. This boat accommodated one MMO and "patrolled" the area outside the WRA to maximize coverage and increase potential for marine mammal sightings.

In-situ hydroacoustic monitoring was used to determine the actual extent of the 120 dB RMS (re: 1 µPa) behavioral disturbance zone, as well as the 180 dB and 190 dB RMS (re: 1 µPa) injury zones. Airborne microphones were used to determine the 100 dB and 90 dB (re: 20 µPa) behavioral disturbance zones for airborne noise.

Environmental Data

Environmental variables were monitored at intervals inside and outside of the WRA. Where operating schedules permitted, environmental data were collected at the top of each hour. During active operations, environmental data were collected as opportunity allowed. Vessel-based instruments were used to gauge water temperature and depth. Observers used anemometers to determine wind speed, humidity, and air temperature. Visual observations of wave height, wind direction, and weather conditions were also recorded (**Appendix B**).

Monitoring Techniques

Pile installation and removal activities occurred intermittently throughout each construction day. In order to gather the maximum amount of data possible, and to better characterize protected marine species occurrence and behavior in the area, marine mammal observers surveyed the EHW-1 PRP site throughout the day, regardless of whether or not pile driving was occurring at that time. Therefore, data gathered on construction days includes observations made during both construction and non-construction periods. Construction monitoring of the shutdown and buffer zones took place from 30 minutes prior to initiation of pile driving through 30 minutes post-completion of all pile installation and removal activities. Pile driving was not initiated until the shutdown zone was clear of marine mammals. When an animal or group of animals was sighted, a series of observations were recorded in order to correlate sightings with other data points. Times of sighting, number of animals, behavior, distance and bearing to the animal(s), and distance to pile were recorded in hardcopy format using a standardized Marine Mammal Sighting Form (**Appendix C**). A worksheet with data codes was provided to each observer in

order to provide a series of project-specific, weather, species, and behavioral codes to enter into the sightings sheets on a per sighting basis (**Appendix D**). At the end of each day, sighting sheets from each monitoring boat were scanned electronically for storage in PDF format. All data were also recorded in spreadsheet format and archived electronically. Standard equipment for each boat included binoculars (7 x 50) with installed reticles, a hand-held GPS unit, VHF radio, clipboard/notebook, and site-specific marine mammal identification guide (*Whales and Other Marine Mammals of Washington and Oregon*, Eder and Sheldon 2001).

To minimize the probability of multiple observers counting a single animal twice (and potentially overestimating takes) sightings were tracked on a continuous basis by an observer on one vessel, and then "handed off" to an observer on a second vessel if the animal(s) headed in the direction of the second vessel. Observers kept detailed sighting data and, whenever possible, indicated in their field notes if an animal was a resight and which observer had seen it previously (see **Appendix E**). Every attempt was made to protect marine mammals from Level A (injury) Harassment *via* continuous monitoring of the behavioral harassment and near-field injury zones. One hundred percent coverage of the Level B [behavioral] harassment zone during vibratory pile installation and removal was not possible due to the large area involved and limited number of monitoring vessels. For this reason, the Navy and NMFS agreed that the monitored area would be a subset of this zone and extend 1.5 miles (2.4 km) from the pile. The measured harassment zone was more than twice as large as the monitored zone, and for this reason potential missed takes were estimated for the ensonified, unmonitored zone (see "Extrapolated Level B Takes" section). As with any survey effort, the efficacy of visual detection of marine mammals depended on several factors, including the observer's ability to detect the animal, the environmental conditions (visibility and sea state), and the position of the monitoring platforms.

Visual Monitoring Protocol

Pre-Activity Monitoring. Prior to the start of pile operations, the shutdown and buffer zones were monitored for 30 minutes to document the presence of marine mammals. The following monitoring methodology was implemented prior to commencing pile installation/removal activities:

- Near-field observers on boats and existing piers monitored the shutdown zone and buffer zones. They ensured that no marine mammals were seen within the shutdown zone before pile driving began.
- If marine mammals were present within or approaching the shutdown zone prior to pile driving or the soft-start[2], the monitoring continued and the start of pile driving was delayed until the animals left the shutdown zone voluntarily.
- If marine mammals were not within the shutdown zone (i.e., the zone was deemed clear of marine mammals), the observers radioed the MC who then notified the Pile Driving Engineer Lead that pile driving could commence.

[2] For a vibratory hammer, the soft start requires the contractor to initiate noise from the vibratory hammer for 15 seconds at reduced energy followed by a 1-minute waiting period. This procedure was repeated two additional times.

- The monitoring boat stationed outside the WRA and monitoring the 120 dB RMS zone (see **Figure 3**) looked for the presence of marine mammals and radioed to near-field observers if marine mammals were traveling toward the WRA/shutdown zone.
- Marine mammal sighting forms were used to document observations (**Appendix C**).

During Activity Monitoring. The shutdown and buffer zones were monitored throughout the time required to install or remove a pile. The following monitoring methodology was implemented during pile operations:

- No impact pile driving was conducted during EHW-1 repairs. During vibratory pile driving, if a marine mammal was observed entering the 1.5 miles (2.4 km) vibratory behavioral disturbance zone, a "take" was recorded and behaviors documented. However, that pile segment would be completed without cessation unless the animal entered or approached the shutdown (injury) zone, at which point all pile installation and removal activities were halted. The observers immediately radioed to alert the Pile Driving Lead Engineer and/or raised a red flag. This action required an immediate "all-stop" on pile operations.
- In the event that a pile was being driven and initiation of the shutdown procedures (if a marine mammal was sighted approaching or entering the 50 m [164 ft] shutdown zone) would pose an imminent human safety hazard, the shutdown procedures were temporarily waived by the MC, and pile driving was allowed to continue. The marine mammal was closely watched and pile driving would have been stopped if the marine mammal showed any signs of distress; however no such behavior was noted.
- After initiation of a shutdown, pile installation and removal activities were delayed until the animal voluntarily left the shutdown zone and had been visually confirmed beyond the shutdown zone, or 30 minutes had passed without re-detection of the animal.
- During the pile driving delay, monitoring continued and pile driving did not resume until the shutdown zone had been deemed clear of all marine mammals.
- If marine mammals were detected outside the shutdown zone after the pile driving was initiated, the MMOs continued to monitor these individuals and recorded their behavior, but pile driving proceeded.
- Marine Mammal Sighting Forms were used to document observations (**Appendix C**).
- Any monitoring boats engaged in marine mammal monitoring maintained speeds equal to or less than 10 knots.
- Experienced MMOs were trained to accurately verify species sighted.
- MMOs used binoculars and the naked eye to search continuously for marine mammals.
- In case of fog or reduced visibility, the MMOs had to be able to see the shutdown and buffer zones, or pile driving was not initiated until visibility in these zones improved to acceptable levels.

Post-Activity Monitoring. Monitoring of the shutdown and buffer zones continued for 30 minutes following completion of pile installation and/or removal activities. These monitoring

efforts focused on observing and reporting unusual or abnormal behavior of marine mammals. During these efforts, if any injured, sick, or dead marine mammals were observed, the U.S. Navy was to notify NMFS immediately. Monitoring results were noted on the Marine Mammal Sighting Form (**Appendix C**).

Piles and Pile-Driving Equipment

Pile driving operations were conducted October 4-27, 2011. During the EHW-1 repairs a total of 45 steel piles were subject to installation or extraction. This 45 pile total consisted of 36 piles installed (28 new permanent piles and 8 temporary falsework piles), and 9 piles extracted. There were 55 pile driving events (36 piles installed) and 10 pile removal events (9 piles were removed) all conducted with a vibratory hammer.

The new permanent production piles were 30" OD (Outside Diameter) open ended steel piles with wall thicknesses of 0.50" and lengths of 140 to 190 ft. In subsequent tables and text, production piles supporting the new walkway are denoted by the prefix "W" (W1 - W12) and replacement wharf piles are denoted by the prefix "EHW" (EHW1 - EHW16). Falsework piles are denoted by the prefix "FW" (FW1 - FW8) and were 16" OD open-end steel piles with variable and undetermined wall thickness. Some original walkway piles were extracted and those and other piles extracted were 12" and 24" piles and may be denoted by the prefix "RX" or "EX" in the pile name. Falsework piles are intended for temporary use to support scaffolding to guide installation of permanent piles. **Table 3** provides the pile specification information for the piles installed and removed at the EHW-1. No impact pile driving occurred during this first year of construction activities associated with EHW-1 repairs.

Pile-driving equipment was provided and operated by Manson Construction Co. One vibratory hammer (APE 200-6) was utilized during the project. The APE 200-6 has a drive force of up to 542 kips or 271 tons.

Acoustic Monitoring

Acoustic monitoring was conducted during vibratory installation and removal activities associated with the EHW-1 PRP in order to determine the actual distances to the underwater and airborne thresholds for marine mammals and pinnipeds. These included the 190-dB re 1µPa RMS, 180-dB re 1µPa RMS, and 120-dB re 1µPa RMS underwater isopleths, and the 100-dB re 20 µPa and 90-dB re 20 µPa unweighted airborne isopleths. Unless otherwise stated, underwater sound pressure is defined as SPL in dB re 1 µPa. Airborne sound pressure is defined as SPL in dB re 20 µPa. The injury and behavioral harassment thresholds for marine mammals are defined as follows:

Underwater Injury Zones:

a. 180 dB RMS isopleth for cetaceans
b. 190 dB RMS isopleth for pinnipeds

Underwater Behavioral Harassment Zones:

a. 120 dB RMS for marine mammals during vibratory driving

Table 3. Pile Specifications for Piles Installed and Removed at EHW-1

Date	Pile	Pile Size	Coordinates	IMP/VIB IN/VIB OUT	Distance from Pile to Acoustic Recording Location			Start Time	Stop Time	Total Driving Time[2]
					WRA	MID	Raft			
10/4/2011	Inside Pile EHW	30"	N47°45.215" W122°43.468"	No Drive	150	821	2346	9:06:33	9:10:42 [1]	0:04:09
10/5/2011	BP1 (EHW-14)	30"	N47°45.215" W122°43.468"	VIB IN	170	10000	2346	8:29:53	8:32:01	0:02:08
	BP2 (EHW-15)	30"	N47°45.215" W122°43.468"	VIB IN	170	10000	2346	8:35:36	8:36:36	0:01:00
10/7/2011	RX5[3]	12"	N47°45.199" W122°43.435"	VIB OUT	118	1895	2395	9:29:17	9:34:09	0:04:52
	RX6[3]	12"	N47°45.215" W122°43.468"	VIB OUT	118	1850	2371	9:40:31	9:40:53	0:00:22
	RX7[3]	12"	N47°45.215" W122°43.468"	VIB OUT	118	1850	2371	9:43:30	9:43:42	0:00:12
	RX8[3]	24"	N47°45.211" W122°43.453"	VIB OUT	150	1865	2365	14:24:18	14:33:30	0:09:12
	RX1[3]	24"	N47°45.201" W122°43.426"	VIB OUT	117	1898	2403	15:00:31	15:08:25	0:07:54
	FW1	16"	N47°45.201" W122°43.426"	VIB IN	120	1898	2403	16:55:37	17:02:40	0:07:03
	FW2	16"	Coordinates not Provided	VIB IN	120	1898	2403	17:15:49	17:19:25	0:03:36
	FW3	16"	Coordinates not Provided	VIB IN	120	1898	2403	17:31:49	17:36:07	0:04:18
	FW4	16"	Coordinates not Provided	VIB IN	120	1898	2403	17:43:36	17:46:46	0:03:10
10/8/2011	FW5	16"	N47°45.204" W122°43.461"	VIB IN	100	885	2359	8:43:33	8:51:03	0:07:30
	FW6	16"	N47°45.204" W122°43.461"	VIB IN	100	885	2359	9:01:45	9:05:03	0:03:18
	FW7	16"	N47°45.204" W122°43.461"	VIB IN	100	885	2359	9:11:52	9:14:11	0:02:19
	FW8	16"	N47°45.204" W122°43.461"	VIB IN	100	885	2359	9:19:13	9:27:23	0:08:10

Date	Pile	Pile Size	Coordinates		IMP/VIB IN/VIB OUT	Distance from Pile to Acoustic Recording Location			Start Time	Stop Time	Total Driving Time[2]
						WRA	MID	Raft			
10/10/2011	W6	30"	Coordinates not Provided		VIB IN	87	995	2374	13:30:46	13:39:27	0:08:41
	W5	30"	Coordinates not Provided		VIB IN	65	995	2374	13:57:17	14:03:46	0:06:29
	W4	30"	Coordinates not Provided		VIB IN	65	995	2374	14;16:28	14:23:32	0:07:04
	W6 Revib	30"	Coordinates not Provided		VIB IN	87	995	2374	14:25;20	14:25:51	0:00:31
	W3	30"	Coordinates not Provided		VIB IN	65	995	2374	14:34:50	14:40:39	0:05:49
	W5 Revib	30"	Coordinates not Provided		VIB IN	55	995	2374	14:45:39	14:54:04	0:08:25
	W11	30"	Coordinates not Provided		VIB IN	115	1025	2403	16:14:03	16:24:49	0:10:46
	W12	30"	Coordinates not Provided		VIB IN	115	1025	2403	16:41:25	16:52:37	0:11:12
10/11/2011	W2	30"	N47 45.204	W122 43.451	VIB IN	146	850	2368	8:56:08	9:04:30	0:08:22
	W1	30"	N 47 45.204	W 122 43.449	VIB IN	135	850	2368	9:21:31	9:25:49	0:04:18
	W7	30"	N 47 45.196	W 122 43.449	VIB IN	130	869	2387	10:53:25	11:05:03	0:11:38
	W9	30"	N 47 45.196	W 122 43.446	VIB IN	130	869	2387	11:13:03	11:23:02	0:09:59
	W10	30"	N 47 45.197	W 122 43.450	VIB IN	122	857	2374	12:20:32	12:31:05	0:10:33
	W8	30"	N 47 45.197	W 122 43.447	VIB IN	130	869	2387	14:01:22	14:11:03	0:09:41
	EHW16	30"	Coordinates not Provided		VIB IN	159	835	2355	16:51:02	17:07:23	0:16:21
									17:13:31	17:27:36	0:14:05
									17:37:56	17:49:15	0:11:19
10/12/2011	EHW12 Battered	30"	N 47 45.214	W 122 43.455	VIB IN	167	1000	NO RAFT[4]	10:58:53	11:39:47	0:40:54
	EHW13 Battered	30"	N 47 45.215	W 122 43.457	VIB IN	1450	1000	NO RAFT[4]	14:57:57	15:20:19	0:22:22
	EHW10 Battered	30"	N 47 45.214	W 122 43.457	VIB IN	1450	1500	NO RAFT[4]	17:47:52	18:14:26	0:26:34
10/13/2011	EHW10 Battered	30"	N 47 45.214	W 122 43.457	VIB IN	1448	3935	2357	9:57:49	10:06:14	0:08:25
									10:32:06	10:45:48	0:13:42
	EHW7 Plumb	30"	N 47 45.212	W 122 43.457	VIB IN	1445	3933	2358	13:01:23	13:07:00	0:05:37
									13:21:34	13:46:55	0:25:21
	EHW5	30"	N 47 45.213	W 122 43.452	VIB IN	1449	3940	2365	13:55:36	14:34:08	0:38:32

Date	Pile	Pile Size	Coordinates		IMP/VIB IN/VIB OUT	Distance from Pile to Acoustic Recording Location			Start Time	Stop Time	Total Driving Time[2]
						WRA	MID	Raft			
10/14/2011	EHW6 Plumb	30"	N 47 45.213	W 122 43.454	VIB IN	1063	890	2361	12:32:50	13:05:34	0:32:44
	EHW5 Cont from 10/13	30"	N 47 45.213	W 122 43.452	VIB IN	1065	890	2365	13:07:52	13:10:43	0:02:51
	EHW4	30"	N 47 45.211	W 122 43.455	VIB IN	1059	890	2359	13:16:31	13:34:33	0:18:02
	EHW3	30"	N 47 45.211	W 122 43.457	VIB IN	1060	890	2361	13:42:03	13:47:09	0:05:06
	EHW1	30"	N47°45.215" W122°43.468"		VIB IN	1063	890	2365	13:51:50	13:57:14	0:05:24
									14:21:35	14:35:56	0:14:21
	EHW3	30"	N 47 45.211	W 122 43.457	VIB IN	1060	890	2361	16:46:11	17:01:47	0:15:36
10/15/2011	EHW2	30"	N 47 45.211	W 122 43.454	VIB IN	1068	3540	2363	10:25:17	10:45:27	0:20:10
	EHW9	30"	N 47 45.214	W 122 43.455	VIB IN	1068	1120	2360	11:28:42	11:42:06	0:13:24
									11:56:19	11:57:12	0:00:53
	EHW8	30"	N 47 45.215	W 122 43.452	VIB IN	210	1124	2363	12:54:35	13:11:31	0:16:56
10/17/2011	EHW14 Revib	30"	N 47 45.216	W 122 43.453	VIB IN	275	2221	2361	14:52:06	14:59:31	0:07:25
									15:25:46	15:32:32	0:06:46
	EHW15Revib	30"	N 47 45.216	W 122 43.455	VIB IN	275	2220	2357	15:58:46	16:05:33	0:06:47
									16:27:34	16:39:14	0:11:40
10/19/2011	EHW11	30"	N 47 45.215	W 122 43.453	VIB IN	155	1096	2362	11:59:25	12:04:53	0:05:28
									12:22:02	12:28:29	0:06:27
10/21/2011	W8 Revib	30"	N 47 45.197	W 122 43.437	VIB IN	143	715	2387	14:43:13	14:51:24	0:08:11
	W10 Revib	30"	N 47 45.197	W 122 43.434	VIB IN	143	715	2387	14:53:59	14:58:38	0:04:39
	W1 Revib	30"	N 47 45.204	W 122 43.449	VIB IN	143	701	2368	14:58:43	15:09:30	0:10:47
	W2 Revib	30"	N47 45.204	W122 43.451	VIBIN	143	701	2368	15:11:56	15:15:29	0:03:33
	W3 Revib	30"	N 47 45.197	W 122 43.447	VIB IN	132	715	2374	15:37:01	15:39:51	0:02:50
	W4 Revib	30"	N 47 45.197	W 122 43.450	VIB IN	132	715	2374	16:00:34	16:11:39	0:11:05
	W5 Revib	30"	N 47 45.196	W 122 43.446	VIB IN	132	715	2374	16:13:55	16:16:47	0:02:52
	W6 Revib	30"	N 47 45.196	W 122 43.449	VIB IN	132	715	2374	16:18:14	16:21:54	0:03:40

Date	Pile	Pile Size	Coordinates		IMP/VIB IN/VIB OUT	Distance from Pile to Acoustic Recording Location			Start Time	Stop Time	Total Driving Time[2]
						WRA	MID	Raft			
10/27/2011	W7 Revib	30"	Coordinates not Provided		VIB IN	183	880	2355	9:55:24	10:03:08	0:07:44
	W9 Revib	30"	N 47 45.196	W 122 43.449	VIB IN	150	885	2374	10:05:17	10:08:51	0:03:34
	W12 Revib	30"	N 47 45.197	W 122 43.447	VIB IN	150	885	2374	10:12:52	10:18:33	0:05:41
	W11 Revib	30"	N 47 45.197	W 122 43.450	VIB IN	150	885	2374	10:21:04	10:26:12	0:05:08
	EX3[3]	12"	Coordinates not Provided, piles part of the old walkway		VIB OUT	180	880	2355	11:24:13	11:25:58	0:01:45
	EX4[3]	12"	Coordinates not Provided, piles part of the old walkway		VIB OUT	180	880	2355	11:28:00	11:28:14	0:00:14
	EX3[3] – REDO	12"	Coordinates not Provided, piles part of the old walkway		VIB OUT	180	880	2355	11:31:00	11:31:18	0:00:18
	EX5[3]	12"	Coordinates not Provided, piles part of the old walkway		VIB OUT	180	880	2355	11:49:48	11:52:38	0:02:50
	EX6[3]	12"	Coordinates not Provided, piles part of the old walkway		VIB OUT	180	880	2355	11:58:49	12:02:13	0:03:24

Notes:

[1] Pile was not driven. Hammer was setup on a permanent pile inside EHW-1, however, due to space limitations as a result of the tidal elevation the hammer could not be turned on and no pile driving occurred on October 4th;

[2] Total Driving times include Soft Starts

[3] RX and EX naming conventions represent fender piles which were extracted

[4] NO RAFT – raft was unable to be deployed due to weather conditions.

Airborne Behavioral Harassment Zones:

a. 100 dB for all pinnipeds except harbor seals
b. 90 dB for harbor seals.

Two hydrophones were typically used to take underwater measurements at four measurement locations to accurately capture sound propagation characteristics both within and outside of the WRA. An air bubble curtain system was not used during pile driving at EHW-1 because all pile driving utilized a vibratory pile driver, and sound attenuation devices were not required for vibratory driving for this project. Ambient underwater and airborne conditions in the absence of construction activities were recorded for comparison. The U.S. Navy's Acoustic Monitoring Plan (**Appendix A**) provides the specific details of the acoustic monitoring requirements and protocol for both underwater and airborne sounds from the EHW-1 PRP.

Underwater sound measurements were conducted at positions both near pile driving and at distant locations. Underwater sound measurements were recorded at 10 meters from the pile to obtain reference readings during vibratory pile driving. These recordings were conducted under a contract with Manson Construction, by Robert Miner Dynamic Testing, Inc. (RMDT). All results associated with these measurements are documented in a separate report (RMDT 2012) which is an appendix to the EHW-1 Acoustic Monitoring Report (NAVFAC 2012). The position of the hydrophones was maintained using a line extending upward from a small steel anchor, with the hydrophones and associated signal cable raised or lowered on that anchor line. The steel anchor and anchor line were typically deployed from the existing wharf so as to make possible an unobstructed "line of sight" between the pile and each hydrophone.

Far-field acoustic measurements were conducted under a contract with HDR, Inc. by the acoustic firm Illingworth & Rodkin. Measurements were conducted from three primary locations – a vessel within the WRA, a vessel stationed near mid-channel, and an autonomous raft near Toandos Peninsula – to determine the extent of marine mammal threshold isopleths. Sound measurements at these locations were typically taken at two depths: one at 10 m, and the other at 20 to 30 m, or 2 to 3 m above the bottom, depending on the depth of the water column. Hydrophones were attached to a weighted line that was deployed from the surface. Tension on the hydrophone signal lines was minimized to reduce strumming noise. However, it was not possible to eliminate all strumming effects during conditions with strong wind, waves, and strong currents. Measurements were conducted inside the WRA at varying distances that typically ranged from 100 to 170 m, although measurements ranged anywhere from 55 to 1,450 m. Measurements were also conducted outside the WRA at distances that were typically beyond 700 m. The hydrophones on the WRA boat measured sound levels in 1-second intervals throughout each workday. While most of the underwater hydrophones and microphones recorded data continuously and were downloaded periodically to obtain the raw data,, some of the acoustic recording equipment provided visual readings in "real-time" on the sound level meters (SLMs). All the data was analyzed after the completion of the project.

Stationary Hydrophones. A stationary 2-channel hydrophone recording system was suspended from the wharf to record sounds at approximately 33 ft (10 m) from each pile. Hydrophones were deployed taking into account tidal variations and were typically deployed with one at approximately 3 ft (1 m) above the mudline and the other hydrophone at a depth equal to one half the water depth, or typically 30 to 40 ft. The equipment field configuration of the

hydrophones allowed for direct field verification of proper function and calibration by means of a calibrated piston-phone sound source. Each measurement day the configuration and instrument settings were checked using a Gras Model 42AC piston-phone with a hydrophone adaptor. The piston-phone was field checked, in turn, using a Class 1 Sound Level Meter (SLM) with a ½" microphone.

In addition to the hydrophone array near the piles, a two channel stationary hydrophone array was deployed near the Toandos Peninsula from an anchored inflatable raft (RFT). The RFT position was an unattended system deployed in waters approximately 18 to 20 meters in depth. One hydrophone was suspended at approximately mid-depth at mean water depth and the other at a position approximately 2 ft (0.61 m) above the bottom at low tide. The distance between the EHW-1 and the RFT position ranged from about 7,710 – 7,875 ft (2,350 to 2,400 m) throughout the project. The SLMs associated with the hydrophones collected data every day and night for several consecutive days at a time. All data was analyzed after the completion of the project.

Vessel-Based Hydrophones and Microphones. All SLMs were calibrated to the hydrophone response with the pistone phone signal and hydrophone coupler at the beginning of each day. The response of SLMs to the calibration tone was noted in field logbooks and logged by the SLM, which was downloaded after each day with a pile driving event. SLMs were used for real-time data acquisition and post-testing recording analysis.

One acoustic vessel within the WRA was equipped with a two-channel hydrophone array which was used inside the WRA to monitor near-filed isopleths for marine mammals . The SLM associated with these hydrophones recorded continuously during pile driving and collected data in real time. In addition to the WRA vessel, a mid-channel vessel (MID) was also used as a platform for deployed hydrophones. The systems outside of the WRA were used to estimate the distances to the marine mammal behavioral threshold isopleths. The MID drifted or was anchored in the channel of the Hood Canal. For the majority of the EHW-1 PRP, the MID remained in the vicinity of the WRA fence (i.e., beyond ± 800 m from the pile driving). But there were times when it was positioned as close as 715 m and as far as 10,000 m from EHW-1. The SLM associated with these hydrophones recorded continuously during pile driving.

For each pile being driven, an airborne microphone was located on the WRA vessel at approximately 55 to 1,450 m from the pile to record airborne sound levels. The microphone was positioned at 4.5 m above the seafloor.

Stationary Microphones. Two land-based microphones were placed to the north and south of the EHW-1 project site. The south stationary airborne system was removed on 7 October 2011. All airborne data were recorded and analyzed after completion of the project.

Section 3 Results

Acoustic Results

In general, underwater and airborne sound measurements collected at the WRA vessel, provided the best acoustic data for construction. However, sound measurements were taken in multiple locations inside and outside the WRA, and the distances to various sound thresholds for marine mammals were calculated using data from all available sources. Only sound levels recorded at the mid-distance (WRA vessel) and distant (raft and mid-channel vessel) locations are presented in this report. For more detailed sound pressure level results please see NAVFAC 2012. In some cases data was not available from the vessel-based sound sensors because of equipment failures/damage, transportation issues, timing limitations, environmental conditions, or communication system failures; in these cases, sound thresholds were calculated based on other sensors located inside and outside the WRA.

Vibratory Pile Driving: Acoustic Results

Typical vibratory pile driving during the EHW-1 resulted in sound levels that varied considerably through the driving periods. Vibratory sounds underwater were characterized by the measurement of RMS sound pressure levels. During the EHW-1 PRP there were 28 permanent steel pipe piles (12 at the walkway and 16 at Bents of the EHW-1 structure) and 8 temporary steel falsework piles which were installed using a vibratory hammer. In addition, two 24-inch steel fender piles and eight 12-inch steel fender piles were removed using a vibratory hammer and/or dead pull. Vibratory pile installation/removal occurred on 14 days between Oct 5 – 27th. Vibratory installation occurred during parts of all of the 14 days, whereas vibratory extraction only occurred on portions of two of the days. During the installation/removal of an individual pile there were occasionally multiple vibratory recording events as a result of the pile driver being temporarily shutdown or the pile requiring additional driving at a later time. In total, 65 vibratory driving events (i.e., installation or removal of piles) were measured. Actual vibratory pile driving events during the EHW-1 lasted from less than 0.5 minutes to almost 41 minutes, and the duration of vibratory extraction events ranged from 3 minutes to 32 minutes per pile. The total duration of all vibratory driving and extraction events over the course of EHW-1 PRP was 13:52:23 (vib in 12:11:36, vib out 1:40:47) (see **Table 3**). **Table 4** presents a summary of the average RMS sound pressure levels measured at the WRA boat and the estimated distance to the 120 dB behavioral harassment threshold for cetaceans and pinnipeds. On average, the WRA-boat sound level was 158 dB RMS (re: 1µPa) for piles less than 30-inches in diameter and 154 dB RMS (re: 1µPa) for 30-inch diameter piles. The maximum event level recorded at this location from all driving was 168 dB RMS (re: 1µPa). The maximum sound pressure level recorded approximately 10 meters from the pile, was 174 dB RMS (re: 1µPa) (NAVFAC 2012). The average sound pressure level for all 30-inch permanently installed piles, using a 10 second integration period, was 166 dB RMS (re: 1µPa) at 10 meters. Sound pressure levels were generally lower during the installation of falsework piles, which were slightly smaller (16–inch diameter), or the vibratory extraction of piles. For environmental compliance documents for the EHW-1 PRP, the near-source level used for consultations was 168 dB RMS (re: 1µPa) at 10 meters. Based on the data recorded during the EHW-1 PRP, the near-source levels used in the consultation process were close or only slightly conservative compared to the recorded levels..

Table 4. Summary of Underwater Sound Levels During Vibratory Pile Installation and Removal

Event Description	Pile Coordinates		Start Time	Stop Time	Sensor	Measured Sound Pressure Level - RMS (WRA Boat)		Calculated distance to 120 dB RMS (m)
						Ave	Max	
Date: 10/4/2011								
Inside Pile EHW1	Lat.	47° 45.215'	9:06:33	9:10:42 [1]	Mid	127	129	N/A[1]
	Long.	122° 43.468'			Down	128	131	
Date: 10/5/2011								
BP1 (EHW-14)	Lat.	47° 45.215'	8:29:53	8:32:01	Mid	141	146	4,312
	Long.	122° 43.468'			Down	144	150	
BP2 (EHW-15)	Lat.	47° 45.215'	8:35:36	8:36:36	Mid	146	147	3,802
	Long.	122° 43.468'			Down	148	149	
Date: 10/7/2011								
RX5	Lat.	47° 45.199'	9:29:17	9:34:09	Mid	144	150	5,462
	Long.	122° 43.435'			Down	145	152	
RX6	Lat.	47° 45.215'	9:40:31	9:40:53	Mid	150	153	5,858
	Long.	122° 43.468'			Down	150	153	
RX7	Lat.	47° 45.215'	9:43:30	9:43:42	Mid	149	152	South ± 7,000 (Land)
	Long.	122° 43.468'			Down	149	152	North 7,700
RX8	Lat.	47° 45.211'	14:24:18	14:33:30	Mid	152	155	South ± 7,000 (Land)
	Long.	122° 43.453'			Down	154	156	North 10,800
RX1	Lat.	47° 45.201'	15:00:31	15:08:25	Mid	151	156	South ± 7,000 (Land)
	Long.	122° 43.426'			Down	153	159	North 10,800
FW1	Lat.	47° 45.199'	16:55:37	17:02:40	Mid	146	151	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	147	151	North 10,800
FW2	Lat.	47° 45.199'	17:15:49	17:19:25	Mid	142	148	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	145	150	North 10,800
FW3	Lat.	47° 45.199'	17:31:49	17:36:07	Mid	142	153	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	144	153	North 10,800
FW4	Lat.	47° 45.199'	17:43:36	17:46:46	Mid	146	149	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	146	154	North 10,800
Date: 10/8/2011								
FW5	Lat.	47° 45.204'	8:43:33	8:51:03	Mid	146	153	South ± 7,000 (Land)
	Long.	122° 43.461'			Down	146	152	North 10,800
FW6	Lat.	47° 45.204'	9:01:45	9:05:03	Mid	145	154	South ± 7,000 (Land)
	Long.	122° 43.461'			Down	145	153	North 10,800
FW7	Lat.	47° 45.204'	9:11:52	9:14:11	Mid	144	154	5,415
	Long.	122° 43.461'			Down	144	154	
FW8	Lat.	47° 45.204'	9:19:13	9:27:23	Mid	144	151	4,294
	Long.	122° 43.461'			Down	144	153	
Date: 10/10/2011								
W6	Lat.	47° 45.199'	13:30:46	13:39:27	Mid	155	163	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	158	164	North 10,800
W5	Lat.	47° 45.199'	13:57:17	14:03:46	Mid	154	162	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	157	164	North 10,800
W4	Lat.	47° 45.199'	14:16:28	14:23:32	Mid	151	167	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	152	168	North ± 13,000 (Land)
W6 - REVIB	Lat.	47° 45.199'	14:25:20	14:25:51	Mid	155	165	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	155	162	North ± 13,000 (Land)

Event Description	Pile Coordinates		Start Time	Stop Time	Sensor	Measured Sound Pressure Level - RMS (WRA Boat)		Calculated distance to 120 dB RMS (m)
						Ave	Max	
Date: 10/10/2011 (continued)								
W3	Lat.	47° 45.199'	14:34:50	14:40:39	Mid	154	161	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	155	163	North 8,717
W5 - REVIB	Lat.	47° 45.199'	14:45:41	14:54:00	Mid	146	156	2,876
	Long.	122° 43.448'			Down	147	158	
W11	Lat.	47° 45.199'	16:14:03	16:24:49	Mid	149	159	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	152	159	North 11,747
W12	Lat.	47° 45.199'	16:41:25	16:52:37	Mid	143	152	6,070
	Long.	122° 43.448'			Down	146	154	
Date: 10/11/2011								
W2	Lat.	47° 45.199'	8:56:08	9:04:30	Mid	147	155	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	149	156	North 9,3080
W1	Lat.	47° 45.199'	9:21:31	9:25:49	Mid	147	159	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	149	157	North 11,567
W7	Lat.	47° 45.199'	10:53:25	11:05:03	Mid	148	154	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	150	155	North 10,934
W9	Lat.	47° 45.199'	11:13:03	11:23:02	Mid	147	155	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	149	158	North ± 13,000 (Land)
W10	Lat.	47° 45.071'	12:20:32	12:31:05	Mid	148	155	5,860
	Long.	122° 43.483'			Down	149	157	
W8	Lat.	47° 45.199'	14:01:22	14:11:03	Mid	145	153	4,791
	Long.	122° 43.448'			Down	147	155	
EHW16	Lat.	47° 45.199'	16:51:02	17:07:23	Mid	147	153	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	151	156	North 8,126
EHW16 - Cont.	Lat.	47° 45.199'	17:13:31	17:27:36	Mid	142	151	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	146	155	North 8,371
EHW16 - Cont.	Lat.	47° 45.199'	17:37:56	17:49:15	Mid	149	154	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	152	158	North 11,375
Date: 10/12/2011								
EHW12	Lat.	47° 45.199'	10:58:53	11:39:47	Mid	147	152	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	151	157	North 8,722
EHW13	Lat.	47° 45.199'	14:57:57	15:20:19	Mid	129	134	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	133	140	North 11,016
EHW10	Lat.	47° 45.199'	17:47:52	18:14:26	Mid	127	138	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	132	140	North 11,900
Date: 10/13/2011								
EHW10	Lat.	47° 45.199'	9:57:49	10:06:14	Mid	134	139	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	138	141	North ± 13,000 (Land)
EHW10 - Cont.	Lat.	47° 45.199'	10:32:06	10:45:48	Mid	127	132	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	130	133	North 9,900
EHW7	Lat.	47° 45.199'	13:01:23	13:07:00	Mid	136	139	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	137	140	North ± 13,000 (Land)
EHW7 - Cont.	Lat.	47° 45.199'	13:21:34	13:46:55	Mid	135	143	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	136	145	North ± 13,000 (Land)
EHW5	Lat.	47° 45.199'	13:55:36	14:34:08	Mid	135	144	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	137	144	North ± 13,000 (Land)

Event Description	Pile Coordinates		Start Time	Stop Time	Sensor	Measured Sound Pressure Level - RMS (WRA Boat)		Calculated distance to 120 dB RMS (m)
						Ave	Max	
Date: 10/14/2011								
EHW6	Lat.	47° 45.199'	12:32:50	13:05:34	Mid	131	138	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	135	140	North ± 13,000 (Land)
EHW5	Lat.	47° 45.199'	13:07:52	13:10:43	Mid	135	138	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	138	142	North ± 13,000 (Land)
EHW4	Lat.	47° 45.199'	13:16:31	13:34:33	Mid	132	139	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	136	142	North ± 13,000 (Land)
EHW3	Lat.	47° 45.199'	13:42:03	13:47:09	Mid	134	134	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	137	137	North 9,600
EHW1	Lat.	47° 45.215'	13:51:50	13:57:14	Mid	125	132	South ± 7,000 (Land)
	Long.	122° 43.468'			Down	131	136	North 9,300
EHW1 - Cont.	Lat.	47° 45.215'	14:21:35	14:35:56	Mid	131	140	South ± 7,000 (Land)
	Long.	122° 43.468'			Down	138	143	North ± 13,000 (Land)
EHW3	Lat.	47° 45.199'	16:46:11	17:01:47	Mid	134	139	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	140	143	North ± 13,000 (Land)
Date: 10/15/2011								
EHW2	Lat.	47° 45.199'	10:25:17	10:45:27	Mid	133	143	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	135	143	North ± 13,000 (Land)
EHW9	Lat.	47° 45.199'	11:28:42	11:42:06	Mid	133	138	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	135	139	North ± 13,000 (Land)
EHW9 - Cont.	Lat.	47° 45.199'	11:56:19	11:57:12	Mid	136	139	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	137	139	North ± 13,000 (Land)
EHW8	Lat.	47° 45.199'	12:54:35	13:11:31	Mid	147	152	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	149	155	North ± 13,000 (Land)
Date: 10/17/2011								
EHW14 - REVIB	Lat.	47° 45.199'	14:52:06	14:59:31	Mid	146	148	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	152	153	North ± 13,000 (Land)
EHW14 - Cont.	Lat.	47° 45.199'	15:25:46	15:32:32	Mid	148	150	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	152	153	North ± 13,000 (Land)
EHW15 - REVIB	Lat.	47° 45.199'	15:58:46	16:05:33	Mid	145	146	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	148	149	North 10,700
EHW15 - Cont.	Lat.	47° 45.199'	16:27:34	16:39:14	Mid	144	151	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	148	155	North ± 13,000 (Land)
Date: 10/19/2011								
EHW11	Lat.	47° 45.199'	11:59:25	12:04:53	Mid	147	150	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	152	155	North ± 13,000 (Land)
EHW11 - Cont.	Lat.	47° 45.199'	12:22:02	12:28:29	Mid	151	153	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	153	155	North ± 13,000 (Land)
Date: 10/21/2011								
W-8 - REVIB	Lat.	47° 45.199'	14:43:13	14:51:24	Mid	153	157	6,899
	Long.	122° 43.448'	14:43:13	14:51:24	Down	152	156	
W-10 - REVIB	Lat.	47° 45.199'	14:53:59	14:58:38	Mid	155	158	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	155	159	North 12,200
W-1 - REVIB	Lat.	47° 45.199'	14:58:43	15:09:30	Mid	144	152	5,242
	Long.	122° 43.448'			Down	146	152	
W-2- REVIB	Lat.	47° 45.199'	15:11:56	15:15:29	Mid	147	153	4,984
	Long.	122° 43.448'			Down	147	152	

Event Description	Pile Coordinates		Start Time	Stop Time	Sensor	Measured Sound Pressure Level - RMS (WRA Boat)		Calculated distance to 120 dB RMS (m)
						Ave	Max	
Date: 10/21/2011 (continued)								
W-3 - REVIB	Lat.	47° 45.199'	15:37:01	15:39:51	Mid			821
	Long.	122° 43.448'			Down			
W-4 - REVIB	Lat.	47° 45.199'	16:00:34	16:11:39	Mid	143	153	5,246
	Long.	122° 43.448'			Down	145	154	
W-5 - REVIB	Lat.	47° 45.199'	16:13:55	16:16:47	Mid	150	153	5,199
	Long.	122° 43.448'			Down	150	155	
W-6 - REVIB	Lat.	47° 45.199'	16:18:14	16:21:54	Mid	151	154	5,643
	Long.	122° 43.448'			Down	153	155	
Date: 10/27/2011								
W7 - REVIB	Lat.	47° 45.199'	9:55:24	10:03:08	Mid			South ± 7,000 (Land)
	Long.	122° 43.448'			Down	160	161	North ± 13,000 (Land)
W9 - REVIB	Lat.	47° 45.199'	10:05:17	10:08:51	Mid			South ± 7,000 (Land)
	Long.	122° 43.448'			Down	151	154	North 10,400
W12 - REVIB	Lat.	47° 45.199'	10:12:52	10:18:33	Mid			South ± 7,000 (Land)
	Long.	122° 43.448'			Down	152	156	North 12,000
W11 - REVIB	Lat.	47° 45.199'	10:21:04	10:26:12	Mid			South ± 7,000 (Land)
	Long.	122° 43.448'			Down	153	157	North ± 13,000 (Land)
EX3	Lat.	47° 45.199'	11:24:13	11:25:58	Mid	145	147	4,706
	Long.	122° 43.448'			Down	146	147	
EX4	Lat.	47° 45.199'	11:28:00	11:28:14	Mid	139	148	4,566
	Long.	122° 43.448'			Down	140	148	
EX3 - Cont.	Lat.	47° 45.199'	11:31:00	11:31:18	Mid	142	142	2,754
	Long.	122° 43.448'			Down	143	144	
EX5	Lat.	47° 45.199'	11:49:48	11:52:38	Mid	128	152	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	128	151	North 8,800
EX6	Lat.	47° 45.199'	11:58:49	12:02:13	Mid	128	151	South ± 7,000 (Land)
	Long.	122° 43.448'			Down	129	150	North 7,700

Notes:

[1] Pile was not driven. Hammer was setup on a permanent pile inside EHW-1, however, due to space limitations as a result of the tidal elevation the hammer could not be turned on and no pile driving occurred on October 4th;

[A] RMS Sound levels during vibratory driving analyzed in 10 sec periods "Max" is the maximum level for any 10 second period "Avg" is the average of the 10 second periods over the duration of the pile driving event.

[B] Based on best available data for each pile driving event

Prior to the EHW-1, the 120-dB behavioral disturbance zone for vibratory driving sounds was predicted to extend out along the main channel about 13,840 meters north to Squamish Harbor and about 6,760 m south to Toandos Peninsula. During the EHW-1 PRP, levels exceeding the 120 dB RMS isopleth were measured at distances out to 3,995 m, where the level was 125 dB RMS (re: 1µPa). However, there were measurements closer than 3,995 m where sound levels did not exceed 120 dB RMS (re: 1µPa). The data collected during the EHW-1 cannot accurately pinpoint a single distance which would estimate the extent of the 120-dB harassment zone, because of the large variability in measured sounds from drive to drive and the extensive size of the area. The data do, however, indicate that levels were not louder than those predicted for the project. Although most measurements were made within the zone predicted to have levels above 120 dB, the measurements made outside of the zone had levels less than 120 dB. Using the

average WRA boat measured level and the average propagation rates from measured vibratory sound levels for all piles, the calculated distance to the 120-dB ranged from 821 to 13,000 m (**Table 4**). 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.

The APE 200-6 vibratory hammer was used to install and remove all piles. **Table 5** summarizes the difference between the modeled and actual harassment sound thresholds for vibratory pile driving. As stated previously, the maximum underwater sound levels recorded at 10 meters from the pile was 174 dB RMS (re: 1µPa) and the average was 166 dB RMS (re: 1µPa). Using the average SPL and assuming practical spreading loss (15LogR), the source levels produced from vibratory driving were below the injury threshold for both cetaceans (180 dB) and pinnipeds (190 dB), therefore there was no risk of injury to any marine mammal during pile driving and removal events associated with the EHW-1 PRP. Even using the maximum SPL produced, the source level of pile driving were always less than 190 dB RMS, and the maximum distance to the 180 dB RMS isopleth would have been less than 4 meters from the pile. Since no cetaceans ever approached or entered within the WRA (over 500 meters from the pile) there was still no risk of injury to cetaceans even if the sound pressure levels exceeded the 180 dB RMS isopleth on occasion.

Table 5. Modeled and Measured Marine Mammal Behavioral Harassment RMS Sound Level Thresholds for Vibratory (120 dB) Pile Driving

Threshold	Modeled Distance (Average, m)	Measured Distance (Average, m)
120 dB	10,300†	4,396

† Average of predicted thresholds to the North (13,840 m) and South (6,760 m) in Hood Canal

Airborne Sound

Airborne measurements were taken using two microphone systems placed along the shoreline on the north and south (removed 7 October 2011) of the project site; also, one microphone was placed on a vessel within the WRA. No injury thresholds exist for marine mammals exposed to airborne sound, and no behavioral harassment threshold exists for cetaceans exposed to airborne sound. The behavioral harassment thresholds for pinnipeds are 90 dB RMS re: 20 µPa (harbor seals only) and 100 dB RMS re: 20µPa (all other pinnipeds).

Summaries of RMS sound levels at these locations, and associated threshold distances, are shown in **Table 6**. Prior to the initiation of the EHW-1 PRP, the distance to the 100 dB (unweighted) airborne harassment zone for vibratory pile driving was predicted to extend 9 m from the pile. Based on the measurement of average RMS L_{eq} levels and applying a 20 Log_{10} propagation rate, the harassment zone was 10 m from the pile for all pile sizes. Likewise, the distance to the 90 dB (unweighted) harassment zone for harbor seals was predicted to extend 28 m from the pile. Based on the measurement of average levels and applying a 20Log_{10} propagation rate, the actual harassment zone was 33 m for all pile sizes (**Table 7**).

Table 6. Summary of Airborne Sound Levels During Pile Driving

Event Description	Weighting	Measured Sound Pressure Level - RMS						Calculated distance (m) to 100 dB RMS	Calculated distance (m) to 90 dB RMS
		WRA Boat		North Shore		South Shore			
		Ave	Max	Ave	Max	Ave	Max		
Date: 10/4/2011									
Inside Pile EHW1	Unweighted	N/A	N/A	69	75	74	79	15	50
	A-weighted	N/A	N/A	59	63	55	62		
	Distance(m)	150		265		527			
Date: 10/5/2011									
BP1	Unweighted	78	85	73	79	66	71	29	92
	A-weighted	67	77	64	72	54	60		
	Distance(m)	170		265		527			
BP2	Unweighted	81	86	73	77	68	73	33	105
	A-weighted	70	78	61	67	54	59		
	Distance(m)	170		265		527			
Date: 10/7/2011									
RX5	Unweighted	78	89	N/A	N/A	Meter Removed 10/5/2011		34	109
	A-weighted	68	82	N/A	N/A				
	Distance(m)	118							
RX6	Unweighted	83	90	N/A	N/A			37	117
	A-weighted	71	83	N/A	N/A				
	Distance(m)	118							
RX7	Unweighted	78	83	N/A	N/A			16	52
	A-weighted	66	73	N/A	N/A				
	Distance(m)	118							
RX8	Unweighted	79	87	N/A	N/A			33	105
	A-weighted	66	79	N/A	N/A				
	Distance(m)	150							
RX1	Unweighted	N/A	N/A	N/A	N/A				
	A-weighted	N/A	N/A	N/A	N/A				
	Distance(m)	117							
FW1	Unweighted	79	85	N/A	N/A			22	68
	A-weighted	68	75	N/A	N/A				
	Distance(m)	120							
FW2	Unweighted	80	84	N/A	N/A			18	58
	A-weighted	65	76	N/A	N/A				
	Distance(m)	120							
FW3	Unweighted	81	87	N/A	N/A			28	88
	A-weighted	67	79	N/A	N/A				
	Distance(m)	120							
FW4	Unweighted	83	85	N/A	N/A			22	68
	A-weighted	66	74	N/A	N/A				
	Distance(m)	120							
Date: 10/8/2011									
FW5	Unweighted	75	80	N/A	N/A			10	30
	A-weighted	64	73	N/A	N/A				
	Distance(m)	100							
FW6	Unweighted	76	82	N/A	N/A			12	38
	A-weighted	64	70	N/A	N/A				
	Distance(m)	100							
FW7	Unweighted	75	81	N/A	N/A			11	36
	A-weighted	64	69	N/A	N/A				
	Distance(m)	100							

Event Description	Weighting	Measured Sound Pressure Level - RMS						Calculated distance (m) to 100 dB RMS	Calculated distance (m) to 90 dB RMS
		WRA Boat		North Shore		South Shore			
		Ave	Max	Ave	Max	Ave	Max		
Date: 10/8/2011 (continued)									
FW8	Unweighted	73	83	N/A	N/A			14	44
	A-weighted	63	78	N/A	N/A				
	Distance(m)	100							
Date: 10/10/2011									
W6	Unweighted	84	89	78	81			24	76
	A-weighted	72	79	66	72				
	Distance(m)	87		238					
W5	Unweighted	83	89	78	84			18	56
	A-weighted	73	81	67	73				
	Distance(m)	65		238					
W4	Unweighted	84	94	79	85			32	102
	A-weighted	72	81	65	84				
	Distance(m)	65		238					
W6 - Revib	Unweighted	82	87	79	83			19	60
	A-weighted	74	80	67	73				
	Distance(m)	87		238					
W3	Unweighted	83	89	79	84			19	61
	A-weighted	72	77	65	70				
	Distance(m)	65		238					
W5 - Revib	Unweighted	80	90	79	83			17	54
	A-weighted	68	77	63	69				
	Distance(m)	55		238					
W11	Unweighted	82	87	78	88			26	83
	A-weighted	67	75	65	75				
	Distance(m)	115		238					
W12	Unweighted	78	86	75	86			23	73
	A-weighted	68	79	65	74				
	Distance(m)	115		238					
Date: 10/11/2011									
W2[1]	Unweighted	80	89	78	81			28	89
	A-weighted	65	78	64	70				
	Distance(m)	146		250					
W1[1]	Unweighted	78	86	78	82			32	102
	A-weighted	68	77	66	74				
	Distance(m)	135		250					
W7[1]	Unweighted	88	100	79	84			37	117
	A-weighted	68	78	66	75				
	Distance(m)	130		230					
W9[1]	Unweighted	82	97	78	86			48	152
	A-weighted	68	83	66	80				
	Distance(m)	130		230					
W10[1]	Unweighted	94	109	79	85			42	132
	A-weighted	70	77	67	74				
	Distance(m)	122		230					
W8[1]	Unweighted	85	98	80	85			40	128
	A-weighted	68	76	66	72				
	Distance(m)	130		230					

Event Description	Weighting	Measured Sound Pressure Level - RMS						Calculated distance (m) to 100 dB RMS	Calculated distance (m) to 90 dB RMS
		WRA Boat		North Shore		South Shore			
		Ave	Max	Ave	Max	Ave	Max		
Date: 10/11/2011 (continued)									
	Unweighted	86	101	75	83			38	120
	A-weighted	69	78	64	71				
	Distance(m)	159		272					
	Unweighted	87	100	73	80			26	83
EHW16[1]	A-weighted	69	76	64	71				
	Distance(m)	159		272					
	Unweighted	89	104	73	86			56	178
	A-weighted	70	79	63	74				
	Distance(m)	159		272					
Date: 10/12/2011									
	Unweighted	82	89	N/A	N/A			45	144
EHW12	A-weighted	73	85	N/A	N/A				
	Distance(m)	167							
	Unweighted	71	83	N/A	N/A			--	--
EHW13[2]	A-weighted	69	82	N/A	N/A				
	Distance(m)	1450							
	Unweighted	73	85	N/A	N/A			--	--
EHW10[2]	A-weighted	64	85	N/A	N/A				
	Distance(m)	1450							
Date: 10/13/2011									
	Unweighted	77	82	N/A	N/A			--	--
	A-weighted	63	81	N/A	N/A				
EHW10[2]	Distance(m)	1448							
	Unweighted	72	85	N/A	N/A			--	--
	A-weighted	61	85	N/A	N/A				
	Distance(m)	1448							
	Unweighted	81	87	N/A	N/A			--	--
	A-weighted	69	77	N/A	N/A				
EHW7[2]	Distance(m)	1445							
	Unweighted	79	90	N/A	N/A			--	--
	A-weighted	66	76	N/A	N/A				
	Distance(m)	1445							
	Unweighted	80	89	N/A	N/A			--	--
EHW5	A-weighted	71	88	N/A	N/A				
	Distance(m)	1449							
Date: 10/14/2011									
	Unweighted	75	84	N/A	N/A			--	--
EHW6[2]	A-weighted	67	76	N/A	N/A				
	Distance(m)	1063							
	Unweighted	75	81	N/A	N/A			--	--
EHW5[2]	A-weighted	66	73	N/A	N/A				
	Distance(m)	1065							
	Unweighted	73	81	N/A	N/A			--	--
EHW4[2]	A-weighted	66	77	N/A	N/A				
	Distance(m)	1059							
	Unweighted	N/A	N/A	N/A	N/A			--	--
EHW3[2]	A-weighted	N/A	N/A	N/A	N/A				
	Distance(m)	1060							

Event Description	Weighting	Measured Sound Pressure Level - RMS						Calculated distance (m) to 100 dB RMS	Calculated distance (m) to 90 dB RMS
		WRA Boat		North Shore		South Shore			
		Ave	Max	Ave	Max	Ave	Max		
Date: 10/14/2011 (continued)									
EHW1[2]	Unweighted	74	81	N/A	N/A			--	--
	A-weighted	68	78	N/A	N/A				
	Distance(m)	1063							
	Unweighted	76	84	N/A	N/A			--	--
	A-weighted	67	80	N/A	N/A				
	Distance(m)	1063							
EHW3[2]	Unweighted	82	86	N/A	N/A			--	--
	A-weighted	68	76	N/A	N/A				
	Distance(m)	1060							
Date: 10/15/2011									
EHW2[2]	Unweighted	75	86	N/A	N/A			--	--
	A-weighted	66	77	N/A	N/A				
	Distance(m)	1068							
EHW9[2]	Unweighted	76	87	N/A	N/A			--	--
	A-weighted	66	75	N/A	N/A				
	Distance(m)	1068							
	Unweighted	N/A	N/A	N/A	N/A			--	--
	A-weighted	N/A	N/A	N/A	N/A				
	Distance(m)	1068							
EHW8	Unweighted	80	89	N/A	N/A			60	189
	A-weighted	74	85	N/A	N/A				
	Distance(m)	210							
Date: 10/17/2011									
EHW14	Unweighted	77	84	N/A	N/A			45	143
	A-weighted	68	83	N/A	N/A				
	Distance(m)	275							
	Unweighted	80	90	N/A	N/A			86	272
	A-weighted	73	88	N/A	N/A				
	Distance(m)	275							
EHW15	Unweighted	77	89	N/A	N/A			73	231
	A-weighted	66	79	N/A	N/A				
	Distance(m)	275							
	Unweighted	77	84	N/A	N/A			44	139
	A-weighted	66	79	N/A	N/A				
	Distance(m)	275							
Date: 10/19/2011									
EHW11	Unweighted	79	87	N/A	N/A			35	110
	A-weighted	71	83	N/A	N/A				
	Distance(m)	155							
	Unweighted	81	89	N/A	N/A			43	137
	A-weighted	68	86	N/A	N/A				
	Distance(m)	155							
Date: 10/21/2011									
W8	Unweighted	82	91	N/A	N/A			53	168
	A-weighted	64	71	N/A	N/A				
	Distance(m)	143							
W10	Unweighted	82	91	N/A	N/A			52	164
	A-weighted	66	71	N/A	N/A				
	Distance(m)	143							

Event Description	Weighting	Measured Sound Pressure Level - RMS						Calculated distance (m) to 100 dB RMS	Calculated distance (m) to 90 dB RMS
		WRA Boat		North Shore		South Shore			
		Ave	Max	Ave	Max	Ave	Max		
Date: 10/21/2011 (continued)									
W1	Unweighted	84	97	N/A	N/A			96	302
	A-weighted	63	71	N/A	N/A				
	Distance(m)	143							
W2	Unweighted	83	94	N/A	N/A			75	237
	A-weighted	63	72	N/A	N/A				
	Distance(m)	143							
W3	Unweighted	N/A	N/A	N/A	N/A				
	A-weighted	N/A	N/A	N/A	N/A				
	Distance(m)								
W4	Unweighted	80	92	N/A	N/A			50	159
	A-weighted	63	73	N/A	N/A				
	Distance(m)	132							
W5	Unweighted	79	86	N/A	N/A			26	83
	A-weighted	63	71	N/A	N/A				
	Distance(m)	132							
W6	Unweighted	79	96	N/A	N/A			86	273
	A-weighted	65	72	N/A	N/A				
	Distance(m)	132							
Date: 10/27/2011									
W7	Unweighted	N/A	N/A	N/A	N/A				
	A-weighted	N/A	N/A	N/A	N/A				
	Distance(m)	183							
W9	Unweighted	N/A	N/A	N/A	N/A				
	A-weighted	N/A	N/A	N/A	N/A				
	Distance(m)	150							
W12	Unweighted	N/A	N/A	N/A	N/A				
	A-weighted	N/A	N/A	N/A	N/A				
	Distance(m)	150							
W11	Unweighted	N/A	N/A	N/A	N/A				
	A-weighted	N/A	N/A	N/A	N/A				
	Distance(m)	150							
EX3	Unweighted	76	83	N/A	N/A			26	81
	A-weighted	61	71	N/A	N/A				
	Distance(m)	180							
EX4	Unweighted	77	81	N/A	N/A			20	62
	A-weighted	62	71	N/A	N/A				
	Distance(m)	180							
EX3	Unweighted	75	81	N/A	N/A			21	65
	A-weighted	62	71	N/A	N/A				
	Distance(m)	180							
EX5	Unweighted	70	78	N/A	N/A			14	45
	A-weighted	59	75	N/A	N/A				
	Distance(m)	180							
EX6	Unweighted	74	81	N/A	N/A			20	65
	A-weighted	60	74	N/A	N/A				
	Distance(m)	180							

Notes:

[1] Airborne data on WRA boat not valid due to contamination from rain

[2] WRA boat was too far from pile driving, sounds were generated by sources other than pile driving.

Table 7. Airborne RMS Levels for Vibratory Pile Driving at WRA Boat (dB re 20 µPa) All Data From Various Distances Normalized to 100 meters

	Distance (meters)			RMS_{Lmax}[1]		RMS_{Leq}[1]	
	100 dB	90 dB		Z-weighted	A-weighted	Z-weighted	A-weighted
Max	16	51	**Max**	98	90	86	80
Min	<10	14	**Min**	80	69	69	63
Average	10	33	**Average**	87	78	79	68
			Stdev	3.63	4.46	3.98	3.85

Note: [1] - Data Normalized to 100 feet

While these distances to the airborne behavioral harassment thresholds during the EHW-1 PRP were slightly larger than those originally modeled, there are no haulout areas within these distances and there were no airborne takings of any pinniped species during vibratory pile driving/removal as part of the project.

Marine Mammal Sightings

There are six marine mammal species (three cetacean and three pinniped), that occur regularly in the waters nearby NBK at Bangor in the Hood Canal: harbor seal *(Phoca vitulina)*, California sea lion *(Zalophus californianus)*, Steller sea lion, killer whale *(Orcinus orca)*, Dall's porpoise *(Phocoenoides dalli)*, and the harbor porpoise *(Phocoena phocoena)*. Of these six marine mammal species, four were observed during the EHW-1 Pile Replacement Program: harbor porpoise, California sea lion, Steller sea lion, and harbor seal. The Steller sea lion is the only ESA-listed marine mammal that occurs in Hood Canal. All marine mammals sighted in the Hood Canal are managed by NMFS.

As Steller sea lions typically do not arrive in the vicinity of NBK at Bangor until well into November (A. Balla-Holden, U.S. Navy, pers. comm.), their appearance during this project was unexpected. No takes for this species of any kind were permitted under the issued IHA (NMFS 2011) or through the ESA consultation. The first sighting of this species during the EHW-1 PRP occurred on 8 October 2011. The majority of sightings were made near Delta Pier, a berthing facility that accommodates multiple submarines at one time. The submarines themselves were used as a haul-out site by both Steller and California sea lions. It is speculated that the heat signature of these vessels provides an attractive haulout site for pinnipeds to rest and thermoregulate. Based on size and morphology, all Steller sea lions appeared to be adult or subadult males, and often had mildly agonistic interactions with the California sea lions also hauled out on the submarines. Steller sea lions were most commonly observed resting, swimming, and vocalizing, usually during interactions with California sea lions. One Steller sea lion observed at Delta Pier was branded with a large "102 Y" along its left flank. This male was branded in July 2002 as a pup at St. George Reef near Crescent City, California (DeLong and Loughlin 2003).

During the EHW-1 PRP, there were also sightings of California sea lions branded with a "C" followed by a number or branded with just a plain number. The Oregon Department of Fish and Wildlife began a California sea lion capture and marking operation in the Columbia River at

Astoria, Oregon, in 1997, as numbers of sea lions foraging for salmonids in upriver areas continued to increase (NOAA 2008). The goal of this project was to apply permanent, individually identifiable marks to California sea lions using the Columbia to: (1) observe the movements and activities of individual sea lions in the river; (2) describe foraging patterns of individual animals; and (3) document the recurrence of individual sea lions at specific foraging areas from year to year. By 2006, nearly 1,000 California sea lions had been captured at the Astoria trap, 621 of which were permanently and uniquely marked with "C" brands (NOAA 2008). Branding of California sea lions also occurred at other locations including Puget Sound and at San Miguel Island, California (NOAA 2008).

Marine Mammal Sightings (Construction and Non-Construction Periods)

A total of 376 sightings of 801 individual marine mammals were observed during the EHW-1 PRP timeframe (**Table 8**). Four species were sighted: the California sea lion, harbor seal, harbor porpoise, and Steller sea lion. The harbor seal was the most frequently sighted species (*n*=308, 0.38 sightings per observer hour), and the California sea lion was the most abundant marine mammal species (*n*=401 individuals, 50%), followed by the harbor seal (*n*=353 individuals, 44%) (**Table 8**). The mean number of California sea lions per sighting (10.3) was more than 9 times that for harbor seals (mean group size 1.1 animals per sighting) (**Table 8, Figure 6**). There were only 12 sightings of harbor porpoise for a total of 27 individuals during the course of the project. This low number was likely due to the fact that monitoring efforts outside the WRA consisted of only one vessel for the EHW-1 PRP, and harbor porpoise were never sighted inside the WRA fence. There were 15 sightings of Steller sea lions for a total of 18 individuals during the course of EHW-1 repairs. All Steller sea lion sightings, with the exception of two, were of animals hauled out on submarines at Delta Pier (**Figure 5**). The largest observed group size for any species in the project area was 38 California sea lions; this sighting was on a day when these animals were hauled out on the WRA fence , approximately 1,300 meters from the EHW-1 piles, in relatively large numbers (**Appendix E**). There were also two sightings for a total of two unidentified pinnipeds: a possible Steller sea lion and a possible harbor seal (**Table 8, Figure 6**).

Table 8. Summary of Marine Mammal Sightings during EHW-1 (Construction and Non-Construction Periods)

Species	Total Number of Animals	Total Number of Sightings	Sightings per Observer Hour	Mean Group Size	Modal Group Size	Max Group Size	Min Group Size
Harbor porpoise	27	12	0.01	2.3	2	2	1
Harbor seal	353	308	0.38	1.1	1	8	1
California sea lion	401	39	0.05	10.3	1	38	1
Steller sea lion	18	15	0.02	1.2	1	2	1
Unidentified pinnipeds*	2	2	<0.01	1	1	1	1
TOTAL	**801**	**376**	**0.46**	-	-	-	-

Note: * Possible Steller sea lion, possible harbor seal

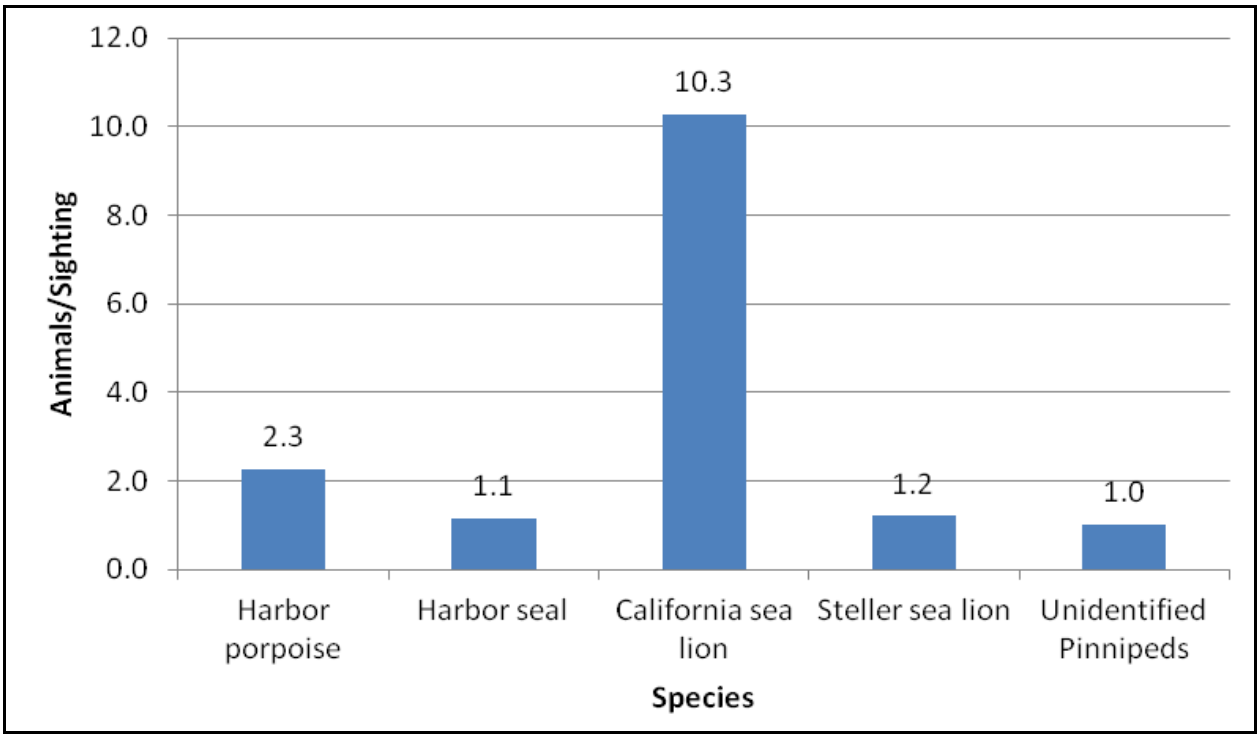


Figure 6. Mean Number of Animals per Sighting (Construction and Non-Construction Periods)

Marine Mammal Sightings (Construction Only)

Four marine mammal species were observed during pile driving activities: California sea lion, Steller sea lion, harbor seal, and harbor porpoise (**Table 9**). Pile installation and removal activities included soft start procedures and the actual installation or removal of a pile. Since EHW-1 repairs during this year did not involve the use of an impact hammer, there were only two types of construction: vibratory pile driving (V), and vibratory soft start (SSV). Soft starts involved several preliminary hammer strikes, performed at reduced force, to the pile about to be driven. Soft starts were intended to provide an opportunity for nearby marine animals to voluntarily leave the area, and thus avoid potential injury and/or harassment. **Figure 5** and **Figures 7 through 9** depict all marine mammal observations made throughout the EHW-1 PRP during construction and non-construction periods. Those recorded during pile driving activities are indicated in red.

A total of 95 sightings of 222 individual marine mammals were observed during pile installation and removal activities (**Table 9**). Four species were sighted: the California sea lion, harbor seal, harbor porpoise, and Steller sea lion. The California sea lion and the harbor seal were the most frequently sighted and most abundant marine mammal species during pile-driving monitoring efforts (**Tables 8** and **9**). The harbor seal was the most frequently sighted species (*n*=64 sightings 0.87 sightings per observer hour) while the California sea lion was the second-most frequently sighted (*n*=25 sightings; 26%). The California sea lion was most abundant (*n*=131individuals; 59%), with the harbor seal ranking second (*n*=81 animals, 36%). Steller sea lion sightings are addressed separately in more detail, due to concerns relative to takes authorized in the IHA.

Table 9. Summary of Marine Mammal Sightings During EHW-1 PRP (Construction Only)

Species	Total Number of Animals	Total Number of Sightings	Sightings per Obs Hr	Construction Type (No. of Animals)*		Mean Group Size	Modal Group Size	Max Group Size	Min Group Size
				SSV	V				
Harbor porpoise	7	4	0.05	2	5	2	2	2	1
Harbor seal	81	64	0.87	13	68	1.2	1	8	1
California sea lion	131	25	0.34	9	122	4.9	1	36	1
Steller sea lion	3	2	0.03	0	3	1.3	1	2	1
TOTAL	**222**	**95**	**1.29**	**24**	**198**	***	***	***	***

Note: *No piles were impact driven for the EHW-1 PRP.
Key: SSV = Vibratory Soft Start; V=Vibratory Pile Driving

Observed Takes

Injury and behavioral harassment takes were calculated for marine mammals sighted during EHW-1 construction, including vibratory and soft start events. Takes were calculated by: (1) measuring the sighting distance to the pile for all animals observed during construction activities, and (2) comparing this distance to underwater and airborne injury and behavioral harassment thresholds on a *per-species* and *per-pile* basis (**Appendix F**). Sighting distance to pile was calculated by plotting animal locations based on distance and direction from the vessel (as recorded by observers on field data sheets) and relating these locations to pile location in a Geographical Information System (ESRI, Arc GIS v.10). If two distances to a sound threshold were measured for a single pile, an average of these two distances was used to estimate the threshold distance and thus estimate takes for that pile driving event. Whenever possible, observers noted if an animal was likely a resighting (**Appendix E**) and communicated with nearby observers in the field to "hand off" sightings of the same animal(s). This information was taken into account when calculating takes to avoid double-counting exposed animals. Takes are reported as the number of individuals (not sightings) observed within a given zone. The total number of marine mammal takes for the EHW-1 is summarized in **Table 10.**

Except in the case of Steller sea lions, the number of observed takes never exceeded those permitted in the revised IHA (NMFS, 2011). There was a total of 246 observed behavioral (Level B) harassment takes during the EHW-1: 67 harbor seals, 167 California sea lions, two Steller sea lions and 10 harbor porpoise fell within the harassment zone during vibratory pile driving. The closest sighting to pile driving activities occurred on 13 October at 14:07. A harbor seal was located 20 m from the pile during vibratory pile driving (**Appendix E, Figure 8**). The sighting was calculated as a Level B take, since all takes were based on actual (corrected) animal-to-pile distances. Corrected distances were calculated based on distance and direction from observer as recorded in sighting data sheets.

Table 10. Summary of Underwater and Airborne Marine Mammal Takes During the EHW-1 PRP

Species	Total Authorized Take for the Entire Project[1]	Portion of Authorized Takes for Steel Pile Installation (14 days) and Removal (2 days)[2]	Total Number of Takes[3]	Underwater Injury Zones (No. of Animals)		Underwater Harassment Zones (No. of Animals)		Airborne Harassment Zones (No. of Animals)	
				190 dB RMS	180 dB RMS	120 dB RMS (Actual)	120 dB RMS (Extrapolated)	100 dB RMS	90 dB RMS
Harbor seal	1,766	836	67	0	0	59	8	0	0
California sea lion	558	268	167	0	0	137	30	0	0
Killer whale	58	30	0	0	0	0	0	0	0
Dall's porpoise	71	32	0	0	0	0	0	0	0
Harbor porpoise	64[4]	16	10	0	0	5	5	0	0
Steller sea lion	0	0	2	0	0	1	1	0	0
TOTAL	**2517[4]**	**1182**	**246**	**0**	**0**	**202**	**44**	**0**	**0**

Notes:

[1] This column represents the total number of takes authorized in the modified IHA dated 10-18-11.

[2] This column represents the number of takes requested (and later authorized) for steel pile installation and steel pile removal based on the calculations in the initial IHA application which broke up takes by pile installation/removal activity. For example, for the harbor seal, 742 takes were requested (pg 68 of IHA application) for 14 days of steel pile installation and 987 takes were requested for 21 days of steel pile removal. During the first in-water work window (2011) the Navy used all 14 days of authorized steel pile installation, but only two days of steel pile removal. In order to determine the takes used using the same mathematical approach as in the initial application, the Navy divided the total number of takes requested in that application for steel pile installation (742) by the total number of days requested for steel pile installation (14) to get a daily take number of 53. Likewise for steel pile removal, 987 takes were divided by the total number of days requested for steel pile removal (21) to get a daily take number of 47. Then the daily number was multiplied by the actual number of days used during the 2011 work. So for pile installation, 53 daily takes was multiplied by 14 actual installation days for a total of 742 takes. For pile removal, 47 daily takes was multiplied by 2 actual removal days for a total of 94 takes. Summing these two numbers together (742+94) results in a total of 836 takes expected during pile installation and pile removal activity from 2011 construction days. These calculations were followed for the other species.

[3] Includes extrapolated takes for the 120 dB Behavioral Harassment zone.

[4] In the original IHA dated 5-17-11 (published in the FR on 5-24-11), there were 35 takes authorized for the harbor porpoise. In the modified IHA, dated 10-18-11, there were 64 harbor porpoises authorized. The total number includes the 64 authorized.

All 246 animals were Level B underwater takes (**Table 10**). In order to qualify as an airborne take, pinnipeds had to 1) be hauled out within the airborne harassment ZOI, or 2) have their head above the water for the duration of the pile driving event (or sighting) (NMFS pers. comm. with Navy, 2012). Of the 19 animals (all harbor seals) that were seen within the airborne ZOI (see **Appendix F**), all were recorded as sinking or diving during pile driving (see **Appendix F**), and therefore did not qualify as airborne takes. The airborne harassment threshold for sea lions and Steller sea lions (100 dB) reached a maximum of 16 m during the EHW-1 PRP, and no animals of either species were seen within this radius during any construction event. California sea lions typically hauled out along the port security barrier (approximately 500 m to 700 m from the

construction area) and at Delta Pier (approximately 1,160 m -1,500 m from the construction area, **Figure 7**). No Dall's porpoise or killer whales were observed during construction (or at any other time) during the EHW-1 PRP.

The distance to the 180 and 190 dB Level A harassment thresholds never exceeded 3 m (RMDT 2012). The closest marine mammal sighting to pile driving throughout the EHW-1 PRP, a harbor seal, was located 20 m from the pile (**Appendix E**). Therefore, no injury takes of cetaceans or pinnipeds occurred during the EHW-1 PRP. No cetacean species were sighted within the WRA, including during all marine mammal monitoring associated with the EHW-1 PRP.

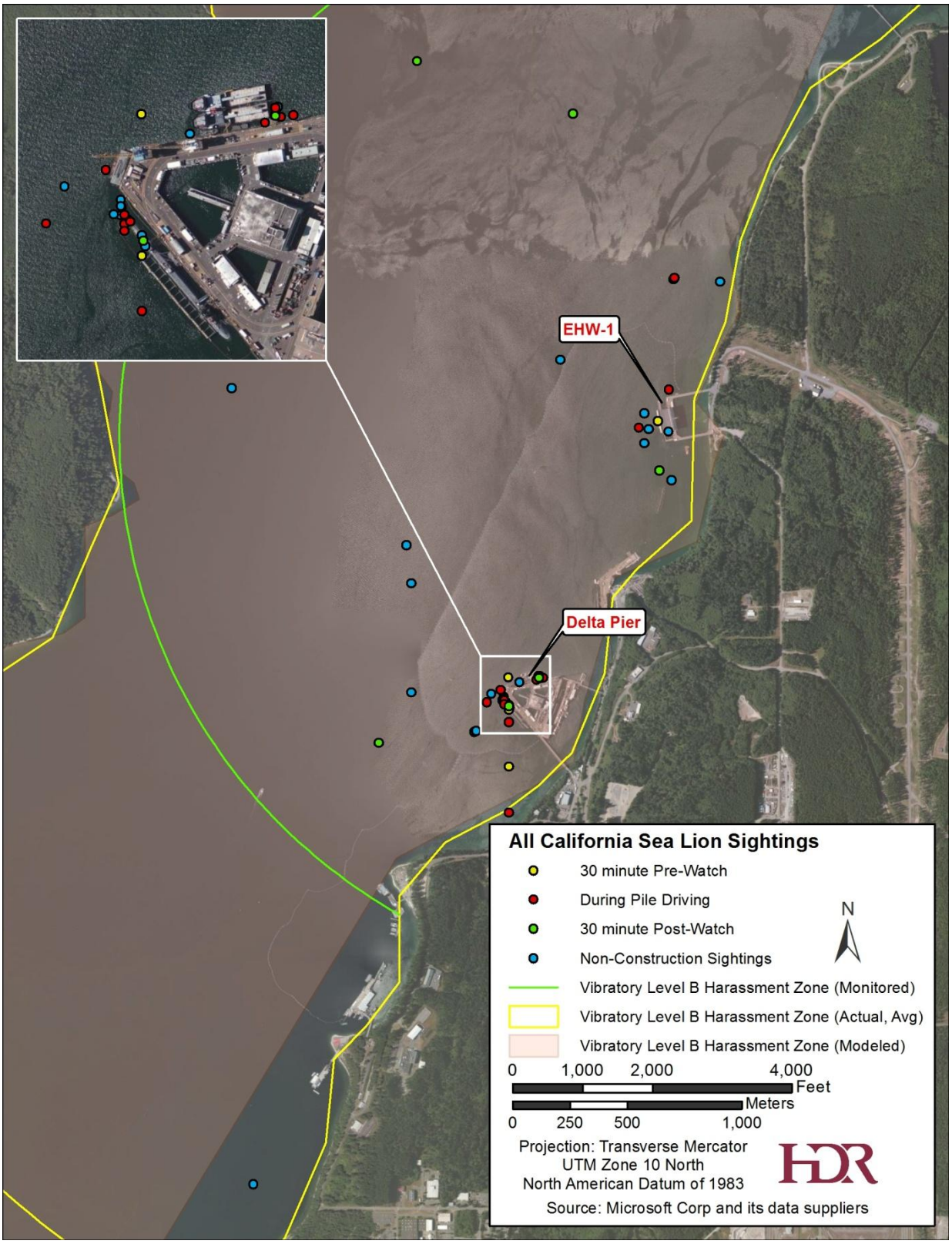
Table 10 shows allowed versus actual take[3] estimates based on the number of marine mammals observed in the shutdown and buffer zones for cetaceans and pinnipeds during pile driving activities (refer to **Appendix F** for takes calculated on a per-pile basis). Takes are reported as the number of individuals (not sightings) observed within a given zone. The majority of takes were for California sea lions, the most abundant marine mammal species during the EHW-1 PRP timeframe. All species sighted, with the exception of Steller sea lions, fell within authorized take numbers. One Steller sea lion was observed hauling out at Delta Pier during vibratory pile driving. Because (1) this animal was in the water during construction, and (2) fell within the 120 dB ZOI, it was considered a Level B take (**Table 10**).

Calculation of Average Sound Thresholds. Measured sound threshold distances varied considerably with pile size, substrate type, environmental conditions, and background noise levels. Therefore, average distances to the behavioral harassment thresholds were calculated for the purposes of: (1) visualizing the relative distances to the actual, modeled, and monitored Level B harassment zones (**Figure 4)** and (2) extrapolating the number of possible Level B takes in the unmonitored ensonified area from known animal density and sighting rates. The average distance to 120 dB threshold for vibratory pile driving was calculated by taking the weighted average of distances to the 120 dB threshold for each pile size and hydrophone depth. Pile sizes were divided into two groups: piles <30 inches, and 30-inch piles. There were 21 <30 inch and 45 30-inch vibratory pile driving events during the EHW-1 project. The mid depth and the down depth data was averaged to obtain a 120 dB distance for both pile size groups. For the piles <30 inches, the average distance was 1.4 miles (2.3 km) and for the 30-inch piles, the average distance was 3.3 miles (5.4 km). The weighted average was then calculated as follows:

(21*2,309) + (45*5,369) / 66 (total number of vibratory drives)

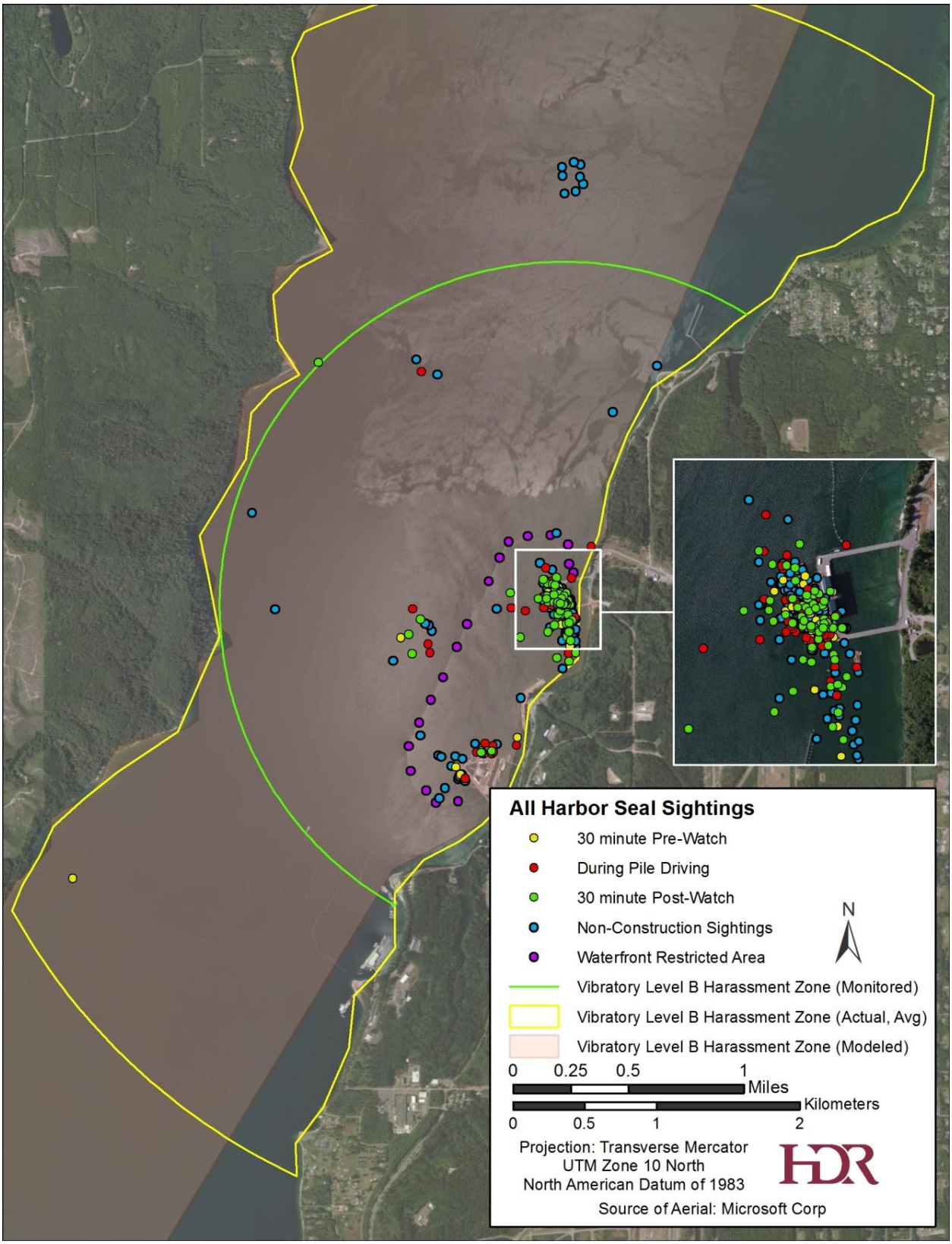
Therefore, the average distance to the 120 dB threshold was 2.7 miles (4.4 km). The predicted (modeled) distance to the 120 dB threshold at the start of the project was 8.6 miles (13.8 km) to the north in Hood Canal, and 4.2 miles (6.8 km) to the south. The area within the average measured 120 dB threshold was 8.8 mi^2 (22.84 km^2).

[3] "Take" is defined in the regulations implementing the MMPA, as: "…to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect or kill any marine mammal. This includes, without limitation, any of the following: The collection of dead animals, or parts thereof; the restraint or detention of a marine mammal, no matter how temporary; tagging a marine mammal; the negligent or intentional operation of an aircraft or vessel, or the doing of any other negligent or intentional act which results in disturbing or molesting a marine mammal; and feeding or attempting to feed a marine mammal in the wild" (50 CFR Section 216.3).



Note: Sightings superimposed on the EHW-1 structure occurred in the water under the cover of the building roof.

Figure 7. All California Sea Lion Sightings. Points may represent more than one individual.



Note: Sightings superimposed on the EHW-1 structure occurred in the water under the cover of the building roof.

Figure 8. All Harbor Seal Sightings. Points may represent more than one individual.

Extrapolated Level B Takes for the Unmonitored Zone

The measured behavioral harassment zone during vibratory pile installation and removal, defined as the area within the average distance to the 120 dB isopleth during the EHW-1 PRP (calculated as a 2.7 miles [4.4 km] radius from the construction location), covered 8.8 mi^2 (22.84 km^2). Only a subset of this area was monitored (1.5 miles [2.4 km] radius from the pile, or 4 mi^2 [10.32 km^2]) because of logistical constraints. It is therefore appropriate to estimate the number of potential Level B marine mammal takes that may have occurred in the ensonfied, but unmonitored, zone. To extrapolate missed takes, species density in Hood Canal (individuals observed during EHW-1 per km^2 per hr) was multiplied by the unmonitored area that fell within the measured harassment zone. The product of these two numbers represents the estimated density (individuals/km^2/hr) in the unmonitored zone. Species density in the unmonitored zone was then multiplied by the total number of construction hours during the EHW-1 PRP to arrive at an estimate of the numbers of takes missed in the unmonitored, ensonified zone (**Table 11**). Only sighting rates from outside the WRA were considered in the analysis, since these were likely more representative of animal densities in the unmonitored zone. It should be noted that the density estimates were not collected using standard line-transect methodology, since at the time of writing these data were not available for Hood Canal for all species in question. Using the methods outlined above, it is estimated that approximately 5 harbor porpoise, 8 harbor seals, 30 California sea lions and 1 Steller sea lion were "taken" in the unmonitored section of the behavioral harassment zone for marine mammals.

Table 11. Missed Takes in the Unmonitored Area of the Behavioral Harassment Zone

Species	Density Estimate	Measured Level B Harassment Zone (Area, km^2)	Monitored Area (km^2)	Unmonitored Harassment Zone (Area, km^2)	Estimated Density in Unmonitored Area	Total Construction Hours During EHW-1	Missed Takes (Estimated)
Harbor porpoise	0.032	22.84	10.32	12.52	0.40	12.4	**4.96**
Harbor seal	0.048				0..60		**7.44**
California sea lion	0.195				2.44		**30.26**
Steller sea lion	0.004				0.05		**0.62**

Marine Mammal Mitigation Procedures: Construction Delays and Shutdowns

In most cases, when a marine mammal was observed in the 164 ft (50 m) shutdown zone, ongoing construction was shut down, and imminent construction was delayed. Shutdowns as a result of pinnipeds inside the 164 ft (50 m) accounted for ten hours and sixteen minutes of delays throughout the lifetime of the project. In five cases, where cessation of pile driving posed a safety hazard, construction was allowed to continue even though a marine mammal was sighted within the 164 ft (50 m) shutdown zone (see highlighting in **Table 12**). Nine piles (EHW-8 through EHW-16) were installed in and under the existing EHW-1 structure, and required the construction crane, hammer and pilings to be positioned within a few feet of the building. Because the hammer required delicate positioning over the pile to avoid building damage, in these situations the construction foreman notified the MC that it was not possible to interrupt the pile driving event without risk to the crew and to the EHW-1 structure from the piling and/or vibratory hammer hitting the building.

Table 12. Marine Mammal Mitigation Events During the EHW-1 PRP

Date	Pile No.	Construction Type	Delay/ Shutdown	Length of Shutdown/Delay (hh:mm)	Species	Number of Animals
5-Oct-2011	BP1	V	D	00:44	HSEA	2
8-Oct-2011	EHW-7	V	D	00:01	HSEA	1
8-Oct-2011	EHW-8	V	D	00:04	HSEA	1
10-Oct-2011	W-3	V	D	00:04	HSEA	1
10-Oct-2011	EHW-10	V	D	00:04	HSEA	1
10-Oct-2011	EHW-13	V	D	00:10	HSEA	1
11-Oct-2011	EHW-2	V	D	00:11	HSEA	1
11-Oct-2011	EHW-16	V	D	00:22	HSEA	1
12-Oct-2011	EHW-12	V	D	00:58	HSEA	1
12-Oct-2011	EHW-13	V	S	00:28	HSEA	1
12-Oct-2011	EHW-10	V	S	01:16	HSEA	1
13-Oct-2011	EHW-10	V	D	00:48	HSEA	?
13-Oct-2011	EW-7	V	D	00:09	HSEA	1
13-Oct-2011	EW-5	V	D	00:16	HSEA	1
13-Oct-2011	EW-5	V	D	00:01	HSEA	1
14-Oct-2011	EHW-1	V	D	00:24	HSEA/ STSL	1/1
15-Oct-2011	EHW-2	V	D	02:05	HSEA/ STSL	1/1
15-Oct-2011	EHW-9	V	NA	00:00	HSEA	1
15-Oct-2011	EHW-8	V	NA	00:00	HSEA	1
15-Oct-2011	EHW-14	V	D	00:58	HSEA	1
17-Oct-2011	EHW-14	V	NA	00:00	HSEA	1
17-Oct-2011	EHW-15	V	NA	00:00	HSEA	1
21-Oct-2011	EHW-8	V	D	00:12	HSEA	1
21-Oct-2011	EHW-3	V	S	00:21	STSL	2
27-Oct-2011	Pile 7	V	D	00:23	HSEA	1
27-Oct-2011	Pile 7	SSV	S	00:02	HSEA	1
27-Oct-2011	EX3	V	D	00:12	HSEA	1
27-Oct-2011	EX6	V	D	00:03	HSEA	1

Key: DP = Dead Pull; V = Vibratory; SSV = Vibratory Soft Start; HSEA = Harbor seal; STSL = Steller sea lion
NA = No delay or shutdowns

In situations involving dangerous pilings, shutdown procedures were temporarily suspended according to the following guidelines:

1. The construction foreman attested that the pile being driven was hazardous or dangerous.
2. No marine mammals were observed within the 164 ft (50 m) EZ in the required 30 minutes prior to initiation of pile driving.

3. No marine mammals were observed within the 164 ft (50 m) EZ during the 3 pulses of hammer activity associated with soft start of the vibratory hammer.
4. Any marine mammal that entered the 164 ft (50 m) EZ did so of its own volition, and was therefore, not being injured or frightened by the sound energy being produced by the hammer.
5. Pile driving was allowed to continue while the MMOs tracked the animal to note its distance from the pile, and to observe any signs of behavioral distress.
6. If signs of behavioral distress were noted, an all-stop on construction was implemented (Note: this situation never occurred during EHW-1 construction activities).

All five instances where the "hazardous piling" standard was invoked occurred on 15 and 17 October, and all resulted in Level B harbor seal takes (**Tables 10** and **12**). There were no Level A takes for any marine mammal species during the EHW-1 PRP because the average RMS sound level recorded during construction activity was 166 dB RMS (re: 1µPa) at 10 meters which would be below the injury thresholds for both pinnipeds and cetaceans at the source. Even the maximum RMS sound level recorded of 174 dB RMS (re: 1µPa) at 10 meters would be below the pinnipeds injury threshold of 190 dB RMS at the source and would only be above the cetacean injury threshold of 180 dB RMS out to less than 4 meters from the pile (**NAVFAC 2012**). No cetacean ever approached or entered the WRA (over 500 meters from EHW-1) therefore there was no risk of injury to these species even though the sound pressure levels were above the 180 dB isopleth on occasion.

During non-hazardous pile driving, there were five construction shutdowns and 20 construction delays due to: (1) marine mammals (in all cases harbor seals) present in the 164 ft (50 m) shutdown zone prior to, or during, pile driving activities; or (2) Steller sea lions observed in the water or moving towards the water while hauled out on submarines at Delta Pier (**Figure 5)**. Either of these scenarios triggered an automatic shutdown of construction to avoid unauthorized Level B Steller sea lion takes (**Table 10**). After 12 October, two MMOs were stationed the Delta Pier during construction in order to perform regular Steller sea lion counts and behavioral focal follows. If a Steller sea lion was observed changing from a resting to active behavioral state while hauled out at Delta pier, the Delta Pier MMO alerted the MC of the potential for a shutdown via handheld VHF radio. If the animal(s) moved towards the water, the MC immediately initiated a construction shutdown, or delayed imminent construction (**Table 12**). Construction was delayed on 14 October because of a Steller sea lion moving towards the water from a resting position. Construction was not resumed until the MMO and MC were confident that the animal did not intend on returning to the water. Construction was delayed again on 15 October because of a Steller sea lion observed in the water prior to construction start, and construction was not allowed to resume until the animal had left the monitored zone. Ongoing construction was shut down on 21 October because a Steller sea lion was observed coming out of the water to haul out on a submarine. The animal approached the submarine from a distance while remaining underwater, and was therefore unseen by the MMOs until it hauled out, as a result this observation was recorded as an unauthorized Level B take.

Another four construction shutdowns were triggered on 12 October, 13 October and 27 October due to a harbor seal observed within the shutdown zone while construction was ongoing. In all cases, construction was not resumed until the animal had left the area. There were a total of 20

delays to imminent construction from 5 October to 27 October because of harbor seals present in the shutdown zone (**Table 12**).

Harbor Porpoise Sightings. A total of 14 harbor porpoise sightings occurred from 4 October to 27 October with a total of 31 individuals (**Table 13**, **Figure 9**). Of those 14 sightings, two sightings (four individuals) were considered to be re-sightings, making a total of 27 individuals sighted. Six sightings occurred during EHW-1 construction activities, totaling 12 animals. On 7 October, two individuals were seen first at 16:48 (before construction began), again at 16:59 (during a soft start) and again at 17:01 (during actual construction). This sighting represented two Level B takes, one for each animal, caused by soft start procedures. The animals were not considered to be "taken" a second time during actual vibratory procedures. Observers were confident these events were resightings of the same animals, since they were a distinctive adult/calf pair (see notes in **Appendix E**). In total, five harbor porpoises were sighted within the 120 dB harassment zone, measured on a per-pile basis (see **Appendix F**), resulting in five Level B takes for this species (**Table 10**).

Steller sea lion sightings. As Steller sea lions typically do not arrive in the vicinity of NBK at Bangor until well into November (A. Balla-Holden, U.S. Navy, pers. comm.), their appearance during this project was unexpected. No takes for this species of any kind were permitted under the issued IHA (NMFS 2011) or through the ESA consultation. The first sighting of this species during the EHW-1 PRP occurred on 10 October 2011 (**Table 14**). The majority of sightings were made near Delta Pier, a berthing facility that accommodates multiple submarines at one time. The submarines themselves were used as a haul-out site by both Steller and California sea lions. It is speculated that the heat signature of these vessels provides an attractive haulout site for pinnipeds to rest and thermoregulate. Based on size and morphology, all Steller sea lions appeared to be adult or subadult males, and often had mildly agonistic interactions with the California sea lions also hauled out on the submarines. Steller sea lions were most commonly observed resting, swimming, and vocalizing, usually during interactions with California sea lions. One Steller sea lion observed at Delta Pier was branded with a large "102 Y" along its left flank. This male was branded in July 2002 as a pup at St. George Reef near Crescent City, California (DeLong and Loughlin 2003).

There were 15 sightings of Steller sea lions for a total of 18 individuals during the course of EHW-1 repairs. Three of these animals were observed during pile driving. Two of the animals were hauled out on a submarine at Delta Pier, but the third was seen hauling out onto a submarine from the water during the course of vibratory driving. As a result, this animal was noted as a Level B take (**Table 14**, **Figure 5**). See **Appendix G** (photos G-4 and G-5) for a representative sample of the animals seen and their location relative to the project area. Sightings that occurred during pile driving activities are indicated in bold type in **Table 14**. Resightings of the same animals during pile driving were not considered to be additional takes. Although several Steller sea lions were observed hauled out during pile driving activities, only one animal was seen in the water while construction was ongoing. Airborne sound pressure levels at Delta Pier were never estimated to reach 100 dB; therefore there were no airborne takes of Steller sea lions (**Appendix F, Table 10**). Two Steller sea lions were observed swimming in the WRA (see **Figure 5**), but both of these sightings were during non-construction periods.

Table 13. All Harbor Porpoise Sightings

Sighting occurred during the EHW-1 PRP, when no construction was underway
Sighting occurred during the EHW-1 PRP, during construction
‡Incident represents a level B take

Date:	Sighting Time	# of Animals	Estimated Distance to Pile (m)	Monitoring Activity Type
6-Oct-11	08:16	4	2,800	New Sighting. Non-construction
6-Oct-11	11:06	1	2,875	New Sighting. Non-construction
6-Oct-11	16:28	3	2,200	New Sighting. Non-construction
6-Oct-11	17:30	2	2,200	New Sighting. Non-construction
7-Oct-11	**15:03**	**2**	**1,904**	**New Sighting. Soft Start ‡**
7-Oct-11	16:15	2	1,700	New Sighting. Non-construction
7-Oct-11	16:40	2	1,925	New Sighting. 30 minute pre-watch (Vibratory)
7-Oct-11	16:48	2	2,000	New Sighting. 30 minute pre-watch (Vibratory)
7-Oct-11	**16:59**	**2**	**2,314**	**Resighting. Soft Start (resighting of individuals seen at 16:48) ‡**
7-Oct-11	**17:01**	**2**	**3,000**	**Resighting. Vibratory pile driving (re-sighting of individuals seen at 16:48)**
7-Oct-11	**17:19**	**1**	**1,914**	**New Sighting. Vibratory pile driving ‡**
7-Oct-11	17:45	2	**1,950**	New Sighting. 30 minute post-watch (Vibratory)
15-Oct-11	09:28	3	4,000	New Sighting. Non-construction
17-Oct-11	14:20	3	2,500	New Sighting. Non-construction
TOTAL #OF INDIVIDUALS SIGHTED				**27 *(5 LEVEL B TAKE)***

Other Sightings

During marine mammal monitoring for the EHW-1 PRP, there was one sighting of the North American river otter (*Lontra canadensis*). The North American river otter is a mammal species that inhabits primarily freshwater rivers and terrestrial habitats. While it occasionally occurs in marine waters, the river otter is not managed under the MMPA or listed under the ESA. The North American river otter is under the jurisdiction of the United States Fish and Wildlife Service (USFWS). The individual was sighted on 27 October at a distance of 400 m (1,312 ft) from the pile during vibratory pile driving, with no apparent adverse reaction to construction activities.

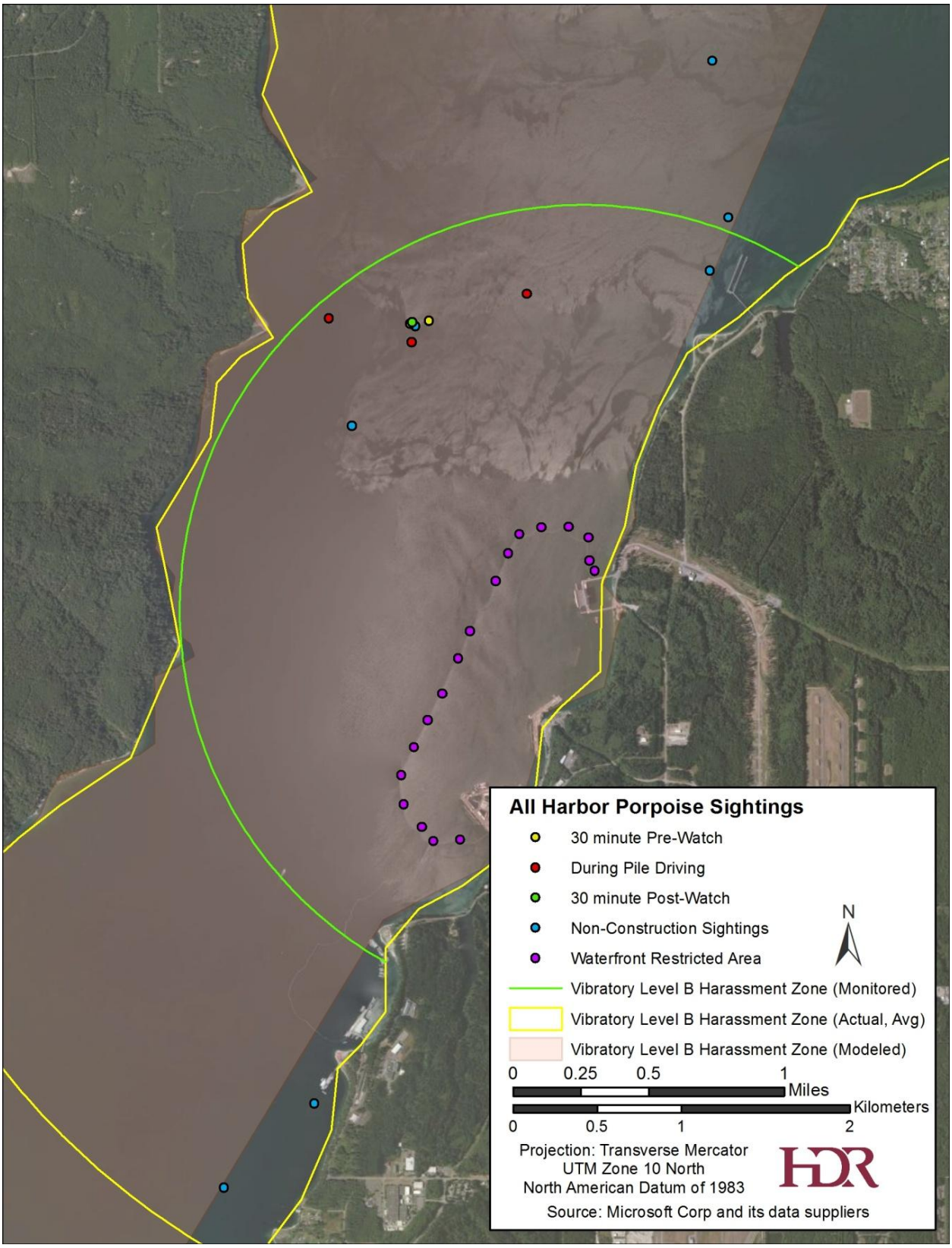


Figure 9. All Harbor Porpoise Sightings. Points may represent more than one individual.

Table 14. All Steller Sea Lion Sightings

Sighting occurred during the TPP project when no construction was underway
Sighting occurred during the EHW-1 project when no construction was underway
Sighting occurred during the EHW-1 project, during construction

Date	Sighting Time (hh:mm)	Project Name	# of Animal(s)	Est. Distance to Pile (m)	Monitoring Activity Type	Notes
8-Oct-11	13:20	TPP	1	N/A	No construction	New Sighting
10-Oct-11	17:15	EHW-1	1	1,400	30 minute post-watch	New Sighting. MMO notes indicate that this individual was hauled out on a submarine.
11-Oct-11	18:04	EHW-1	1	1,080	30 minute post-watch	New Sighting. MMO notes indicate that this individual was hauled out on a submarine and was identifiable because it was "very blonde"
11-Oct-11	18:10	EHW-1	1	1,450	30 minute post-watch	New Sighting. MMO notes indicate that this individual was hauled out on a submarine and was identifiable because it was a "very large individual" that "had small wound or scar in left corner of mouth and noticeably protruding front teeth."
12-Oct-11^	07:34	EHW-1	1	N/A	No construction	New Sighting
12-Oct-11	07:48	EHW-1	2	N/A	No construction	New Sighting
12-Oct-11	07:48	EHW-1	1	N/A	No construction	Resighting. Individual judged to be a resighting of the individual at 07:34 based on MMO notes, a continuation of the same sighting number, and timeframes associated with sightings.
12-Oct-11	09:10	EHW-1	1	N/A	No construction	Resighting. Individual judged to be a resighting of one of the individuals at 07:48 based on MMO notes, a continuation of the same sighting number, and timeframes associated with sightings.
12-Oct-11	09:20	EHW-1	1	N/A	No construction	Resighting. Individual judged to be a resighting of one of the individuals at 07:48 based on MMO notes, a continuation of the same sighting number, and timeframes associated with sightings.
12-Oct-11	18:28	EHW-1	1	1,500	30 minute post-watch	New Sighting. MMO notes indicate that this individual was hauled out on a submarine and was identifiable because it was a "large Steller."

Date	Sighting Time (hh:mm)	Project Name	# of Animal(s)	Est. Distance to Pile (m)	Monitoring Activity Type	Notes
13-Oct-11	14:40	EHW-1	1	1,300	30 minute post-watch	New Sighting. MMO notes indicate that this individual was hauled out on a submarine and was identifiable because of a brand showing "102Y."
14-Oct-11*	11:03	EHW-1	1	N/A	No construction	New Sighting
14-Oct-11	11:23	EHW-1	1	N/A	No construction	Resighting. This individual was sighted by a different MMO than the sighting at 11:03. However, based on the MMO notes, focal follow data, and proximity of the MMO to the MMO who made the sighting at 11:03, this sighting is considered as a resighting of the same individual seen at 11:03.
14-Oct-11	16:40	EHW-1	1	2,000	30 minute pre-watch	New Sighting
15-Oct-11	07:47	EHW-1	1	N/A	No construction	New Sighting. Sighted Prior to beginning Monitoring effort. Therefore, not counted as sighting in summary tables. Last seen at 08:20 leaving area to south.
15-Oct-11	08:18	EHW-1	2	N/A	No construction	New Sighting
15-Oct-11	09:14	EHW-1	1	N/A	No construction	Resighting. MMO notes indicate that the individual swam from the north submarine to the south submarine. Considered a re-sighting of one of the two individuals seen at 08:18
15-Oct-11	09:53	EHW-1	1	N/A	No construction	New Sighting
15-Oct-11	12:29	EHW-1	1	2,000	30 minute pre-watch	Resighting. One of two individuals noted at 08:18. Identified by brand 102Y.
17-Oct-11	08:15	TPP	1	N/A	No construction	New Sighting
17-Oct-11	08:51	TPP	1	N/A	No construction	New Sighting
17-Oct-11	09:22	TPP	1	N/A	No construction	Resighting. MMO notes indicate that the same individual was seen swimming back and forth from one sub to the other throughout the day. Considered as a re-sighting of the same individual seen at 08:15.
17-Oct-11	10:11	TPP	1	N/A	No construction	Resighting. MMO notes indicate that the same individual was seen swimming back and forth from one sub to the other throughout the day. Considered as a re-sighting of the same individual seen at 08:15.

Date	Sighting Time (hh:mm)	Project Name	# of Animal(s)	Est. Distance to Pile (m)	Monitoring Activity Type	Notes
17-Oct-11	11:22	TPP	1	N/A	No construction	Resighting. MMO notes indicate that the same individual was seen swimming back and forth from one sub to the other throughout the day. Considered as a re-sighting of the same individual seen at 08:15.
17-Oct-11	11:27	TPP	1	N/A	No construction	Resighting. MMO notes indicate that the same individual was seen swimming back and forth from one sub to the other throughout the day. Considered as a re-sighting of the same individual seen at 08:15.
17-Oct-11	11:45	TPP	1	N/A	No construction	Resighting. MMO notes indicate that the same individual was seen swimming back and forth from one sub to the other throughout the day. Considered as a re-sighting of the same individual seen at 08:15.
17-Oct-11	12:07	TPP	1	N/A	No construction	Resighting. MMO notes indicate that the same individual was seen swimming back and forth from one sub to the other throughout the day. Considered as a re-sighting of the same individual seen at 08:15.
17-Oct-11	12:44	TPP	1	2,000	30 minute pre-watch	Resighting. MMO notes indicate that the same individual was seen swimming back and forth from one sub to the other throughout the day. Considered as a re-sighting of the same individual seen at 08:15.
17-Oct-11	12:48	TPP	1	2,000	30 minute pre-watch	Resighting. MMO notes indicate that the same individual was seen swimming back and forth from one sub to the other throughout the day. Considered as a re-sighting of the same individual seen at 08:15.
17-Oct-11	14:17	TPP	1	N/A	No construction	Resighting. MMO notes indicate that the same individual was seen swimming back and forth from one sub to the other throughout the day. Considered as a re-sighting of the same individual seen at 08:15.
18-Oct-11	08:15	TPP	1	N/A	No construction	New Sighting
19-Oct-11	07:50	TPP	1	N/A	No construction	New Sighting

Date	Sighting Time (hh:mm)	Project Name	# of Animal(s)	Est. Distance to Pile (m)	Monitoring Activity Type	Notes
19-Oct-11	09:48	TPP	1	910	30 minute pre-watch	Resighting. MMO notes indicate that the individual was resting until it entered the water and surfaced outside of the WRA at 09:48. Considered as a re-sighting of the same individual seen at 07:50. It left the area, and did not come back.
20-Oct-11	14:49	TPP	1	N/A	No construction	New Sighting
21-Oct-11	**15:39**	**EHW-1**	**1**	1330	**Vibratory pile driving‡**	**New sighting. MMO notes indicate that this was a "large Steller" that hauled out onto a submarine during vibratory driving. Construction shut-down.**
21-Oct-11	15:40	EHW-1	1	1,360	Between two hammer run times	New Sighting. MMO notes indicate that this was a "small Steller" that was hauled out on a submarine. Hammer was not on during sighting.
27-Oct-11	**09:56-10:05**	**EHW-1**	**2**	1,250	**Vibratory pile driving**	**New Sighting. MMO notes indicate that these individuals were hauled out on a submarine prior to and during pile driving activities.**
27-Oct-11	**10:07-10:11**	**EHW-1**	**2**	1,250	**Vibratory pile driving**	**Resighting. Considered as a resighting of the same individuals noted during the 09:56 to 10:05 timeframe because the MMO was watching the same location at all times, and MMO notes did not indicate that new individuals arrived on site. Animal was hauled out during pile driving activities.**
27-Oct-11	**10:15-10:20**	**EHW-1**	**2**	1,250	**Vibratory pile driving**	**Resighting. Considered as a resighting of the same individuals noted during the 09:56 to 10:05 timeframe because the MMO was watching the same location at all times, and MMO notes did not indicate that new individuals arrived on site. Animal was hauled out during pile driving activities.**
27-Oct-11	**10:23-10:28**	**EHW-1**	**2**	1,250	**Vibratory pile driving**	**Resighting. Considered as a resighting of the same individuals noted during the 09:56 to 10:05 timeframe because the MMO was watching the same location at all times, and MMO notes did not indicate that new individuals arrived on site. Animal was hauled out during pile driving activities.**

Date	Sighting Time (hh:mm)	Project Name	# of Animal(s)	Est. Distance to Pile (m)	Monitoring Activity Type	Notes
27-Oct-11	**11:26-11:36**	**EHW-1**	**2**	1,360	**Pile extraction**	**Resighting. Considered as a resighting of the same individuals noted during the 09:56 to 10:05 timeframe because the MMO was watching the same location at all times, and MMO notes did not indicate that new individuals arrived on site. Animal was hauled out during pile driving activities.**
27-Oct-11	11:47	EHW-1	2	1,360	Between two hammer run times	Resighting. Considered as a resighting of the same individuals noted during the 09:56 to 10:05 timeframe because the MMO was watching the same location at all times, and MMO notes did not indicate that new individuals arrived on site. Animal was hauled out. Hammer was not on during sighting.
27-Oct-11	**12:03-12:07**	**EHW-1**	**2**	1,360	**Pile extraction**	**Resighting. Considered as a resighting of the same individuals noted during the 09:56 to 10:05 timeframe because the MMO was watching the same location at all times, MMO notes did not indicate that new individuals arrived on site. Animal was hauled out during pile driving activities.**
TOTAL #OF INDIVIDUALS SIGHTED PER PROJECT					**TPP: 6 (*NO LEVEL B TAKES*)**	
					EHW-1: 18 *(1 LEVEL B TAKE)*	

Notes:

^First day of marine mammal counts at Delta Pier.

‡Incident represents a level B take; fell within the measured 120 dB RMS behavioral harassment zone for vibratory pile driving

*First day of Steller sea lion focal follow data collection at Delta Pier.

Marine Mammal Sightings and Environmental Conditions

Perhaps not surprisingly, most marine mammal sightings were made in calm conditions with low wave height (**Figures 10a** and **10b)**. Ninety-five percent (465 of a total 491) of marine mammal sightings were made during Beaufort sea state conditions of 0-2 (winds at or below 6 knots) (see **Appendix A** for the Beaufort scale). Marine mammal surveys were conducted during sea states no greater than Beaufort 5 (winds at or below 21 knots), and there were zero sightings made in a Beaufort sea state of 5. Ninety percent (444 of a total of 491) of sightings were made when weather conditions were overcast (OC), partly cloudy (PC), or sunny (S). More marine mammals were observed during partly cloudy and overcast conditions than in sunny conditions, likely because of reduced glare on the water. (Note: animal resightings were included in this analysis, since all sightings were considered to be of interest in relation to environmental variables. Therefore, the total number of sightings indicated is slightly higher than the sightings total shown in **Table 6**).

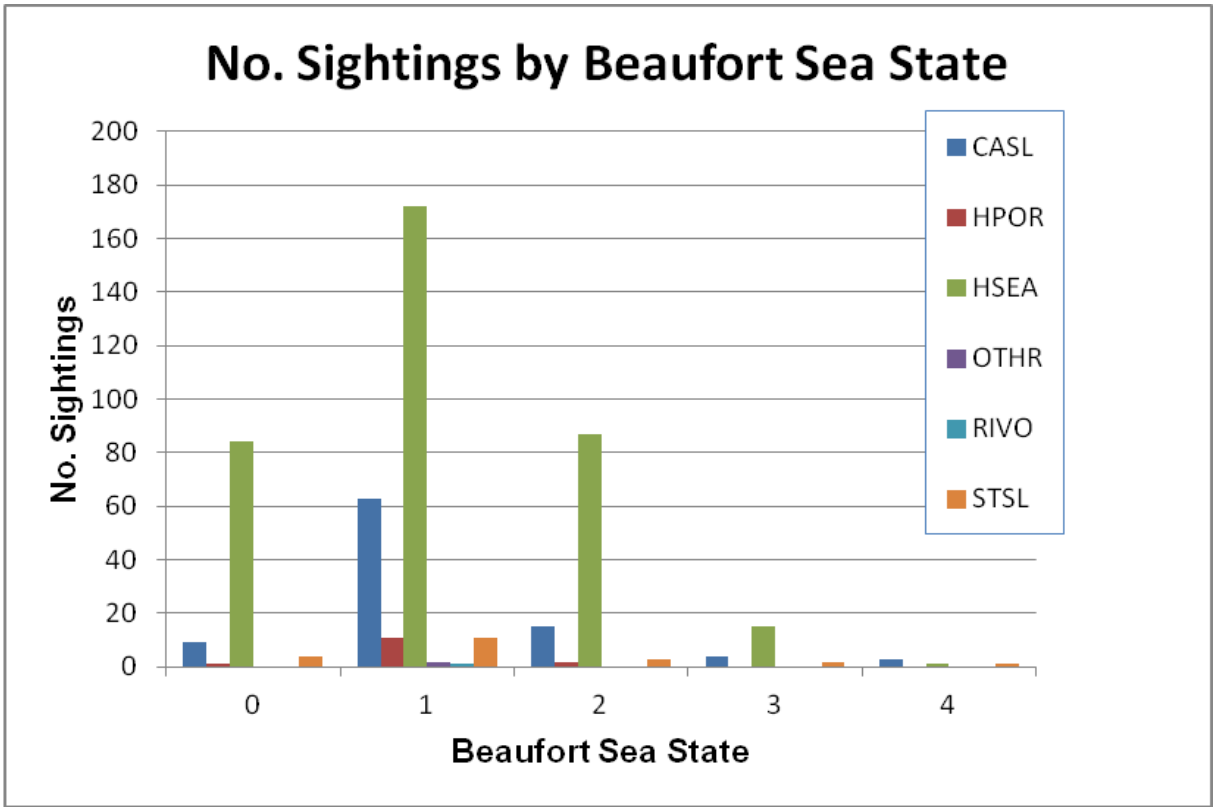


Figure 10a. Number of Sightings by Sea State Condition

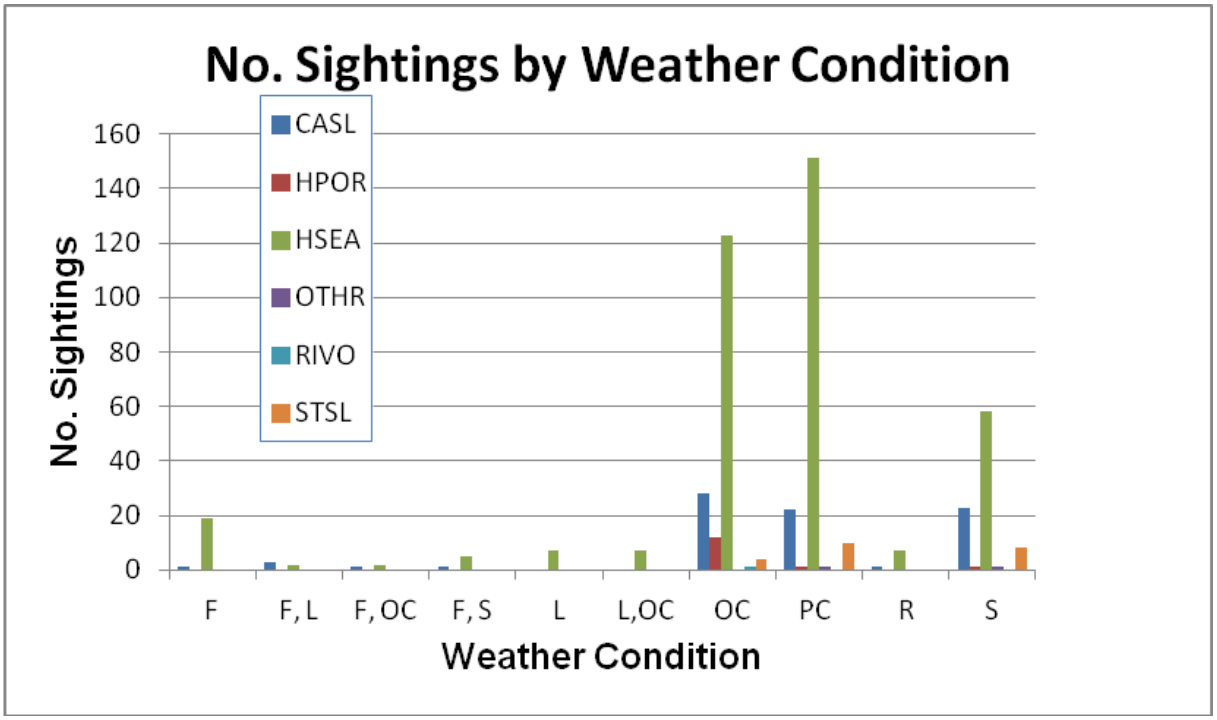


Figure 10b. Number of Sightings by Weather Condition

Marine Mammal Behavior During the EHW-1 PRP

Quantitative Analysis.

Marine mammal behavior was recorded during both construction and non-construction periods (**Appendix E**), and was analyzed by: (1) distance from the pile (during construction only), (2) construction vs. non-construction periods, (3) pre-, during, and post-watch periods, and 4) type of construction activity. Note that animals may have been engaged in one or more behaviors during a given sighting. Behavior codes are found in **Appendix D**.

The only cetacean observed during the EHW-1 PRP was the harbor porpoise. During the 12 cetacean sightings, four types of behaviors (*n*=17) were recorded. During the monitoring effort (construction and non-construction periods), cetaceans were most often observed "swimming" (*n*=12; 70.6%) (**Figures 11** and **12**).

Pinnipeds observed during the EHW-1 PRP were the harbor seal, California sea lion, and Steller sea lion. During the 364 combined pinniped species sightings, 16 types of behaviors (*n*=859) were recorded. During the monitoring effort (construction and non-construction periods), pinnipeds were most frequently observed "swimming" (*n*=182; 21.2%), "diving" (*n*=170; 19.8%), "looking" (*n*=149; 17.3%), and "sinking" (*n*=99; 11.5%) (**Figures 13** and **14**).

Analysis of Behavior by Distance from Pile. Behavior was analyzed as a function of distance from pile for sightings made during monitoring of construction activities (refer to **Appendix E**). Distance categories for the monitored zones for analyses were: (1) the shutdown zone (50 m [164 ft]); the 51 m to 6,000 m (167 to 19,685 ft) behavioral harassment zone (buffer zone); and the area beyond 6,000 m (19,685 ft or 6,562 yards).

Cetaceans

There were three cetacean sightings that occurred during construction activity (**Table 15**; green shaded lines in **Appendix E**). None of these sightings occurred within the shutdown zone (50 m [164 ft]). All cetacean sightings during construction activity were in the monitored buffer zone (Level B behavioral harassment) at distances of 51 to 6,000 m (167 to 19,685 ft) from the pile (**Table 15**). The only observed cetacean behaviors during construction activity were "swimming" (*n*=3; 75%) and diving (*n*=1; 25%) (**Table 15**). No cetacean sightings were recorded during construction activities beyond the monitored buffer zone for vibratory pile driving.

Pinnipeds

There were 114 pinniped sightings that occurred during construction activity (**Table 16**; green shaded lines in **Appendix E**). Observations included behaviors within all zones of the construction area, but not beyond the average 5.4 km buffer (Level B harassment) zone. There were 17 pinniped sightings within the 50m (164ft) safety zone during construction activity, with a total of 19 records encompassing six types of behavior. The most common pinniped behaviors within 50 m (164 ft) of piles were "looking" (*n*=6; 3.9%) and "diving" (*n*=5; 3.25%) (**Table 16**). There were 97 pinniped sightings in the buffer zone between 51 and 6,000 m for a total of 128 records encompassing 13 types of behavior. The most common pinniped behaviors between 51 and 6,000 m of piles were "swimming" (*n*=25; 16.23%), "looking" (*n*=24; 15.58%), and "diving" (*n*=21; 13.63%) (**Table 16**). No pinniped sightings were recorded during construction activities beyond the monitored buffer zone for vibratory pile driving.

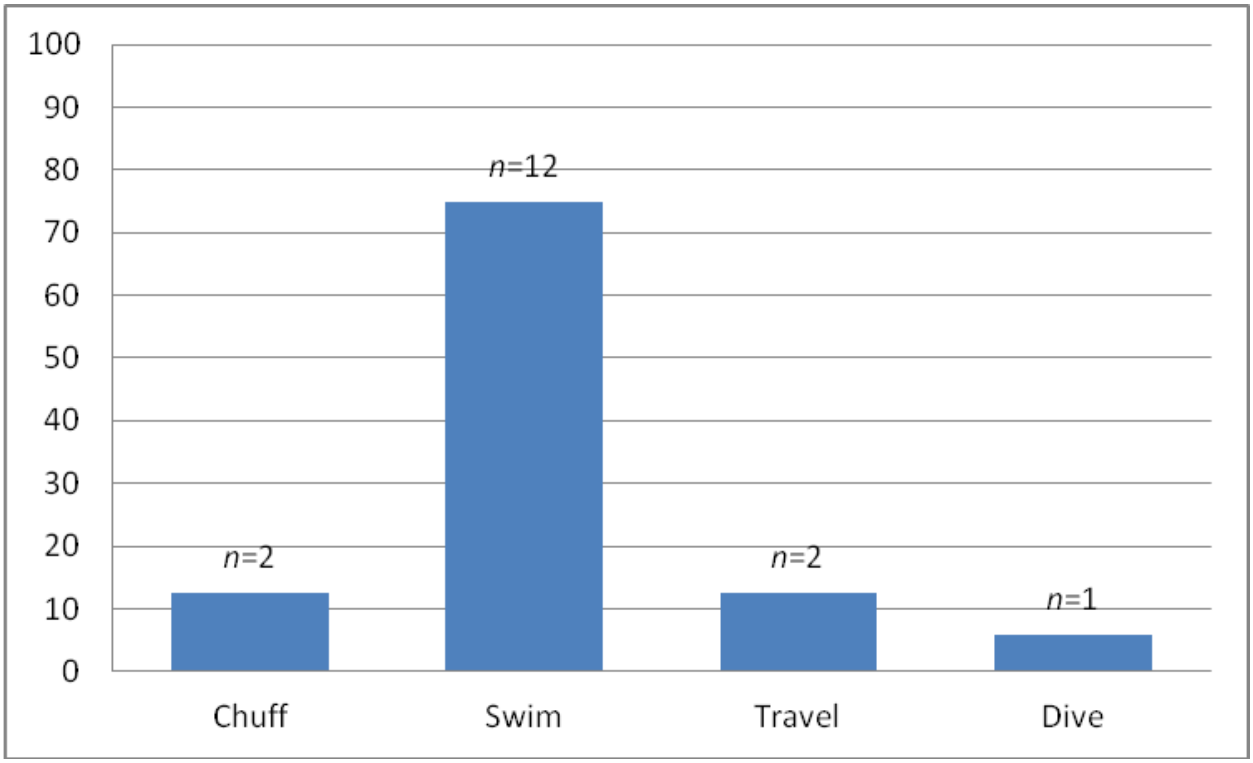


Figure 11. Observed Cetacean Behaviors

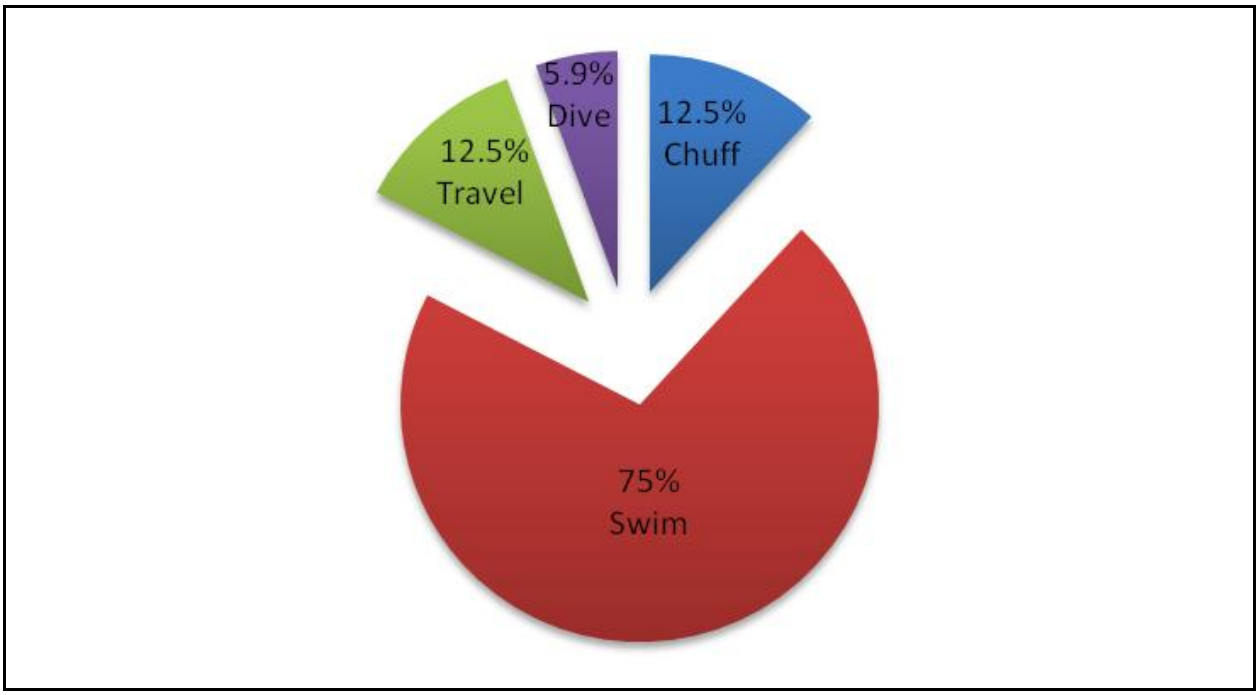


Figure 12. Observed Cetacean Behaviors (Percent of Total)

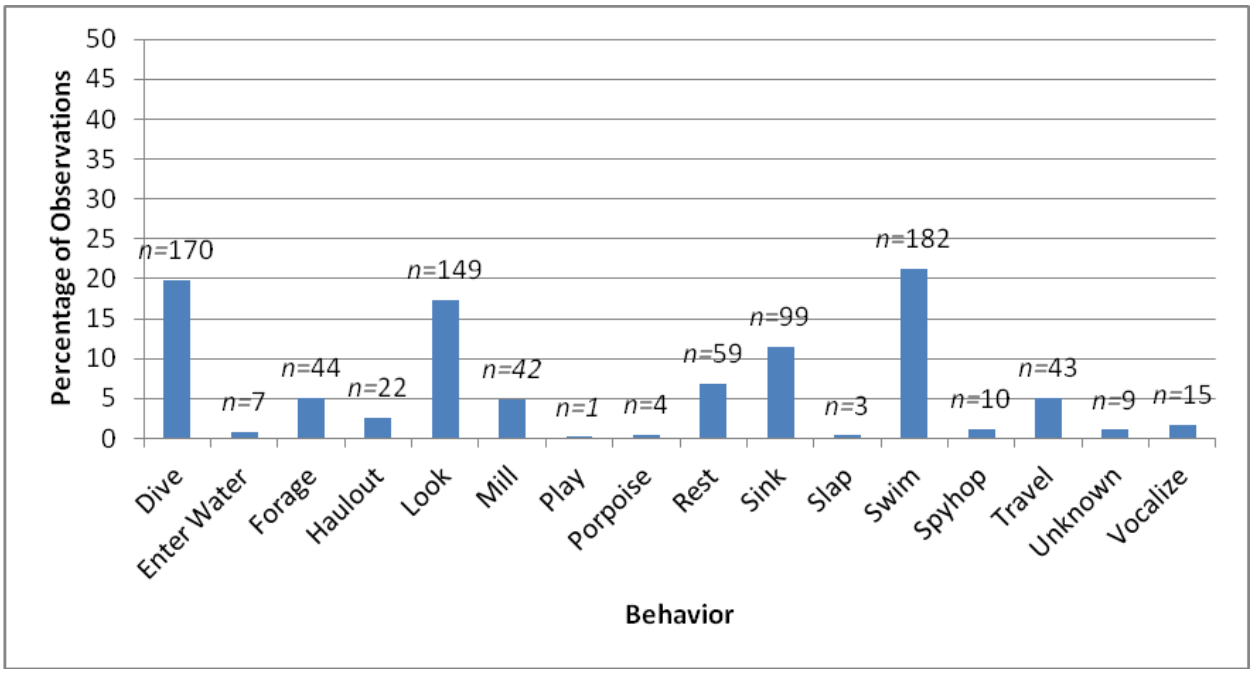


Figure 13. Observed Pinniped Behaviors

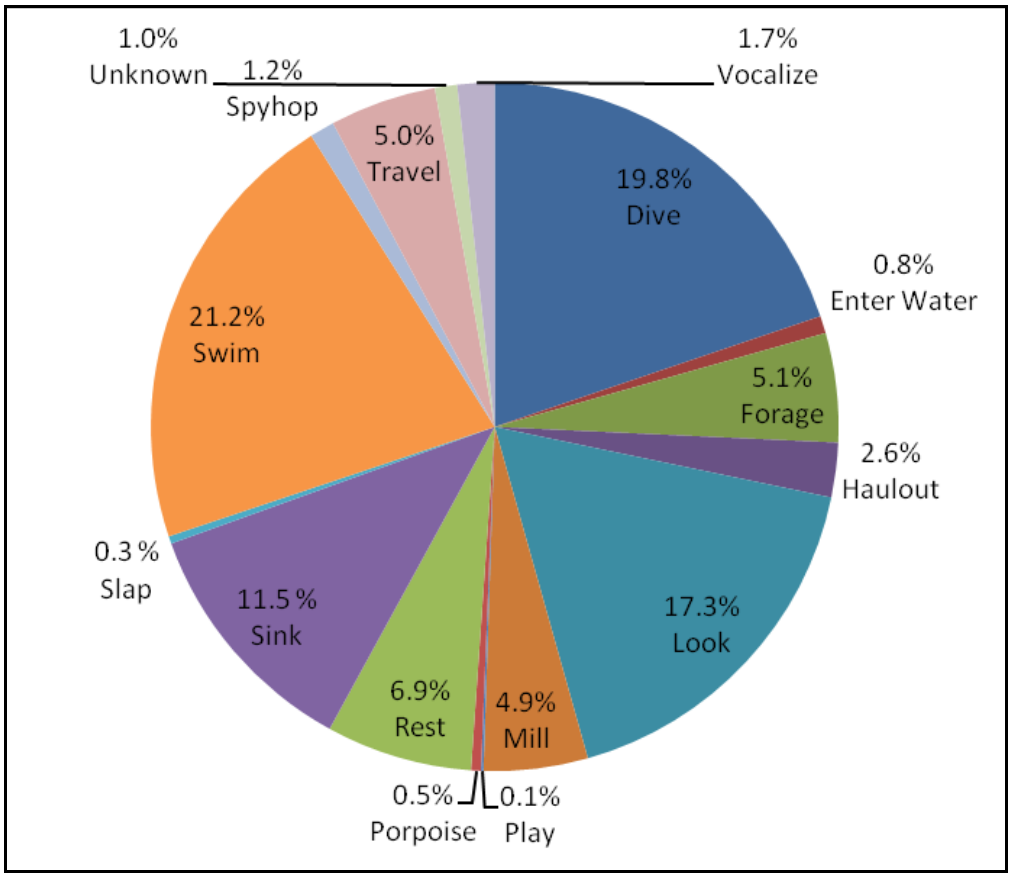


Figure 14. Observed Pinniped Behaviors (Percent of Total)

Table 15. Cetacean Behaviors by Distance from Pile (During Construction Activity Only)

Behavior	Distance from Pile				
	Percent Among Distances Bins [percent (*n*)]				
	0-50 m	End of Shutdown Zone	51-6,000 m	End of Buffer Zone	>6,000 m
Swim	0 (0)		75 (3)		0 (0)
Dive	0 (0)		25 (1)		0 (0)

Note: [1] Observations in the table only include those activities for which distances to the nearest pile were known. Any observations with unknown distances were not included in the analysis.

Table 16. Pinniped Behaviors by Distance From Pile[1] (During Construction Activity Only)

Behavior	Distance from Pile				
	Percent Among Distances Bins [percent (*n*)]				
	0-50 m	End of Shutdown Zone	51-6,000 m	End of Buffer Zone	>6,000 m
Dive	3.25 (5)		13.63 (21)		0 (0)
Enter Water	0 (0)		2.60 (4)		0 (0)
Forage	0.65 (1)		1.30 (2)		0 (0)
Haulout	0 (0)		3.24 (5)		0 (0)
Look	3.90 (6)		15.58 (24)		0 (0)
Mill	0 (0)		5.19 (8)		0 (0)
Play	0 (0)		0.65 (1)		0 (0)
Rest	0 (0)		4.55 (7)		0 (0)
Sink	1.95 (3)		11.69 (18)		0 (0)
Slap	0 (0)		0.65 (1)		0 (0)
Swim	1.95 (3)		16.23 (25)		0 (0)
Travel	0 (0)		6.49 (10)		0 (0)
Unknown	0.65 (1)		1.30 (2)		0 (0)
Vocalize	0 (0)		4.55 (7)		0 (0)

Note: [1] Observations in the table only include those activities for which distances to the nearest pile were known. Any observations with unknown distances were not included in the analysis.

Analysis of Construction Versus Non-Construction. Animal behavior recorded during construction periods was compared to information collected during non-construction periods.

Cetaceans

For cetaceans, "traveling" only occurred during non-construction periods. "Chuffing" and "diving" occurred only during construction activities. "Swimming" appeared to be unaffected by the occurrence of construction activities (**Table 17**).

Table 17. Cetacean Behaviors Observed During Construction Versus Non-Construction Periods During EHW-1 PRP

Behavior	Construction? [percent (*n*)]	
	No	Yes
Chuff	0 (0)	11.8 (2)
Swim	29.4 (5)	41.2 (7)
Travel	11.8 (2)	0 (0)
Dive	0 (0)	5.9 (1)

Pinnipeds

During non-construction period monitoring, MMOs most commonly observed pinnipeds "sinking" (*n*=238; 21.98%), "looking" (*n*=221; 20.41%), and "swimming" (*n*=188; 17.36) (**Table 18**). The most common pinniped behaviors during construction were "swimming" (*n*=37; 3.42%) and "looking" (*n*=35; 3.23%) (**Table 18**). The majority of observed pinniped behaviors decreased from non-construction to construction periods. "Chuffing" and "entering the water" remained the same between both periods. There were increases in "change direction," "flushing," and "unknown" from the non-construction period to construction period.

Analysis of Behavioral Observations Made Before, During, and After Construction.

Marine mammal behaviors were documented for sightings that occurred during the 30-minute construction pre-watch; during construction activity; and during the 30-minute construction post-watch – before, during, and after construction activity, respectively (refer to **Appendix E**).

Cetaceans

The most common cetacean behavior during construction activities was "swimming" (before [*n*=2; 0.2%]; during [*n*=4; 0.4%]; after [*n*=1; 0.1%] pile driving). "Chuffing" occurred before and after pile driving (each *n*=1; 0.1%). Occurrence of "swimming" decreased post-construction in relation to pre-construction. "Swimming" behaviors increased during construction (**Table 19**, **Figure 15**).

Pinnipeds

Pinnipeds were most often "looking" (*n*=6; 3.9%) and "milling" (*n*=4; 2.6%) during the 30-minute before pile-driving period (**Table 20, Figure 16**). During pile driving, pinnipeds most often were "swimming" (*n*=24; 15.5%), "looking" (*n*=23; 14.8%), and "diving" (*n*=19; 12.3%). During the 30-minute after pile driving period, pinnipeds were most often "looking" (*n*=7; 4.5%), "sinking" (*n*=6; 3.9%), and "diving" (*n*=4; 2.6%).

Table 18. Pinniped Behaviors Observed During Construction Versus Non-Construction Periods During EHW-1 PRP

Behavior	Construction Variable [percent (*n*)]	
	No	Yes
Breach	0.092 (1)	0 (0)
Change Direction	0.092 (1)	0.18 (2)
Chuff	0.28 (3)	0 (0)
Dive	9.05 (98)	2.40 (26)
Enter Water	0.18 (2)	0.18 (2)
Flush	0 (0)	0.092 (1)
Forage	0.83 (9)	0.092 (1)
Haul out	0.83 (9)	0.28 (3)
Look	20.41 (221)	3.23 (35)
Mill	1.85 (20)	0.28 (3)
Porpoise	0.18 (2)	0 (0)
Rest	7.11 (77)	0.92 (10)
Sink	21.98 (238)	2.77 (30)
Slap	0.46 (5)	0 (0)
Spyhop	0.37 (4)	0 (0)
Swim	17.36 (188)	3.42 (37)
Travel	3.14 (34)	0.74 (8)
Unknown	0.092 (1)	0.37 (4)
Vocalize	0.46 (5)	0.28 (3)

Table 19. Cetacean Behaviors Observed Before, During, and After Pile Driving Activities During EHW-1 PRP

Behavior	Percentages Among All Categories [percent (*n*)]		
	Before	During	After
Swim	20 (2)	40 (4)	10 (1)
Chuff	10 (1)	0 (0)	10 (1)
Dive	0 (0)	10 (1)	0 (0)

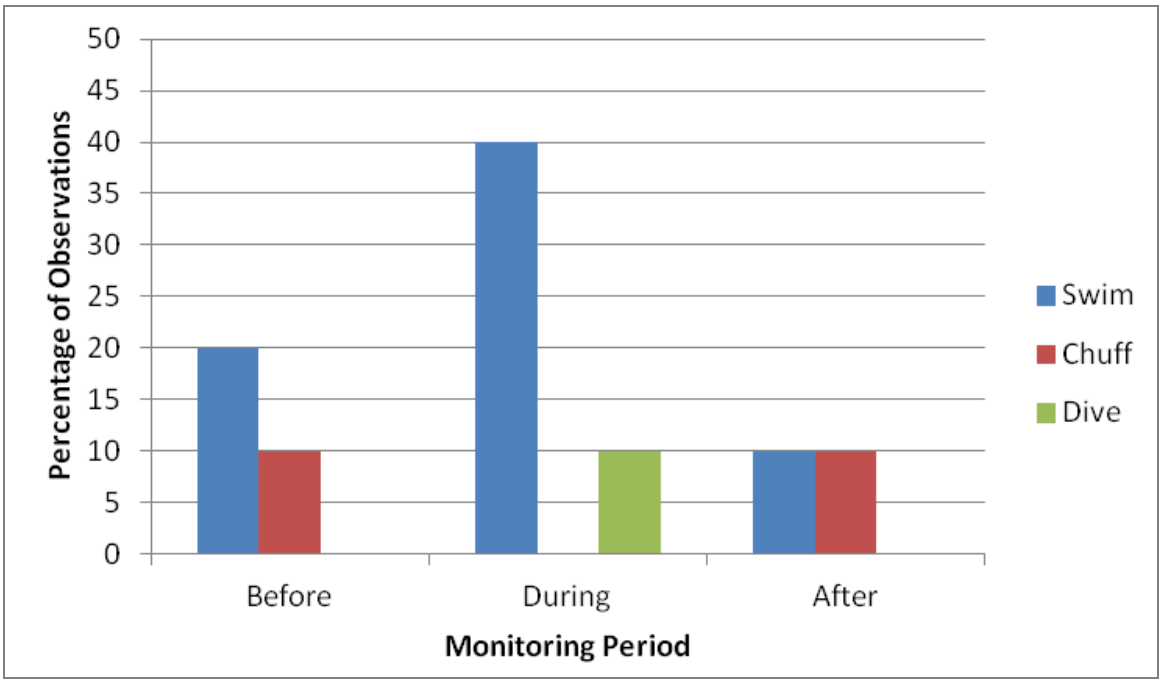


Figure 15. Cetacean Behaviors Before, During, and After Pile Driving

Incidences of "hauling out," and "milling" decreased during the post-construction period in relation to the pre-construction period. Most behaviors, such as "diving," "sinking," "vocalizing," "traveling," "resting," and "looking," increased post-construction in relation to pre-construction. "Entering the water," "diving," "traveling," "swimming," "slapping," "sinking," "resting," "looking," "foraging," "hauling out," and "vocalizing" increased during construction (**Table 20**, **Figure 16**).

Table 20. Pinniped Behaviors Before, During, and After Pile Driving

Behavior	Percentages Among All Categories [percent (*n*)]		
	Before	During	After
Dive	1.3 (2)	12.3 (19)	2.6 (4)
Enter Water	0 (0)	2.6 (4)	0 (0)
Forage	0 (0)	1.9 (3)	0 (0)
Haul Out	1.3 (2)	1.9 (3)	0 (0)
Look	3.9 (6)	14.8 (23)	4.5 (7)
Mill	2.6 (4)	2.6 (4)	0.6 (1)
Rest	0 (0)	2.6 (4)	1.3 (2)
Sink	1.9 (3)	3.9 (6)	3.9 (6)
Slap	0 (0)	0.6 (1)	0 (0)
Swim	1.9 (3)	15.5 (24)	1.9 (3)
Travel	0 (0)	6.5 (10)	1.3 (2)
Unknown	0 (0)	0 (0)	1.3 (2)
Vocalize	0.6 (1)	2.6 (4)	1.3 (2)

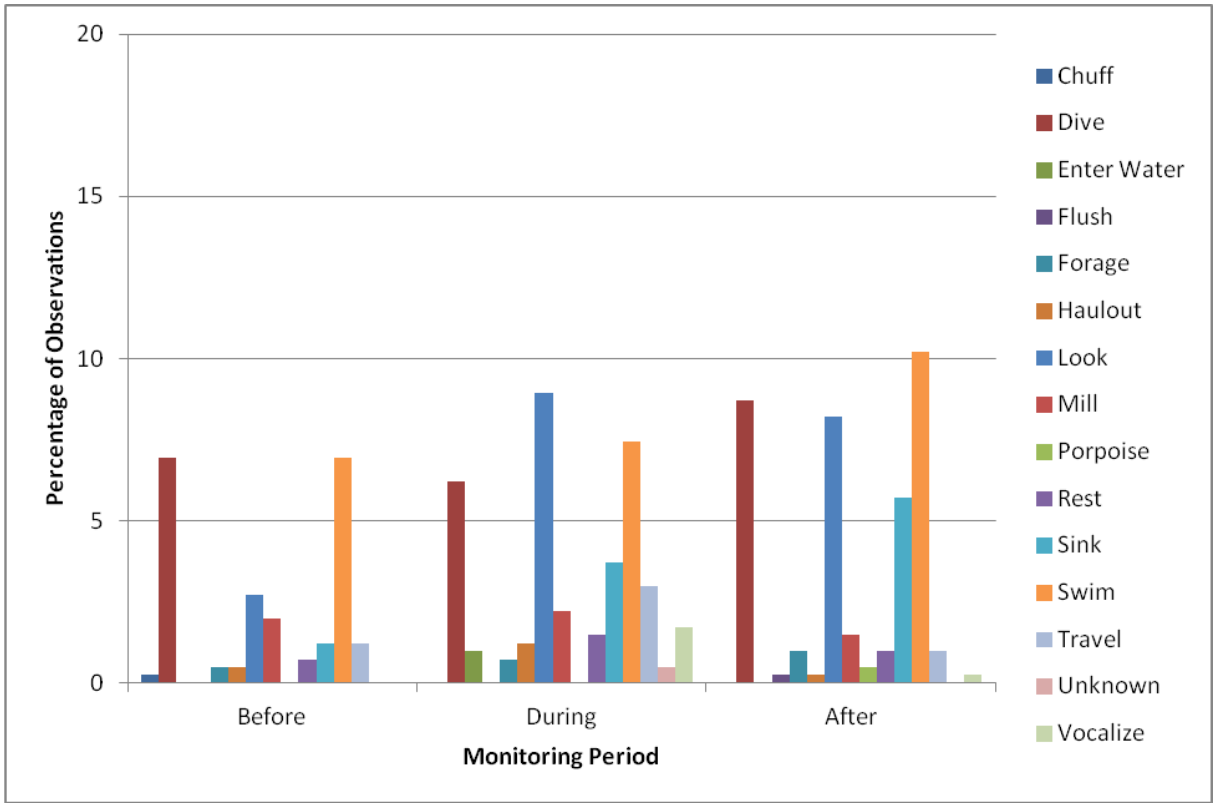


Figure 16. Pinniped Behavioral Events Observed Before, During, and After Pile Driving

Analysis of Behavior by Construction Type. Behaviors were compared for V and SSV to determine if behavior differed between these two types of construction.

Cetaceans

The only behavior for cetaceans during both SSV and V was "swimming." The only cetacean sighting during SSV was an individual "swimming" (**Table 21, Figure 17**). During V, cetaceans were most often "swimming" (*n*=3; 60%) (**Table 21, Figure 17**). "Diving" was only observed during V.

Table 21. Cetacean Behaviors by Construction Type

Behavior	Pile Driving Category [percent (*n*)]	
	SSV	V
	% Obs	% Obs
Swim	20 (1)	60 (3)
Dive	0 (0)	20 (1)

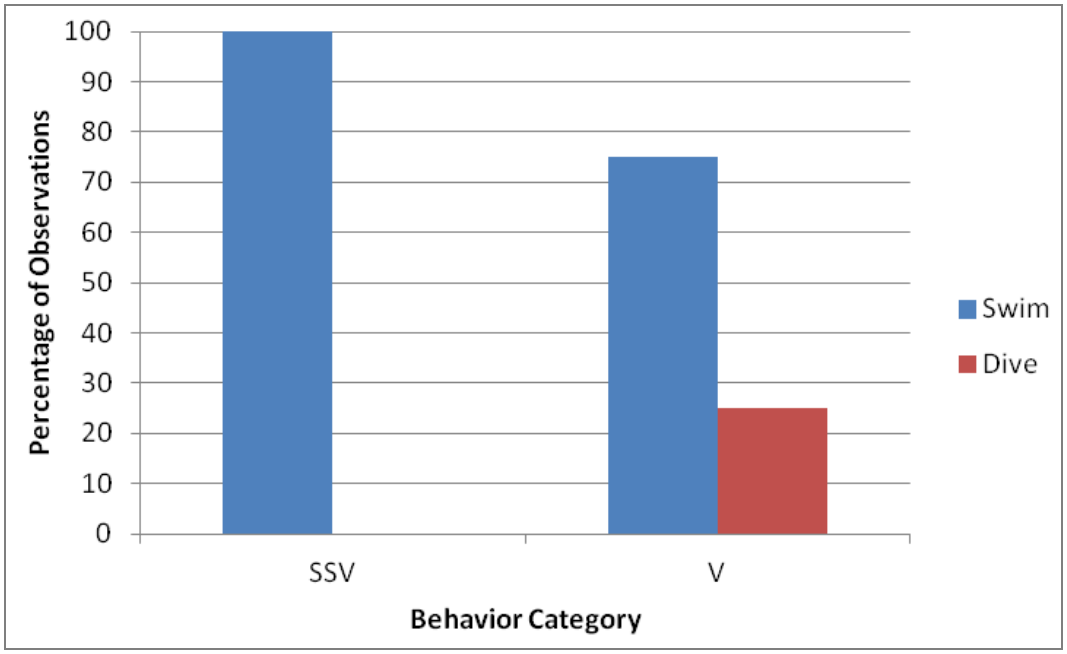


Figure 17. Cetacean Behaviors by Construction Type

Pinnipeds

During both SSV and V procedures, pinnipeds most often were "looking." During SSV procedures, pinnipeds were most often "looking" (*n*=6; 4.6%) and "milling" (*n*=4; 3.2%) (**Table 22, Figure 18**). During V, pinnipeds were most often "swimming" (*n*=24; 19.1%), "looking" (*n*=23; 18.3%), and "diving" (*n*=19; 15.1%). All behaviors were seen with greater frequency during V than SSV, including more "looking," "diving," "swimming," and "traveling" (**Table 22**, **Figure 18**).

Table 22. Pinniped Behaviors by Construction Type

Behavior	Percentages Among All Categories [percent (n)]	
	By Pile Driving Activity	
	SSV	V
Dive	1.6 (2)	15.1 (19)
Enter Water	0 (0)	3.2 (4)
Forage	0 (0)	2.4 (3)
Haul Out	1.6 (2)	2.4 (3)
Look	4.6 (6)	18.3 (23)
Mill	3.2 (4)	3.2 (4)
Rest	0 (0)	3.2 (4)
Sink	2.4 (3)	4.8 (6)
Slap	0 (0)	0.8 (1)
Swim	2.4 (3)	19.1 (24)
Travel	0 (0)	7.9 (10)
Vocalize	0.8 (1)	3.2 (4)

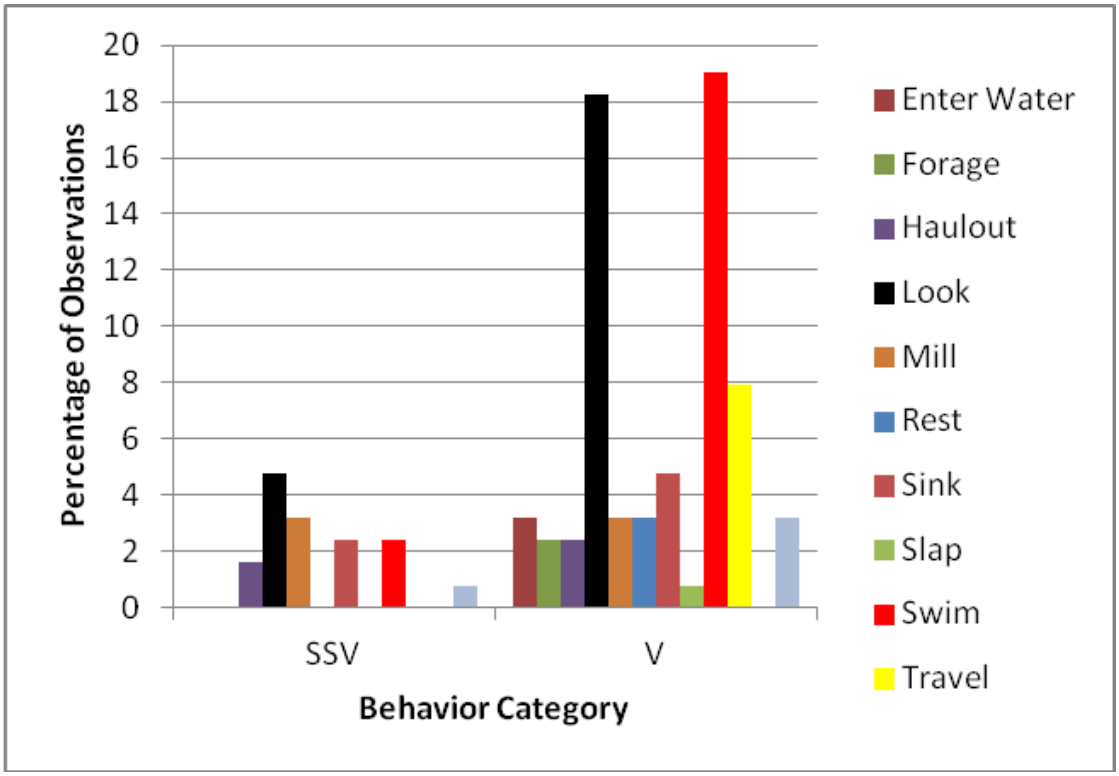


Figure 18. Pinniped Behaviors by Construction Type

Summary of Quantitative Analysis.

Because of the relatively small number of harbor porpoises observed during pile driving events, no clear cetacean behavior patterns emerged with distance from pile. Pinnipeds were more likely to engage in all activities as distance to the pile increased. There was an increase in cetacean and pinniped foraging behaviors during construction as compared to non-construction periods. Both cetaceans and pinnipeds were more likely to swim during construction, and pinnipeds were slightly more likely to enter the water, dive, look and forage during construction. Cetaceans were most commonly observed swimming before, during and after construction, and an increase in swimming activity was observed during construction as opposed to just before and just after construction. Pinnipeds most commonly dove, looked, traveled, sank and swam in conjunction with construction activities. A general increase in these activities was noted during actual construction, as opposed to just before and after construction periods. Pinnipeds were more likely to look, sink and dive just after construction as opposed to just before construction.

Pinnipeds and cetaceans were more often observed swimming during vibratory procedures than during other types of construction. Generally, more behavior categories were observed during vibratory pile driving, likely because this type of pile driving typically lasted longer than the soft starts to vibratory pile driving, which provided more opportunities to observe marine mammal behavior. Vibratory drives lasted up to 41 minutes, while most soft start events occurred only over a 3- to 4-minute timeframe. Therefore, there was typically more time to collect marine mammal observations during vibratory drives than during soft starts.

Qualitative Observations

In addition to the quantitative results presented above, MMOs made a number of qualitative observations on the movements and distribution of animals, and on the potential effects of driving activities on marine mammal behavior. Within the EHW-1 structure, which contains hundreds of pilings and a large overhead structure, MMOs documented the presence of at least two "resident" harbor seals, repeatedly observed and easily recognizable by their distinctive pelage patterns. These two animals, both juveniles, were constantly swimming into and out of the pile driving and construction areas, as well as within other portions of the EHW-1 structure. These two animals were observed during the entire duration of monitoring activities in EHW-1 PRP (approximately 4 weeks). Harbor seals spent more time in the vicinity of EHW-1 PRP, and their use of space and diving/surfacing patterns suggested that they were foraging, rather than simply transiting through the area. In addition, the two juvenile animals mentioned above were directly documented foraging in and near the construction zone on several occasions, either because they were observed with shells or fish in their mouths, or were seen nosing into the hard growth on the pilings.

Observations at EHW-1 involved multiple observations on a daily basis of one or both of the "resident" juvenile harbor seals within the 50m (164ft) shutdown zone, and at other locations within hundreds of meters from the piles. Additionally, EHW-1 repairs involved a number of other activities including welding; construction of scaffolding on newly driven piles; and the presence and movement of boats and barges within a confined area. Thus, the number of sightings available to develop qualitative observations was far greater, albeit with a smaller number of individual animals. Generally, the "resident' harbor seals showed little avoidance of any of the areas of noise or disturbance, and instead often surfaced in areas of activity and then remained either lying on their backs, or positioned vertically in the water, moving their heads back and forth scanning the activity area. After 10-20 seconds, they would then dive and either resurface in a new area or would not be resighted. The MMOs noted that these observations were consistent with an interpretation of animal curiosity about the activity being conducted.

As a consequence of seals frequently moving into and out of the 50m (164ft) shutdown zone, pile driving often did not begin and/or did not continue once initiated. Once the shutdown zone was "cleared" (i.e., no animal within 50 m (164 ft) for 30 minutes, or if within 50 m (164 ft) but then re-sighted outside the shutdown zone), animals seemed to keep from approaching the shutdown zone during soft start events and pile-driving activities. However, on a number of occasions they moved within 50 m (164 ft) of the pile, which resulted in a shutdown of pile driving. At no time were either distress behaviors or rapid flight observed. Once pile driving had ceased, the MMOs noted that animals moved back within 50 m (164 ft) of the pile that had been driven within a few minutes of pile driving cessation. Again, these animals were positively identified by pelage markings, and MMOs were confident that these animals tolerated multiple weeks of pile driving activities without abandoning the construction area, or without exhibiting distress or flight behaviors. Instead, animals maintained heavy use of the area, which may indicate their habituation, or indifference, to noise and disturbance. Other harbor seals were also observed within 100 m (328 ft) of pile driving locations before and during pile driving, with no visible distress signs or active flight behaviors. California sea lions were only occasionally sighted during monitoring at EHW-1 and were always in transit, generally moving from north to south. Transiting did not appear to be impaired or accelerated by the pile driving activities. In

addition, a number of California sea lions hauled out on the floating security fence before, during and after pile driving. In summary, MMOs had the general impression that neither harbor seals nor California sea lions were adversely affected by the pile driving activities at the EHW-1 PRP. Some animals were observed diving at the initiation of soft start, reemerging further away and continuing their movements. Multiple-week observations of two individual harbor seals suggested that these animals were drawn to the area by curiosity and did not appear to be repelled by marine noise or construction-related activities.

Section 4 Recommendations

1. Observational data collected during the EHW-1 PRP did not indicate any adverse reaction of marine mammals to pile driving activities. The harbor seal, which is the species that most heavily utilizes the WRA (in particular, the EHW-1 structure), did not appear to be affected by construction as it often came in the closest to investigate construction activities. Based on the observational data collected during the EHW-1 PRP, the standoff distances currently used for marine mammals may be overly conservative (i.e., overestimated), especially given that vibratory pile driving does not produce SPLs that would exceed the injury criteria within more than a few meters of the pile. A smaller shutdown zone (e.g., 10 m [33 ft] rather than the 50 m [164 ft] used during this project) should be utilized for future construction projects in this area. A shutdown zone of 10 m (33 ft) would prevent direct interactions with marine mammals and would be sufficient to avoid adverse behavioral reactions to pile driving activities. If feasible, differentiate the shutdown zone for pinnipeds versus cetaceans, because the acoustic criteria levels are different for these species, as is their use of the nearshore areas (i.e., inside the WRA) at NBK at Bangor.
2. The 1-minute pauses in between soft start sounds employed during this project may have been too long to send an effective warning to animals in the area. Longer breaks between the sounds may be interpreted by the animals as transient noise and may not serve the intended purpose of providing an indication that louder sounds from pile driving are about to begin. It is recommended that noise bursts during soft start events occur at 30-second intervals and with increasing intensity, as done for seismic surveys Soft start pauses should at least be shortened to 30 seconds, even if SPLs remain the same throughout soft start.
3. Due to the substantial effort and cost of monitoring the entire Hood Canal area, future monitoring efforts might effectively be confined to the shutdown zone and adjacent areas (i.e., inside the WRA fence) to document behavioral impacts to marine mammals.
4. Steller sea lion takes should be included in take permits for future construction projects in Hood Canal.
5. Further detailed analysis of harbor porpoise density, abundance and habitat use should be completed to provide updates to current available data.

Section 5 Acknowledgements

Thanks are due to Andrea Balla-Holden (NAVFAC NW) and Danielle Buonantony (NAVFAC LANT) for their support and organization of monitoring efforts; lead boat captain, Captain Lou Schwartz (Tetra Tech, Inc.); monitoring coordinators Jeff Barrett and Jason Stutes (Hart Crowser); and acousticians James Reyff and Keith Pommerenck (Illingworth and Rodkin).

Section 6 List of Preparers

Kristen Ampela, PhD
HDR
Project Manager and Chief Scientist

Todd McConchie
HDR
Data Analysis/Author

Cathy Bacon
HDR
Data Analysis/Author

Christopher McJetters
HDR
Technical Editor

Phil Thorson, PhD
HDR
Technical Reviewer

Cheryl Myers
HDR
Document Formatting and Production

Section 7 References

DeLong, R., and T. Loughlin. 2003. Survival/mortality of marked sea lions and food habits of sea lions in Oregon and California (02SSL-12). Page 30 in L. Fritz (compiler). Alaska Fisheries Science Center, Steller Sea Lion Research Reports, Fiscal Year 2002. AFSC Processed Report 2003-08. National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, Washington.

DoN (Department of the Navy). 2011. Final Environmental Assessment. Explosives Handing Wharf 1 Pile Replacement Project Naval Base Kitsap at Bangor Silverdale WA.

Eder, T., and I. Sheldon. 2001. Whales and Other Marine Mammals of Washington and Oregon. Auburn, Washington: Lone Pine Publishing.

HDR Inc. 2012. Naval Base Kitsap at Bangor Test Pile Program, Bangor, Washington. Final Marine Mammal Monitoring Report. Prepared for Naval Facilities Engineering Northwest, Silverdale, WA. April 2012.

NAVFAC (Naval Facilities Engineering Command). 2012. Naval Base Kitsap at Bangor EHW-1 Pile Replacement Project, Bangor, Washington. Final Acoustic Monitoring Report. Prepared by Illingworth & Rodkin. April 2012.

NMFS (National Marine Fisheries Service). 2011. Incidental Harassment Authorization to take small numbers of marine mammals, by Level B harassment only, incidental to a pile replacement project in the Hood Canal, Washington. Issued June 24, 2011.

NOAA (National Oceanic and Atmospheric Administration). 2008. Seal & sea lion facts of the Columbia River & adjacent nearshore marine areas. Accessed April 9, 2012 at: < http://www.nwr.noaa.gov/marine-mammals/seals-and-sea-lions/upload/cr-pinniped-fs.pdf>.

RMDT (Robert Miner Dynamic Testing) Inc. 2012. Hydroacoustic monitoring at the Explosives Handling Wharf No. 1, October 4 - 27, 2011, Naval Base Kitsap, Bangor, Washington. Report submitted to the Manson Construction and Engineering Company, April 27, 2012. 142 pp.

APPENDIX A

U.S. Navy EHW-1 Pile Replacement Program in Hood Canal Final Marine Mammal Monitoring Plan

U.S. Navy EHW-1 Pile Replacement Project
In Hood Canal

FINAL MARINE MAMMAL MONITORING PLAN

May 2011

TABLE OF CONTENTS

LIST OF FIGURES

APPENDIX

1.0 INTRODUCTION

The purpose of this survey plan is to monitor for the presence of marine mammals in the vicinity of the proposed EHW-1 Pile Replacement Project at the Naval Base Kitsap (NBK) at Bangor, WA waterfront. These surveys will be conducted before, during, and after pile driving and removal activities, within the areas that are estimated to be encompassed by the airborne and underwater injury or behavioral disturbance thresholds. Real-time acoustic monitoring (see Navy's Acoustic Monitoring Plan) will be used to determine the distances to the injury and behavioral disturbance zone isopleths and the visual marine mammal monitoring survey protocols will be adjusted accordingly (either larger or smaller survey areas) to encompass the actual zones of influence.

2.0 ACTION AREA

The action area includes "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action" (50 CFR § 402.02). Specifically, the action area is defined as the geographic extent of physical, biological, and chemical effects of the action above baseline conditions. The action area boundary takes into account how the action's physical, chemical, and biotic effects (stressors) move across the landscape, through direct and indirect pathways, over time, to identify the spatial and temporal scale of the action area (USDI et al. 2008; ODOT 2006; WSDOT 2008).

Underwater noise from vibratory pile driving was the stressor identified to have the furthest geographic distribution above ambient conditions. The EHW-1 Pile Replacement Project will generate both airborne and underwater sound from impact and vibratory pile driving and pneumatic chipping. To determine which noise effect extended the furthest, attenuation was modeled and compared to ambient levels. The ambient noise levels at NBK at Bangor were previously measured over a one month period in the summer of 2007 (July 10 – Aug 14) (Slater 2009). No other baseline underwater noise measurements have been taken at NBK at Bangor. The underwater sound measurements were conducted at several locations in the vicinity of the project area. The location closest to the project area, designated as Marginal Wharf in the report, recorded data from two hydrophones deployed 300-500 feet north of the Marginal Wharf. Recordings were made 5 minutes per hour throughout the entire study period (Slater 2009). Average underwater broadband ambient noise levels near the project site were 114 dB RMS re at 1 microPascal (dB re 1µPa) between 100 hertz (Hz) and 20 kilohertz (kHz). Airborne noise levels at the NBK at Bangor waterfront in the daytime ranged between 60 and 104 dBA (decibels in the A-weighted scale) and averaged 64 dBA; night levels ranged between 64 and 96 dBA, averaging 64 dBA, consistent with other urbanized environments where equipment is operating.

Using the practical spreading loss model for transmission (15 log), it was determined that underwater sound from vibratory pile driving was the stressor identified to have the furthest geographic distribution to be distinguishable above ambient conditions. Sound generated from vibratory pile driving would intersect land masses (e.g., Toandos Peninsula) prior to attenuating to measured background levels. As such, the geographic boundary of the Action Area was defined by the line-of-sight intersection of land and water and is shown on Figure 1.

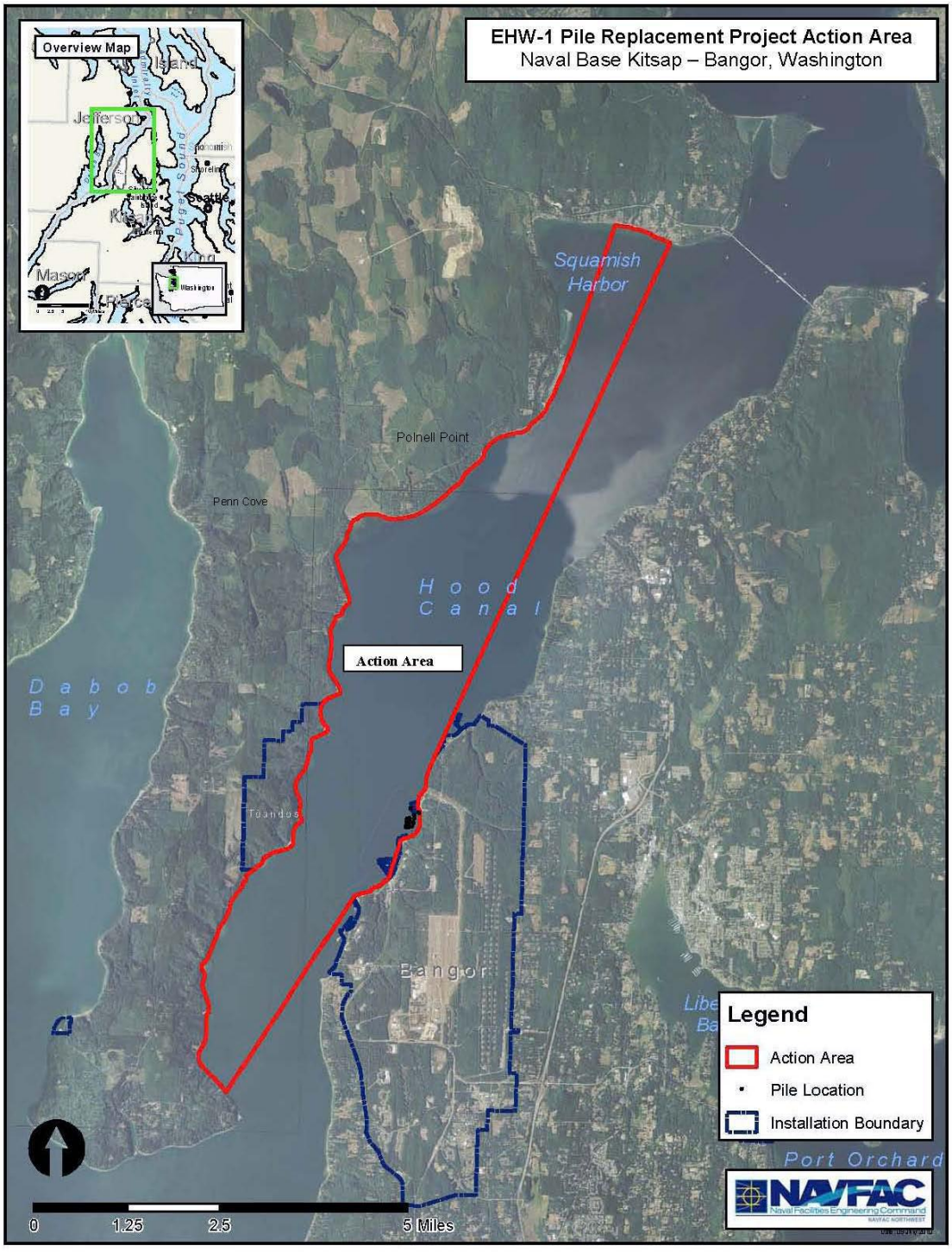


Figure 1. EHW-1 Pile Replacement Action Area

The EHW-1 Pile Replacement project involves the installation and removal of piles of different sizes and composition (i.e. steel and concrete), as well as the use of different installation and removal methodologies. As a result, in developing the monitoring plan for marine mammals for the EHW-1 Pile Replacement Project the shutdown and buffer zones were based on the pile type, size, and installation/removal methodologies either in-air or underwater which would have the largest zone of influence. The largest zones of influence was determined to occur during the installation of the twenty eight steel pipe piles. As a result, only the figures and distances relative to the NMFS established thresholds during steel pile installation are provided in the remainder of the monitoring plan (see Figures 2 – 5).

The distances to and the area encompassed by the underwater noise thresholds for cetaceans from impact and vibratory pile driving during steel pile installation are shown in Figure 2.

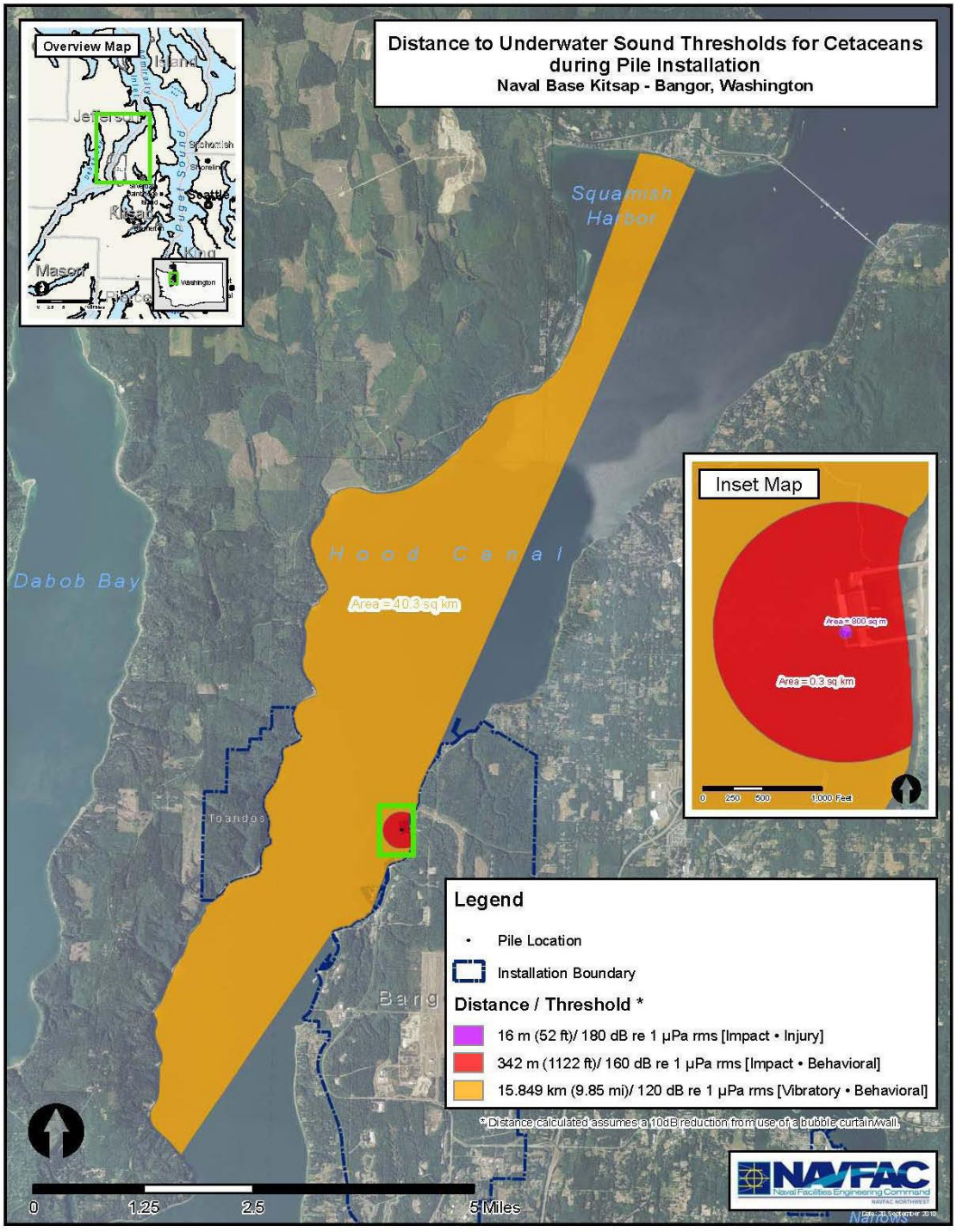


Figure 2. Distance to NMFS Underwater Noise Thresholds for Cetaceans

Figures 4 and 5 indicate the airborne noise thresholds for harbor seals and other pinnipeds, respectively, from impact and vibratory pile driving during steel pile installation.

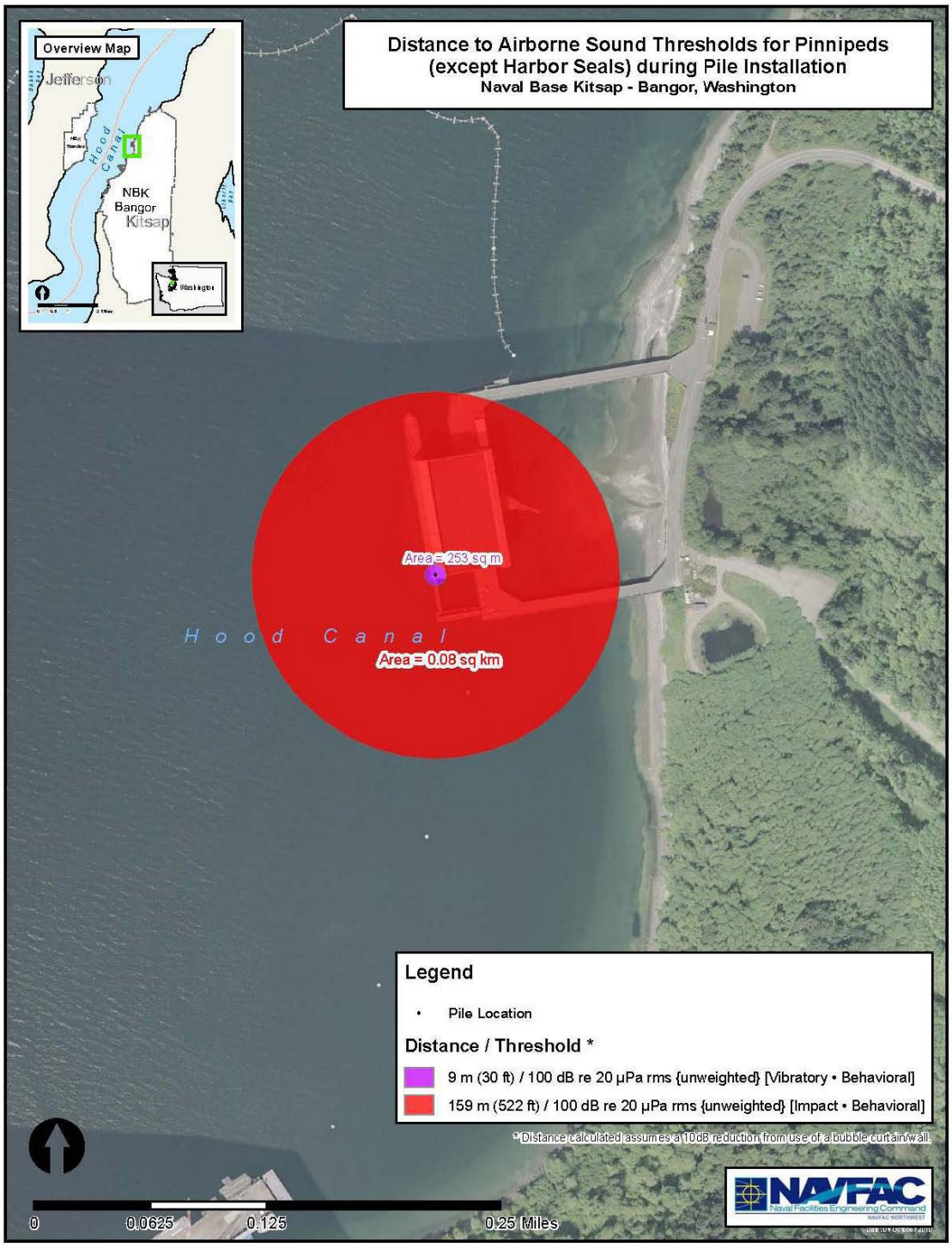


Figure 4. Distance to NMFS Airborne Noise Thresholds for Pinnipeds

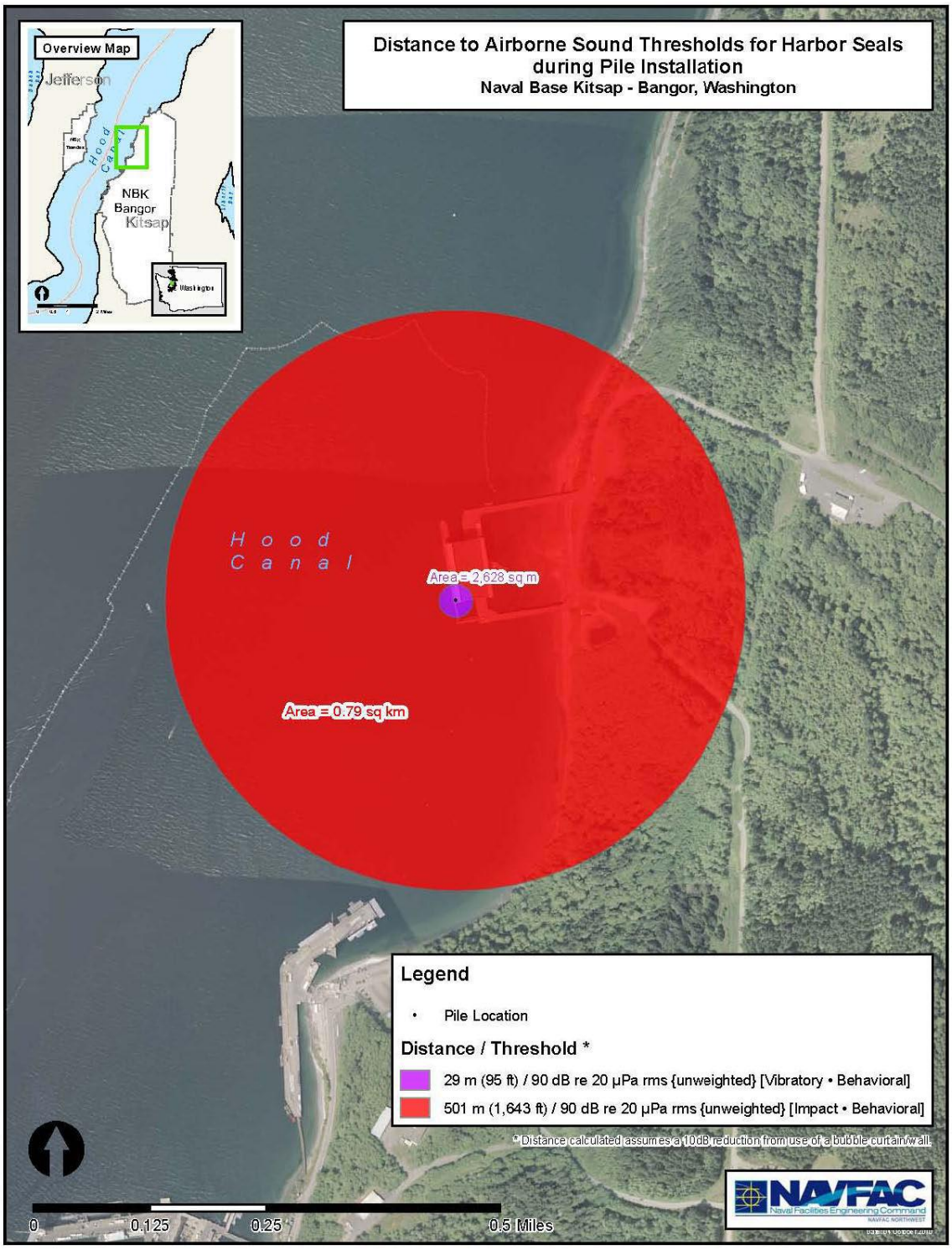


Figure 5. Distance to NMFS Airborne Noise Thresholds for Harbor Seals

3.0 METHODOLOGY

3.1 OBSERVER QUALIFICATIONS

All observers will be experienced biologists with training in marine mammal identification and behaviors. Trained observers have specific knowledge of marine mammal physiology, behavior, and life-history, which may improve their ability to detect individuals or help determine if observed animals are exhibiting behavioral reactions to construction activities. The observers will have no other construction related tasks while conducting monitoring.

3.2 DATA COLLECTION

The marine mammal observers (MMOs) will use the NMFS-approved Marine Mammal Sighting Form (Appendix A) which will be completed by each observer for each survey day. The following information will be collected on the sighting form.

- Date and time that pile driving begins or ends;
- Construction activities occurring during each observation period;
- Weather parameters identified in the acoustic monitoring (e.g. wind, humidity, temperature);
- Tidal elevation and direction of change, sea state, and water currents: The Beaufort Sea State Scale (Appendix B) will be used to determine sea-state.
- Visibility
- Species, numbers, and if possible, sex and age class of marine mammals;
- Marine mammal behavior patterns observed, including bearing from observer and direction of travel. If possible, include the correlation to sound pressure levels for context;
- Distance from pile driving activities to marine mammals and distance from the marine mammal to the observation point;
- Locations of all marine mammal observations;
- Other human activity in the area.

3.3 EQUIPMENT

The following equipment will be required to conduct marine mammal monitoring:

1. Survey boats with elevated platforms (with depth finder/ measuring tape, range finder, navigational plotting equipment, and GPS Units)
2. Hearing protection for biologists in the airborne impact injury zone
3. Portable radios to communicate with the Pile Driving Engineer Lead and other observers
4. Cellular phones (one per boat and for each land observer) with contact information for the other observers (boats/land), Pile Driving Engineer Lead, and NMFS point of contact.
5. Green flags (one per boat/land observer) as back-up for radio communication
6. Red flags (one per boat/land observer) as back-up for radio communication
7. Nautical charts
8. Daily tide and current tables for the project area within the Hood Canal
9. Steel-cased thermometer or an equivalent electronic instrument (YSI) with underwater temperature probe

10. Watch or Chronometer
11. Binoculars with built-in rangefinder or reticles (quality 7 x 50 or better)
12. Monitoring plan and equipment list in sealed clear plastic cover
13. Notebook with pre-standardized monitoring Marine Mammal Observation Record forms on non-bleeding paper
14. Marine mammal visual guides encased in clear plastic
15. Large zip-lock bags
16. Clipboard / Tatum
17. Pen / Pencil

3.4 SHUTDOWN AND BUFFER ZONES

The acoustic modeling results presented within the Environmental Assessment and the request for an Incidental Harassment Authorization were used to develop the shutdown and buffer zones for pile installation and removal activities associated with the EHW-1 Pile Replacement Project. While the acoustic zones of influence vary between the different types and diameter piles and types of installation and removal methodologies, the Navy established monitoring zones – shutdown and buffer zones - based on the maximum zone of influence for all pile installation and removal activities (see analysis in compliance documents for details). The monitoring zones were created to delineate areas that are important to species that are sensitive to the proposed action. Monitoring of these zones and implementing other minimization measures, such as the use of sound attenuation devices, will reduce the impacts of underwater sound from pile driving/removal on these species.

Shutdown Zone:

The shutdown zone shall include all areas where the underwater sound pressure levels (SPLs) are anticipated to equal or exceed the Level A (injury) Harassment criteria for marine mammals (180 dB isopleths for cetaceans; 190 dB isopleths for pinnipeds). For impact and vibratory pile installation and removal, monitoring will be conducted for a 50 meter * shutdown zone (Level A harassment) surrounding each pile for the presence of marine mammals before, during, and after pile operations.

Buffer Zone:

The buffer zone shall include all areas where the underwater or airborne sound pressure levels are anticipated to equal or exceed the Level B (behavioral disturbance) Harassment criteria for marine mammals (160 dB re 1µPa - impact hammer; 120 dB re 1µPa - vibratory hammer; 90 or 100 dB re 20µPa - airborne). For impact pile installation, monitoring will be conducted for a 501 meter buffer zone (Level B harassment) surrounding each pile for the presence of marine mammals before, during, and after impact pile driving activities. The buffer zone was set at 501 meters, since the largest Level B behavioral disturbance zone calculated during impact pile driving was from airborne disturbance to harbor seals. For vibratory pile installation and removal activities, the modeling predicts an affected area of 41.5 sq. km for the 120 dB RMS disturbance criterion. Due to the difficulty of effectively monitoring such a large area, the Navy intends to

* Based on coordination with NMFS HQ, a minimum shutdown zone of 50 meters was recommended to standardize monitoring activities at the NBK waterfront, even though this zone is slightly larger than the modeled Level A harassment zone. This measure will be implemented for impact and vibratory pile installation and removal activities. This mitigation only applies to marine mammals

monitor a buffer zone equivalent to the width of the Hood Canal for the presence of marine mammals before, during, and after pile installation and removal activities. However, if the in-situ acoustic monitoring indicates that the 120 dB rms isopleth is smaller than the width of the Hood Canal, the monitoring zone would be reduced accordingly. Observers will still be placed at various locations throughout the 120 dB rms vibratory disturbance zone, as indicated in Figure 8, and sightings occurring in this area, including the general location of the animal, will still be recorded and noted as a take. However, detailed observations within this zone may not be possible. Due to the large area that each observer would be required to monitor the distance between the observer and the animal may preclude the ability to determine fine-scale behavioral movements. Due to the uncertainty regarding the sound pressure levels produced underwater by a chipping hammer the Navy will initially monitor a buffer zone equivalent to that used for vibratory pile installation/removal since these machineries both produce continuous type sounds. However, once the Navy has collected in-situ recordings of the sound pressure levels produced by a chipping hammer, the monitoring zone will be adjusted accordingly. The current analysis indicates that the likely behavioral zone of influence will be approximately 542 meters; however this zone was based on data from a jackhammer due to a lack of empirical data for a chipping hammer.

To verify the required monitoring zones, the survey boats will be equipped with GPS units to ensure they travel out to the appropriate distances and maintain the integrity of the monitoring zones throughout the pile driving period. The buffer and shutdown zones will initially be based on the distances discussed previously. However, the Navy will also conduct in-situ acoustic monitoring to determine the actual distances to these threshold zones, and the size of the shutdown and buffer zones will be adjusted accordingly (increased or decreased) based on the received sound pressure levels. As these buffers are adjusted, the number of personnel and/or positioning of observers will also be adjusted accordingly. For instance, the Navy anticipates that the actual zone of influence for the 120 dB rms behavioral disturbance threshold is likely to be much smaller than was modeled. If in-situ recordings result in a substantial decrease in the area necessary to be surveyed for the 120 dB rms disturbance zone, one or more of the vessels in this area may be removed if unnecessary for effective monitoring of marine mammals. It is anticipated that two of the far-field monitoring vessels may not be needed on-site for the duration of the project.

3.5 OBSERVER MONITORING LOCATIONS

In order to effectively monitor the shutdown and buffer zones marine mammal observers will be positioned at the best practicable vantage point(s), taking into consideration security, safety, and space limitations, in order to properly monitor these zones. Security restrictions inside the water restricted area (WRA) have precluded the placement of boats/personnel at certain locations within the fence line. In order to provide adequate security within the WRA, the Navy limits, to the extent practicable, the number of boats and personnel that are allowed within this area at any one time. As a result, the number of vessels permitted to be used for the acoustic, marine mammal, and marbled murrelet monitoring for the EHW-1 Pile Replacement Project and the Test Pile Program has been limited to three boats total, in additional to the necessary construction related vessels (i.e. barges, tugs, etc.). Additionally, security requires that all vessels maintain a minimum standoff distance of 25 feet from the fence at all times. Due to ongoing operations that may occur at the EHW-1 facility and Marginal Wharf, monitoring personnel are also precluded from being

stationed on these structures. Lastly, marine mammal observers were not placed on the barge(s) due to safety concerns from the construction contractor.

The following near-field locations (depicted in Figure 6) have been identified to provide adequate visual coverage:

Near-field Locations:

- **North Monitoring Boat**: Small boat vantage point located within the Water Restricted Area (WRA) that will survey the injury zone and impact behavioral disturbance zone to the north of each pile location. This boat will accommodate both marine mammal and marbled murrelet observers. During impact pile driving the boat will undertake a circular transect pattern to aid in marbled murrelet monitoring. At all other times it can either use a transect search pattern or be stationary and positioned at a location to provide the best vantage point,
- **South Monitoring Boat**: Small boat vantage point located within the Water Restricted Area (WRA) that will survey the injury zone and impact behavioral disturbance zone to the south of each pile location. This boat will accommodate both marine mammal and marbled murrelet observers. During impact pile driving the boat will undertake a circular transect pattern to aid in marbled murrelet monitoring. At all other times it can either use a transect search pattern or be stationary and positioned at a location to provide the best vantage point,
- **West Monitoring Boat**: Small boat vantage point located within the Water Restricted Area (WRA) that will survey the injury and impact behavioral disturbance zone to the west of each pile location. This boat will be used for acoustic monitoring and will also accommodate marine mammal observers.

Figure 6 depicts the relationship of the buffer and shutdown zones to the near-field monitoring positions. Each near-field monitoring location will have a minimum of 1 dedicated marine mammal observer (not including boat operators). The use of the above boat-based monitoring locations offers the Navy the ability to coordinate assets that may also be needed for marine mammal monitoring during the Test Pile Program. All monitoring vessels will be used for marine mammal monitoring during concurrent pile driving that may also occur just south of the EHW-1 wharf as part of the Test Pile Program. As a result, the location of vessels will be positioned to provide adequate coverage for both projects. The positions pictured in Figure 6 are considered to be generally representative of the locations that will be used to accommodate monitoring for both projects.

As part of the Navy's Acoustic Monitoring Plan, additional boats with hydrophones are being positioned throughout the action area. These additional vessels will be used to obtain underwater sound pressure levels to accurately determine the sound propagation parameters present at the EHW-1 Pile Replacement project area. Marine mammal observers will be placed on these vessels in order to provide additional visual coverage throughout the modeled behavioral disturbance zone for vibratory pile installation/removal. These far-field observation locations will enable the Navy to track marine mammals as they ingress/egress the northern portion of the action area near Squamish Harbor and ingress/egress the action area south of the Base (*e.g.* Hazel Point).

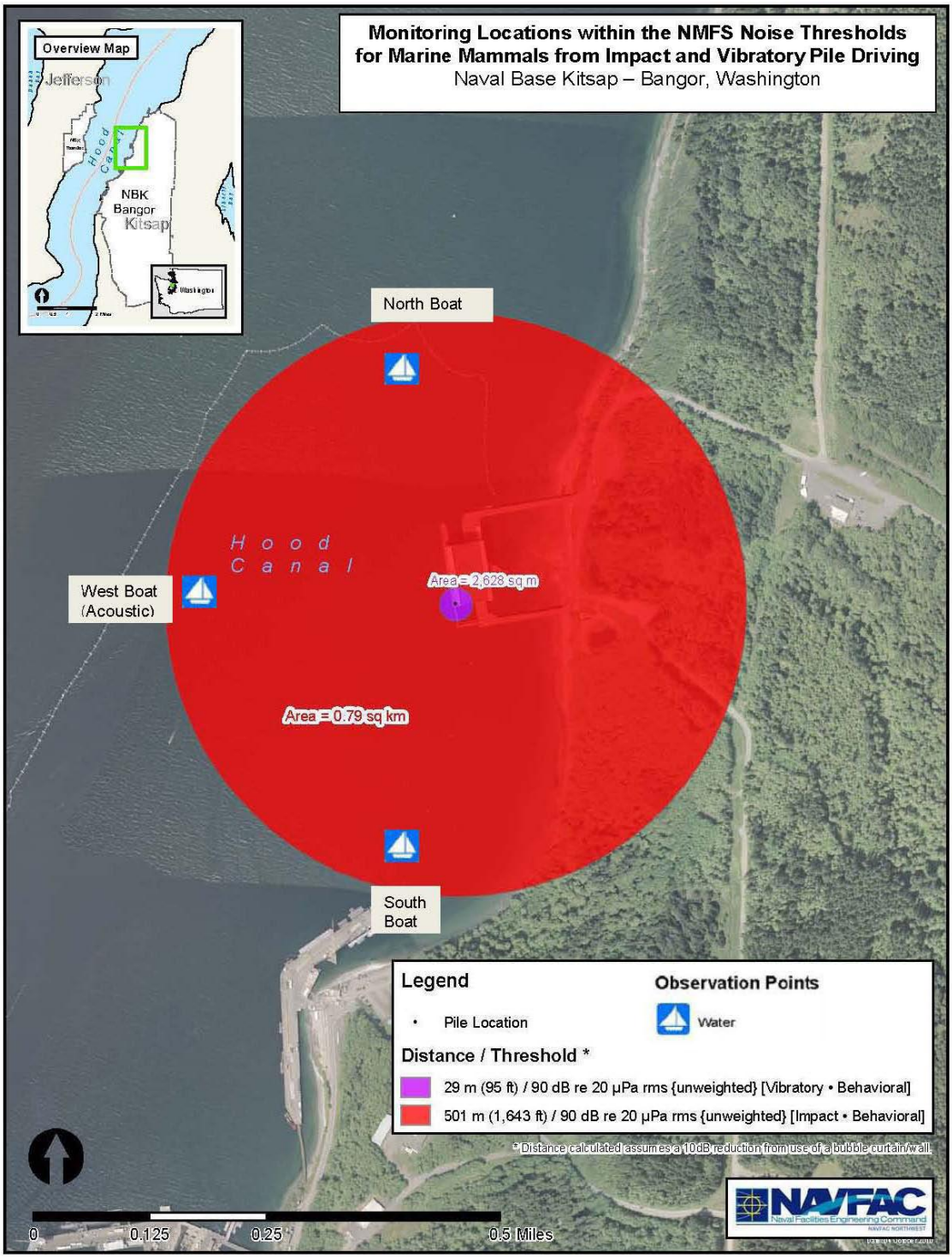


Figure 6. Boat-based Near-field Monitoring Locations within the NMFS Underwater Noise Thresholds for Marine Mammals from Impact and Vibratory Pile Installation

U.S. Navy EHW-1 Pile Replacement Project in Hood Canal
MARINE MAMMAL MONITORING PLAN
May 2011

The following far-field locations (depicted in Figure 7) have been identified:

Far-field Locations:

- North Far-Field Location: Small boat vantage point located towards Squamish Harbor.
- Mid-Channel Boat Location: Small boat vantage point located in the middle of the Hood Canal directly west of the EHW- location.
- South Far-Field Boat Location: Small boat vantage point located towards Hazel Point.

Each far-field monitoring boat will have a minimum of 1 marine mammal observer not including boat operators or hydroacoustic monitoring staff. In-situ acoustic monitoring will be used to determine the actual extent of the 120 dB rms behavioral disturbance zone. If the acoustic recordings indicate that the actual zone of influence is significantly smaller than the modeled area, some of the far-field monitoring locations may be removed or consolidated if they are unnecessary for effective marine mammal monitoring. It is anticipated that two of the far-field monitoring vessels may not be needed on-site for the duration of the project.

3.6 MONITORING TECHNIQUES

It should be recognized that although marine mammals will be protected from Level A (injury) Harassment by the utilization of a sound attenuation devices and observers monitoring the near-field injury zones, mitigation may not be one hundred percent effective at all times in locating marine mammals within the buffer zone (Level B [behavioral] harassment zone). This is largely due to the size of the buffer zone area. However, the efficacy of visual detection depends on several factors including the observer's ability to detect the animal, the environmental conditions (visibility and sea state), and monitoring platforms. Monitoring of the shutdown and buffer zones will take place from 30 minutes prior to initiation through 30 minutes post-completion of all pile installation and removal activities.

3.6.1 Visual Survey Protocol – Pre-Activity Monitoring

Prior to the start of pile operations, the shutdown and buffer zones will be monitored for 30 minutes to ensure that there are no marine mammals present. The following survey methodology will be implemented prior to commencing pile installation/removal activities:

- Near-field observers on boats and existing piers will survey the shutdown zone and buffer zones. They will ensure that no marine mammals are seen within the shutdown zone before pile-driving begins;
- If marine mammal(s) are present within or approaching the shutdown zone prior to pile driving, or during the soft-start[1], the survey will continue and the start of pile driving will be delayed until the animal(s) leave the shutdown zone voluntarily.
- If marine mammals are not within the shutdown zone (i.e. the zone is deemed clear of marine mammals), the observers will raise a green flag and radio the Pile Driving Engineer Lead that pile driving can commence;

[1] The Test Pile Program will utilize soft-start techniques recommended by NMFS for impact and vibratory pile driving. For a vibratory hammer, the soft start requires the contractor to initiate noise from the vibratory hammer for 15 seconds at reduced energy followed by a 1-minute waiting period. This procedure should be repeated two additional times. For an impact hammer, contractors are required to provide an initial set of three strikes from the impact hammer at approximately 40 percent energy followed by a 1-minute waiting period, then two subsequent 3-strike sets.

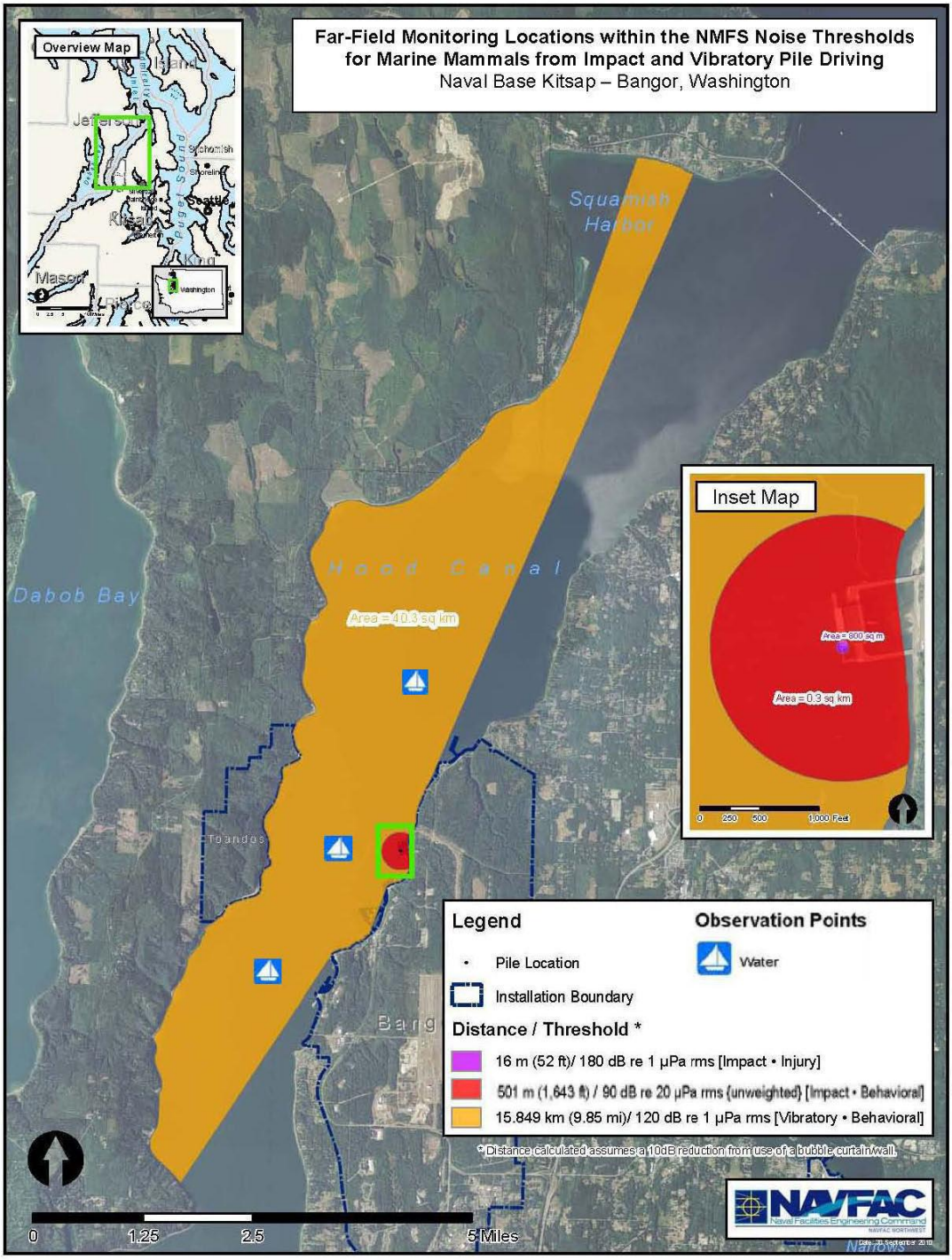


Figure 7. Far-Field Marine Mammal Monitoring Locations within the NMFS Noise Thresholds for Impact and Vibratory Pile Installation Activities

- The survey boats within the vibratory behavioral zone, stationed to the north and south of the WRA, as indicated in Figure 7, will look for the presence of marine mammals and will radio to near-field observers if marine mammals are traveling toward the buffer/shutdown zones.
- Marine Mammal Observation Record forms (Appendix A) will be used to document observations.

3.6.2 Visual Survey Protocol – During Activity Monitoring

The shutdown and buffer zones will be monitored throughout the time required to install or remove a pile. The following survey methodology will be implemented during pile operations:

- If a marine mammal is observed entering the buffer zone (or larger vibratory behavioral disturbance zone), a "take" would be recorded and behaviors documented. However, that pile segment would be completed without cessation, unless the animal enters or approaches the shutdown (injury) zone, at which point all pile installation/removal activities will be halted. The observers shall immediately radio to alert the Pile Driving Lead Engineer and raise a red flag. This action will require an immediate "all-stop" on pile operations.
- Pile installation/removal activities will be delayed until the animal has voluntarily left the shutdown zone and has been visually confirmed beyond the shutdown zone, or 30 minutes have passed without re-detection of the animal.
- During the pile driving delay, surveys will continue to be conducted and pile driving will not resume until the shutdown zone has been deemed clear of all marine mammals (see Section 3.6.1 regarding procedures for proceeding with pile driving);
- If marine mammals are detected outside the shutdown zone, the observers will continue to monitor these individuals and record their behavior, but pile driving may proceed. Any marine mammals detected outside the shutdown zone after pile driving is initiated shall likewise continue to be monitored and their behaviors recorded;
- Marine Mammal Observation Record forms (Appendix A) will be used to document observations.
- Any survey boats engaged in marine mammal monitoring will maintain speeds equal to or less than 10 knots;
- Observers will be trained and experienced marine mammal observers in order to accurately verify species sighted;
- Observers will use binoculars and the naked eye to search continuously for marine mammals;
- In case of fog or reduced visibility, the observers must be able to see the shutdown and buffer zones or pile driving will not be initiated until visibility in these zones improves to acceptable levels;
- The above described monitoring efforts will be run concurrently with the marbled murrelet monitoring protocols.

3.6.3 Visual Survey Protocol – Post-Activity Monitoring

Monitoring of the shutdown and buffer zones will continue for 30 minutes following completion of pile installation and/or removal activities. These surveys will focus on observing and reporting unusual or abnormal behavior of marine mammals. In general, the same protocols described in

section 3.6.2 would apply. During these surveys, if any injured, sick, or dead marine mammals are observed procedures outlined in Section 4.0 should be following regarding notifying the appropriate authorities. Survey results will be noted in the Marine Mammal Sighting form in Appendix A.

3.6.4 Acoustic Measurements

The Navy will conduct acoustic monitoring for impact and vibratory installation and removal activities associated with the EHW-1 Pile Replacement Projcet in order to determine the actual distances to the underwater and airborne thresholds for marine mammals and pinnipeds. These include the 190 dB re 1µPa rms/180 dB re 1µPa rms/160 dB re 1µPa rms and 120 dB re 1µPa rms underwater isopleths, and the 100 dB re 20 µPa and 90 dB re 20 µPa unweighted airborne isopleths. The Navy may place additional hydrophones/microphones at other distances and depths as appropriate to accurately capture sound propagation characteristics at the EHW-1 project area. Ambient underwater and airborne conditions in the absence of construction activities will also be recorded for comparison. The Navy's Acoustic Monitoring Plan provides the specific details of the acoustic monitoring requirements and protocol for both underwater and airborne sounds from the EHW-1 Pile Replacement Project.

4.0 INTERAGENCY NOTIFICATION

If the Navy finds an injured, sick, or dead marine mammal, the Navy shall notify NMFS immediately. Notification should be made to Brent Norberg (NMFS NW) at (206) 526-6140 and Ben Laws (NMFS HQ) (301) 713-2289 x159. The Navy will provide NMFS with the species or description of the animal(s), the condition of the animal (including carcass condition if the animal is dead), location, the date and time of first discovery, observed behaviors (if alive), and photo or video (if available).

Care should be taken in handling dead specimens to preserve biological materials in the best possible state for later analysis of cause of death, if that occurs. In preservation of biological materials from a dead animal, the finder (i.e. marine mammal observer) has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed.

5.0 MONITORING REPORT

A draft report will be submitted to NMFS within 45 days of the completion of the marine mammal monitoring associated with the EHW-1 Pile Replacement Project. The report will summarize all of the marine mammal observations and data gathered during pile installation and removal activities. The results should include graphs, tables, figures, and summary statistics as necessary. A final report will be prepared and submitted to the NMFS within 30 days following receipt of comments on the draft report from the NMFS. The report shall include at a minimum:

- General data:
  - Date and time of activity
  - Water conditions (e.g., sea-state, surface water temperature)
  - Weather conditions (e.g., wind speed and direction, air temperature, humidity)
  - Physical characteristics of the bottom substrate into which the piles are driven
- Specific pile driving data:
  - Description of the pile driving activity being conducted (pile size and type)

- Detailed description of the sound attenuation system, including design specifications
- Impact or vibratory hammer force used to drive/extract the piles
- Description of the monitoring equipment
- Distance between hydrophone(s) and pile
- Depth of the hydrophone(s)
- Depth of water in which the pile was driven
- Depth into the substrate that the pile was driven
- Ranges and means for peak, RMS, and SEL's for each pile
- Results of the acoustic measurements, including the frequency spectrum, peak and RMS SPL's, and single-strike and cumulative SEL with and without the attenuation system
- Results of the airborne noise measurements including dBA and unweighted levels;

- Pre-activity observational survey-specific data:
  - Dates and time survey is initiated and terminated
  - Description of any observable marine mammals and their behavior in the immediate area during monitoring
  - If possible, the correlation to underwater sound levels occurring at the time of this observable behavior for context to exposure.
  - Actions performed to minimize impacts to marine mammals

- Post-activity observational survey-specific data:
  - Results, which include the detectability of marine mammals, species and numbers observed, sighting rates and distances, behavioral reactions within and outside the shutdown and buffer zones;
  - Refined take estimate based on the number of marine mammals observed in the safety and buffer zones. This may be reported as one or both of the following: a rate of take (number of marine mammals per hour), or take based on density (number of individuals within the area).

APPENDIX B

Environmental, Oceanographic, and Sighting Conditions

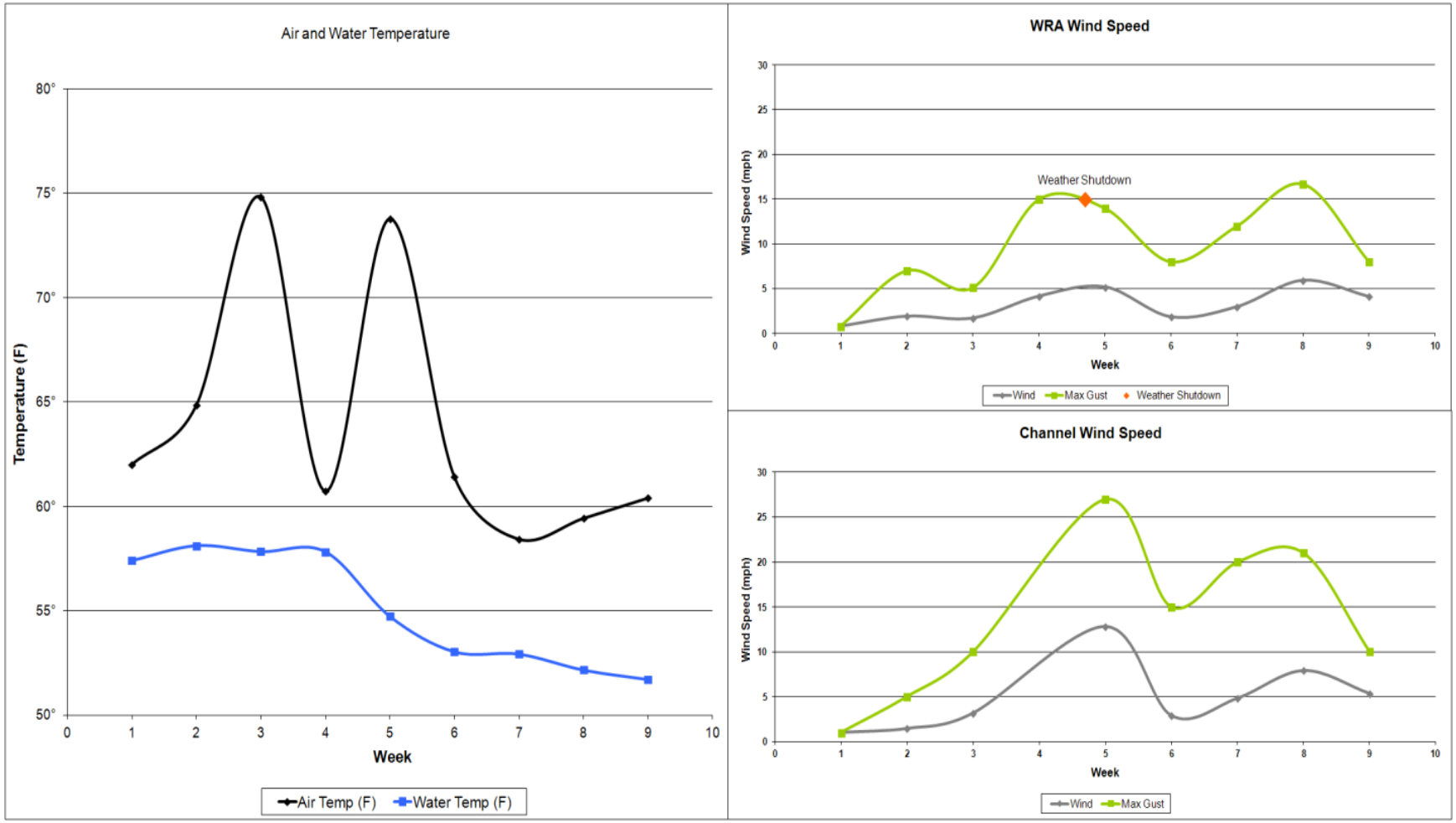


Figure B-1. Air and Water Temperature and Wind Speed

Table B-1. Environmental Data from Boats Inside and Outside the WRA

Date	Time (hh:mm)	Boat[1]	Wind Speed (mph)	Wind Direction	Humidity	Air Temp (°F)	Water Temp (°F)	Water Depth (ft)	Wave Height (ft)	Weather Conditions	Background Sound Level Notes
Boats Inside the WRA											
10/4/2011	8:00	Shocker	--	SW	100	54	53	Variable	0.5	PC	Boats
10/4/2011	8:30	Swift	12	SW	85.2	52.3	53.4	170	1	LR	Boats
10/4/2011	10:08	Swift	4	SW	95.3	55.5	53.4	170	0	OC	Boats
10/4/2011	11:09	Swift	6	SW	87.6	58.6	53.4	170	0.5	OC/LR	Boats
10/4/2011	12:11	Swift	8	SW	84.6	56.3	53.4	170	0	OC	Boats
10/4/2011	14:30	Swift	6	SW	88.3	58.2	53.4	70	0	PC	Boats
10/4/2011	16:07	Swift	4	SW	83.2	58.7	53.4	150	0	PC	Boats
10/5/2011	7:07	Swift	3	SW	87.4	51.4	52.7	170	0	PC	Boats
10/5/2011	8:31	Swift	3	SW	91.7	51	52.7	170	0	PC	Boats
10/5/2011	11:36	Swift	1	SW	92.5	54.8	53	200	0	OC	Boats
10/5/2011	12:40	Swift	1	SW	84.3	54.5	53	170	0	OC	Boats, generator
10/5/2011	14:38	Swift	3	SW	88.2	54	53	140	0	LR	Boats, crane
10/5/2011	16:35	Swift	1	SW	92	54.2	53	110	0	LR	boats, vibratory hammer
10/6/2011	8:55	Swift	4	SW	94.2	51.6	52.6	140	0	PC	Boats, crane
10/6/2011	10:05	Swift	3	SW	93.6	54.1	52.7	140	0	OC	Boats,
10/6/2011	13:30	Swift	2	SW	87.8	59.8	53	100	0	PC	(No boats) deck machine
10/6/2011	14:35	Swift	0	SW	74.5	60.3	53.4	100	0	OC	deck machinery
10/6/2011	15:35	Swift	2	N	84.2	55.5	53	100	0	OC	crane, deck machinery
10/6/2011	16:27	Swift	2	N	86.5	55.7	53.9	100	0	OC	crane
10/6/2011	17:12	Swift	1	N	92.4	54.1	53.5	100	0	OC	none
10/7/2011	7:30	Shocker	0	--	87	51.8	52.1	53	0	LR, FOG	--
10/7/2011	7:30	Swift	0	--	95	54.1	53	Variable	0	R	Boats
10/7/2011	8:25	Shocker	0	--	HI	54.7	52.1	44.1	0	FO	Cutting machine in EHW bldg
10/7/2011	8:30	Swift	0	--	95	55	52	162	0	C	Boats, saws, generator
10/7/2011	9:30	Swift	3	SW	95	56	52	150	0	LR	Boats, generator
10/7/2011	9:32	Shocker	0	--	HI	54	52.1	45.2	0	FO	Between vibes in EHW bldg
10/7/2011	10:30	Swift	3	SW	90	53	52	Variable	0.25	C	Boats
10/7/2011	10:33	Shocker	0	--	HI	55.4	53.2	61.5	0	FO	Shocker engine, outside EHW

[1] Boat abbreviations: Ugle = Ugle Duckling, Streak = Silver Streak. Shocker and Swift are the full boat names.

Date	Time (hh:mm)	Boat[1]	Wind Speed (mph)	Wind Direction	Humidity	Air Temp (°F)	Water Temp (°F)	Water Depth (ft)	Wave Height (ft)	Weather Conditions	Background Sound Level Notes
10/7/2011	11:23	Shocker	0	--	80	56.7	53.2	49.5	0	OC	Concrete saw in EHW
Boats Inside the WRA (continued)											
10/7/2011	12:30	Swift	6	NE	99	58	53	170	0	C	Boats, generator
10/7/2011	13:05	Shocker	0	--	HI	55.8	53.2	52	0	OC	Concrete saw in EHW
10/7/2011	13:30	Swift	7	NE	97	53	53	170	0	C	Generator
10/7/2011	14:30	Swift	6	NNE	95	53	53	170	0	C	Generator
10/7/2011	14:38	Shocker	0	--	88	56.7	52.3	52	0	OC	Crane machinery in EHW
10/7/2011	15:22	Shocker	0	N	89	56.5	53	51.9	0	OC	Crane machinery in EHW
10/7/2011	15:30	Swift	2	NNE	85	54	53	Variable	0	C	Generator, boats
10/7/2011	16:05	Shocker	0	N	74	55.8	53.2	80.1	0	OC	--
10/7/2011	16:30	Swift	2	NNE	80	54	53	Variable	0	C	Generator
10/7/2011	16:58	Shocker	0	N	82	54.9	53	50.7	0	OC	Crane, in EHW
10/7/2011	17:30	Swift	4	N	90	54	53	Variable	0	C	Vibratory hammer, generator
10/7/2011	17:45	Shocker	0	NW	87	54.3	53	50.1	0	OC	None, in EHW
10/8/2011	8:00	Swift	1	NE	87	52	52	82	0	FOG	Boats, generator
10/8/2011	8:10	Shocker	0	--	88	51.1	52.2	45	0	OC, FO	Crane operations in EHW
10/8/2011	9:00	Swift	1	--	88	52	52	Variable	0	PC	Boats, hammer, generator
10/8/2011	9:40	Shocker	0	--	HI	52.2	52.2	44.9	0	OC, FO	Crane operations in EHW
10/8/2011	13:30	Swift	11	S	82	58	52	Variable	0.25	S	Boats, generator
10/8/2011	14:00	Swift	10	S	77	59	52	Variable	0.5	S	Boats, generator
10/8/2011	14:30	Shocker	Beau = 2	SW	62	63.9	52.7	128	0.5	PC	Boat engine at Delta Pier
10/8/2011	15:20	Shocker	Beau = 2	SW	63	62.8	52.7	92	0.5	PC	Shocker engine at TP-1
10/8/2011	16:27	Shocker	Beau = 2	SW	62	63.9	52.7	58.3	0.5	PC	None, in EHW
10/8/2011	16:40	Swift	10	S	67	62	53	Variable	0.5	C	Boats, generator
10/10/2011	10:15	Swift	4	SW	91.8	53.5	56.6	115	0.2	R	
10/10/2011	11:24	Swift	3	SW	100	52.7	52.9	120	0.1	R	Tug
10/10/2011	13:11	Swift	2	SW	100	53.6	53	120	0	R	
10/10/2011	15:30	Swift	4	SW	100	56.5	53	120	0.1	OC	
10/10/2011	16:30	Swift	3	SW	100	59.5	53	120	0.1	OC	
10/11/2011	7:55	Swift	4	NW	89.6	52.8	52.4	110	0.2	PC	North EHW
10/11/2011	8:55	Swift	3	NW	89.9	53.8	52.2	110	0.3	PC	Behind barge, sheltered

Date	Time (hh:mm)	Boat[1]	Wind Speed (mph)	Wind Direction	Humidity	Air Temp (°F)	Water Temp (°F)	Water Depth (ft)	Wave Height (ft)	Weather Conditions	Background Sound Level Notes
10/11/2011	9:55	Swift	5	NW	84.5	56.5	52.2	110	0.4	PC	Behind barge, sheltered
Boats Inside the WRA (continued)											
10/11/2011	10:55	Swift	8	N	77.3	59.6	52.2	110	0.7 to 0.8	PC	Behind barge, sheltered
10/11/2011	11:55	Swift	9	N	68.1	64	52.2	110	0.7 to 0.8	PC	Behind barge, sheltered
10/11/2011	12:55	Swift	7	NNW	69.9	63.1	52.2	110	0.7 to 0.8	PC	Behind barge, sheltered
10/11/2011	13:55	Swift	7	NNW	70.5	62.5	52.2	110	0.5	PC	Behind barge, sheltered
10/11/2011	14:55	Swift	12	NNW	71	62.1	52.2	110	0.4	PC	NW corner of EHW
10/11/2011	15:55	Swift	17	NNW	71.9	58.8	52.2	110	0.1	PC	NW corner of EHW
10/11/2011	16:55	Swift	12	NNW	77.2	58.8	52.2	110	0.2	PC	Delta pier near fence
10/12/2011	10:00	Swift	5	N	83	53.4	52.1	100	0.1	C	Delta pier near fence
10/12/2011	11:00	Swift	4	NNW	77.1	50.6	51.7	100	0 to 0.1	S	Delta pier near fence
10/12/2011	12:24	Swift	3	NNW	73	63.4	51.7	100	0	S	Delta pier near fence
10/12/2011	13:00	Swift	2	NNW	66.5	63.7	52.1	100	0	S	Delta pier near fence
10/12/2011	14:00	Swift	1	NNW	59.6	63.3	52.2	110	0	S	NW corner of EHW sheltered
10/12/2011	15:00	Swift	4	NNW	61.4	61.3	52.2	110	0.1	S	NW corner of EHW sheltered
10/12/2011	16:16	Swift	2	N	65.3	51.1	52.2	110	0 to 0.1	C	NW corner of EHW sheltered
10/12/2011	17:00	Swift	1	N	72.6	57.7	51.9	110	0	C	NW corner of EHW sheltered
10/13/2011	8:00	Swift	2	N	92.2	45.2	51.2	110	0	F	NW corner of EHW
10/13/2011	9:00	Swift	3	N	93	47.3	51.2	110	0	F	NW corner of EHW
10/13/2011	10:00	Swift	2	N	94.2	48.3	51.2	110	0	S/F	NW corner of EHW
10/13/2011	11:42	Swift	5	Variable	74.6	56	51.6	110	0	S	NW corner of EHW
10/13/2011	13:00	Swift	5	S	60.7	61.3	51.7	110	0.2	S/PC	NW corner of EHW
10/13/2011	14:00	Swift	4	S	54.7	58.6	51.7	110	0.4 to 0.5	S/PC	NW corner of EHW
10/13/2011	15:00	Swift	16	S	59.8	61.2	51.7	110	0.7	S/PC	NW corner of EHW
10/14/2011	12:00	Swift	11	S	75.2	55.1	51.7	110	0.2	C	NW corner of EHW
10/14/2011	13:05	Swift	12	S	64.4	56.7	51.6	110	0.2	C	NW corner of EHW
10/14/2011	14:00	Swift	10	S	72.4	53.2	51.7	110	0.2	C	NW corner of EHW
10/14/2011	15:00	Swift	11	S	70.9	55.8	51.7	110	0.2	C	NW corner of EHW
10/14/2011	16:00	Swift	8	S	75.4	55	51.7	110	0.1	C	NW corner of EHW
10/14/2011	17:00	Swift	8	S	68.2	54.6	51.7	110	0.1	C	NW corner of EHW
10/17/2011	10:45	Streak	0	--	--	56	52	155	0	S	
10/17/2011	11:30	Streak	2	N	65	56	52	152	0	S	
10/17/2011	12:30	Streak	4	NNW	66	65	52	55	0	PC	

Date	Time (hh:mm)	Boat[1]	Wind Speed (mph)	Wind Direction	Humidity	Air Temp (°F)	Water Temp (°F)	Water Depth (ft)	Wave Height (ft)	Weather Conditions	Background Sound Level Notes
10/17/2011	14:00	Streak	8	N	62	56	52	54	0	PC	
Boats Inside the WRA (continued)											
10/17/2011	15:15	Streak	8	NNE	52	52	52	54	0	PC	
10/18/2011	11:50	Streak	5	NW	76	57	50	50	0	S	
10/18/2011	13:10	Streak	3	NW	72	58	51	50	0	S	
10/18/2011	14:10	Streak	4	NW	85	55	51.6	50	0	S	
10/18/2011	15:10	Streak	4	NW	71.5	58	51	50	0	S	
Boats Outside the WRA											
10/4/2011	7:30	Ugle	2	N	--	56.8	52.7	200	<1	OC	
10/4/2011	9:30	Ugle	4	N	--	58.7	52.6	190	<1	OC	
10/4/2011	10:30	Ugle	0	--	--	64.5	52.6	40	<1	OC	At Dock
10/4/2011	11:30	Ugle	0	--	--	68.7	52.6	385	<1	OC	
10/4/2011	12:30	Ugle	0	--	--	66	52.6	380	0	OC	
10/4/2011	13:30	Ugle	0	--	--	65.6	52.6	211	0	OC	
10/4/2011	14:41	Ugle	6	N	--	59.8	53.5	220	<1	OC	
10/4/2011	15:30	Ugle	0	N	--	65.6	52.6	211	0	R	
10/4/2011	15:31	Ugle	10	N	--	55.5	53.2	220	<1	LR	
10/6/2011	9:20	Ugle	3	N	--	59.5	52.4	165	<1	S	
10/6/2011	10:20	Ugle	2	N	--	57.7	52.6	160	<1	OC	
10/6/2011	13:20	Ugle	4	N	--	56.5	52.7	164	<1	OC	
10/6/2011	15:00	Ugle	1	N	--	62.1	53.5	162	<1	OC	
10/6/2011	16:00	Ugle	0	--	--	60.6	53	163	0	OC	
10/6/2011	17:00	Ugle	0	--	--	59	53.7	162	0	OC	
10/7/2011	7:50	Ugle	0	--	--	57.1	52.7	75	0	OC	
10/7/2011	10:30	Ugle	3	S	--	61.5	53	235	<1	OC	
10/7/2011	11:30	Ugle	2	S	--	61.3	53	235	<1	OC	
10/7/2011	12:30	Ugle	2	S	--	61	53	289	<1	OC	
10/7/2011	14:30	Ugle	1	S	--	56.6	53	258	1	OC	
10/7/2011	15:30	Ugle	0	--	--	60.8	53	250	0	OC	
10/7/2011	16:30	Ugle	0	--	--	61.8	53	250	0	OC	
10/8/2011	8:20	Ugle	0	--	--	55.5	52.4	357	0	--	
10/8/2011	9:30	Ugle	2	N	--	56.5	52.1	350	<1	--	
10/8/2011	10:30	Ugle	6	N	--	57.9	52.4	350	<1	--	

Date	Time (hh:mm)	Boat[1]	Wind Speed (mph)	Wind Direction	Humidity	Air Temp (°F)	Water Temp (°F)	Water Depth (ft)	Wave Height (ft)	Weather Conditions	Background Sound Level Notes
10/8/2011	11:30	Ugle	7	N	--	68.1	52.4	230	1 to 2	--	
Boats Outside the WRA (continued)											
10/8/2011	12:30	Ugle	8	N	--	77.5	52.6	215	1 to 2	--	
10/8/2011	13:30	Ugle	11	N	--	70.1	52.4	130	1 to 2	--	
10/8/2011	14:30	Ugle	10	N	--	73.2	52.6	220	2 to 3	--	
10/8/2011	15:30	Ugle	12	N	--	64.5	52.2	180	3	--	
10/8/2011	16:30	Ugle	20	N	--	65.1	52.6	180	2	--	
10/10/2011	11:10	Ugle	2	S	--	59	52.4	50	--	--	
10/10/2011	12:10	Ugle	8	SW	--	57.7	52.9	259	--	--	
10/10/2011	13:10	Ugle	4	S	--	59.5	--	287	--	--	
10/10/2011	14:10	Ugle	7	S	--	57.9	--	260	--	--	
10/10/2011	15:10	Ugle	9	S	--	61.7	--	260	--	--	
10/10/2011	16:10	Ugle	3	SW	--	61	--	260	--	--	
10/10/2011	16:50	Ugle	18	S	--	60	--	260	--	--	
10/11/2011	7:55	Ugle	13	SW	--	54.1	--	200	1 to 2	--	
10/11/2011	8:55	Ugle	17	S	--	55.5	52	240	2 to 3	--	
10/11/2011	9:55	Ugle	15	S	--	68	52	240	2 to 3	--	
10/11/2011	10:03	Ugle	19	S	--	65	52	240	3 to 4	--	
10/11/2011	10:50	Ugle	21	S	--	65	52	240	2 to 3	--	
10/11/2011	11:50	Ugle	13	S	--	68	52	252	1 to 2	--	
10/11/2011	12:50	Ugle	17	S	--	64	52	132	1 to 2	--	
10/11/2011	13:30	Ugle	19	S	--	71	52	132	2	--	
10/11/2011	14:10	Ugle	16	S	--	70	52	132	1 to 2	--	
10/11/2011	15:10	Ugle	13	S	--	68	52	132	1 to 2	--	
10/11/2011	16:10	Ugle	17	S	--	64	52	132	1 to 2	--	
10/11/2011	17:00	Ugle	11	S	--	61	52	132	1	--	
10/12/2011	8:30	Ugle	8	S	--	53.4	52	240	1	--	
10/12/2011	9:30	Ugle	5	S	--	56.8	52	240	<1	--	
10/12/2011	10:35	Ugle	2	S	--	66.6	51.6	240	<1	--	
10/12/2011	11:30	Ugle	4	S	--	66	51.6	240	<1	--	
10/12/2011	12:45	Ugle	0	--	--	68.2	51.6	240	<1	--	
10/12/2011	13:43	Ugle	0	--	--	--	51.6	240	<1	--	
10/12/2011	14:30	Ugle	3	W	--	66	51.6	240	<1	--	

Date	Time (hh:mm)	Boat[1]	Wind Speed (mph)	Wind Direction	Humidity	Air Temp (°F)	Water Temp (°F)	Water Depth (ft)	Wave Height (ft)	Weather Conditions	Background Sound Level Notes
10/12/2011	15:30	Ugle	1	SW	--	63.3	51.6	240	<1	--	
Boats Outside the WRA (continued)											
10/12/2011	16:30	Ugle	2	W	--	64.4	51.6	240	<1	--	
10/12/2011	18:00	Ugle	1	NW	--	64.5	51.4	368	<1	--	
10/13/2011	8:22	Ugle	0	--	--	53.8	50.7	103	<1	--	
10/13/2011	9:22	Ugle	0	--	--	53.9	50.6	103	<1	--	
10/13/2011	10:30	Ugle	0	--	--	55	50.9	100	<1	--	
10/13/2011	11:20	Ugle	4	N	--	60.3	51.6	227	<1	--	
10/13/2011	12:20	Ugle	8	N	--	62.3	51.6	231	1 to 2	--	
10/13/2011	13:20	Ugle	12	N	--	64	51.6	260	1 to 2	--	
10/13/2011	14:20	Ugle	13	N	--	64.2	51.6	250	2	--	
10/13/2011	15:26	Ugle	10	N	--	65.3	51.7	249	1 to 2	--	
10/14/2011	11:34	Ugle	10	N	--	59.9	51.7	249	1 to 2	--	
10/14/2011	12:30	Ugle	7	N	--	64	51.4	266	1 to 2	--	
10/14/2011	13:30	Ugle	7	N	--	64	51.4	268	1	--	
10/14/2011	14:37	Ugle	7	N	--	59.9	51.4	270	1	--	
10/14/2011	15:30	Ugle	3	N	--	63.3	51.4	270	1	--	
10/14/2011	16:30	Ugle	6	N	--	61.1	51.4	270	1	--	
10/14/2011	17:23	Ugle	8	N	--	56.6	51.4	270	<1	--	
10/15/2011	8:25	Ugle	0	--	--	-	52	-	-	--	
10/15/2011	9:10	Ugle	0	--	--	-	54	50.9	-	--	
10/15/2011	10:00	Ugle	9	--	--	-	55	50.9	-	--	
10/15/2011	10:42	Ugle	9	--	--	-	56	50.9	-	--	
10/15/2011	11:35	Ugle	8	--	--	-	56	51.2	-	--	
10/15/2011	12:30	Ugle	10	--	--	-	60	51.2	-	--	
10/17/2011	8:34	Ugle	7	S	--	50.1	51	320	<1	--	
10/17/2011	9:33	Ugle	4	SW	--	59.5	51.4	266	<1	--	
10/17/2011	10:30	Ugle	1	S	--	60	51.9	220	<1	--	
10/17/2011	12:28	Ugle	1	S	--	67.2	52.6	238	<1	--	
10/17/2011	13:30	Ugle	1	W	--	69.8	52.9	230	<1	--	
10/17/2011	14:30	Ugle	6	NNE	--	62.3	52.9	230	1 to 2	--	
10/17/2011	15:30	Ugle	6	NE	--	66.7	52.9	230	2	--	
10/17/2011	16:30	Ugle	8	NE	--	70.7	52.9	230	1 to 2	--	

Date	Time (hh:mm)	Boat[1]	Wind Speed (mph)	Wind Direction	Humidity	Air Temp (°F)	Water Temp (°F)	Water Depth (ft)	Wave Height (ft)	Weather Conditions	Background Sound Level Notes
10/18/2011	11:32	Ugle	6	N	--	60.8	--	263	<1	--	
Boats Outside the WRA (continued)											
10/18/2011	12:30	Ugle	5	N	--	60.5	--	263	1	--	
10/18/2011	13:30	Ugle	6	N	--	64.3	--	263	1	--	
10/18/2011	14:30	Ugle	9	NW	--	66	--	263	1	--	
10/18/2011	15:29	Ugle	10	N	--	66.3	--	263	1 to 2	--	
10/19/2011	8:30	Ugle		S	--	55.6	51.2	270	<1	S	
10/19/2011	9:30	Ugle		N	--	60	51.2	270	<1	S	
10/19/2011	10:30	Ugle		N	--	64.2	51.2	270	<1	S	
10/19/2011	11:30	Ugle		N	--	66.2	51.2	270	<1	S	
10/19/2011	12:30	Ugle		N	--	68	51.2	270	<1	S	
10/19/2011	13:30	Ugle		S	--	64.4	51.2	270	<1	S	
10/19/2011	14:30	Ugle		S	--	68	51.2	270	1	OC	
10/19/2011	15:30	Ugle		SE	--	66.9	51.2	270	<1	OC	
10/19/2011	16:30	Ugle		S	--	65.1	51.2	270	<1	OC	
10/20/2011	8:30	Ugle		N	--	53.8	52	275	<1	OC	
10/20/2011	9:30	Ugle		N	--	54.5	52	275	<1	OC	
10/20/2011	10:30	Ugle		N	--	53.2	52	275	<1	OC	
10/20/2011	11:30	Ugle		N	--	53.5	52	275	<1	LR	
10/20/2011	12:30	Ugle		N	--	52.1	52	275	1	LR	
10/20/2011	13:30	Ugle		N	--	52.1	52	275	<1	LR	

APPENDIX C

Marine Mammal Sighting Form

Marine Mammal Observation Record Form										Observer(s):			Date:
Boat Name/Location:				Time Effort Initiated:									
				Time Effort Completed:						Page _____ of _____ Pages			
Project Name	**Sighting #**	**Sighting Time**	**Latitude**	**Longitude**	**Species**	**# of Anim**	**Dist/Dir to Anim**	**Beh Type(s)**	**Const Type**	**Dist to Pile**	**Weath Cond**	**Beauf**	**Notes**

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D
Sightings Codes

Behavior codes

Code	Behavior	Definition
BR	Breaching	Leaps clear of water.
CD	Change Direction	Suddenly changes direction of travel.
CH	Chuff	Makes loud, forceful exhalation of air at surface.
DI	Dive	Forward dives below surface.
DE	Dead	Shows decomposition or is confirmed as dead by investigation.
DS	Disorientation	Multiple behaviors that have no clear reason or direction.
FI	Fight	Agonistic interactions between two or more individuals
FO	Foraging	Confirmed by food seen in mouth.
MI	Milling	Moving slowly at surface, changing direction often, not moving in any particular direction.
PL	Play	Behavior that does not seem to be directed towards a particular goal; may involve one, two or more individuals
PO	Porpoising	Moving rapidly with body breaking surface of water.
SL	Slap	Vigorously slaps surface of water with body, flippers, tail, etc.
SP	Spyhopping	Rises vertically in the water to "look" above the water.
SW	Swimming	General progress in a direction. Note general direction of travel when last seen [Example: “SW (N)” for swimming north].
TR	Traveling	Traveling in an obvious direction. Note direction of travel when last seen [Example: “TR (N)” for traveling north].
UN	Unknown	Behavior of animal undetermined, does not fit into another behavior.
Pinniped only		
EW	Enter Water (from haul out)	Enters water from a haul-out for no obvious reason.
FL	Flush (from haul out)	Enters water in response to disturbance.
HO	Haul out (from water)	Hauls out on land.
RE	Resting	Resting onshore or on surface of water.
LO	Look	Is upright in water "looking" in several directions or at a single focus.
SI	Sink	Sinks out of sight below surface without obvious effort (usually from an upright position).
VO	Vocalizing	Animal emits barks, squeals, etc.
Cetacean only		
LG	Logging	Resting on surface of water with no obvious signs of movement

Project Name

Code	Activity Type
EHW	Explosives Handling Wharf
TPP	Test Pile Program

Construction Type

Code	Activity Type
V	Vibratory Pile Driving
SSV	Vibratory Soft Start
NA	No Pile Driving

Weather Conditions

Code	Weather Condition
S	Sunny
PC	Partly Cloudy
L	Light Rain
R	Steady Rain
F	Fog
OC	Overcast

Marine Mammal Species

Code	Marine Mammal Species
CASL	CA Sea Lion
HSEA	Harbor Seal
STSL	Steller Sea Lion
RIVO	River Otter
HPOR	Harbor Porpoise
UNKW	Unknown

APPENDIX E

All Sightings During EHW-1 PRP Pile Driving and Non-Pile Driving Activities

Sighting occurred when no construction was ongoing
Sighting occurred during the 30-minute construction pre-watch
Sighting occurred during construction activity
Sighting occurred during the 30-minute construction post-watch

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	4-Oct-11	07:50	16:42	47 44.002	122 44.886	07:50	CASL	7	NA	NA	200/120	RE	1,800	PC	3	Hauled out on WRA fence and package.
EHW	4-Oct-11	08:05	16:40	47 45.012	122 43.451	08:05	HSEA	1	NA	NA	100/170	SW,DI	450	OC	2	Waypoint 003.
EHW	4-Oct-11	08:05	16:40	47 45.176	122 43.361	08:57	HSEA	1	NA	NA	120/275	SW,DI	75	OC,L	2	Waypoint 004.
EHW	5-Oct-11	07:20	17:23	47 45.308	122 43.452	07:00	HSEA	1	NA	NA	40/335	LO,SI	105	OC	1	(Probably same seal noted in Sighting 2). Notes: Smaller seal, very dark, only visible because not in pilings, seen again inside EHW piles at northwest end, 30 m from end of piles,105 m from pile to be driven (Waypoint taken at EHW. 1 HSEA at approximately 10 m east of HSEA,07:24 Swift MMO sees HSEA out north of end OF EHW,MC mentions seeing seal at 0727, Swift sees 2 HSEA at same time and same area
EHW	5-Oct-11	07:20	17:23	47 45.190	122 43.491	07:14	HSEA	1	NA	NA	200/105	SW,DI	250	OC	1	Heading north.
EHW	5-Oct-11	07:20	17:23	47 45.190	122 43.499	07:20	HSEA	1	NA	NA	25/290	SW,DI	105	OC	1	Heading south.
EHW	5-Oct-11	07:20	17:23	47 45.191	122 43.504	07:21	CASL	1	NA	NA	30/255	TR	115	OC	1	Heading south
EHW	5-Oct-11	07:20	09:07	47 45.123	122 43.459	07:22	HSEA	1	NA	NA	75/270	SW,LO,DI	150	OC	1	
EHW	5-Oct-11	07:20	17:23	47 45.190	122 43.512	07:23	HSEA	1	NA	NA	180/360	LO,SI	120	OC	1	BM's Sighting #1, direction of travel unknown
EHW	5-Oct-11	07:20	17:23	47 45.182	122 43.534	07:28	HSEA	1	NA	NA	150/8	SW,DI	160	OC	1	At fence line, direction of travel unknown.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	5-Oct-11	07:20	17:23	47 45.215	122 43.468	07:38	HSEA	1	NA	NA	3M/SE OF PILE	DI	4	OC	1	Reported by MC , first seen hauled out on float, 3 m from pile, 07:39 seen outside containment boom in EZ.
EHW	5-Oct-11	07:06	09:06			07:40	HSEA	1	NA	NA	50/270 from northeast corner of EHW building	DI	150	S		Distance noted from capstan at south end of EHW, unless otherwise noted.
EHW	5-Oct-11	07:20	17:23	47 45.255	122 43.455	07:44	HSEA	1	NA	NA	6/250	SW,LO,DI	50	OC	1	Up in EZ, heading 210 degrees down center of piles towards pile to be driven, 08:00 in EZ under piles, 08:09 forward dive in EZ, 08:11 up in EZ, 08:13 up in EZ.
EHW	5-Oct-11	07:06	09:06			07:48	HSEA	1	NA	NA	40/0	DI	30	S		
EHW	5-Oct-11	07:06	09:06			08:00	HSEA	1	V	Before	50/45	DI	45	S		
EHW	5-Oct-11	07:20	09:07	47 45.123	122 43.459	08:10	HSEA	1	V	Before	20/17	SW,LO,DI	170	OC	1	07:39-08:28, HSEA in and out of EZ.
EHW	5-Oct-11	07:06	09:06			08:11	HSEA	1	V	Before	40/270	DI	40	S		
EHW	5-Oct-11	07:06	09:06			08:13	HSEA	1	V	Before	40/270	DI	40	S		
EHW	5-Oct-11	07:20	17:23	47 45.306	122 43.478	08:45	HSEA	1	V	After	10/340	MI,SI	160	OC	1	Seen during 30 minute post-drive outside north end EHW.
EHW	5-Oct-11	07:20	09:07	47 45.123	122 43.459	08:51	HSEA	1	V	After	125/17	SW,DI	225	OC	1	
EHW	5-Oct-11	07:20	17:23	47 45.199	122 43.529	09:00	HSEA	1	V	After	80/355	SW,DI	100	OC	1	Heading south, at 09:03 still heading south.
EHW	5-Oct-11	07:06	09:06			09:05	HSEA	1	V	After	40/315	DI	20	S		
EHW	6-Oct-11	07:50	16:42	47 43.680	122 44.735	08:16	HPOR	4	NA	NA	100/175	SW(W)	2,800	OC	1-2	Used EHW for distance to pile; sighted southeast of Charlie buoy
EHW	6-Oct-11	08:45	17:35	47 45.266	122 43.553	09:05	HSEA	1	NA	NA	50/100	SW(S),DI	100	PC	2	Heading south.
EHW	6-Oct-11	08:45	17:35	47 45.271	122 43.461	09:10	HSEA	1	NA	NA	15/100	LO,DI	-	PC	1	On the hook inside EHW1, no distance, since we do not know where pile will be.
EHW	6-Oct-11	08:45	17:35	47 45.127	122 43.435	09:17	HSEA	1	NA	NA	200/330	TR	-	OC	0	Attached to Columbia, swimming at 225 degrees.
EHW	6-Oct-11	08:45	17:35	47 45.271	122 43.461	09:24	HSEA	1	NA	NA	30/277	LO,DI	10	PC	1	Note: distance is to "forks" on Scandia, barge has yet to be moved so don't know where the pile will be.
EHW	6-Oct-11	08:45	17:35	47 45.127	122 43.435	09:36	HSEA	1	NA	NA	150/115	TR	-	OC	0	
EHW	6-Oct-11	07:50	16:42	47 46.855	122 43.401	09:50	HSEA	1	NA	NA	50/274	LO,RE,SI	3,506	OC	2	

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	6-Oct-11	08:45	17:35	47 45.127	122 43.435	10:21	HSEA	1	NA	NA	200/110	TR	-	OC	0	
EHW	6-Oct-11	08:45	17:35	47 45.127	122 43.435	10:22	HSEA	1	NA	NA	125/20	TR	-	OC	0	Inside EZ (outside at 10:41) between piles and retaining wall.
EHW	6-Oct-11	08:45	17:35	47 45.127	122 43.435	10:38	HSEA	1	NA	NA	150/55	TR(S)	-	OC	0	Traveling south, last seen under the derrick, heading north at 10:46 just off bow at 10:53.
EHW	6-Oct-11	08:45	17:35	47 45.281	122 43.456	10:57	HSEA	1	NA	NA	30/205	SW,DI	100	OC	1	Right behind Derrick Barge 6 (DB6).
EHW	6-Oct-11	08:45	17:35	47 45.267	122 43.528	11:04	HSEA	1	NA	NA	63/50	SW,DI	150	PC	1	In piles, heading south in EHW1.
EHW	6-Oct-11	07:50	16:42	47 46.855	122 43.401	11:06	HSEA	1	NA	NA	81/75	LO,RE,SI	3,052	OC	1-2	
EHW	6-Oct-11	07:50	16:42	47 46.855	122 43.401	11:06	HPOR	1	NA	NA	752/75	SW(N)	2,875	OC	1-2	
EHW	6-Oct-11	07:50	16:42	47 46.855	122 43.401	12:20	HSEA	1	NA	NA	75/220	LO,SI	3,015	PC	1-2	
EHW	6-Oct-11	08:45	17:35	47 45.266	122 43.501	14:04	HSEA	1	NA	NA	20/300	LO,DI	150	PC	1	Heading north, at 14:07, approximately 300 m north.
EHW	6-Oct-11	08:45	17:35	47 45.127	122 43.435	14:16	HSEA	1	NA	NA	178/115	TR(S)	-	OC	0	Traveling south, small seal, hung out around Columbia all day.
EHW	6-Oct-11	07:50	16:42	47 46.855	122 43.401	14:37	HSEA	1	NA	NA	50/40	LO,SW(E), DI	3050	PC	1-2	
EHW	6-Oct-11	07:50	16:42	47 46.855	122 43.401	15:00	HSEA	1	NA	NA	185/190	LO,SI	2906	OC	1	
EHW	6-Oct-11	08:45	17:35	47 45.115	122 43.443	15:16	HSEA	1	NA	NA	92/85	TR(S)	-	OC	0	Might be same HSEA as above, traveling south.
EHW	6-Oct-11	07:50	16:42	47 46.855	122 43.401	15:23	HSEA	1	NA	NA	170/165	LO,SI	3,000	OC	1	
EHW	6-Oct-11	07:50	16:42	47 46.855	122 43.401	15:24	HSEA	1	NA	NA	150/140	LO,SI	2,780	OC	1	Could be the same individual as the previous sighting.
EHW	6-Oct-11	08:45	17:35	47 45.256	122 43.496	15:44	HSEA	1	NA	NA	50/180	SW(E),DI	125	C	1	Heading east towards EHW1.
EHW	6-Oct-11	08:45	17:35	47 45.257	122 43.488	16:07	HSEA	1	NA	NA	40/005	LO,DI	180	C	1	At 16:09, approximately 80 m north outside EHW1, facing east, medium-sized, light in color.
EHW	6-Oct-11	08:45	17:35	47 45.223	122 43.446	16:10	HSEA	1	NA	NA	15/43	SW,DI	93	OC	1	
EHW	6-Oct-11	08:45	17:35	47 45.114	122 43.442	16:16	HSEA	1	NA	NA	200/98	TR	300	OC	0	TR rapidly, might be same as Shocker 16:10 sighting.
EHW	6-Oct-11	15:15	17:35	47 45.199	122 45.435	16:19	HSEA	1	NA	NA	2/180	SW	59	S		
EHW	6-Oct-11	08:45	17:35	47 45.114	122 43.442	16:23	HSEA	1	NA	NA	76/189	TR	350	OC	0	

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	6-Oct-11	07:50	16:42	47 46.855	122 43.401	16:28	HPOR	3	NA	NA	1100/132	SW(N)	2,200*	OC	1	*Used closest buoy (Alpha) spotted 100 m south of Magnetic Pier; last sighted 16:38 outside (north) of Alpha buoy; moved faster as vibing occurred - could be due to current flow.
EHW	6-Oct-11	07:50	16:42	47 46.855	122 43.401	16:34	HSEA	1	NA	NA	100/130	LO,SI	2,500	OC	1	Last sighted 16:43.
EHW	6-Oct-11	15:15	17:35	47 45.199	122 45.435	16:47	HSEA	2	NA	NA	30/180	SW	50	S		Within EZ. 30 minute shutdown.
EHW	6-Oct-11	08:45	17:35	47 45.230	122 43.492	17:17	CASL	1	NA	NA	500/305	TR(S)	575	C	1	Traveling south along fence line.
EHW	6-Oct-11	15:15	17:35	47 45.199	122 45.435	17:22	HSEA	1	NA	NA	40/45° from fire hydrant	SW(N)	80	S		
EHW	6-Oct-11	07:50	16:42	47 45.772	122 44.938	17:30	HPOR	2	NA	NA	500/85	SW(N)	2,200	OC	1	*Pulling pile, no vibing; 1 adult and 1 calf.
EHW	6-Oct-11	07:50	16:42	47 44.606	122 44.384	17:50	CASL	42	NA	NA	50/100	HO,RE	1,800	OC	1	Used closest CASL; 1 was trying to haul out on the package; sighted these at the end of the day.
EHW	7-Oct-11	07:25	18:18	47 45.251	122 43.484	07:47	HSEA	1	NA	NA	50/150	SW,DI	60	L	1	Direction of travel unknown.
EHW	7-Oct-11	07:25	?	47 45.211	122 43.460	07:48	HSEA	1	NA	NA	200/25	TR(S)	-	LR	0	Heading south.
EHW	7-Oct-11	07:25	?	47 45.211	122 43.460	07:50	HSEA	1	NA	NA	30/145	LO	-	LR	0	5 m from GC barge..
EHW	7-Oct-11	07:25	18:18	47 45.242	122 43.489	08:02	HSEA	1	NA	NA	25/100	SW(E),DI	60	OC	1	Dove under boom and into EHW1 heading east, at 08:06 in EZ.
EHW	7-Oct-11	07:25	16:42	47 46.089	122 44.221	08:11	HSEA	1	NA	NA	96/330	LO,SI,SW (N)	2,100	F	0-1	
EHW	7-Oct-11	07:25	18:18	47 45.241	122 43.495	08:15	HSEA	1	NA	NA	50/350	SW(SE),DI	100	OC	1	Direction of travel possibly southeast, at 08:17 in EZ, at 08:23 out of EZ, approximately 70 m from pile.
EHW	7-Oct-11	07:25	?	47 45.211	122 43.460	08:18	HSEA	1	NA	NA	260/220	SL	-	OC	0	West of GC barge by 10 m.
EHW	7-Oct-11	07:25	18:18			08:25	HSEA	1	NA	NA	35/180	SW,DI	55	S		
EHW	7-Oct-11	07:25	?	47 45.211	122 43.460	08:25	HSEA	1	NA	NA	200/300	TR(N)	-	OC	0	Heading north 325 degrees.
EHW	7-Oct-11	07:25	18:18	47 45.242	122 43.504	08:27	HSEA	1	NA	NA	400/257	FO	450	OC	1	Observed with fish in mouth.
EHW	7-Oct-11	07:25	16:42	47 46.089	122 44.221	08:29	HSEA	1	NA	NA	100/104	LO,SI,SW (E)	1,980	F	0-1	
EHW	7-Oct-11	07:25	?	47 45.211	122 43.460	08:31	HSEA	1	NA	NA	177/300	TR(E)	-	R	0	Heading east under Scandia barge, could be same as above. 08:33 inside EZ.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	7-Oct-11	07:25	18:19	47 45.194	122 43.439	08:34	HSEA	1	NA	NA	35/230	SW,LO,DI	45	OC,L	0	
EHW	7-Oct-11	07:25	18:18			08:34	HSEA	1	NA	NA	40/180° from hydrant	SW,DI	60	Calm		Same HSEA as before.
EHW	7-Oct-11	07:25	18:18			08:40	HSEA	1	NA	NA	45/180° from hydrant	SW(W),DI	55	Calm		Same HSEA as before, swimming westward.
EHW	7-Oct-11	07:25	18:18	47 45.247	122 43.495	08:45	HSEA	1	NA	NA	40/120	SW(SE),DI	40	OC	1	Heading southeast in EZ, at 08:48 still in EZ inside EHW1.
EHW	7-Oct-11	07:25	18:19	47 45.194	122 43.439	08:48	HSEA	1	NA	NA	30/175	SW,LO,DI	20	OC,L	0	08:06, HSEA in EZ, resighted from Swift. 08:17 seal in EZ, this is a possible resight of Swift sighting
EHW	7-Oct-11	07:25	18:18			08:51	HSEA	1	NA	NA	10/180° from frag barrier	SW,DI	40	S		In EZ, shutdown. Swimming north.
EHW	7-Oct-11	07:25	18:18			08:53	HSEA	1	NA	NA	10/180° from frag barrier	MI	40	Calm		Milling.
EHW	7-Oct-11	07:25	18:18			09:02	HSEA	1	V	Before	10/180° from frag barrier	SW,DI	40	Calm		
EHW	7-Oct-11	07:25	18:18	47 45.240	122 43.502	09:03	HSEA	1	V	Before	45/100	SW,DI	40	OC	1	Could be resight.
EHW	7-Oct-11	07:25	18:19	47 45.194	122 43.439	09:09	HSEA	1	V	Before	30/280	SW,DI	80	OC,L	0	
EHW	7-Oct-11	07:25	18:19	47 45.194	122 43.439	09:21	HSEA	1	V	Before	37/270	SW,DI	50	OC	0	
EHW	7-Oct-11	07:25	18:19	47 45.194	122 43.439	09:34	HSEA	1	V	During	10m / 65	SW,DI	87	OC	0	
EHW	7-Oct-11	07:25	?	47 45.148	122 43.418	09:41	HSEA	1	V	During	300/365	TR(S)	-	R	0	Traveling south.
EHW	7-Oct-11	07:25	18:19	47 45.194	122 43.439	09:43	HSEA	1	V	During	30/267	DI	90	OC	0	
EHW	7-Oct-11	07:25	16:42	47 46.089	122 44.221	09:44	HSEA	3	V	During	15/255	LO,SI	2,100	LR,OC	1	3rd individual was spotted closer to boat about 15 m.
EHW	7-Oct-11	07:25	?	47 45.148	122 43.418	09:45	HSEA	1	V	After	400/143	PO(E)	-	R	0	Heading east toward beach.
EHW	7-Oct-11	07:25	?	47 45.148	122 43.418	09:47	HSEA	2	V	After	350/251	TR(S)	-	R	0	Heading south 215 degrees.
EHW	7-Oct-11	07:25	18:18			09:52	HSEA	1	V	After	15/90° from lightning tower	SW(S),DI	80	S		Swimming south.
EHW	7-Oct-11	07:25	18:18	47 45.241	122 43.510	09:53	HSEA	1	V	After	250/185	SW(SSE), DI	300	OC	1	Heading south-southeast.
EHW	7-Oct-11	07:25	18:18	47 45.239	122 43.507	09:55	HSEA	1	V	After	60/105	SW(E),DI	55	OC	1	Heading east, possibly under EHW1, at 09:59 to west, approximately 40 m heading northwest.
EHW	7-Oct-11	07:25	18:18			10:02	HSEA	1	V	After	5/180° from lightning tower	SW,DI	80	Calm		Same seal as before.
EHW	7-Oct-11	07:25	18:18			10:22	HSEA	1	NA	NA	5/90° from lightning tower	SW(S),DI	80	Calm		Swimming south.
EHW	7-Oct-11	07:25	?	47 45.148	122 43.418	10:23	HSEA	1	NA	NA	30/210	LO	-	LR	0	

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	7-Oct-11	07:25	?	47 45.148	122 43.418	10:24	HSEA	1	NA	NA	50/140	TR(S)	-	OC	0	Traveling south 160 degrees.
EHW	7-Oct-11	07:25	18:18	47 45.304	122 43.493	11:00	HSEA	1	NA	NA	50/155	SW(NNW), LO,DI	150	OC	1	Heading north-northwest.
EHW	7-Oct-11	07:25	18:18			11:05	HSEA	1	NA	NA	5/225° from Scandia barge	SW,DI	55	S		
EHW	7-Oct-11	07:25	18:18	47 45.315	122 43.480	11:10	HSEA	1	NA	NA	185/150	SW,DI	80	OC	1	In EHW1.
EHW	7-Oct-11	07:25	18:18			11:19	HSEA	1	NA	NA	15/90° from lightning tower	SW,DI	85	S		
EHW	7-Oct-11	07:25	18:18	47 45.261	122 43.515	11:22	HSEA	1	NA	NA	45/160	LO,DI	100	OC	1	Sank at stern of Scandia, direction of travel unknown.
EHW	7-Oct-11	07:25	18:19	47 45.194	122 43.439	11:33	HSEA	1	NA	NA	25/270	SW,DI	100	OC	1	
EHW	7-Oct-11	07:25	?	47 45.148	122 43.418	11:58	HSEA	1	NA	NA	108/330	TR(N),LO	-	OC	0	Traveling north, 50 m in EZ, but no construction was occurring.
EHW	7-Oct-11	07:25	18:18			12:03	HSEA	1	NA	NA	20/180° from lightning tower	SW,DI	60	S		
EHW	7-Oct-11	07:25	?	47 45.141	122 43.415	13:29	HSEA	1	NA	NA	15/70	TR(S)	-	OC	0	Traveling south 145 degrees.
EHW	7-Oct-11	07:25	18:18			13:46	HSEA	1	NA	NA	20/315° from life ring	SW(S),DI	85	S		Swimming south.
EHW	7-Oct-11	07:25	18:18	47 45.261	122 43.533	14:13	HSEA	2	V	Before	80/75	MI,DI	120	OC	1	Dove, appeared to be heading under boom into EHW1, at 14:52 west of stern of Scandia.
EHW	7-Oct-11	07:25	?	47 45.141	122 43.415	14:16	HSEA	1	V	Before	200/325	TR(N)	70	OC	0-1	Traveling north.
EHW	7-Oct-11	07:25	18:18	47 45.240	122 43.525	14:31	HSEA	1	V	During	110/14	SW(S)	180	OC	1	Heading south into mouth of EHW1-north end.
EHW	7-Oct-11	07:25	?	47 45.141	122 43.415	14:34	HSEA	1	V	After	15/240	LO	300	OC	0-1	Heading north.
EHW	7-Oct-11	07:25	18:19	47 45.194	122 43.439	14:46	HSEA	1	V	After	10/280	LO,SI	100	OC	1	
EHW	7-Oct-11	07:25	18:18	47 45.255	122 43.525	14:46	HSEA	1	V	After	80/005	SW(N),DI	180	OC	1	At north entrance of EHW1, same as previous location.
EHW	7-Oct-11	07:25	18:18	47 45.255	122 43.525	14:47	HSEA	1	V	After	60/158	LO,SI	130	OC	1	Heading north.
EHW	7-Oct-11	07:25	18:18	47 45.262	122 43.507	15:02	HSEA	1	SSV	During	30/16	MI,DI	150	OC	2	Milling at northwest corner of EHW1 during soft start.
EHW	7-Oct-11	07:25	16:42	47 46.117	122 44.247	15:03	HPOR	2	SSV	During	100/185	SW(E)	1,800	OC	1	Sighted traveling east during vibe
EHW	7-Oct-11	07:25	?	47 45.141	122 43.415	15:06	HSEA	1	V	During	200/300	LO,TR(NE)	70	OC	0	Heading northeast.
EHW	7-Oct-11	07:25	?	47 45.141	122 43.415	15:13	HSEA	1	V	After	15/127	LO,TR,SI	300	OC	0	
EHW	7-Oct-11	07:25	?	47 45.141	122 43.415	15:22	HSEA	1	V	After	200/315	LO,SI	30	OC	0	During 30 minutes of post-construction monitoring, 15:41 inside EHW1 pool, surfaced 8 m from men on raft

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	7-Oct-11	07:25	18:19	47 45.338	122 43.503	16:10	HSEA	1	NA	NA	100/300	SW,LO,SI	350	OC	1	
EHW	7-Oct-11	07:25	16:42	47 46.117	122 44.247	16:15	HPOR	2	NA	NA	15/110	SW(SW)	1,700	OC	1	1 adult and 1 neonate (spotted undeveloped melon and linings/folds alongside of body); smaller individual swimming and surfacing in unison with larger individual; smaller individual was 1/3 the size of the larger; last sighted around 16:28 heading southwest.
EHW	7-Oct-11	07:25	18:18	47 45.240	122 43.474	16:20	HSEA	1	NA	NA	40/120	MI,DI	70	PC	1	Direction of travel unknown, at 16:24 outside EZ at corner of barge, juvenile, at 16:27 in same area, sank, no direction of travel, at 16:32 same area milling then sank, at 16:38 last sighting.
EHW	7-Oct-11	07:25	16:42	47 46.117	122 44.247	16:40	HPOR	2	V	Before	20/295	SW(SW), CH	1,925	OC	1	Much larger individual; brown to tan in color; last sighted at 16:46.
EHW	7-Oct-11	07:25	16:42	47 46.117	122 44.247	16:48	HPOR	2	V	Before	100/75	SW(SW)	2,000	OC	1	Adult/neonate last sighted at 16:15.
EHW	7-Oct-11	07:25	16:42	47 46.117	122 44.247	16:59	HPOR	2	V	During	500/275	SW(S)	3,000	OC	1	TRsouth along bank.
EHW	7-Oct-11	07:25	16:42	47 46.117	122 44.247	17:01	HPOR	2	V	During	500/260	SW(S),DI	3,000	OC	1	TR south along bank; last sighted at 17:06 about 100m N of Duck about 1.6k from boat
EHW	7-Oct-11	07:25	?	47 45.141	122 43.415	17:01	HSEA	1	V	During	15/291	LO,SI	100	OC	0	Heading southeast of 175 degrees.
EHW	7-Oct-11	07:25	18:19	47 45.194	122 43.439	17:02	HSEA	2	V	During	15/35	LO,SI	91	OC	1	Second sighting was only 5 m from boat.
EHW	7-Oct-11	07:25	18:18	47 45.248	122 43.483	17:18	HSEA	1	V	During	70/330	SW(ESE), DI	180	OC	1	Heading east-southeast.
EHW	7-Oct-11	07:25	16:42	47 46.117	122 44.247	17:19	HPOR	1	V	During	700/75	SW(S)	1,500	OC	1	Spotted several rolls, heading southwest toward WRA. Headed north at 17:30.
EHW	7-Oct-11	07:25	?	47 45.141	122 43.415	17:20	HSEA	1	V	After	100/260	LO	120	OC	0	Moved away from vibing area toward beach, 17:32 heading south 182 degrees, 10 m off beach.
EHW	7-Oct-11	07:25	18:19	47 45.194	122 43.439	17:30	HSEA	1	V	After	40/145	LO,SI	50	OC	1	
EHW	7-Oct-11	07:25	16:42	47 46.117	122 44.247	17:40	HSEA	1	V	After	700/271	FO	3,000	OC	1	Fish struggling, seal playing with it.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	7-Oct-11	07:25	18:18			17:41	HSEA	1	V	After	40/90° from hydrant	SW,DI	75	S		
EHW	7-Oct-11	07:25	?	47 45.141	122 43.415	17:43	HSEA	1	V	After	75/310	LO	80	OC	0	Dove when vibratory turned on.
EHW	7-Oct-11	07:25	16:42	47 46.117	122 44.247	17:45	HPOR	2	V	After	20/340	SW(NNW), CH	1,950	OC	1	Traveling north-northwest between vibe on-vibe off-Vibe on-vibe off; last sighted 17:50.
EHW	7-Oct-11	07:25	16:42	47 46.117	122 44.247	17:52	CASL	1	V	After	100/240	SW(N)	2,500	OC	1	
EHW	7-Oct-11	07:25	18:18	47 45.241	122 43.482	17:54	HSEA	1	V	After	35/172	LO,SI	80	OC	1	Looking at barge activity then sank.
EHW	7-Oct-11	07:25	18:18	47 45.252	122 43.500	18:08	HSEA	1	V	After	300/270	SW(N),DI	380	PC	1	Heading north.
EHW	7-Oct-11	07:25	16:42	47 44.439	122 44.506	18:16	CASL	29	V	After	100/37	RE	1,800	OC	1	8 on package and 21 on WRA fence.
EHW	8-Oct-11	08:05	17:00	47 45.156	122 43.419	08:12	HSEA	1	NA		100/285	LO,SI	100	F	0	
EHW	8-Oct-11	08:05	09:56			08:16	HSEA	1	V	Before	30/135° from lightning tower	SW (N), DI	82	S		
EHW	8-Oct-11	08:05	17:00	47 45.249	122 43.493	08:36	HSEA	2	V	Before	60/190	MI	90	-	0	Milling around stern of Scandia
EHW	8-Oct-11	08:05	17:00	47 45.156	122 43.419	08:42	HSEA	1	V	Before	125/177	SW,LO,DI	225	-	0	08:44 re-sight 125m from pile
EHW	8-Oct-11	08:05	09:56			8:45	HSEA	1	SSV	During	40/45° from lightning tower	SW, DI	115	-	0	Same seal as before.
EHW	8-Oct-11	08:05	17:00	47 45.156	122 43.419	08:49	HSEA	2	V	During	300/280	LO,di	200	-	0	Swift resight their #1.
EHW	8-Oct-11	08:05	17:00	47 45.230	122 43.482	08:53	HSEA	1	V	After	120/330	SW (N),DI	90	PC	0	Heading north.
EHW	8-Oct-11	08:05	17:00	47 45.243	122 43.488	08:57	HSEA	1	V	After	120/258	SW (E),DI	200	PC	0	Heading west.
EHW	8-Oct-11	08:05	17:00	47 45.156	122 43.419	09:00	HSEA	2	V	After	25/002	SW (SW),LO,SI	75	PC	0	Resight of animal obs by JR, headed south.
EHW	8-Oct-11	08:05	17:00	47 45.238	122 43.503	09:02	HSEA	1	V	During	300/255	SW (W)	380	PC	0	Heading west.
EHW	8-Oct-11	08:05	17:00	47 45.380	122 43.127	09:05	HSEA	1	V	During	40/315	LO	1,000	PC	0	
EHW	8-Oct-11	08:05	17:00	47 45.237	122 43.500	09:09	HSEA	1	V	After	30/94	SW (ENE),DI	60	PC	0	Heading east-northeast.
EHW	8-Oct-11	08:05	17:00	47 45.237	122 43.490	09:13	HSEA	1	V	During	140/330	SW (NW),DI	200	PC	0	Heading northwest, at 09:15 approximately 70 m north, moving towards EHW1.
EHW	8-Oct-11	08:05	17:00	47 45.237	122 43.490	09:15	HSEA	1	V	After	70/339	SW(E),LO, DI	160	PC	0	At 09:35 in EHW1, approximately 85 m from pile, at 09:38 in EZ, approximately 46 m from pile.
EHW	8-Oct-11	08:05	09:56			09:25	HSEA	1	V	During	0 from lightning tower	SW, DI	100	S		

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	8-Oct-11	08:05	17:00	47 45.156	122 43.419	09:27	HSEA	1	V	During	10/005	SW,LO,SI	100	-	0	09:22 shutdown, seal in EZ, 09:24 in EZ,09:25 out of EZ; 09:27 resight of small animal possibly from EZ.
EHW	8-Oct-11	08:05	09:56			09:42	HSEA	1	V	After	35/45° from lightning tower	SW (N), DI	130	S		
EHW	8-Oct-11	08:05	17:00	47 45.241	122 43.477	09:43	HSEA	3	V	After	150/320	SW (E),DI	150	-	0	heading east, 1 seal ~100m , the other 2 ~150m north, at 0945 1 entered EHW1, all animals moving east, at 0948 1 left EHW1 heading SW under boom, at 0951 heading south closer to pile, ~50m from pile
EHW	8-Oct-11	08:05	09:56			09:50	HSEA	1	V	After	20/90 from hydrant	FO	65	S		
EHW	8-Oct-11	08:05	17:00	47 45.156	122 43.419	09:53	HSEA	1	V	After	75/290	LO,SI	100	-	0	Resight of 09:39 (Brian's #2); sighted out of EZ on south side.
EHW	8-Oct-11	08:05	17:00	47 45.206	122 43.468	09:59	HSEA	1	NA	NA	5/E	FO/SW	10	-	0	HSEA underwater swimming, never surfaced,foraging.
EHW	8-Oct-11	08:05	17:00	47 45.042	122 43.250	11:00	HSEA	1	NA	NA	10/90	LO	1,000	-	0	
EHW	10-Oct-11	11:15	17:23	47 44.618	122 44.102	09:50	CASL	8	NA	NA	75/180	RE	1,200	F,L	2	Animals resting on most northern package.
EHW	10-Oct-11	11:15	17:23	47 44.618	122 44.102	09:55	CASL	6	NA	NA	75/140	RE	1,600	F,L	2	On package, where STSL was.
EHW	10-Oct-11	11:15	17:23	47 44.618	122 44.102	10:05	CASL	8	NA	NA	20/180	RE	1,800	F,L	2	On floats along fence.
EHW	10-Oct-11	11:15	17:23	47 45.258	122 43.493	10:26	HSEA	1	NA	NA	30/232	LO,SI	125	F,L	2	
EHW	10-Oct-11	11:15	17:23	47 45.258	122 43.493	11:22	HSEA	1	NA	NA	20/250	LO,DI	100	F,L	2	
EHW	10-Oct-11	11:15	17:23	47 45.249	122 43.536	11:36	HSEA	1	NA	NA	30/220	SW,SI	45	R	2	
EHW	10-Oct-11	11:15	17:23	47 45.249	122 43.536	12:05	HSEA	1	NA	NA	33/225	SW,SI	70	R	2	Southwest 143 degrees towards pile, 12:39 probably same seal heading north.
EHW	10-Oct-11	11:15	17:23	47 45.249	122 43.536	12:44	HSEA	1	NA	NA	60/200	SW,DI	60	R	2	In EZ by pile, barge heading southeast, 12:48 clear of EZ, headed north.
EHW	10-Oct-11	11:15	17:23	47 45.249	122 43.536	14:18	HSEA	1	V	During	15/230	SW,LO,SI	74	PC	2	Sighting triggered shutdown
EHW	10-Oct-11	11:15	17:23			15:00	HSEA	1	V	After	20/0° from capstan	SW	15	-		NOTE: Same as BM sighting#4
EHW	10-Oct-11	11:15	17:23			15:18	HSEA	1	NA	NA	10/0° from fire hydrant	SW	15	-		NOTE: Same as BM sighting #4
EHW	10-Oct-11	11:15	17:23	47 45.229	122 43.459	15:41	HSEA	1	NA	NA	20/347	LO,SI	150	PC	2	

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	10-Oct-11	11:15	17:22	47 45.243	122 44.254	16:21	HSEA	1	V	During	100/203	SW,DI	1,100	PC	1	Heading west.
EHW	10-Oct-11	11:15	17:23	47 45.249	122 43.536	16:33	HSEA	1	V*	After	35/180	SW,SI	65	PC	2	*Hammer fell off pile, 16:44 seen leaving EZ by Swift MMO now outside EWHI while vibing pile.
EHW	10-Oct-11	11:15	17:23	47 45.229	122 43.459	16:35	HSEA	1	V	After	5/030	FO	75	PC	2	Chasing fish and catching and eating them.
EHW	10-Oct-11	11:15	17:23	47 44.618	122 44.102	17:15	STSL	1	V	After	80/110	RE	1,400	PC	4	STSL on package, no brand, slightly smaller than STSL branded #102Y seen yesterday. Coat was wet, RE with 14 CASL. Location is about 1,400 m from last pile driven.
EHW	11-Oct-11	07:50	18:19	47 44.587	122 44.230	07:43	CASL	26	NA		200/85	RE	1,500	PC	2	All animals hauled out at Delta pier, 11 on vessel 1 (north), 5 on vessel 2 (middle), 1 on vessel 3 (south), 9 on fence. One individual had brand (partially readable) C_6_.
EHW	11-Oct-11	07:50	18:19	47 45.226	122 43.477	09:09	HSEA	1	V	After	17/33	SW,DI	55	PC	2	In EZ heading north
EHW	11-Oct-11	07:50	18:19	47 45.226	122 43.477	09:20	HSEA	1	V	After	90/335	SW,DI	90	PC	2	Out of EZ, heading east possibly under boom, at 0922 inside EHW1 heading east, still out of EZ.
EHW	11-Oct-11	07:45	18:16			10:20	HSEA	1	V	After	5/0° from capstan					
EHW	11-Oct-11	07:50	18:19	47 45.225	122 43.470	11:41	HSEA	1	NA		10/290	SW,LO,SI	90	PC	3	09:09 in EZ swift sighted, 09:20 out of EZ.
EHW	11-Oct-11	07:50	18:19	47 45.226	122 43.493	11:55	HSEA	1	V	Before	20/66	SW,DI	80	PC	3	Resight of B. Dawe sighting #1, heading east under EHW boom, resurfaced inside at 11:57 out of EZ.
EHW	11-Oct-11	07:50	18:19	47 45.471	122 43.471	13:05	HSEA	1	NA	NA	15/310	LO,DI,RE, SI	-	PC	4	Large adult, came up just behind boat, startled, then bobbed resting.
EHW	11-Oct-11	07:50	18:19	47 45.576	122 43.421	13:24	CASL	1	NA	NA	200/095	DI,TR	-	PC	4	Moving fast at 175 degrees along shore towards north entry to WRA, 14:08
EHW	11-Oct-11	07:50	18:19	47 45.576	122 43.421	14:01	CASL	1	SSV	During	6M/210	LO,SW,DI	702	PC	4	Swam around boat, porpoising and diving for several minutes.
EHW	11-Oct-11	07:50	18:19	47 45.236	122 43.484	14:08	HSEA	1	V	During	50/48	SW,DI	110	PC	3	Heading south inside EHW1.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	11-Oct-11	07:50	18:19	47 45.576	122 43.421	14:08	CASL	1	V	During			400		4	PROBABLY RE-SIGHTED BY EMILY ON STREAK HEADING SOUTH, PROBABLY IN WRA DURING VIBE, CHECK END VIBE TIME, OTHERWISE IT WAS SIGHTED DURING BEGINNING OF POST VIBE 30 MINUTE WATCH
EHW	11-Oct-11	07:50	18:19	47 45.245	122 43.485	14:22	HSEA	1	V	After	20/36	RE,SI	100	L	3	Resting, then sank. No direction of travel, at 14:27, in same area, resting then sank. No direction of travel.
EHW	11-Oct-11	07:50	18:19	47 45.274	122 43.518	15:19	HSEA	1	NA	NA	40/150	LO,SI	75	PC	3	Direction of travel unknown.
EHW	11-Oct-11	07:50	18:19	47 45.276	122 43.493	15:57	HSEA	1	NA	NA	50/164	LO,SI	75	PC	3	Young animal, facing barge.
EHW	11-Oct-11	07:50	18:19	47 45.215	122 43.423	16:17	HSEA	2	V	Before	10/270	LO,DI	40	PC	3	
EHW	11-Oct-11	07:50	18:19	47 45.244	122 43.495	17:25	HSEA	1	V		15/260	RE,SI	75	PC	3	No direction of travel, near corner of M35, rest then sink.
EHW	11-Oct-11	07:50	18:19	47 45.215	122 43.423	18:02	HSEA	1	V	After	60/315	LO,DI	80	PC	3	13:35-13:46 in EZ, 15:26-16:00 animal in EZ. 16:06
EHW	11-Oct-11	07:50	18:19	47 44.681	122 43.883	18:04	STSL	1	V	After	75/175	RE	1,080	PC	3	Hauled out (and dry) resting on vessel, very blonde individual, only saw right side of animal
EHW	11-Oct-11	07:50	18:19	47 45.215	122 43.423	18:06	HSEA	1	V	After	10/270	SW,LO,DI	35	PC	3	1617 in EZ,1623 in EZ;1628 fire up tender vessel (cable tender) and rev engine louder and louder right where animal was seen.1642 now revving engines again as well as generators, right on top of "block one" where animal was last seen.
EHW	11-Oct-11	07:50	18:19	47 44.614	122 44.048	18:10	STSL	1	V	After	60/75	RE	1,450	PC	3	Hauled out on vessel, very large individual, observed both sides of animal-no brand, had small wound or scar in left corner of mouth and noticeably protruding front teeth.
EHW	12-Oct-11	08:00	18:45	47 44.675	122 43.857	07:34	CASL	31	NA	NA	75/183	RE	1,080	PC	1	Hauled out on Vessel 1 (north) at Delta pier, one CASL had brand C84.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	12-Oct-11	08:00	18:45	47 44.675	122 43.857	07:34	STSL	1	NA	NA	75/183	RE	1,080	PC	1	Hauled out on Vessel 1 (north) at Delta pier, only right side of animal visible.
EHW	12-Oct-11	08:00	18:45	47 44.608	122 44.051	07:48	STSL	2	NA	NA	75/106	RE	1,310	PC	1	"102Y' and one other large male hauled out on Vessel 2 (middle) at Delta pier.
EHW	12-Oct-11	08:00	18:45	47 44.608	122 44.051	07:48	CASL	17	NA	NA	75/106	RE	1,310	PC	1	Hauled out on Vessel 2 (middle) at Delta pier.
EHW	12-Oct-11	08:00	18:45	47 44.608	122 44.051	07:48	STSL	1	NA	NA	75/106	MI	1,310	PC	1	In water, joined with large male from Vessel 2, milling in water moving slowly towards fence, last sight 07:58.
EHW	12-Oct-11	08:00	18:45	47 44.550	122 44.074	08:07	CASL	7	NA	NA	100/220	RE	1,410	PC	1	Hauled out on fence.
EHW	12-Oct-11	08:00	18:45	47 44.542	122 44.210	09:10	CASL	14	NA	NA	80/86	FL	1,450	PC	1	
EHW	12-Oct-11	08:00	18:45	47 44.542	122 44.210	09:10	STSL	1	NA	NA	80/86	FL	1,450	PC	1	
EHW	12-Oct-11	08:00	18:45	47 45.214	122 43.441	09:14	HSEA	1	NA	NA	75/315	SW,LO,SI	120	PC	1	STSL in water 09:09.
EHW	12-Oct-11	08:00	18:45	47 45.214	122 43.441	09:18	HSEA	2	NA	NA	10/052	SW,LO,DI	50	PC	1	2 animals moving south, 9:23-9:37 HSEA in and out of EZ.
EHW	12-Oct-11	08:00	18:45	47 45.125	122 43.461	09:19	HSEA	1	NA	NA	120/130	LO,RE,MI	350	PC	1	0922, 0925, 0927 sighting. Last sighted 11:49
EHW	12-Oct-11	08:00	18:45	47 44.542	122 44.210	09:20	STSL	1	NA	NA	210/200	MI	1,800	PC	1	STSL that was flushed off vessel milling outside fence, no direction of travel, perhaps SW, last sight was 0920.
EHW	12-Oct-11	08:00	18:45	47 45.125	122 43.466	09:29	HSEA	1	NA	NA	200/150	LO,MI	450	PC	1	Joined Sighting 1
EHW	12-Oct-11	08:00	18:45	47 45.125	122 43.466	09:41	HSEA	1	NA	NA	250/135	LO,SI	350	PC	1	Joined Sighting 1 and 2
EHW	12-Oct-11	08:00	18:45	47 45.069	122 44.187	09:44	HSEA	2	NA	NA	80/010	SW,DI	-	OC	2	SWIMMING GOING 300 DEGREES
EHW	12-Oct-11	08:00	18:45	47 45.214	122 43.441	09:54	CASL	1	NA	NA	3/270	TR	50	PC	1	CASL traveling fast to the north through EHW canal 958 out of EZ
EHW	12-Oct-11	08:00	18:45	47 44.556	122 44.159	10:34	HSEA	1	V	Before	180/60	SW,DI	1,450	C	2	heading south near Delta pier
EHW	12-Oct-11	08:00	18:45	47 45.125	122 43.466	10:36	HSEA	1	V	Before	200/135	SW	350	PC	1	Joined sighting 1, 2 and 3
EHW	12-Oct-11	08:00	18:45	47 45.125	122 43.466	10:59	HSEA	1	SSV	During	200/100	SW	400	PC	1	Same seals/different activity. Swimming away from piling

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	12-Oct-11	08:00	18:45	47 45.125	122 43.461	11:00	HSEA	1	SSV	During	250/140	LO,SW,SI	350	PC	1	Swimming north along beach toward EHW1 and piling
EHW	12-Oct-11	08:00	18:45	47 44.548	122 44.144	11:02	CASL	5	SSV	During	180/54	MI,VO	1,450	PC	1	animals in water at Delta pier-no change in behavior observed, moving in and out of water
EHW	12-Oct-11	08:00	18:45	47 45.069	122 44.187	11:22	HSEA	1	V	During	20/222	SI	935	PC	2	DURING PAUSE IN VIBE AFTER MC INVOKED A THIRD SOFT START VIBE ~15 MINUTES AFTER PARTIAL SS?, VIBE ON 11:26, MC ALLOWING/DOING 3 SEPARATE SS STYLE VIBES BUT SEPERATED BY SEVERAL MINUTES, THEN VIBE
EHW	12-Oct-11	08:00	18:45	47 44.551	122 44.140	11:37	CASL	6	V	During	90/57	MI,VO	1,500	PC	2	multiple animals (likely all previous sightings) near vessel and fence line, in water milling and vocalizing
EHW	12-Oct-11	08:00	18:45	47 45.276	122 43.464	11:38	CASL	1	V	During	75/22	TR	250	PC	1	1055 moved to west side near ehw1 entrance, Manson is moving DB6
EHW	12-Oct-11	08:00	18:45	47 44.563	122 44.059	11:47	CASL	1	v	After	70/82	FL	1,450	PC	1	
EHW	12-Oct-11	08:00	18:45	47 45.069	122 44.187	12:42	HSEA	1	NA	NA	120/356	TR,LO,SI	935	PC	1	Traveling 150 degrees.
EHW	12-Oct-11	08:00	18:45	47 44.888	122 43.748	12:52	HSEA	3	NA	NA	100/125	HO	400	PC	1	Hauled out on small dock west of Marginal pier
EHW	12-Oct-11	08:00	18:45	47 45.206	122 43.428	13:26	HSEA	1	NA	NA	5/345	LO,DI	45	PC	0	1454-1743 animals in and out of EZ at 1743 MC called for a two minute clear then gave the ok to start
EHW	12-Oct-11	08:00	18:45	47 45.234	122 43.483	13:34	HSEA	2	NA	NA	20/343	LO,SI	70	PC	1	both heading east, resurfaced near boat looking, at 1443 still in area, out of EZ looking then sinking
EHW	12-Oct-11	13:40	17:45	--	--	13:40	CASL	22	NA	NA	7/N	RE,VO,UN	1500	OC	0	CASLs were emitting many behaviors and hauling on and off the east end of the package at Delta Pier N.
EHW	12-Oct-11	08:00	18:45	47 44.529	122 44.083	14:23	HSEA	1	NA	NA	400/330	RE,SW,SI, DI	100	PC	1	14:27 SW, DI 15:57 LO, SI.
EHW	12-Oct-11	08:00	18:45	47 45.206	122 43.428	14:24	HSEA	1	V	Before	5/345	SW,LO,DI	50	PC	0	
EHW	12-Oct-11	13:40	17:45	--	--	14:40	HSEA	1	V	Before	10/E	TR,SI	1,500	OC	0	

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	12-Oct-11	07:45	18:45			14:47	HSEA	1	V		10/270 from west corner of fragmentation barrier	SW	40	S		
EHW	12-Oct-11	13:40	17:45	--	--	14:50	CASL	2	V	Before	8/NE	UN,MI	1,500	OC	1	2 of the CASL males began to fight and slid off the package and into the water to continue.
EHW	12-Oct-11	08:00	18:45	47 45.206	122 43.428	14:54	HSEA	1	V	Before	20/220	SW,LO,DI	20	PC	0	
EHW	12-Oct-11	07:45	18:45			14:57	HSEA	1	SSV	During	40/180 from West corner of fragmentation barrier		80			
EHW	12-Oct-11	13:40	17:45	--	--	15:00	CASL	21	V	During	7/N	RE,VO,UN	1,500	OC	1	Same animals as above, initiated hourly counts and behavioral focal follows at Delta Pier
EHW	12-Oct-11	07:45	18:45			15:00	HSEA	1	V	During	15/270 from West corner of frag barrier	DI	55			On itsback, then took breath and dove. No abnormal behavior noted. During pile driving, inside EZ, but per MC's volitional standard, pile driving continued.
EHW	12-Oct-11	13:40	17:45	--	--	15:00	CASL	1	V	During	8/N	HO	1,500	OC	1	One of the animals that was observed at 13:40 came back at 15:00 and hauled out during "full" vibratory activity.
EHW	12-Oct-11	13:40	17:45	--	--	15:06	HSEA	1	V	During	30/W	TR,LO,SI	1,500	OC	1	
EHW	12-Oct-11	08:00	18:45	47 45.069	122 44.187	15:08	HSEA	1	V*	During	75/182	SW,SI	935	OC	1	* VIBE ENDED JUST ENDED
EHW	12-Oct-11	08:00	18:45	47 45.221	122 43.487	15:10	CASL	1	NA	During	75/274	TR	125	PC	1	Moved into EHW1, rapidly moving through the piles and into EZ-no vibe-CASL continued south and out of EZ heading south, vibe recommenced at 15:12.
EHW	12-Oct-11	07:45	18:45			15:11	CASL	1	V	During	10/225° from West corner of frag barrier	SW(S)	70			Resighting.
EHW	12-Oct-11	13:40	17:45	--	--	15:14	HSEA	1	V	During	20/N	TR,SI	1,500	OC	1	
EHW	12-Oct-11	08:00	18:45	47 45.217	122 43.494	15:14	HSEA	1	V	During	40/272	SW,LO,DI	75	PC	1	Heading east into EHW1-no behavior observed.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	12-Oct-11	08:00	18:45	47 45.217	122 43.494	15:14	HSEA	1	V	During	25/165	LO,SI	70	PC	1	Sank, no direction of travel
EHW	12-Oct-11	13:40	17:45	--	--	15:20	CASL	1	V	During	8/NE	SW	1,500	OC	1	CASL was in water when V was on as well as when it was turned off.
EHW	12-Oct-11	08:00	18:45	47 45.231	122 43.469	15:29	HSEA	1	NA	After	20/285	SW,DI	60	PC	1	Could be resight, at 15:33 off northwest corner of barge.
EHW	12-Oct-11	07:45	18:45			15:43	HSEA	1	V	After	25/270° from West corner of frag barrier		65			Resurfaces periodically in same location.
EHW	12-Oct-11	13:40	17:45	--	--	15:47	HSEA	1	NA	After	40/N	MI,SI	1,500	OC	1	
EHW	12-Oct-11	08:00	18:45	47 45.535	122 44.187	15:47	CASL	1	NA	After	950/33	PO,TR	-	PC	1	Reported by MC, going southwest "fast".
EHW	12-Oct-11	08:00	18:45	47 45.206	122 43.428	15:53	HSEA	1	NA	NA	20/246	SW,LO,DI	20	PC	0	18:45, end of watches as Manson has damaged part of EHW1
EHW	12-Oct-11	08:00	18:45	47 44.592	122 44.079	16:10	CASL	1	NA	NA	20/60	PO	1,500	PC	1	PO, but twirling and throwing head up
EHW	12-Oct-11	08:00	18:45	47 45.246	122 43.507	16:16	HSEA	1	NA	NA	175/002	SW,DI	250	PC	1	Heading northwest.
EHW	12-Oct-11	08:00	18:45	47 45.230	122 43.470	16:29	HSEA	1	NA	NA	5/20	LO,SW,DI	37	PC	1	Small animal, heading east into EHW1.
EHW	12-Oct-11	13:40	17:45	--	--	16:31	HSEA	1	NA	NA	50/N	LO	1,500	OC	1	
EHW	12-Oct-11	08:00	18:45	47 45.231	122 43.464	16:47	HSEA	1	NA	NA	10/252	LO,SW,DI	50	PC	1	Heading west, at 16:53 approximately 60 m from pile, direction of travel unknown.
EHW	12-Oct-11	07:45	18:45			16:51	HSEA	1	NA	NA	10/0° from West corner of frag barrier		55			
EHW	12-Oct-11	08:00	18:45	47 45.232	122 43.461	16:55	HSEA	1	NA	NA	30/64	SW,DI	30	PC	1	In EHW1, approximately 30 m from pile.
EHW	12-Oct-11	07:45	18:45			16:55	HSEA	2	NA	NA	10/180° from West corner of frag barrier		60			
EHW	12-Oct-11	08:00	18:45	47 45.206	122 43.428	16:59	HSEA	1	NA	NA	10/210	FO	20	PC	0	
EHW	12-Oct-11	08:00	18:45	47 45.525	122 45.220	17:06	HSEA	1	V	NA	80/40	SW,DI	2,350	PC	2	SEEN AT A WEST SIDE ACOUSTIC BUOY, JUST AS JUST AS VIBE STARTED
EHW	12-Oct-11	13:40	17:45	--	--	17:17	CASL	24	V	Before	7/N	RE,VO,UN	1500	OC	1	Same animals as above, Andrea asked me to count the mammals every hour to see how the count varied throughout the day.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	12-Oct-11	08:00	18:45	47 45.206	122 43.428	17:23	HSEA	1	V	Before	40/270	SW,SI	30	PC	0	
EHW	12-Oct-11	13:40	17:45	--	--	17:36	HSEA	2	V	Before	50/N	MI,SI	1,500	OC	1	
EHW	12-Oct-11	08:00	18:45	47 45.236	122 43.466	17:41	CASL	1	V	Before	20/292	TR	60	PC	1	Heading south.
EHW	12-Oct-11	13:40	17:45	--	--	17:46	CASL	1	V	Before	9/N	HO	1,500	OC	1	CASL hauled out during soft start.
EHW	12-Oct-11	13:40	17:45	--	--	17:49	HSEA	1	V	During	120/NE	LO	1,000	OC	1	In between south end of Marginal pier and northeast end of Delta pier.
EHW	12-Oct-11	13:40	17:45	--	--	17:51	CASL	1	V	During	8/N	TR	1,500	OC	1	CASL swimming during full vibe, normal behavior exhibited.
EHW	12-Oct-11	07:45	18:45			17:54	HSEA	1	V	During	20/135		75			During pile driving. Dist/dir from west corner of frag barrier
EHW	12-Oct-11	13:40	17:45	--	--	18:00	CASL	23	V	During	7/N	RE,VO,UN	1,500	OC	1	Same animals as above
EHW	12-Oct-11	13:40	17:45	--	--	18:05	HSEA	1	V	During	70/E	TR,SI	1,500	OC	1	
EHW	12-Oct-11	08:00	18:45	47 45.234	122 43.471	18:05	HSEA	1	V	During	40/008	SW,DI	80	PC	1	Heading south inside the west wall of EHW1.
EHW	12-Oct-11	08:00	18:45	47 45.233	122 43.472	18:08	HSEA	1	V	During	10/210	SW,DI	50	PC	1	Direction of travel unknown, possibly south, vibing began as animal dove.
EHW	12-Oct-11	07:45	18:45			18:16	HSEA	1	V	After	20/270		60			Dist/dir from west corner of frag barrier
EHW	12-Oct-11	08:00	18:45	47 45.206	122 43.428	18:18	HSEA	1	V	After	30/270	LO,SI	15	PC	0	
EHW	12-Oct-11	13:40	17:45	--	--	18:28	CASL	23	V	After	7/N	RE,VO,UN	1,500	OC	1	Same animals as above hourly count
EHW	12-Oct-11	13:40	17:45	--	--	18:28	STSL	1	V	After	7/N	HO,RE	1,500	OC	1	Was in the water during vibing activity, HO when hammer was off.
EHW	12-Oct-11	08:00	18:45	47 45.242	122 43.499	18:36	HSEA	1	V	After	80/355	SW,DI	200	PC	1	Heading NW but not clear, light conditions poor (dark).
EHW	13-Oct-11	07:45	15:30	47 44.604	122 44.030	07:45	CASL	7	NA	NA	100M/75	HO	1,300	OC,FO	0-1	
EHW	13-Oct-11	07:45	15:05	47 45.232	122 43.490	07:48	HSEA	1	NA	NA	20/220	SW(NE),DI	75	F	0	Heading northeast.
EHW	13-Oct-11	07:45	15:05	47 45.239	122 43.490	07:54	HSEA	1	NA	NA	20/35	SW(N),DI	100	F	0	Heading north.
EHW	13-Oct-11	07:45	15:30			08:15	HSEA	1	NA	NA	5/0	SW(S)	85	F	1	Dist/ Dir from South causeway
EHW	13-Oct-11	07:45	15:30	47 44.604	122 44.030	08:23	HSEA	1	NA	NA	50M/265	LO,SI	1,300	OC,FO	0-1	
EHW	13-Oct-11	07:45	15:39	47 45.217	122 43.433	08:25	HSEA	1	NA	NA	5/012	SW,LO,DI	50	F	0	8:25-9:56, seal in EZ, seen chasing fish and feeding.
EHW	13-Oct-11	07:45	15:05	47 45.255	122 43.490	08:37	HSEA	1	NA	NA	40/344	SW(ESE), DI	120	F	0	Heading east-southeast into EHW1.
EHW	13-Oct-11	07:45	15:45	--	--	08:45	HSEA	1	NA	NA	5/N	TR	1,500	OC	0	Submerged next to package (south side).

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	13-Oct-11	07:45	15:05	47 45.242	122 43.500	09:00	HSEA	1	NA	NA	25/32	SW(S),DI	80	F	0	Heading south, could be resight.
EHW	13-Oct-11	07:45	15:05	47 45.248	122 43.478	09:11	HSEA	1	NA	NA	10/336	LO,SW(E), DI	80	F	0	Heading east into EHW1, small animal, at 09:17 in same area.
EHW	13-Oct-11	07:45	15:30			09:22	HSEA	1	NA	NA	10/315	LO	35	F	1	Dist/ Dir from West corner of fragmentation barrier
EHW	13-Oct-11	07:45	15:05	47 45.257	122 43.484	09:34	HSEA	1	V	Before	45/114	SW,DI	50	F	0	At 09:2,2 inside EHW1 in piles, looking and diving approximately 80 m from pile, at 09:46 85 m from pile inside EHW1 piles on west.
EHW	13-Oct-11	07:45	15:39	47 44.185	122 46.212	09:56	HSEA	1	V	Before	35M/95	SW(S),SI	4,000	F	1	Very foggy (approximately 100 m visibility), HSEA swimming 185 degrees.
EHW	13-Oct-11	07:45	15:05	47 45.243	122 43.481	10:10	HSEA	1	V	After	55/198	SW(SE),DI	80	F	1	Heading southeast.
EHW	13-Oct-11	07:45	15:05	47 45.247	122 43.480	10:16	HSEA	1	V	After	15/84	SW(S),DI	75	F	1	Heading south toward pile.
EHW	13-Oct-11	07:45	15:39	47 45.217	122 43.433	10:19	HSEA	1	V	After	10/200	SW,LO,DI	30	PC	1	
EHW	13-Oct-11	07:45	15:39	47 45.217	122 43.433	10:45	HSEA	1	V	During	5/057	LO,DI,FO	47	S	1	Seen chasing fish and feeding, right after hammer off.
EHW	13-Oct-11	07:45	15:30			11:16	HSEA	1	V	NA	15/0	LO	20	F	1	. Distance/direction from west corner of fragmentation barrier.
EHW	13-Oct-11	07:45	15:05	47 45.238	122 43.490	12:50	HSEA	2	V	Before	10/224	LO,MI,DI	70	PC	2	Milling, playing, looking at vessel, dove heading east, both smaller animals, one darker.
EHW	13-Oct-11	07:45	15:45	--	--	13:04	CASL	1	SSV	During	7/N	HO	1,500	S	0	HO during soft 3.
EHW	13-Oct-11	07:45	15:05	47 45.232	122 43.516	13:14	HSEA	1	V	After	65/70	SW,DI	50	PC	2	In EZ heading southeast, re-sighted at 1323 by JS out of EZ, surfaced in EZ between vibes.
EHW	13-Oct-11	07:45	15:05	47 45.232	122 43.518	13:17	HSEA	1	V	After	25/265	SW,LO,SI	110	PC	2	No direction of travel, at 13:23 to north approximately 100 m from pile heading north.
EHW	13-Oct-11	07:45	15:05	47 45.234	122 43.486	13:28	HSEA	1	V	During	100/340	RE,SI	150	PC	2	No direction of travel.
EHW	13-Oct-11	07:45	15:30			13:37	HSEA	1	V	During	15/180	LO	55	S	1	During pile driving. Normal behavior observed. Dist/ Dir from west corner of fragmentation barrier.
EHW	13-Oct-11	07:45	15:30			13:58	HSEA	1	V	During	10/270	LO	40	S	1	Pile driving shut down. Dist/ Dir from West corner of fragmentation barrier.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	13-Oct-11	07:45	15:30			14:05	HSEA	1	V	During	40/180	SW(S)	85	S	1	Dist/ Dir from fire hydrant on South causeway
EHW	13-Oct-11	07:45	15:39	47 45.197	122 43.438	14:07	HSEA	1	V	During	20/193	LO,DI	20	S	1	
EHW	13-Oct-11	07:45	15:05	47 45.230	122 43.488	14:11	HSEA	1	V	During	30/337	SW,DI	80	PC	2	BD sighting #4, heading south
EHW	13-Oct-11	07:45	15:05	47 45.228	122 43.489	14:17	HSEA	1	V	During	30/346	SW(SE),DI	80	PC	2	Heading southeast towards boom.
EHW	13-Oct-11	07:45	15:39	47 45.197	122 43.438	14:24	HSEA	1	V	During	40/270	LO,DI	45	S	1	Possible Swift #11 sighting
EHW	13-Oct-11	07:45	15:05	47 45.228	122 43.490	14:28	HSEA	1	V	During	40/006	RE,SI	80	PC	2	No direction of travel, animal sank as vibe resumed.
EHW	13-Oct-11	07:45	15:05	47 45.231	122 43.498	14:32	HSEA	1	V	During	30/61	LO,SI	90	PC	2	No direction of travel, at 14:41 in EZ again (non vibe).
EHW	13-Oct-11	07:45	15:30	47 44.604	122 44.030	14:40	STSL	1	V	After	60M/75	HO,RE,LO	1,300	S	2	Branded 102Y. Hauled out on sub w/8 CASL.
EHW	13-Oct-11	07:45	15:39	47 45.197	122 43.438	14:41	HSEA	1	V	After	35/230	LO,DI,FO	35	S	1	14:34 STSL hauled out on vessels (102Y).
EHW	13-Oct-11	07:45	15:45	--	--	14:45	CASL	28	V	After	7/N	HO,RE,LO, VO	1,500	S	3	Vibe stopped due to STSL at South Delta, all animals HO.
EHW	13-Oct-11	07:45	15:30			15:15	HSEA	1	NA	NA	5/270	LO	45	S	1	Dist/ Dir from west corner of fragmentation barrier.
EHW	13-Oct-11	07:45	15:30			15:38	HSEA	1	NA	NA	5/225	LO	45	Clear	1	Dist/ Dir from West corner of fragmentation barrier
EHW	14-Oct-11	11:03	17:41	--	--	11:03	STSL	1	NA	NA	7/N	HO,RE	1,500	OC	2	STSL laying amongst CASL
EHW	14-Oct-11	11:03	17:41	--	--	11:03	CASL	24	NA	NA	7/N	HO,RE	1,500	OC	2	All CASL RE
EHW	14-Oct-11	11:03	17:41	--	--	11:05	CASL	12	NA	NA	Unk/E	HO(on fence)	-	OC	1-2	
EHW	14-Oct-11	11:03	17:41	--	--	11:05	CASL	1	NA	NA	Unk	TR	-	OC	1-2	
EHW	14-Oct-11	11:45	17:41	47 44.686	122 43.843	11:23	STSL	1	NA	NA	150/190	HO	1,150	OC	2	
EHW	14-Oct-11	11:03	17:41	--	--	11:31	CASL	7	NA	NA	30/S	HO,RE,LO, VO	2,000	OC	1-2	All HO.
EHW	14-Oct-11	11:03	17:41	--	--	11:31	CASL	2	NA	NA	30/SE	TR,HO,VO	2,000	OC	1-2	2 CASLs FO and HO and playing with one another.
EHW	14-Oct-11	11:45	17:41	47 45.253	122 43.452	12:03	HSEA	1	V	Before	20/208	SW,DI	20	PC	1	
EHW	14-Oct-11	11:45	17:41	47 44.686	122 43.843	13:06	HSEA	1	V	After	75/190	LO,SI	1,000	OC	2	
EHW	14-Oct-11	11:03	17:41	--	--	13:07	CASL	1	V	During	30/SE	VO,HO,FO	2,000	OC	3-2	During soft start 1, submerging and surfacing.
EHW	14-Oct-11	11:45	17:41	47 44.686	122 43.843	13:09	HSEA	1	V	During	50/270	LO,SI	1,000	OC	2	
EHW	14-Oct-11	11:45	17:41	47 45.253	122 43.452	13:39	HSEA	1	V	After	35/156	LO,SI	10	PC	1	
EHW	14-Oct-11	11:45	17:41	47 45.257	122 43.526	13:57	HSEA	1	V	During	100/106	SW(S),DI	40	C	2	surfaced in EZ during vibe heading south inside EHW1

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	14-Oct-11	11:45	17:41	47 45.257	122 43.526	14:14	HSEA	1	V	After	25/172	LO,SI	120	C	2	no direction of travel
EHW	14-Oct-11	11:45	17:41	47 45.257	122 43.526	14:15	HSEA	1	V	After	70/68	SW(E),DI	110	C	2	heading east
EHW	14-Oct-11	11:45	17:41	47 45.257	122 43.526	14:22	HSEA	1	V	During	90/156	SW(E),LO, DI	105	C	2	heading east behind Scandia
EHW	14-Oct-11	11:45	17:41	47 45.257	122 43.526	14:24	HSEA	1	V	During	90/156	LO,SW,DI	105	C	2	same position, direction of travel unknown
EHW	14-Oct-11	11:45	17:41	47 45.257	122 43.562	14:43	HSEA	1	V	After	90/160	LO,SI	105	C	2	same position, no direction of travel
EHW	14-Oct-11	11:55	17:45			14:45	HSEA	1	V	After	10/0	SW	40	PC	2	Post-driving. Dist/ Dir from West corner of fragmentation barrier. Nancy M located near West corner of fragmentation barrier
EHW	14-Oct-11	11:45	17:41	47 45.253	122 43.452	14:47	HSEA	1	V	After	10/210	LO,SI	20	PC	1	1409 Steller in water 14:09:25
EHW	14-Oct-11	11:55	17:45			14:51	HSEA	1	V	After	10/0	SW	40	Cloudy	2	Dist/ Dir from West corner of fragmentation barrier. Nancy M located near West corner of fragmentation barrier
EHW	14-Oct-11	11:55	17:45			14:57	HSEA	1	V	After	10/0	SW	80	PC	2	Dist/ Dir from West corner of fragmentation barrier. Nancy M located near West corner of fragmentation barrier
EHW	14-Oct-11	11:45	17:41	47 45.257	122 43.510	15:13	HSEA	1	NA	NA	80/164	SW,DI	150	PC	2	Dove heading east, likely sighting #2, at 15:17 same location, looking then sank.
EHW	14-Oct-11	11:45	17:41	47 44.686	122 43.843	15:26	HSEA	1	NA	NA	30/100	LO,SI	1,000	OC	2	
EHW	14-Oct-11	11:45	17:41	47 45.252	122 43.527	15:33	HSEA	1	NA	NA	60/132	LO,SI	80	PC	2	Looking at barge then sank, no direction of travel.
EHW	14-Oct-11	11:55	17:45			15:55	HSEA	1	NA	NA	20/215	SW	70	Cloudy	2	PV's sighting...Dist/ Dir from West corner of fragmentation barrier.
EHW	14-Oct-11	11:45	17:41	47 45.253	122 43.452	16:05	HSEA	1	NA	NA	60/285	SW,DI	80	PC	1	
EHW	14-Oct-11	11:55	17:45			16:14	HSEA	1	V	Before	40/180	SW	85	Cloudy	2	Dist/ Dir from west corner of fragmentation barrier.
EHW	14-Oct-11	11:55	17:45			16:30	HSEA	1	V	Before	45/215	SW	80	Cloudy	2	Dist/ Dir from west corner of fragmentation barrier.
EHW	14-Oct-11	11:45	17:41	47 45.264	122 43.522	16:38	HSEA	1	V	Before	15/71	LO,RE,DI	125	PC	2	dove heading north, medium size paler face

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	14-Oct-11	11:03	17:41	--	--	16:40	STSL	1	V	Before	30/SE	SI	2,000	OC		HO on package from the south, surfaced within the boom and quickly HO onto package. The STSL began to be aggressive to all CASL on the package and ended up fighting with 1-3 of them for the next hour HO and FO the package, preventing vibratory driving. Observation period ended with them still fighting.
EHW	14-Oct-11	11:55	17:45			16:43	HSEA	1	V	Before	70/225	SW	130	Cloudy	2	Distance/direction from west corner of fragmentation barrier.
EHW	14-Oct-11	11:45	17:41	47 44.686	122 43.843	16:48	HSEA	1	SSV	During	60/170	LO,SW(E), DI	1,000	OC	1	
EHW	14-Oct-11	11:03	17:41	--	--	16:55	CASL	2	V	During	30/SE	TR	2,000	OC		During full vibe, FO into the water during fight.
EHW	14-Oct-11	11:03	17:41	--	--	16:57	CASL	1	V	During	10/W	TR	2,000	OC		Came from west and began fighting with another CASL near west end of package.
EHW	14-Oct-11	11:55	17:45			17:10	HSEA	1	V	After	80/225	SW	140	Cloudy	2	Distance/direction from west corner of fragmentation barrier.
EHW	15-Oct-11	08:09	13:42	47 45.247	122 43.500	08:15	HSEA	1	NA	NA	20/129	SW(E),DI	40	S	1	Heading east towards EHW1.
EHW	15-Oct-11	08:09	13:42	--	--	08:18	CASL	16	NA	NA	8/S	RE,VO,HE	2,000	S	0	All animals hauled out.
EHW	15-Oct-11	08:09	13:42	--	--	08:18	STSL	2	NA	NA	8/S	RE,HO	2000	S	0	One branded "102Y," other not branded.
EHW	15-Oct-11	08:09	13:42	47 45.223	122 43.474	08:23	HSEA	1	NA	NA	5/120	LO,SI	35	S	1	Looking at vessel, then sink, no direction of travel.
EHW	15-Oct-11	08:09	13:42	47 45.223	122 43.474	08:26	HSEA	2	NA	NA	5/124	MI	32	S	1	Milling, 2 young animals.
EHW	15-Oct-11	08:09	13:42	47 45.227	122 43.470	08:43	HSEA	1	NA	NA	5/181	LO,SL	35	S	1	No direction, looking at vessel then sank. Very small, dark individuals/probably resight of one of pair (sighting #3), at 08:47 in EZ looking, then SL.
EHW	15-Oct-11	08:09	13:42	47 45.225	122 43.472	08:52	HSEA	1	NA	NA	30/251	LO,SI	65	S	1	Out of EZ, 32 m northwest of our vessel.
EHW	15-Oct-11	08:09	13:42	47 45.225	122 43.472	08:52	HSEA	1	NA	NA	15/130	LO,SI	30	S	1	Back in EZ, no direction of travel.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	15-Oct-11	08:09	13:42	--	--	08:53	HSEA	1	NA	NA	10/SW	MI,TR(N)	2,000	S	0	MI at north side of southern package, went under pier and lost visual.
EHW	15-Oct-11	08:09	13:42	47 45.225	122 43.472	08:56	HSEA	1	NA	NA	60/208	SW(S),DI	80	S	1	Out of EZ, approximately 80 m, west end of Manson 70 barge.
EHW	15-Oct-11	08:09	13:42	--	--	09:07	HSEA	2	NA	NA	180/SW	PO,MI	2,180	S	0	Hanging out in midpoint between pier and fence line.
EHW	15-Oct-11	08:09	13:42	--	--	09:09	CASL	1	NA	NA	200 to 8/S to SW	TR(NE),HO	2,000	S	0	Large CASL, swam in from the southwest, directly to southern package and hauled out.
EHW	15-Oct-11	08:09	13:42	47 45.230	122 43.476	09:12	HSEA	1	NA	NA	95/312	SW(E)	130	S	1	Heading east into EHW1, at 09:24 inside EHW1, heading south out of EZ.
EHW	15-Oct-11	08:09	13:42	--	--	09:12	CASL	3	NA	NA	20 to 8/W to SW	TR(SE)	2,000	S	0	All 3 CASLs swam in from the west and came from N package. Confirmed by Streak.
EHW	15-Oct-11	08:10	13:42			09:13	HSEA	1	NA	NA	5/270	SW	40	S	1	Post-driving. Dist/ Dir from West corner of fragmentation barrier. Nancy M located near West corner of fragmentation barrier
EHW	15-Oct-11	08:09	13:42	--	--	09:14	STSL	1	NA	NA	8/SW	HO,SI	2,000	S	0	Came from northern package at 9:11 and arrived on southern package at 9:14.
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	09:24	HSEA	1	NA	NA	20/232	MI(S),LO, SI	75	PC	1	
EHW	15-Oct-11	08:10	13:42			09:24	HSEA	1	NA	NA	5/270	MI	40	Clear	1	Distance/direction from west corner of fragmentation barrier. Nancy M located near west corner of fragmentation barrier.
EHW	15-Oct-11	08:09	13:42	47 43.661	122 44.994	09:28	HPOR	3	NA	NA	600/200	TR(360)	4,000	PC	0	TR 360 degrees slowly north, mother and calf + 1 adult.
EHW	15-Oct-11	08:09	13:42	47 45.236	122 43.472	09:33	HSEA	1	NA	NA	80/237	RE,SI	120	S	1	No direction of travel.
EHW	15-Oct-11	08:09	13:42	47 45.231	122 43.477	09:35	HSEA	1	NA	NA	3/174	LO,SI	43	S	1	In EZ, medium-sized and color, at 09:43 out of EZ.
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	09:35	HSEA	1	NA	NA	150/289	LO,SW(W), SI	220	PC	1	
EHW	15-Oct-11	08:09	13:42	47 45.231	122 43.477	09:39	CASL	1	NA	NA	80/309	TR(S)	120	S	1	Heading south-southwest, just saw glimpse as it went under.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	15-Oct-11	08:09	13:42	47 43.661	122 44.994	09:41	CASL	1	NA	NA	420/164	LO,SW(130)DI(130)	3,400	PC	0	
EHW	15-Oct-11	08:09	13:42	--	--	09:42	CASL	6	NA	NA	10/to 8/S to SW	MI,SW,HO	2,000	S	0	Swam over from northern package. 4 animals playing outside boom and 2 came to the package and hauled out.
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	09:45	HSEA	1	NA	NA	35/169	MI(SW),SI	35	PC	1	
EHW	15-Oct-11	08:09	13:42	47 45.231	122 43.477	09:46	CASL	1	NA	NA	5/220	CH,TR(S)	45	S	1	Heading south slowly, chuff signaled resight.
EHW	15-Oct-11	08:09	13:42	47 45.230	122 43.476	09:52	HSEA	1	NA	NA	2/138	FO,LO	42	S	1	At 09:53, looking at vessel in EZ, with fish in mouth.
EHW	15-Oct-11	08:09	13:42	47 43.611	122 44.997	09:53	STSL	1	NA	NA	200/280	TR(10)	3,400	PC	0	Steady travel 10 degrees, taking multiple shallow breathing dives in rapid succession, last seen 09:53.
EHW	15-Oct-11	08:09	13:42	47 45.230	122 43.476	09:57	HSEA	1	V	Before	47/210	SW,LO,SI	55	S	1	West end of 70 barge, no direction sank, could be same individual as #4
EHW	15-Oct-11	08:09	13:42	47 44.707	122 43.821	10:09	HSEA	1	V	Before	150/90	SW(N),DI	1,100	S	1	
EHW	15-Oct-11	08:09	13:42	47 45.229	122 43.475	10:14	HSEA	1	V	Before	36/124	SW(S),DI	5	S	1	In EZ, in between skiffs.
EHW	15-Oct-11	08:09	13:42	--	--	10:16	CASL	3	V	Before	300/S	HO,RE	2,300	S	0-1	Hauled out on fence at south end of WRA.
EHW	15-Oct-11	08:10	13:42			10:20	HSEA	1	V	Before	35/270	MI	75	S	1	Distance/direction from west corner of fragmentation barrier. Nancy M located near West corner of fragmentation barrier
EHW	15-Oct-11	08:09	13:42	--	--	10:22	HSEA	1	V	Before	7/S	TR(W),FO	2000	S	0-1	Submerged.
EHW	15-Oct-11	08:09	13:42	--	--	10:30	HSEA	2	V	During	50/E	MI,FO	2000	S	0-1	On north side of package about 1 m from side.
EHW	15-Oct-11	08:09	13:42	47 44.707	122 43.821	10:32	HSEA	1	V	During	150/110	SW(North), DI	1100	S	1	
EHW	15-Oct-11	08:09	13:42	--	--	10:32	CASL	1	V	During	8/S	HO,EW	2000	S	0-1	Hauled out during full vibe, exhibiting normal behavior.
EHW	15-Oct-11	08:09	13:42	--	--	10:37	CASL	1	V	During	200-8/S	TR(N),HO, EW	2,000-2,200	S	0-1	TR(N) from south end of WRA near fence, hauled out on package.
EHW	15-Oct-11	08:09	13:42	47 45.227	122 43.476	10:39	HSEA	1	V	During	35/240	SW(S),DI	75	S	1	Larger, lighter-colored animal, moving at moderate pace.
EHW	15-Oct-11	08:09	13:42	--	--	10:40	CASL	4	V	During	500/S	HO,RE	2500	S	0-1	Hauled out on fence.
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	10:50	HSEA	1	V	After	25/196	MI(WNW), DI	60	PC	2	

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	10:53	HSEA	1	V	After	15/205	MI(SE),DI	65	pc	2	10:37, wind has been picking up since 10am, B2 now in EHW1. Wind NNE.
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	10:57	HSEA	1	V	After	40/165	FO	30	pc	2	Chasing fish around pier piling and catching them in EZ.
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	11:12	HSEA	1	V	After	25/196	MI(S),SI	55	pc	2	
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	11:16	HSEA	1	V	After	35/196	MI(S),SI	60	pc	2	
EHW	15-Oct-11	08:09	13:42	47 45.230	122 43.474	11:17	HSEA	1	V	Before	2/90	LO,DI	35	S	1	BD sighting #4, looking at vessel, direction of travel unknown.
EHW	15-Oct-11	08:09	13:42	47 45.083	122 44.324	11:22	HSEA	1	V	Before	35/280	LO,SI	1,114	PC	3	
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	11:45	HSEA	1	V	After	60/275	SW(S),DI	130	PC	2	Near entrance to EHW1 and guard tower, seen after hammer off
EHW	15-Oct-11	08:09	13:42	47 45.083	122 44.324	11:48	HSEA	1	V*	After	35/35	TR(12),LO, DI(12)	1,114	PC	3	*Sighted during pause in vibe to pile EHW9, pause 11:42.40
EHW	15-Oct-11	08:09	13:42	47 45.225	122 43.482	11:53	HSEA	1	V	After	23/72	SW(S),DI	20	S	1	BD sighting #5, at 11:54 at stern of D6 in EZ, at 11:56 in EZ 45 m from pile looking then dove, direction unknown, sighted in between vibes.
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	11:54	HSEA	1	V	After	47/140	MI(W),DI	16	pc	2	Seen after hammer off, but during an adjustment of pile and hammer.
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	11:58	HSEA	1	V	After	15/180	MI(E),SI,DI (NNE)	45	pc	2	
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	12:18	HSEA	1	V	After	70/300	LO,SW(E), SI	140	PC	2	Sighted after hammer off, after sink animal turned NNE.
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	12:19	HSEA	1	V	After	24/223	SW(SSW), DI	95	PC	2	
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	12:29	HSEA	1	V	Before	41/267	MI(N),DI	110	pc	2	
EHW	15-Oct-11	08:09	13:42	--	--	12:29	STSL	1	V	Before	8/S	HO,RE,EW	2,000	S	0 to 1	Branded STSL, EW then HO and is RE.
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	12:31	HSEA	1	V	Before	25/205	SW(S),SI	65	pc	2	Animal moving back and forth approximately 50 m distance north and south thru the west pier of EHW1.
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	12:33	HSEA	1	V	Before	41/265	MI(N),SI	110	pc	2	
EHW	15-Oct-11	08:09	13:42	--	--	13:03	CASL	1	V	During	8/S	EW	200	S	0-1	Floating in water. Cooling off next to package. HO at 13:05.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	15-Oct-11	08:10	13:42			13:05	HSEA	2	V	During	5/0	MI	55	S	1	During pile driving. Distance/direction from west sign in EHW. No abnormal behavior noted. Milling with belly up.
EHW	15-Oct-11	08:09	13:42	47 45.225	122 43.493	13:06	HSEA	1	V	During	22/60	SW(SW),DI	35	S	2	surfaced in EZ, turned on back briefly, then rolled over and dove.
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	13:08	HSEA	1	V	During	35/185	MI(S),DI	80	PC	2	12:40 left EHW1 for dock break. 13:08 animal at surface faced east, dove south around pier piles.
EHW	15-Oct-11	08:09	13:42	--	--	13:09	CASL	1	V	During	8/S	EW	2,000	S	0-1	Floating and rolling inside boom, south side of package.
EHW	15-Oct-11	08:09	13:42	47 45.263	122 43.441	13:18	HSEA	1	V	After	15/193	MI(W),SI	65	pc	2	13:05 back at EHW1 entrance, go to volitional standard for animals in EZ. Hammer close to building.
EHW	15-Oct-11	13:21			1321 Nancy M entering EHW1											
EHW	15-Oct-11	08:09	13:42	47 45.240	122 43.490	13:41	HSEA	1	V	After	30/60	RE,DI	60	S	2	On back in piles in EHW1, then dove, looked to be in response to vessel moving.
EHW	15-Oct-11	08:09	13:42	47 45.106	122 43.473	13:42	HSEA	1	NA	NA	200/85	SW(S)	350	S	1	
EHW	17-Oct-11	08:20	17:09	47 45.279	122 44.932	08:27	CASL	1	NA	NA	90/330	LO,DI(272)	-	S	2	Series of lunging, forward dives, then a deep dive.
EHW	17-Oct-11	08:20	17:09	47 45.024	122 44.501	08:46	STSL	1	NA	NA	370/183	DI(270)	-	S	1	Between 2 fishing operations.
EHW	17-Oct-11	08:20	17:09	47 45.024	122 44.501	08:50	OTHR	1	NA	NA	250/135	MI	-	S	1	Unknown pinniped (possibly STSL, large).
EHW	17-Oct-11	08:20	17:09	47 45.024	122 44.423	08:53	HSEA	1	NA	NA	60/145	LO,DI(175)	-	S	1	
EHW	17-Oct-11	08:20	17:09	47 45.024	122 44.423	08:55	CASL	1	NA	NA	160/150	MI	-	S	1	Seems to be associated with fishing operations.
EHW	17-Oct-11	08:20	17:09	47 45.127	122 44.308	09:27	CASL	1	NA	NA	500/185	MI	-	S	1	
EHW	17-Oct-11	08:20	17:09	47 46 093	122 42.960	11:15	HSEA	1	NA	NA	250/200	MI,SI	-	S	1	
EHW	17-Oct-11	08:20	17:09	47 46 161	122 42.740	11:17	HSEA	7	NA	NA	100/330	RE	-	S	1	Hauled out on dock at Magnetic pier.
EHW	17-Oct-11	08:15	17:09	47 45.214	122 43.474	13:46	HSEA	1	NA	NA	70/335	SW(E),DI	60	S	1	
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	13:58	HSEA	1	NA	NA	20/220	LO,SI	52	C	0	Inside EHW1. Coordinates are approximate. HSEA was seen under the west side of EHW1.
EHW	17-Oct-11	08:25	17:07			14:00	STSL	1	NA	NA	30/SE	EW,TR(W)	2000	S	0 to 1	EW slowly, traveling west.
EHW	17-Oct-11	08:25	17:07			14:01	STSL	1	NA	NA	30/SE	HO,EW	2000	S	0 to 1	HO 14:01, EW 14:02

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	14:04	HSEA	1	NA	NA	33/240	LO,SI	30	C	0	
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	14:07	HSEA	1	NA	NA	30/160	LO,SI	25	C	0	
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	14:09	HSEA	1	NA	NA	25/190	LO,SI	28	C	0	
EHW	17-Oct-11	08:25	17:07			14:12	STSL	1	NA	NA	30/SE	EW	2000	S	0 to 1	Could be going north, slide off north side of southern package
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	14:13	HSEA	1	NA	NA	5/87	LO,SI	50	C	0	Seen during 30inute pre-watch. Small gray juvenile.
EHW	17-Oct-11	08:15	17:09	47 45.209	122 43.498	14:15	HSEA	1	NA	NA	45/22	SW(E),LO, DI	15	S	2	
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	14:18	HSEA	1	NA	NA	30/205	SW(S),DI	40	C	0	Adult.
EHW	17-Oct-11	08:15	17:09	47 45.072	122 43.427	14:19	HSEA	1	NA	NA	75/110	SW(N),DI	275	PC	2	Stopped WRA transects at 11:20 and took up a central stationary position.
EHW	17-Oct-11	08:20	17:09	47 46.342	122 42.696	14:20	HPOR	3	NA	NA	200/240	TR(190)	NA	S	1	2 adult and juvenile.
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	14:25	HSEA	1	V	Before	30/192	SW(S),FO	30	C	0	Fish seen in mouth (sculpin)
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	14:29	HSEA	1	V	Before	45/125	LO,SI	35	C	0	Originally sighted by PV outside EHW-1.
EHW	17-Oct-11	13:40	17:15			14:30	HSEA	1	V	Before	50/0	MI	35	Clear	2	Distance/direction from capstan (MMO location)
EHW	17-Oct-11	13:40	17:15			14:49	HSEA	1	V	Before	5/270	MI	20	S	2	Distance/direction from southeast corner of D-6 (MMO location)
EHW	17-Oct-11	08:15	17:09	47 45.213	122 43.499	14:51	HSEA	1	V	Before	5/26	SW(NW), DI	58	S	2	re-sight of small dark seal/last sighted by Jonah.
EHW	17-Oct-11	08:15	17:09	47 45.072	122 43.427	14:53	HSEA	8	SSV	During	175/20	LO,MI,DI (N,S,E,W)	200	PC	2	8 animals in total sighting at once, cannot track and get behavior on all of them at once. Animals dove in various directions.
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	14:58	HSEA	1	V	During	27/200	LO,SI	30	C	0	Hammer recently off. HSEA looked towards pile. Small juvenile.
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	15:00	HSEA	1	V	After	25/210	LO,SI	35	C	0	Hammer recently off. HSEA looked towards pile. Small juvenile.
EHW	17-Oct-11	08:15	17:09	47 45.072	122 43.427	15:08	HSEA	1	V	After	30/12	LO,SI	240	PC	2	
EHW	17-Oct-11	08:15	17:09	47 45.209	122 43.518	15:09	HSEA	2	V	After	90/96	SW(E),LO	70	S	2	Heading east, possibly same animal as sighted by JB
EHW	17-Oct-11	08:15	17:09	47 45.206	122 43.503	15:15	HSEA	1	V	After	35/75	SW,LO	35	S	2	Surfaced during pause, direction of travel unknown.
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	15:28	HSEA	1	V	Before	15/75	SW(N),DI	50	C	0	
EHW	17-Oct-11	08:25	17:07			15:28	CASL	1	V	Before	50/S	TR(E),CH	2000	S	0-1	Outside boom.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	17-Oct-11	08:15	17:09	47 45.201	122 43.506	15:49	HSEA	1	NA	Before	100/345	RE	80	S	2	
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	16:29	HSEA	1	V	During	28/200	LO,SI	30	C	0	Hammer was turned off right before the sighting occurred. At 14:31 the HSEA was obscured by a barge and was not seen again.
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	16:38	HSEA	1	V	During	70/250	SW(E),LO, SI	50	C	0	HSEA looked towards pile from outside. Looked in pile direction. Seen swimming towards EHW-1. At 16:43 it was outside EHW-1. At 16:59 it was inside EHW-1.
EHW	17-Oct-11	08:15	17:09	47 45.072	122 43.427	16:51	HSEA	1	V	After	30/90	SW(N),SI	130	PC	2	
EHW	17-Oct-11	08:20	17:09	47 45.250	122 43.433	16:54	HSEA	1	V	After	10/60	LO,DI,SI, SW(S)	50	C	0	Looked at boat.
EHW	19-Oct-11	11:27	13:00			11:40	HSEA	1	V	Before	25/315	SW	65	Calm	2	Pile EHW11.
EHW	19-Oct-11	11:27	13:00			11:45	HSEA	1	V	Before	30/270	SW	35	Calm	2	In zone. Not during driving.
EHW	19-Oct-11	11:59	16:41	--	--	11:59	CASL	2	V	During	8/SE	PL,SW,VO	2000m	S	0	Behavior normal and unchanged from when vibratory is on and off.
EHW	19-Oct-11	07:48	16:41	47 45.196	122 43.448	12:02	HSEA	1	V	During	15/22	MI(N),SI	55	PC	1	
EHW	19-Oct-11	11:27	13:00			12:16	HSEA	1	V	After	35/0	MI	70	Calm	2	
EHW	19-Oct-11	11:27	13:00			12:36	HSEA	1	V	After	60/0	MI	100	S	2	After pile driving finished. No abnormal behavior noted.
EHW	19-Oct-11	11:27	13:00			12:50	HSEA	1	V	After	30/270	SW	55	S	2	After pile driving finished. No abnormal behavior noted.
EHW	19-Oct-11	07:48	16:41	47 45.014	122 44.298	12:57	HSEA	1	V	After	25/025	SI,LO,MI	900	PC	1	During final movements of EHW1 post vibe watch.
EHW	21-Oct-11	13:26	16:51	47 45.118	122 43.555	13:26	HSEA	1	NA	NA	300/110	SW(S)	450	L	2	
EHW	21-Oct-11					13:41	CASL	16	NA	NA						Resting.
EHW	21-Oct-11					13:48	CASL	1	NA	NA						Branded 941, Resting, 1 left.
EHW	21-Oct-11	13:35	16:52	*		13:52	CASL	17	NA	NA		RE	NA	R	3	17 CASL on fence by Delta wharf.
EHW	21-Oct-11					14:00	CASL	16	NA	NA						Resting.
EHW	21-Oct-11	13:35	16:51	47 45.233	122 43.451	14:23	HSEA	1	V	Before	20/230	SW(SSW), DI(SSW)	40	L,OC	1	B1 inside EHW1 B2+ outside, seal in EZ at 14:23.
EHW	21-Oct-11	13:35	16:53			14:43	HSEA	1	V	During	5/270	MI	70	Windy	3	Dark stripe on head.
EHW	21-Oct-11	13:30	16:52			14:43-14:52	CASL	34	V	During	15/N	RE,VO	1200	C	2	34:RE. 0-8:VO. No behavior change.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	21-Oct-11	13:26	16:51	47 45.118	122 43.555	14:49	HSEA	1	V	During	175/85	SW(S)	350	L	2	Swimming south toward Marginal pier. Probably was the animal that Swift sighted before vibratory began. Never was in the zone.
EHW	21-Oct-11	13:30	16:52			14:54-14:59	CASL	34	V	During	15/N	RE,VO	1200	C	1	34:RE. 0-6 VO. No change in behavior.
EHW	21-Oct-11					15:00	CASL	16	V	During						Resting, scratching
EHW	21-Oct-11	13:30	16:52			15:06-15:10	CASL	34	V	During	15/N	RE	1200	C	1	34:RE.
EHW	21-Oct-11	13:26	16:51	47 45.118	122 43.555	15:10	CASL	1	V	After	100/85	SW(S)	175	OC	2	Surfaced right after vibratory hammer stopped. Surfaced 6 times.
EHW	21-Oct-11	13:30	16:52			15:12-15:16	CASL	34	V	During	15/N	RE,VO	1200	C	1	0-5:VO. No change in behavior.
EHW	21-Oct-11	13:30	16:52			15:37	CASL	36	V	During	15/N	RE,VO	1200	C	1	0-4:VO. No change in behavior.
EHW	21-Oct-11					15:39	STSL	1	V	During						Large STSL hauled out 9:56-10:05.
EHW	21-Oct-11					15:40	STSL	1	V	After						Small STSL HO.
EHW	21-Oct-11	13:35	16:51	47 45.233	122 43.451	15:45	HSEA	1	V	After	2/230	SW(NW), LO(SE),SW(E),DI(E),MI,DI	30	L,OC	2	Animal swimming upside down by boat, surfaced looked at us then swim behind vessel and dove, 16:01 resighted outside zone by Swift milling and sink.
EHW	21-Oct-11					16:00	CASL	20	V	During						Only 4 new individuals.
EHW	21-Oct-11	13:30	16:52			16:01-16:04	CASL	28	V	During	15/N	RE,SW,VO	1200	C	1	0-5:VO. 15:SW. No change in behavior.
EHW	21-Oct-11					16:06	CASL	1	V	During						in the water
EHW	21-Oct-11	13:30	16:52			16:08-16:11	CASL	28	V	During	15/N	RE,SW,VO	1200	C	1	0-4:VO. 3:SW. No change in behavior.
EHW	21-Oct-11	13:30	16:52			16:14-16:17	CASL	28	V	During	15/N	RE,SW,VO	1200	C	1	0-8:VO. 5:SW. No change in behavior.
EHW	21-Oct-11	13:30	16:52			16:18-16:22	CASL	25	V	During	15/N	RE,SW,VO	1200	C	1	0-4:VO. 3:SW. No change in behavior.
EHW	21-Oct-11					16:20	CASL	2	V	During						2 CASL in water.
EHW	21-Oct-11	13:35	16:53			16:21	HSEA	1	V	During	10/0	MI	80	Windy	3	During post-construction survey.
EHW	21-Oct-11	13:35	16:53			16:32	HSEA	1	V	After	3/270	MI	65	Windy	3	
EHW	21-Oct-11	13:26	16:51	47 45.004	122 43.520	16:45	HSEA	1	V	After	50/85	SW(N)	400	OC	1	
EHW	27-Oct-11	08:00	14:05			08:45	CASL	8	NA	NA	15/N	RE,FO	1200	C	0	
EHW	27-Oct-11	08:48	14:04	47 45.102	122 43.418	08:57	HSEA	1	NA	NA	300/75	SW	400	S	1	09:07 LO, SI 09:10, 09:23 LO SI.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	27-Oct-11	08:48	14:04	47 45.102	122 43.418	09:00	HSEA	1	NA	NA	50/350	SW,SI	400	S	1	09:08, 09:18 LO, SI 09:27 SW into shut down zone.
EHW	27-Oct-11	08:48	14:04	47 45.221	122 43.469	09:11	HSEA	1	NA	NA	60/345	SW(E),DI	120	S	1	Heading east towards EHW1.
EHW	27-Oct-11	08:48	14:04	47 45.221	122 43.472	09:14	HSEA	1	NA	NA	10/86	SW(S),DI	50	S	1	Heading south, in EZ, at 0929 swimming NW then sank outside of EZ.
EHW	27-Oct-11	08:48	14:04	47 45.102	122 43.418	09:15	HSEA	3	NA	NA	175/65	SW(N)	350	S	1	
EHW	27-Oct-11	08:48	14:43			09:16	HSEA	3	NA	NA	50/90	MI	85	F	1	JR next to fire hydrant. Swimming north.
EHW	27-Oct-11	08:48	14:04	47 45.223	122 43.472	09:22	CASL	1	NA	NA	50/264	SW(S),DI	110	F,S	1	Heading south.
EHW	27-Oct-11	08:48	13:20	47 45.125	122 44.137	09:24	HSEA	2	NA	NA	100/285	SW(N),SI	1000	F	1	Gillnetter nearby, but most of gear is on boat. Looks like haul is just ending. HSEA swimming away from vessel.
EHW	27-Oct-11	08:48	14:04	47 45.218	122 43.483	09:47	HSEA	1	V	Before	35/26	SW(N),DI	70	F,S	1	Heading north.
EHW	27-Oct-11	08:48	14:04	47 45.219	122 43.477	09:55	HSEA	1	SSV	During	30/228	LO,SI	95	F,S	1	No direction of travel, sank as vibe began, at 09:57 resurfaced looking at vessel.
EHW	27-Oct-11	08:00	12:07	-	-	09:56-10:05	CASL	35	SSV	During	15/S	RE,SW,VO	1300	C	0-1	
EHW	27-Oct-11	08:48	14:04	47 45.219	122 43.477	10:01	HSEA	1	V	During	250/341	SW(W),DI	310	F	1	Smaller animal.
EHW	27-Oct-11	08:00	14:05			10:07-10:11	CASL	1	V	During	25/N	SW,DI	1200	C	1	SW/DI, no change in behavior.
EHW	27-Oct-11	08:48	14:04	47 45.219	122 43.481	10:14	HSEA	1	V	During	25/235	LO,SI	105	F,C	1	No direction of travel.
EHW	27-Oct-11	08:00	12:07	-	-	10:15-10:20	CASL	35	V	During	15/S	RE,SW,VO	1300	C	0-1	2 HO (HSEA).
EHW	27-Oct-11	08:48	14:04	47 45.218	122 43.482	10:16	HSEA	1	V	During	40/229	LO,DI,SL	120	F,C	1	no direction, larger animal, slapped as it dove.
EHW	27-Oct-11	08:48	14:04	47 45.217	122 43.482	10:23	HSEA	1	V	During	25/270	LO,SW,DI	105	F,C	1	Possibly heading east towards EHW1, pale-faced animal.
EHW	27-Oct-11	08:48	13:20	47 45.124	122 44.140	10:32	HSEA	1	V	After	140/294	SW(S),SI	NA	OC	1	Swam slowly towards net from north, seen to poke head under cork line, head pops up occasionally along cork line, started closer to tail buoy and slowly worked net towards boat. The boat was about 200 m away as crow flies, but net was in a long curve.
EHW	27-Oct-11	08:48	14:04	47 45.219	122 43.481	10:32	HSEA	1	V	After	50/340	RE,DI	110	C	1	On back, then dove.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	27-Oct-11	08:48	14:04	47 45.102	122 43.418	10:38	HSEA	1	V	After	125/50	SW(S)	450	OC	1	10:46 SW (S).
EHW	27-Oct-11	08:48	14:04	47 45.102	122 43.418	10:49	HSEA	1	V	After	10/045	SW(SE)	350	OC	1	12:03, 2 HSEA, most likely sightings #4 and #5, together LO. 12:05, 1 HSEA LO.
EHW	27-Oct-11	08:48	14:04	47 45.214	122 43.483	11:05	HSEA	1	V	Before	20/236	LO,DI	90	C	1	Possibly heading south under barge,
EHW	27-Oct-11	08:48	14:04	47 45.218	122 43.481	11:05	HSEA	1	V	Before	40/110	MI,DI	40	C	1	At 11:13, same area, dove heading south in EZ, at 11:14 in EZ, at 11:16 approximately 55 m heading east back into EHW, at 11:17 in EZ
EHW	27-Oct-11	08:48	14:04	47 45.218	122 43.481	11:12	HSEA	1	NA	NA	40/110	MI,DI	40	C	1	At 11:13, same area, dove heading south in EZ, at 11:14 in EZ, at 11:16 approximately 55 m, heading east back into EHW, at 11:17 in EZ.
EHW	27-Oct-11	08:00	12:07	-	-	11:47	CASL	35	V	After	15/S	RE,SW,VO	1300	PC	1	2 SW. 1-2 individuals VO.
EHW	27-Oct-11	08:00	14:05			11:47	CASL	2	V	After	15/N	SW,DI	1200	C	2	2 CASL appeared during vibe. SW/DI around package.
EHW	27-Oct-11	08:48	14:04	47 45.102	122 43.418	11:48	HSEA	1	V	After	70/005	SW(E),DI, LO	125	S	1	
EHW	27-Oct-11	08:48	14:04	47 45.102	122 43.418	11:52	HSEA	1	V	During	300/120	LO	500	S	1	
EHW	27-Oct-11	08:48	14:04	47 45.218	122 43.485	11:54	HSEA	1	V	After	15/94	LO,DI	35	PC	1	Small dark animal, in EZ heading south, at 12:01 out of EZ, and heading northwest.
EHW	27-Oct-11	08:48	14:04	47 45.102	122 43.418	12:00	RIVO	1	V	During	200/70	OT	400	OC	1	
EHW	27-Oct-11	08:00	12:07	-	-	12:03-12:07	CASL	38	V	During	15/S	RE	1300	S	1	Resting.
EHW	27-Oct-11	08:48	14:04	47 45.218	122 43.483	12:18	HSEA	1	NA	After	30/116	SW,LO,DI	35	S	1	Looking at EHW activity, then dove.
EHW	27-Oct-11	08:48	14:04	47 45.102	122 43.418	12:32	HSEA	1	NA	After	300/120	LO,SI	250	OC	1	
EHW	27-Oct-11	08:48	14:04	47 45.102	122 43.418	12:34	CASL	1	NA	NA	20/260	SW(S)	200	S	1	
EHW	27-Oct-11	08:48	13:20	47 45.305	122 44.736	12:55	OTHR	1	NA	NA	150/186	LO,SI	NA	PC	1	Unknown pinniped (possibly HSEA) surfacing and diving along cork line of gillnet.
EHW	27-Oct-11	08:48	14:04	47 45.102	122 43.418	13:01	HSEA	1	NA	NA	10/350	LO,SI	150	S	1	
EHW	27-Oct-11	08:48	14:04	47 45.102	122 43.418	13:07	HSEA	3	NA	NA	300/105	SW(S),OT	300	S	1	13:17, 2 HSEA rolling around on each other. 13:26 same behavior.

Project	Date	Time Observation Initiated:	Time Observation Completed:	Latitude	Longitude	Sighting Time	Species	Number of Animals	Construction Type	Construction Monitoring (Before/ During/ After)	Distance (m)/Direction to Animals (°)	Behavior	Estimated Distance to Pile (m)	Weather Conditions	Beaufort Sea State	Notes
EHW	27-Oct-11	08:48	13:20	47 45.226	122 44.916	13:10	HSEA	2	NA	NA	180/250	LO,SW,SI, DI	NA	PC	1	2 HSEA at net, while net is being set. Next seen widely-separated moving along net at 13:19.
EHW	27-Oct-11	08:48	14:43			13:20	HSEA	1	NA	NA	45/90	MI	80	S	1	Swimming south.

APPENDIX F

Underwater and Airborne Marine Mammal Takes for the EHW-1 PRP (Vibratory Driving)

Table G-1. Underwater and Airborne Marine Mammal Takes for the EHW-1 PRP (Vibratory Driving)

Sighting Date	Sighting Time (hh:mm)	Number of Individuals	Pile Driving Type	Actual Distance from Animal(s) to Pile (m)	190 dB RMS		180 dB RMS		120 dB RMS		100 dB RMS		90 dB RMS	
					Distance (m) to Threshold	Take	Distance (m) to Threshold	Take	Distance (m) to Threshold	Take	Distance (m) to Threshold	Take	Distance (m) to Threshold	Take
California Sea Lion														
11-Oct-11	14:01	1	SSV	698	NA	0	NA	0	4,093	1	658	0	NA	NA
11-Oct-11	14:08	1	V	709	NA	0	NA	0	4,082	1	669	0	NA	NA
12-Oct-11	11:02	5	SSV	1,335	NA	0	NA	0	6,526	5	1,290	0	NA	NA
12-Oct-11	11:37	6	V	1,414	NA	0	NA	0	6,447	6	1,369	0	NA	NA
12-Oct-11	11:38	1	V	185	NA	0	NA	0	7,676	1	140	0	NA	NA
12-Oct-11	15:00	21	V	1,214	NA	0	NA	0	7,794	21	1,175*	0	NA	NA
12-Oct-11	15:10	1	V	112	NA	0	NA	0	8,896	1	73*	0	NA	NA
12-Oct-11	15:20	1	V	1,214	NA	0	NA	0	7,794	1	1,175*	0	NA	NA
12-Oct-11	17:51	1	V	1,211	NA	0	NA	0	8,239	1	1,172*	0	NA	NA
12-Oct-11	18:00	23	V	1,211	NA	0	NA	0	8,239	23	1,172*	0	NA	NA
13-Oct-11	13:04	1	SSV	1,208	NA	0	NA	0	8,792	1	1,169*	0	NA	NA
14-Oct-11	13:07	1	V	1,223	NA	0	NA	0	8,777	1	1,180*	0	NA	NA
14-Oct-11	16:55	2	V	1221	NA	0	NA	0	8779	2	1,178*	0	NA	NA
14-Oct-11	16:57	1	V	1217	NA	0	NA	0	8,783	1	1,174*	0	NA	NA
15-Oct-11	10:32	1	V	1350	NA	0	NA	0	8,650	1	1,290	0	NA	NA
15-Oct-11	10:37	1	V	1435	NA	0	NA	0	8,565	1	1,375	0	NA	NA
15-Oct-11	10:40	4	V	1796	NA	0	NA	0	8,204	4	1,736	0	NA	NA
15-Oct-11	13:03	1	V	1360	NA	0	NA	0	8,640	1	1,300*	0	NA	NA
15-Oct-11	13:09	1	V	1361	NA	0	NA	0	8,639	1	1,301*	0	NA	NA
19-Oct-11	11:59	2	SSV	1355	NA	0	NA	0	8,645	2	1,320	0	NA	NA
21-Oct-11	15:37	36	V	1179	NA	0	NA	0	4,937	36	1,116*	0	NA	NA
21-Oct-11	16:00	20	V	1325	NA	0	NA	0	3,921	20	1,275	0	NA	NA
21-Oct-11	16:06	1	V	1324	NA	0	NA	0	3,922	1	1,274	0	NA	NA
21-Oct-11	16:20	2	V	1324	NA	0	NA	0	3,922	2	1,238	0	NA	NA

Sighting Date	Sighting Time (hh:mm)	Number of Individuals	Pile Driving Type	Actual Distance from Animal(s) to Pile (m)	190 dB RMS		180 dB RMS		120 dB RMS		100 dB RMS		90 dB RMS	
					Distance (m) to Threshold	Take	Distance (m) to Threshold	Take	Distance (m) to Threshold	Take	Distance (m) to Threshold	Take	Distance (m) to Threshold	Take
California Sea Lion (continued)														
27-Oct-11	11:47	2	V	1200	NA	0	NA	0	3,922	2	1180	0	NA	NA
Take Subtotal						**0**		**0**		**137**		**0**		**0**
Harbor Seal														
7-Oct-11	9:34	1	V	7	NA	0	NA	0	5455	2	NA	NA	102	0
7-Oct-11	9:41	1	V	196	NA	0	NA	0	5662	1	NA	NA	79	0
7-Oct-11	9:43	1	V	41	NA	0	NA	0	7309	1	NA	NA	11	0
7-Oct-11	9:44	3	V	1877	NA	0	NA	0	5473	3	NA	NA	1825	0
7-Oct-11	14:31	1	V	173	NA	0	NA	0	8727	1	NA	NA	68	0
7-Oct-11	15:06	1	V	160	NA	0	NA	0	8740	1	NA	NA	73*	0
7-Oct-11	17:01	1	V	106	NA	0	NA	0	8794	1	NA	NA	38	0
7-Oct-11	17:02	2	V	8	NA	0	NA	0	8892	4	NA	NA	60	0
7-Oct-11	17:18	1	V	170	NA	0	NA	0	8730	1	NA	NA	112	0
8-Oct-11	8:45	1	SSV	69	NA	0	NA	0	8831	1	NA	NA	39	0
8-Oct-11	8:49	2	V	246	NA	0	NA	0	8654	2	NA	NA	216	0
8-Oct-11	9:02	1	V	343	NA	0	NA	0	8557	1	NA	NA	305	0
8-Oct-11	9:05	1	V	526	NA	0	NA	0	8374	1	NA	NA	488	0
8-Oct-11	9:13	1	V	211	NA	0	NA	0	5204	1	NA	NA	175	0
8-Oct-11	9:27	1	V	95	NA	0	NA	0	4199	1	NA	NA	51	0
10-Oct-11	14:18	1	V	147	NA	0	NA	0	9853	1	NA	NA	45	0
10-Oct-11	16:21	1	V	1047	NA	0	NA	0	8327	1	NA	NA	964	0
11-Oct-11	14:08	1	V	106	NA	0	NA	0	4685	1	NA	NA	22	0
11-Oct-11	17:25	1	V	78	NA	0	NA	0	7608	1	NA	NA	5	0
12-Oct-11	11:00	1	SSV	388	NA	0	NA	0	7473	1	NA	NA	244	0
12-Oct-11	11:22	1	V	971	NA	0	NA	0	6890	1	NA	NA	827	0
12-Oct-11	14:57	1	SSV	57	NA	0	NA	0	8951	1	NA	NA	45*	0
12-Oct-11	15:06	1	V	1233	NA	0	NA	0	7775	1	NA	NA	1221*	0
12-Oct-11	15:08	1	V	978	NA	0	NA	0	8030	1	NA	NA	966*	0
12-Oct-11	15:14	1	V	1201	NA	0	NA	0	7807	1	NA	NA	1189*	0
12-Oct-11	15:14	1	V	86	NA	0	NA	0	8922	1	NA	NA	74*	0
12-Oct-11	15:14	1	V	45	NA	0	NA	0	8963	1	NA	NA	33*	0
12-Oct-11	17:49	1	SSV	1103	NA	0	NA	0	8347	1	NA	NA	1091*	0
12-Oct-11	17:54	1	V	46	NA	0	NA	0	9404	1	NA	NA	34*	0

Sighting Date	Sighting Time (hh:mm)	Number of Individuals	Pile Driving Type	Actual Distance from Animal(s) to Pile (m)	190 dB RMS		180 dB RMS		120 dB RMS		100 dB RMS		90 dB RMS	
					Distance (m) to Threshold	Take	Distance (m) to Threshold	Take	Distance (m) to Threshold	Take	Distance (m) to Threshold	Take	Distance (m) to Threshold	Take
Harbor Seal (continued)														
12-Oct-11	18:05	1	V	1187	NA	0	NA	0	8263	1	NA	NA	1175*	0
12-Oct-11	18:05	1	V	78	NA	0	NA	0	9372	1	NA	NA	66*	0
12-Oct-11	18:08	1	V	36	NA	0	NA	0	9414	1	NA	NA	24*	0
13-Oct-11	10:45	1	V	35	NA	0	NA	0	8415	1	NA	NA	23*	0
13-Oct-11	13:28	1	V	152	NA	0	NA	0	9848	1	NA	NA	140*	0
13-Oct-11	13:37	1	V	33	NA	0	NA	0	9,967	1	NA	NA	21*	0
13-Oct-11	14:07	1	V	51	NA	0	NA	0	9,949	1	NA	NA	39*	0
13-Oct-11	14:11	1	V	82	NA	0	NA	0	9,918	1	NA	NA	70*	0
13-Oct-11	14:24	1	V	37	NA	0	NA	0	9,963	1	NA	NA	25*	0
14-Oct-11	13:09	1	V	1115	NA	0	NA	0	8,885	1	NA	NA	972*	0
14-Oct-11	13:57	1	V	56	NA	0	NA	0	8,094	2	NA	NA	87*	0
14-Oct-11	14:22	1	V	36	NA	0	NA	0	9,964	2	NA	NA	107*	0
14-Oct-11	16:48	1	SSV	1135	NA	0	NA	0	8,865	1	NA	NA	992*	0
15-Oct-11	10:30	2	V	1320	NA	0	NA	0	8,680	2	NA	NA	1,131	0
15-Oct-11	10:32	1	V	1035	NA	0	NA	0	8,965	1	NA	NA	846	0
15-Oct-11	10:39	1	V	59	NA	0	NA	0	9,941	2	NA	NA	130	0
15-Oct-11	13:05	2	V	20	NA	0	NA	0	9,980	4	NA	NA	169*	0
15-Oct-11	13:06	1	V	44	NA	0	NA	0	9,956	2	NA	NA	145*	0
15-Oct-11	13:08	1	V	55	NA	0	NA	0	9,945	2	NA	NA	134*	0
17-Oct-11	14:53	8	SSV	138	NA	0	NA	0	9,862	8	NA	NA	5	0
17-Oct-11	14:58	1	V	41	NA	0	NA	0	9,959	2	NA	NA	102	0
17-Oct-11	16:29	1	V	41	NA	0	NA	0	9,959	2	NA	NA	98	0
17-Oct-11	16:38	1	V	55	NA	0	NA	0	9,945	2	NA	NA	84	0
19-Oct-11	12:02	1	SSV	24	NA	0	NA	0	9,976	2	NA	NA	86	0
21-Oct-11	14:43	1	V	22	NA	0	NA	0	6,877	2	NA	NA	146	0
21-Oct-11	14:49	1	V	134	NA	0	NA	0	6,765	1	NA	NA	34	0
27-Oct-11	9:55	1	SSV	61	NA	0	NA	0	9,939	2	NA	NA	123*	0
27-Oct-11	10:01	1	V	297	NA	0	NA	0	9,703	1	NA	NA	113*	0
27-Oct-11	10:14	1	V	68	NA	0	NA	0	9,432	2	NA	NA	116*	0
27-Oct-11	10:16	1	V	75	NA	0	NA	0	9,425	2	NA	NA	109*	0
27-Oct-11	10:23	1	V	75	NA	0	NA	0	9,925	2	NA	NA	109*	0

Sighting Date	Sighting Time (hh:mm)	Number of Individuals	Pile Driving Type	Actual Distance from Animal(s) to Pile (m)	190 dB RMS		180 dB RMS		120 dB RMS		100 dB RMS		90 dB RMS	
					Distance (m) to Threshold	Take	Distance (m) to Threshold	Take	Distance (m) to Threshold	Take	Distance (m) to Threshold	Take	Distance (m) to Threshold	Take
Harbor Seal (continued)														
27-Oct-11	11:52	1	V	444	NA	0	NA	0	7,456	1	NA	NA	399	0
Take Subtotal						**0**		**0**		**69**		**0**		**0**
Harbor Porpoise														
7-Oct-11	15:03	2	SSV	1,904	NA	0	NA	0	6,996	2	NA	NA	NA	NA
7-Oct-11	16:59	2	V	2,314	NA	0	NA	0	6,586	2	NA	NA	NA	NA
7-Oct-11	17:19	1	V	1,914	NA	0	NA	0	6,986	1	NA	NA	NA	NA
Take Subtotal						**0**		**0**		**5**		**0**		**0**
Steller Sea Lion														
21-Oct-11	15:39	1	V	1,328	NA	0	NA	0	4,778	1	1,265*	0	NA	NA
Take Subtotal										**1**				

*Acoustic measurements unavailable; isopleths calculated from measurements of similarly sized piles.

†Animals did not enter water during pile driving activities

APPENDIX G
Photos of Project Area

Figure H-1. California sea lions (*Zalophus californianus*) on submarine at Delta Pier South. Photo courtesy of A. Balla-Holden, U.S. Navy.

Figure H-2. Delta Pier North, looking towards EHW-1. Photo courtesy of A. Balla-Holden, U.S. Navy.

Figure H-3. California sea lions (*Zalophus californianus*) on port security barrier. Photo courtesy of A. Balla-Holden, U.S. Navy.

Figure H-4. California sea lion (*Zalophus californianus*, left) and a branded Steller sea lion (*Eumetopias jubatus*, right) on submarine at Delta Pier. Brand reads "102Y." Photo courtesy of A. Balla-Holden, U.S. Navy.

Figure H-5. California sea lions (*Zalophus californianus*) and a Steller sea lion (*Eumetopias jubatus*; indicated by yellow arrow) on submarine at Delta Pier. Photo courtesy of A. Balla-Holden, U.S. Navy.

THIS PAGE INTENTIONALLY LEFT BLANK