

Naval Base Kitsap-Bangor Explosives Handling Wharf 2

Year 3 Marine Mammal Monitoring Report (2014-2015)

BANGOR, WASHINGTON



March 2015



Prepared by:



Suggested Citation

Department of Navy (DoN), 2015. Naval Base Kitsap at Bangor Explosives Handling Wharf 2, Bangor, Washington. Draft Year 3 Marine Mammal Monitoring Report. Prepared by Hart Crowser, Inc. for Naval Facilities Engineering Northwest, Silverdale, Washington. March 2015.

ACRONYMS AND ABBREVIATIONS

APE	American Piledriving Equipment
BSS	Beaufort sea state
cfm	cubic feet per minute
cm	centimeters
CMP	Construction Monitoring Program
dB	decibel
° F	degrees Fahrenheit
EHW-1	Explosives Handling Wharf #1
EHW-2	Explosives Handling Wharf #2
ESA	Endangered Species Act
ft	foot/feet
GPS	global positioning system
IHA	Incidental Harassment Authorization
km	kilometers
km ²	square kilometers
m	meters
MC	monitoring coordinator
MMO	marine mammal observer
MMPA	Marine Mammal Protection Act
mph	miles per hour
NBK	Naval Base Kitsap
NMFS	National Marine Fisheries Service
PPE	personal protective equipment
PSB	Port Security Barrier
re	referenced to
μPa	micropascal
TPP	Test Pile Program
WRA	Waterfront Restricted Area

Table of Contents

ACRONYMS AND ABBREVIATIONS.....	INSIDE FRONT COVER
SECTION 1 INTRODUCTION.....	3
SECTION 2 METHODS	3
SECTION 3 RESULTS	25
SECTION 4 RECOMMENDATIONS.....	ERROR! BOOKMARK NOT DEFINED.
SECTION 5 LIST OF PREPARERS.....	47
SECTION 6 REFERENCES.....	47

Tables

Table 1. Project Staff	7
Table 2. Summary of Construction Monitoring Effort	10
Table 3. Total Number of Animals and Sightings by Species.....	26
Table 4. Summary of Unique Marine Mammal Sightings during Pile Installation and Removal Activities.....	30
Table 5. Summary of Observed Level B Harassment Takes (includes resightings)	31
Table 6. Summary of Observed Level B Harassment Takes Per Production Pile.....	31
Table 8. Summary of Observed and Extrapolated Level B Harassment Takes.....	33
Table 9. Marine Mammal Mitigation Delays and Shutdowns.....	34
Table 10. Summary of Herring Kill Observations.....	43

Figures

Figure 1. Vicinity Map.....	5
Figure 2. Project Area.....	6
Figure 3. Typical Observer Monitoring Platform during Marine Mammal Monitoring	9
Figure 4. Marine Mammal Monitoring Zones for Impact and Vibratory Pile Driving	16
Figure 5. Modeled Vibratory Harassment Zone for Marine Mammals.....	17
Figure 6. Production Pile Locations.....	23
Figure 7. California and Steller Sea Lion Sightings	27
Figure 8. Harbor Seal Sightings.....	28
Figure 9a. Sightings by Sea State	35
Figure 9b. Sightings by Weather Condition	35
Figure 10a. California Sea Lion Behaviors Before, During and After Construction	37
Figure 10b. California Sea Lion Behaviors By Construction Type.....	37
Figure 11a. Harbor Seal Behaviors Before, During and After Construction.....	38

Figure 11b. Harbor Seal Behaviors By Construction Type	38
Figure 12a. Steller Sea Lion Behaviors Before, During and After Construction	39
Figure 12b. Steller Sea Lion Behaviors By Construction Type.....	39
Figure 13. Relative Motion of Marine Mammals by Construction Event	40
Figure 14. Harbor Seal Sightings per Hour by Month.....	43
Figure 15. Average Air and Water Temperatures in the WRA	45
Figure 16. Wind Speed in the WRA	46

Photographs

Photograph 1. External signs of barotrauma on herring retrieved during impact pile driving on 21 August 2014.	43
Photograph 2. Hemorrhaging in the abdominal wall of herring.	44

Appendices

- A. Department of the Navy Trident Support Facilities Explosives Handling Wharf (EHW-2) Final Marine Mammal Monitoring Plan
- B. All In-Water Noise-Producing Events during the Year 3 EHW-2 CMP
- C. Marine Mammal Sighting Form and Data Codes
- D. Pile Survey Table
- E. Bubble Curtain and Bubble Pile Specifications
- F. Marine Mammal Sightings
- G. Weather Conditions

Section 1 Introduction

This report summarizes the Year 3 marine mammal monitoring effort implemented for the Trident Support Facilities Explosives Handling Wharf #2 (EHW-2) Construction Monitoring Program (CMP) that occurred from 16 July 2014 to 14 January 2015 at Naval Base Kitsap (NBK) at Bangor. The purpose of the EHW-2 CMP is to provide marine mammal and marbled murrelet monitoring during pile installation required to construct the new wharf (DoN 2012).

Discussions of the Year 1 EHW-2 CMP, which occurred from 28 September 2012 to 14 February 2013, and the Year 2 EHW-2 CMP, which occurred from 16 July 2013 to 15 February 2014 are presented in separate reports (DoN 2013, DoN 2014). Marine mammal monitoring for the Year 3 EHW-2 CMP occurred from 16 July 2014 to 14 January 2015. Work consisted of marine mammal monitoring during EHW-2 pile driving-related activities.

The marine mammal monitoring performed for this project was conducted to ensure compliance with the Marine Mammal Protection Act (MMPA) authorization and Endangered Species Act (ESA). Marine mammal monitoring performed for this project followed procedures and requirements in the EHW-2 Marine Mammal Monitoring Plan (Monitoring Plan; **Appendix A**). The Monitoring Plan was developed in coordination with the National Marine Fisheries Service (NMFS) to ensure compliance with the terms and conditions of the Incidental Harassment Authorization (IHA) issued for in-water construction (NMFS 2014). The Monitoring Plan included the requirement that a marine mammal monitoring report be prepared by the Navy and submitted to NMFS. This document is meant to satisfy that reporting requirement.

Section 2 Methods

Project Area

NBK at Bangor, Washington is located on Hood Canal approximately 20 miles (32.2 kilometers [km]) west of Seattle, Washington (**Figure 1**). NBK at Bangor provides berthing and support services to U.S. Navy submarines and other fleet assets. The EHW-2 site was located within the Waterfront Restricted Area (WRA) at NBK at Bangor, immediately south of the existing Explosives Handling Wharf #1 (EHW-1) structure (**Figure 2**). Marine mammal monitoring was

focused within this area and the waters immediately adjacent to the WRA, where sound pressure levels associated with pile installation and removal activities could potentially be transmitted at levels that could affect marine mammals (monitoring area clipped in accordance with NMFS consultation [DoN 2012]).



Figure 1. Vicinity Map

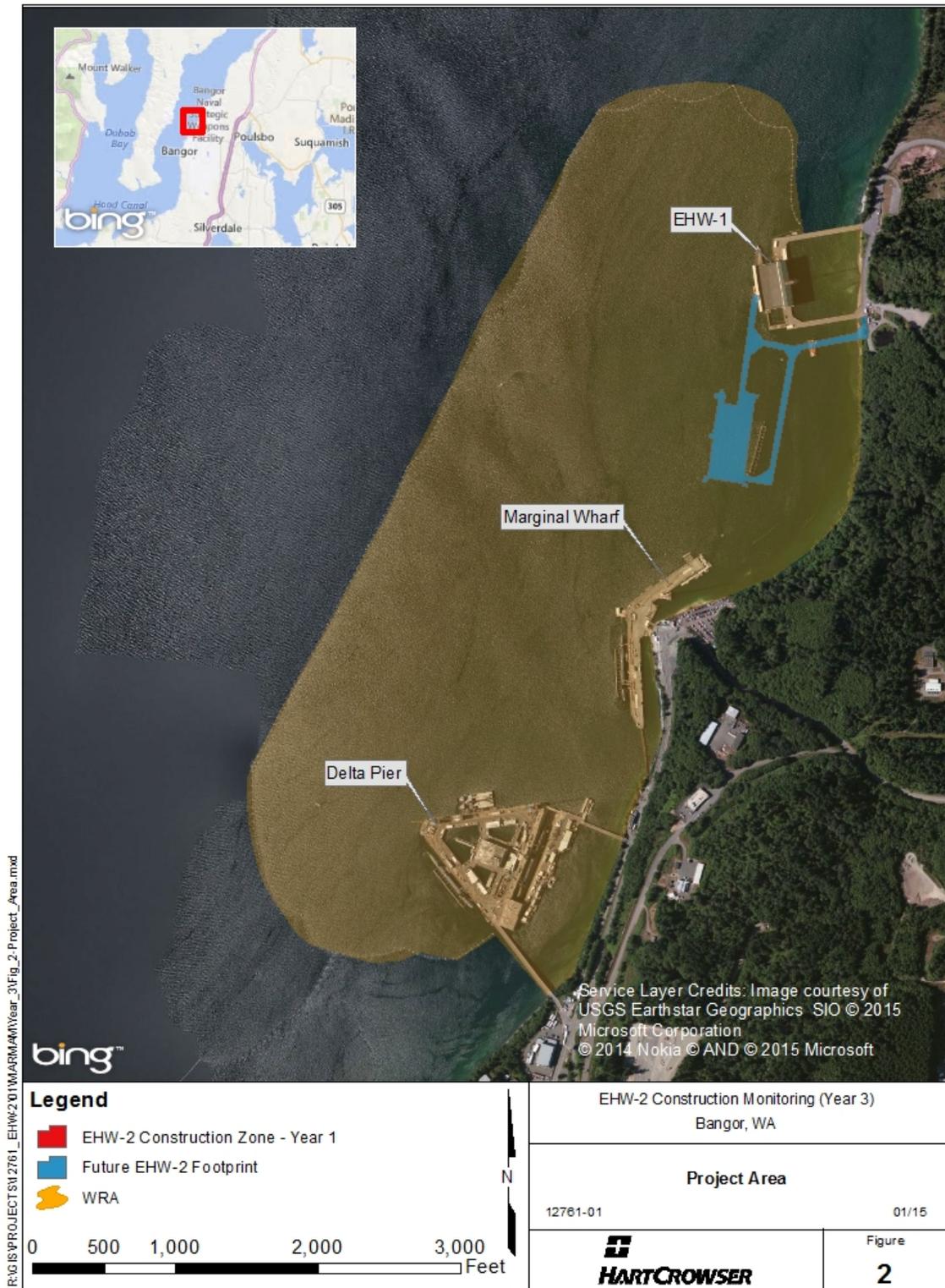


Figure 2. Project Area

Project Staffing

Staff for the Year 3 EHW-2 CMP (**Table 1**) included the Project Managers, the Monitoring Coordinators (MC), Marbled Murrelet Observers, and Marine Mammal Observers (MMOs). All MCs and MMOs were experienced in marine mammal identification, and had extensive knowledge of the biology and behavior of locally occurring marine species. With few exceptions, all MCs and MMOs had been observers for one or more of the following previous marine mammal monitoring efforts at Bangor: (1) the 2011 Test Pile Program (TPP) for NBK at Bangor, (2) the 2011/2012 EHW-1 Pile Replacement Project, and (3) the Year 1 and Year 2 EHW-2 CMP monitoring efforts. All marine mammal observers were dedicated to that task and served no other function while conducting observations.

Table 1. Project Staff

Name	Role(s)	Company
Hans Hurn	Project Manager / MC	Hart Crowser
Jeff Barrett	Project Manager / MC	Hart Crowser
Caanan Cowles	MC	Hart Crowser
Emily Duncanson	MC	Hart Crowser
Jim Starkes	MC	Hart Crowser
Michelle Havey	MC	Hart Crowser
Steve Hall	MC	Hart Crowser
Andy Clodfelter	MMO	Hart Crowser
Beth Sosik	MMO	Hart Crowser
Diane Hennessey	MMO	Hart Crowser
Jamey Selleck	MMO	Hart Crowser
Jessica Blanchette	MMO	Hart Crowser
Jim Shannon	MMO	Hart Crowser
Kelsey Donahue	MMO	Hart Crowser
Kerry Hosken	MMO	Hart Crowser
Nick Galvin	MMO	Hart Crowser
Maria Sandercock	MMO	Hart Crowser
Paula von Weller	MMO	Hart Crowser
Stefanie Hawks-Johnson	MMO	Hart Crowser

Marine Mammal Monitoring Platforms

The Monitoring Plan required that MMOs be positioned at the best practicable vantage points, taking into consideration security, safety, and space limitations on the waterfront. A minimum of three monitors were used for marine mammal monitoring (one MC, one monitor dedicated to monitor the shutdown zone and one boat-based monitor focused on observations on the buffer zone; **Figure 3**). Typically, the MC was stationed with the dedicated MMO to provide additional monitoring of the shutdown zone from the barge. This allowed the MC to effectively coordinate with observers and the pile driving foreman. Additional MMOs were used to monitor the shutdown zone as needed. For example, if more than one pile was being driven simultaneously; additional MMOs were assigned to observe the shutdown zone of each pile.

Vessel-based Monitoring. Vessels were used as observation platforms and for transportation to pile driving barges. The Year 3 EHW-2 CMP included one 32-foot (9.8-meter [m]) fiberglass-hulled Bayliner, which was used daily as the primary monitoring platform for the MMO conducting surveys of the buffer zone. Tugboats and several other smaller vessels were used for transportation of personnel and equipment when navigation or barge access was difficult, but were not used as monitoring platforms. Vessels were equipped with VHF radios and depth sounders. All captains were United States Coast Guard-certified and were familiar with the Puget Sound waterways and the unique characteristics of the region. MMO monitoring vessels were equipped with elevated observation platforms, which provided maximum viewing capability. The MMO monitoring vessel's observation platform was approximately 3 to 4 m (9.8 to 13.1 feet [ft]) above the water line.



Figure 3. Typical Observer Monitoring Platform during Marine Mammal Monitoring

Pier- and Barge-based Monitoring. The MC was typically located on the construction barge, and served as an additional marine mammal observer as needed from that relatively stationary location. The MC was typically 5 to 20 m (16 to 66 feet) from the pile, and at all times had a view of most of the shutdown zone. Since the MC served as an additional marine mammal observer to compliment the boat- and barged-based MMOs required by the protocol, the MCs were not required to have full observation of the shutdown zone at all times. During instances where two pile-driving rigs were running simultaneously, the MC was positioned with a barge-based MMO to provide full coverage of the shutdown zone of one of the operating rigs, while an additional barge-based MMO monitored the shutdown zone of the second operating rig. During these instances, the additional barge-based MMO was given full shutdown authority and therefore was able to initiate immediate shutdown when necessary. The MC position was in close proximity to the construction foreman or in the foreman’s line-of-sight, 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 and vessel captains, all of whom monitored the same radio channel. The MC logged pile driving times and related construction activities for each pile (**Appendix B**). This served as the basis for data quality control of marine mammal sightings.

Monitoring Summary

In total, 939 hours and 57 minutes of marine mammal surveys were conducted on 128 construction days during the course of the Year 3 EHW-2 CMP (**Table 2**). The monitoring times listed in **Table 2** represent the monitoring duration for a given construction day, which consisted of periods of both active pile driving activity and periods without construction (i.e., between pile driving events).

Table 2. Summary of Construction Monitoring Effort

Date	Start Time (hh:mm)	End Time (hh:mm)	Total Time (hh:mm)
Construction Monitoring			
7/16/2014	6:47	18:48	12:01
7/17/2014	6:33	16:38	10:05
7/18/2014	6:21	15:53	9:32
7/19/2014	6:40	15:09	8:29
7/21/2014	6:40	16:22	9:42
7/22/2014	6:20	17:00	10:40

Date	Start Time (hh:mm)	End Time (hh:mm)	Total Time (hh:mm)
7/23/2014	7:30	16:32	9:02
7/24/2014	7:07	14:42	7:35
7/25/2014	6:30	16:37	10:07
7/26/2014	6:26	14:00	7:34
7/28/2014	6:40	15:47	9:07
7/29/2014	6:25	15:05	8:40
7/30/2014	9:08	16:12	7:04
7/31/2014	10:20	16:09	5:49
8/1/2014	6:55	16:45	9:50
8/2/2014	6:35	16:46	10:11
8/4/2014	7:14	16:58	9:44
8/5/2014	7:06	16:56	9:50
8/6/2014	7:00	16:58	9:58
8/7/2014	6:45	16:36	9:51
8/8/2014	6:21	15:39	9:18
8/9/2014	6:17	16:40	10:23
8/11/2014	7:05	17:19	10:14
8/12/2014	7:28	18:30	11:02
8/13/2014	7:28	17:13	9:45
8/14/2014	6:40	15:10	8:30
8/15/2014	6:35	15:00	8:25
8/16/2014	8:05	14:11	6:06
8/18/2014	7:39	15:59	8:20
8/19/2014	8:30	12:17	3:47
8/20/2014	9:25	13:40	4:15
8/21/2014	6:40	17:12	10:32
8/22/2014	6:55	15:50	8:55
8/23/2014	6:40	15:44	9:04
8/25/2014	7:55	15:00	7:05
8/25/2014	7:55	15:30	7:35
8/26/2014	6:20	17:01	10:41
8/27/2014	6:35	16:33	9:58
8/28/2014	6:00	15:15	9:15
9/2/2014	7:05	18:17	11:12
9/3/2014	7:00	18:15	11:15
9/4/2014	8:00	18:10	10:10
9/5/2014	7:40	16:50	9:10
9/6/2014	7:15	12:50	5:35
9/8/2014	6:30	15:30	9:00
9/9/2014	6:50	14:45	7:55
9/10/2014	6:50	13:00	6:10
9/11/2014	7:00	16:45	9:45
9/12/2014	6:55	14:09	7:14
9/15/2014	8:00	17:16	9:16
9/16/2014	8:20	15:19	6:59

Date	Start Time (hh:mm)	End Time (hh:mm)	Total Time (hh:mm)
9/17/2014	9:45	17:30	7:45
9/18/2014	7:31	16:46	9:15
9/19/2014	7:00	16:29	9:29
9/20/2014	7:30	14:46	7:16
9/22/2014	7:40	18:10	10:30
9/23/2014	6:55	16:17	9:22
9/24/2014	6:59	16:57	9:58
9/25/2014	6:55	11:02	4:07
9/26/2014	7:10	14:01	6:51
9/29/2014	10:05	16:01	5:56
9/30/2014	12:15	16:53	4:38
10/1/2014	7:30	17:00	9:30
10/2/2014	7:55	14:31	6:36
10/3/2014	8:30	15:54	7:24
10/6/2014	8:00	15:35	7:35
10/7/2014	7:50	13:30	5:40
10/8/2014	7:56	16:30	8:34
10/9/2014	7:15	11:13	3:58
10/10/2014	7:45	14:17	6:32
10/13/2014	8:03	14:30	6:27
10/14/2014	9:15	16:11	6:56
10/15/2014	8:30	17:20	8:50
10/16/2014	7:50	9:38	1:48
10/17/2014	8:00	18:01	10:01
10/20/2014	9:00	15:00	6:00
10/21/2014	10:30	18:13	7:43
10/22/2014	8:10	15:47	7:37
10/24/2014	14:50	16:05	1:15
10/27/2014	7:44	16:35	8:51
10/28/2014	9:07	14:43	5:36
10/29/2014	12:40	16:24	3:44
10/30/2014	7:30	16:42	9:12
10/31/2014	7:55	16:46	8:51
11/1/2014	9:40	15:19	5:39
11/3/2014	13:30	15:50	2:20
11/4/2014	9:00	11:22	2:22
11/7/2014	7:52	15:44	7:52
11/8/2014	8:09	15:16	7:07
11/10/2014	13:30	16:55	3:25
11/11/2014	9:30	14:10	4:40
11/12/2014	9:43	15:17	5:34
11/13/2014	10:15	16:21	6:06
11/14/2014	11:11	16:14	5:03
11/17/2014	7:30	10:28	2:58
11/18/2014	10:05	12:23	2:18

Date	Start Time (hh:mm)	End Time (hh:mm)	Total Time (hh:mm)
11/19/2014	8:05	15:49	7:44
11/20/2014	8:00	16:24	8:24
11/21/2014	7:25	8:30	1:05
11/24/2014	12:57	16:43	3:46
11/25/2014	7:15	16:02	8:47
11/25/2014	7:18	16:02	8:44
11/26/2014	7:30	11:45	4:15
12/1/2014	8:00	16:40	8:40
12/2/2014	7:47	16:45	8:58
12/5/2014	13:30	16:45	3:15
12/8/2014	9:45	14:35	4:50
12/9/2014	7:42	16:51	9:09
12/10/2014	7:45	16:37	8:52
12/12/2014	8:45	14:53	6:08
12/13/2014	7:40	9:48	2:08
12/15/2014	8:07	16:45	8:38
12/16/2014	7:36	15:32	7:56
12/17/2014	7:45	16:19	8:34
12/18/2014	7:45	16:49	9:04
12/19/2014	8:00	16:37	8:37
12/22/2014	7:48	15:35	7:47
12/23/2014	9:40	16:36	6:56
12/23/2014	9:40	16:37	6:57
12/24/2014	8:48	12:05	3:17
1/5/2015	7:49	15:28	7:39
1/6/2015	8:55	10:00	1:05
1/7/2015	13:10	15:14	2:04
1/8/2015	7:48	15:39	7:51
1/9/2015	13:24	15:02	1:38
1/12/2015	8:10	15:30	7:20
1/13/2015	8:40	10:33	1:53
1/14/2015	8:10	15:13	7:03
TOTAL			939:57:36

Monitoring Zones

The analysis of the TPP and Year 1 EHW-2 CMP acoustic data (Illingworth and Rodkin 2013), and modeling results (presented within the Environmental Assessment, Biological Assessment, and the IHA) were used to develop the shutdown and buffer zones for pile installation and removal activities associated with the EHW-2 CMP. While the acoustic zones of influence varied among the different diameter piles and types of installation and removal methodologies,

shutdown and buffer zones were based on the maximum zone of influence for all pile installation and removal activities. Monitoring of these zones and the implementation of other minimization measures, such as the use of sound attenuation devices, were designed to reduce the impacts of underwater sound from pile driving and removal on marine mammals.

Shutdown Zone. The shutdown zone included all areas where the underwater sound pressure levels were anticipated to equal or exceed the Level A (injury) Harassment criteria for marine mammals (180 decibels referenced to 1 micropascal [dB re 1 μ Pa] isopleths for cetaceans; 190 dB re 1 μ Pa isopleths for pinnipeds). For vibratory pile installation and removal, monitors enforced a 10-m (32.8-ft) shutdown zone, which encompassed the Level A Harassment zones for cetaceans and pinnipeds (**Figure 4**). For impact pile installation, monitors enforced a 20-m (65.6-ft) shutdown zone for pinnipeds and an 85-m (278.9-ft) shutdown zone for cetaceans (**Figure 4**). The 10-m shutdown zone was also monitored during other activities with the potential to affect marine mammals, including movement of a barge to the pile location, and the removal or insertion of a pile from the water column via a crane (“dead pull” and “stabbing,” respectively).

Buffer Zone. Although a buffer zone (Level B harassment, 120 dB isopleth) for vibratory pile removal was predicted to have an area of 41.4 square kilometers ([km²]; 16.0 square miles), monitoring an area of that size would have been impractical (**Figure 5**). Instead, MMOs monitored from locations throughout the WRA during vibratory pile driver activity (approximately 1.4 km² **Figure 4**). However, since all MMOs were aware that the disturbance zone extended beyond the WRA, all identifiable marine mammals, regardless of whether inside or outside the WRA, were recorded.

Observer Monitoring Locations

In order to monitor buffer and shutdown zones, MMOs were positioned at various vessel-, pier-, and land-based vantage points, taking into consideration security, safety, and space limitations at the NBK at Bangor waterfront (**Figure 3**). One monitoring vessel was positioned inside the WRA. MMOs also monitored the shutdown zone from the construction barge. The MC was stationed with a supplementary MMO to provide additional monitoring of the shutdown zone from the barge. This allowed the MC to effectively coordinate with observers and the pile driving foreman. Additional MMOs were placed on barges to monitor the shutdown zone as

needed. For example, if more than one pile was being driven simultaneously, additional MMOs were assigned to observe the shutdown zone of each pile.

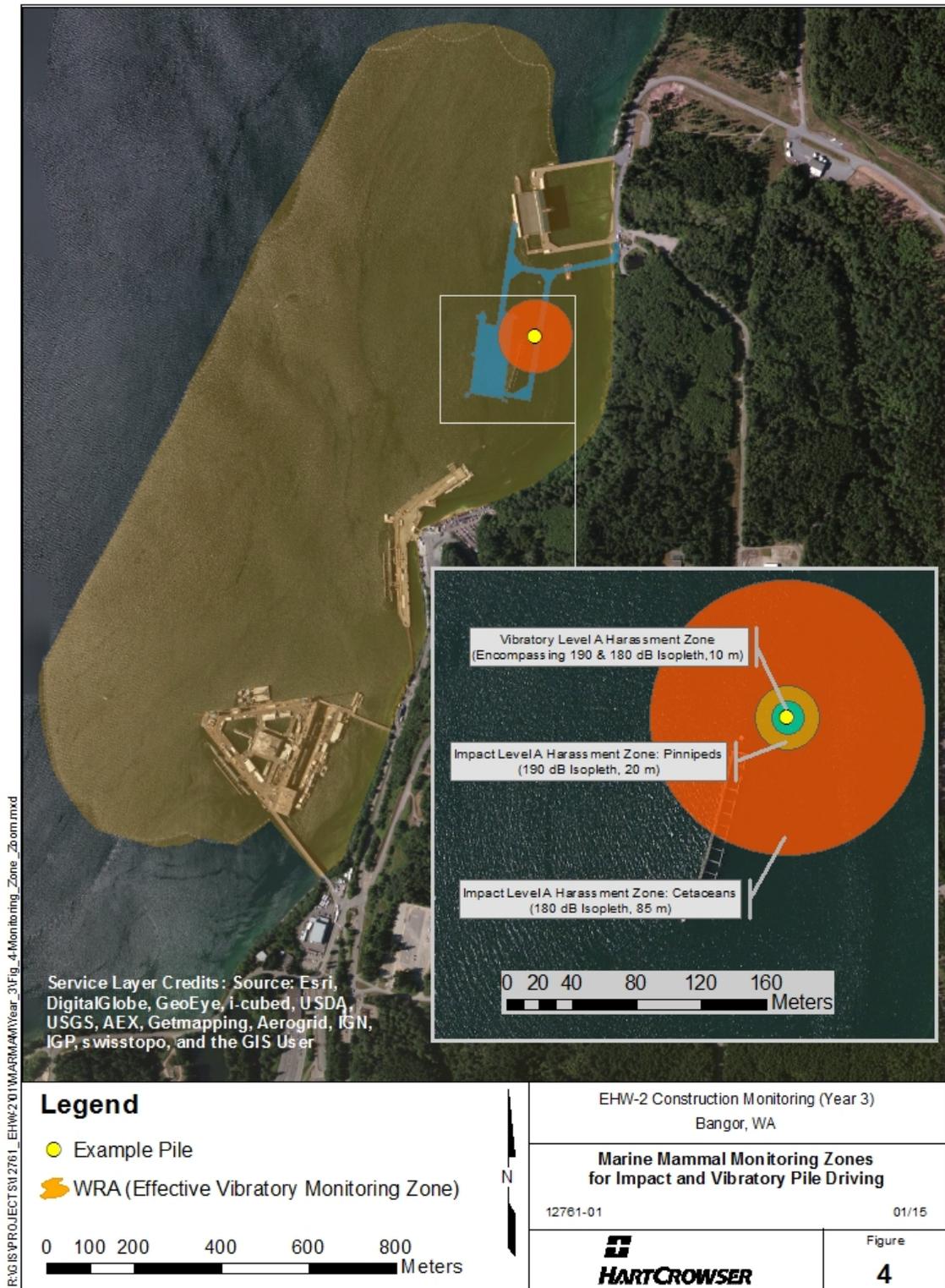


Figure 4. Marine Mammal Monitoring Zones for Impact and Vibratory Pile Driving

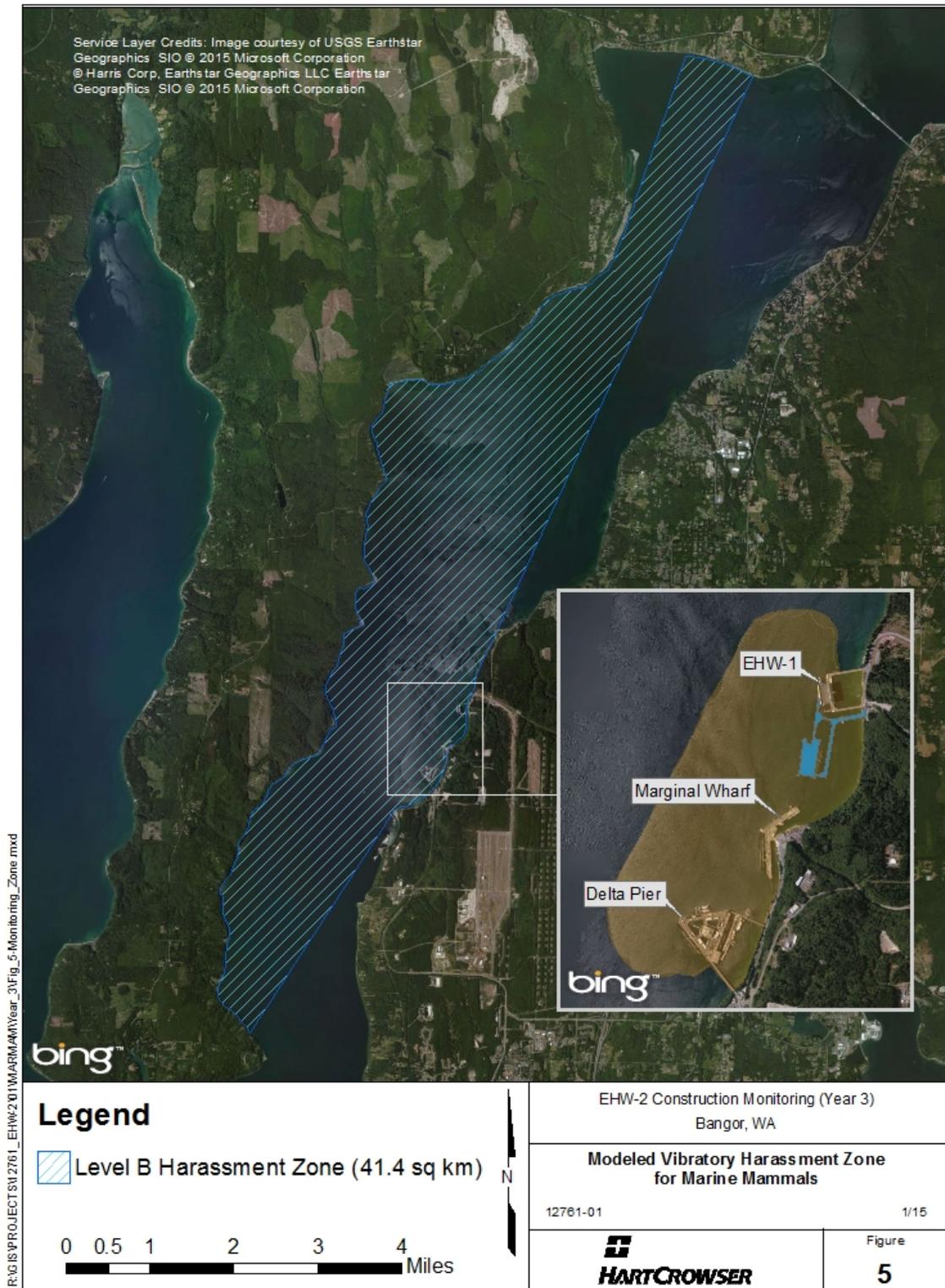


Figure 5. Modeled Vibratory Harassment Zone for Marine Mammals

Monitoring Techniques

Pile installation and removal activities occurred intermittently throughout each construction day. In order to best characterize marine species occurrence and behavior in the area, MMOs surveyed 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 construction and non-construction periods. Construction monitoring began at least 15 minutes prior to the initiation of pile driving (pre-construction monitoring) and ended at least 30 minutes after completion of all pile driving (post-construction monitoring). Observers recorded time, number of animals, behavior, distance and bearing to the animal(s), and distance to pile for each sighting using the standardized Marine Mammal Sightings form (**Appendix C**). This form was digitally reproduced, allowing MMOs to enter data directly into a database using handheld tablet computers. A sheet of data codes was supplied to each MMO as a reference to project-specific codes for construction type, weather, and marine mammal species and behavior (**Appendix C**). At the end of each day, all digitized sightings underwent a rigorous quality control process before being appended to the primary database. Other standard MMO equipment included personal protective equipment (PPE), binoculars with rangefinders, a global positioning system (GPS) unit, a VHF radio, a clipboard, and a marine mammal identification guide. The required PPE for all observers while on site was a personal flotation device, hardhat, steel toe boots, gloves, and hearing and eye protection.

To minimize the probability of multiple observers counting a single animal (and thereby potentially overestimating takes), sightings were tracked on a continuous basis by an observer on one monitoring platform, and then “handed off” to an observer on a second vessel if the animal(s) headed in the direction of the second monitoring platform. Observers kept detailed sighting data and, whenever possible, indicated in their field notes if an animal was a re-sight. However, due to large populations of marine mammals in the WRA and animals often being observed at great distances, re-sighting numbers are conservative.

Every attempt was made to protect marine mammals from Level A (injury) Harassment via the use of sound attenuation devices and continuous monitoring of the behavioral harassment and near-field injury zones. Monitoring coverage of the entire Level A shutdown zone was

consistently excellent. It was not possible to have 100% coverage of the Level B (behavioral) harassment zone during vibratory pile driving/removal due to the large area, the presence of construction barges and vessels, and the limited number of monitoring vessels. 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. Pile driving was not initiated until the shutdown zone was clear of marine mammals. In addition, pile driving was halted when a marine mammal was sighted within or approaching the shutdown zone during pile driving activities.

Visual Monitoring Protocol

Pre-Construction Monitoring. Prior to the start of pile operations, the shutdown and buffer zones were monitored for at least 15 minutes to document the presence of marine mammals. The following monitoring methodology was implemented prior to commencing pile installation/removal activities:

- MMOs 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, monitoring continued and the start of pile driving was delayed until the animals left the shutdown zone voluntarily and had been visually confirmed beyond the shutdown zone, or if 15 minutes had elapsed without re-detection of the animal.
- If marine mammals were not within the shutdown zone (i.e., if the zone was deemed clear of marine mammals), the observers radioed the MC who then notified the pile driving foreman that pile driving could commence.
- If marine mammals were detected within the buffer zone, pile driving and removal or other in-water construction activities (activities not involving a pile driver, but having the potential to affect marine mammals; e.g., “stabbing” the pile) were not delayed, but observers monitored and documented the behavior of marine mammals that remained in the buffer zone.

- Marine Mammal Sightings forms were used to document observations (**Appendix C**).

During Construction Monitoring. The shutdown and buffer zones were monitored throughout the time required to install or remove a pile and during other in-water construction activities. The following monitoring methodology was implemented during pile operations:

- If a marine mammal was observed entering the buffer zone, an “exposure” 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/removal activities associated with that rig were halted. The observers immediately radioed to alert the MC, who alerted the pile driving foreman. This action required an immediate “all-stop” to pile operations. Shutdown at one pile driving location did not necessarily trigger shutdowns at other locations where pile driving was occurring simultaneously.
- Under certain construction circumstances where initiating the shutdown and clearance procedures would result in an imminent concern for human safety, the Monitoring Plan provided that the shutdown provision would be waived. The shutdown provision was not waived during the Year 3 EHW-2 CMP.
- Pile installation/removal activities were delayed until the animal voluntarily left the shutdown zone and had been visually confirmed beyond the shutdown zone, or 15 minutes had passed without re-detection of the animal.
- During the pile driving delay, monitoring continued to be conducted and pile driving did not resume until the shutdown zone had been deemed clear of all marine mammals.
- Once marine mammals were no longer detected within the shutdown zone, or 15 minutes had elapsed without the re-sighting of the animal in the shutdown zone, the observers radioed the MC that activities could re-commence.
- If marine mammals were detected outside the shutdown zone, the observers continued to monitor these individuals and recorded their behavior, but pile driving proceeded. Any

marine mammals detected outside the shutdown zone after pile driving was initiated continued to be monitored and their behaviors recorded.

- 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 marine mammal observers were trained to accurately verify species sighted.
- Observers used binoculars and the naked eye to search continuously for marine mammals.
- In case of fog or reduced visibility, the observers had to be able to see the shutdown and buffer zones; otherwise, pile driving was halted or not initiated until visibility in these zones improved to acceptable levels.
- During impact pile driving, marbled murrelet monitoring protocols were run concurrently with the above described monitoring efforts.

Post-Construction Monitoring. Monitoring of the shutdown and buffer zones continued for 30 minutes following completion of pile installation and removal activities. The post-monitoring period was not required for other in-water construction. 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 had been observed, the U.S. Navy was to notify NMFS immediately. No injured, sick or dead marine mammals were observed during the Year 3 EHW-2 CMP. Monitoring results were noted on a digitized version of the Marine Mammal Sighting form (**Appendix C**).

Piles and Pile Driving Equipment

Pile Descriptions. During the Year 3 EHW-2 CMP, 397 production steel piles (piles that will remain as part of the EHW-2 structure) were driven by vibratory and impact hammers. All 397 piles were driven by a vibratory hammer, and 121 of those piles were subsequently proofed by an impact hammer. Piles impacted consisted of 63 plumb piles and 58 batter piles (additional

“temp” piles were installed as discussed below). Production piles ranged in diameter from 24- to 36-inches (0.61 to 0.92 m) (**Figure 6; Appendix D**).

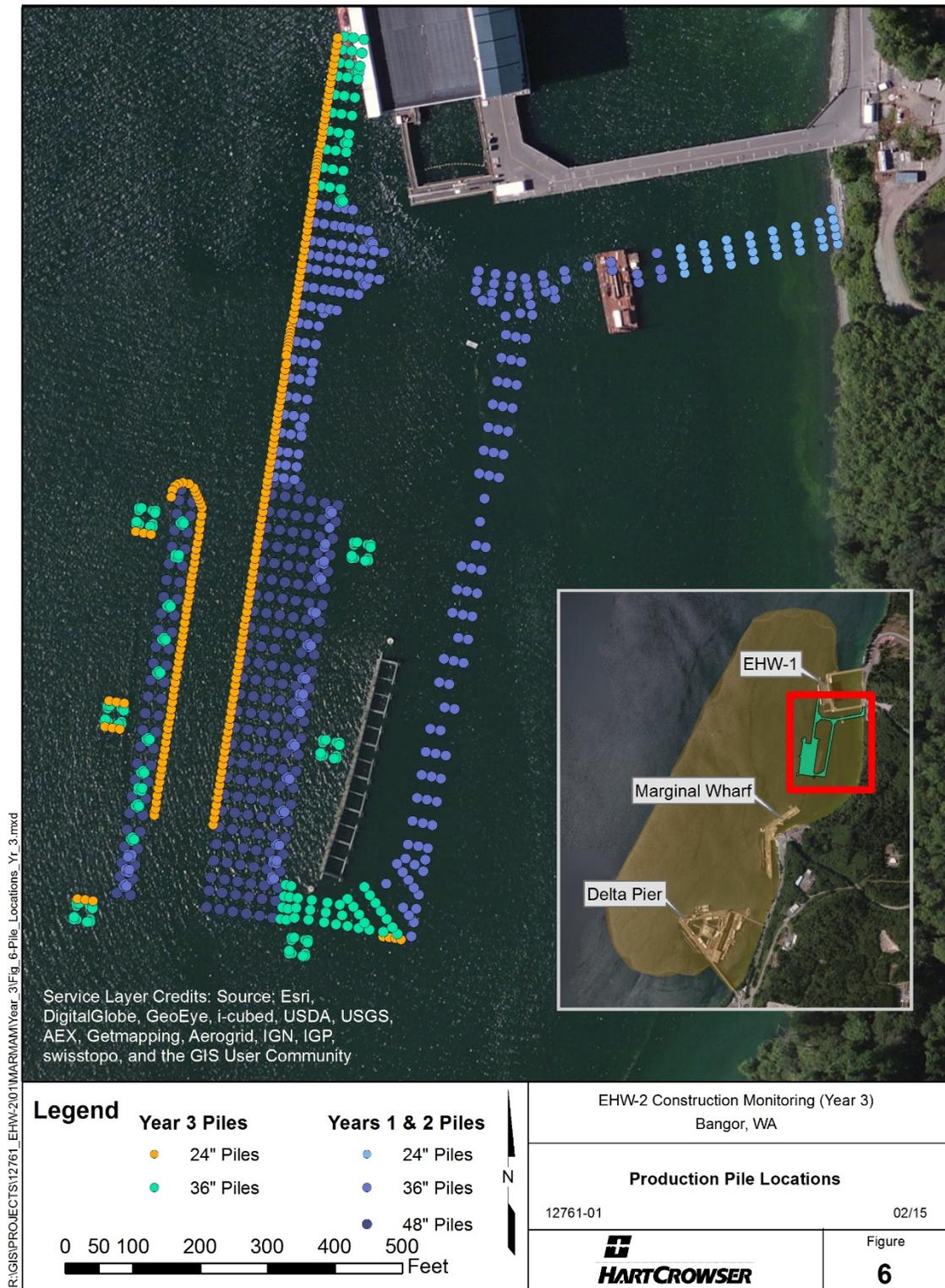


Figure 6. Production Pile Locations

During Year 3 of the EHW-2 CMP, template pin piles and falsework (referred to as “temp” piles in **Appendix D**) were also installed and removed with vibratory hammers. These template pin and falsework piles ranged in size from 24- to 36-inches (0.61 to 1.22 m) in diameter (**Appendix D**). There were 256 vibratory pile driving events of such piles during Year 3.

Pile Driving Equipment. Pile driving equipment was provided and operated by EHW Constructors’ pile driving crews. Vibratory (J&M Model 66-80, American Piledriving Equipment [APE] 200, APE 300, and APE 600) and impact hammers (APE D100) were used during the project, though only one impact hammer was in operation at any time.

The APE 200, APE 300, and APE 600 have drive forces of 170 tons, 160 tons and 445 tons, respectively. The impact hammer APE D100 was rated for 248,063 foot-pounds. The APE D100 was used to impact 36-inch piles (**Appendix D**). In total, there were 164 instances where piles were driven with an impact hammer (some of the 121 piles subject to impact driving were driven on more than one occasion), and therefore required formal monitoring for marbled murrelets. Marbled murrelet monitoring methods and findings are presented in a separate report (DoN 2015).

A sound attenuation bubble curtain or bubble pile was utilized during all impact driving events (**Appendix E**). The bubble curtain was used for sound attenuation during impact pile driving of all plumb piles. The curtain was designed with an adjustable number of rings spaced no further than 15 feet (4.6 m) apart vertically, and were constructed of 3-inch (7.6 centimeter [cm])-diameter pipe rolled into a circle 4 feet, 10 inches (1.5 m) in diameter. Vent holes were 1/16 inches (0.16 cm) in diameter in three sets with a set of center top holes and two additional sets of holes at 45-degree angles to the inside and outside of the ring. The top sets of holes were spaced 1 inch apart (2.5 cm) and the inside/outside sets were spaced 3 inches (7.6 cm) apart around the ring. Each ring was required to pass approximately 501 cubic feet per minute ([cfm]; 14.2 cubic meters per minute) of oil-free air to meet design requirements. To maximize effectiveness, the MC worked with the contractor and checked pressures to ensure that the bubble curtain reached the seafloor and each ring received adequate air pressure.

Batter piles are driven into the substrate at an angle. The bubble curtain was difficult to place on the batter piles due to the presence of the template used to maintain the required angle during

pile driving. In addition, given their angle through the water column, batter piles were not as effectively covered with bubbles using the bubble curtain as for plumb piles. To reduce the inefficiencies and ineffectiveness of the bubble curtain for use during impact pile driving of batter piles, EHW Constructors designed an air bubble pile during the Year 2 EHW-2 CMP. The bubble pile was used during impact pile driving of batter piles during the Year 2 and Year 3 EHW-2 CMP. The bubble pile was designed with ten 3-inch (7.6 cm) by 9.5-foot (2.90 m) pipes installed vertically around a 110-foot (33.5 m), 24-inch (61 cm)-diameter pile. The 3-inch pipes were installed end-to-end along the length of the pile and were connected to hoses to supply air to the system. Vent holes were 1/16 inches (0.16 cm) in diameter in three sets with a set of center holes spaced 1 inch (2.5 cm) apart and two additional sets of holes offset at 45 degree angles spaced 3 inches (7.6 cm) apart. The bubble pile was placed within 10 feet (3 m) of the pile during impact pile driving.

Environmental Data

Environmental parameters were obtained either by direct measurement within the WRA or from coastal weather stations. Wind and air temperature data were collected from permanent weather stations. Environmental parameters were obtained from a coastal weather station in Lofall, Washington, 5.25 miles to the northeast of the work site. A HOBO Water Temperature Pro Data Logger was deployed at Marginal Wharf to collect water temperatures. The HOBO Data Logger was removed from the water for a period of 17 days from 13 October 2014 to 4 November 2014 by unknown persons. Visual observations of wave height, wind direction, and weather conditions continued to be based on observations within the WRA, and were included in the sightings data.

Section 3 Results

The MC logged pile driving times and related construction activities for each pile, which served as the basis for marine mammal sightings data quality control (**Appendix B**).

Marine Mammal Sightings

Three marine mammal species were observed during the Year 3 EHW-2 CMP: harbor seal (*Phoca vitulina*), California sea lion (*Zalophus californianus*), and Steller sea lion (*Eumetopias*

jubatus). Steller sea lions were removed from ESA-listing at the end of October 2013 (NOAA 2013). All marine mammals sighted in Hood Canal are regulated by NMFS and are protected under the MMPA.

Marine Mammal Sightings. Marine mammal sightings include sightings made during pile driving activities and those made during down time (non-construction periods). Observers typically surveyed for marine mammals during the entire construction day (8 to 10 hours). Results from all marine mammal sightings are presented in **Figures 7 and 8**.

A total of 2,642 sightings of 4,886 individual animals were observed during marine mammal surveys of the Year 3 EHW-2 CMP (**Table 3, Appendix F**). A sighting could include more than one animal, which is why the total number of sightings is less than the total number of animals. Of the three marine mammal species identified (harbor seal, California sea lion, and Steller sea lion), harbor seals were the most abundant. Harbor seals were usually observed singularly, with a mean group size of one. California sea lions and Steller sea lions were most frequently observed hauled out in large groups, on one or two submarines at Delta Pier and on floats of the port security barrier, with a mean group size of 12 California sea lions and 3 Steller sea lions. Harbor seals were occasionally seen hauled out on submarines, Port Security Barrier (PSB) floats, and on the pile driving template. In one instance, 14 individuals were observed hauled out on a submarine at Marginal Pier.

Table 3. Total Number of Animals and Sightings by Species

Species	Total # of Animals	Total # of Sightings	Mean Group Size
California sea lion	1,798	151	12
Harbor seal	2,968	2,450	1
Steller sea lion	120	41	3

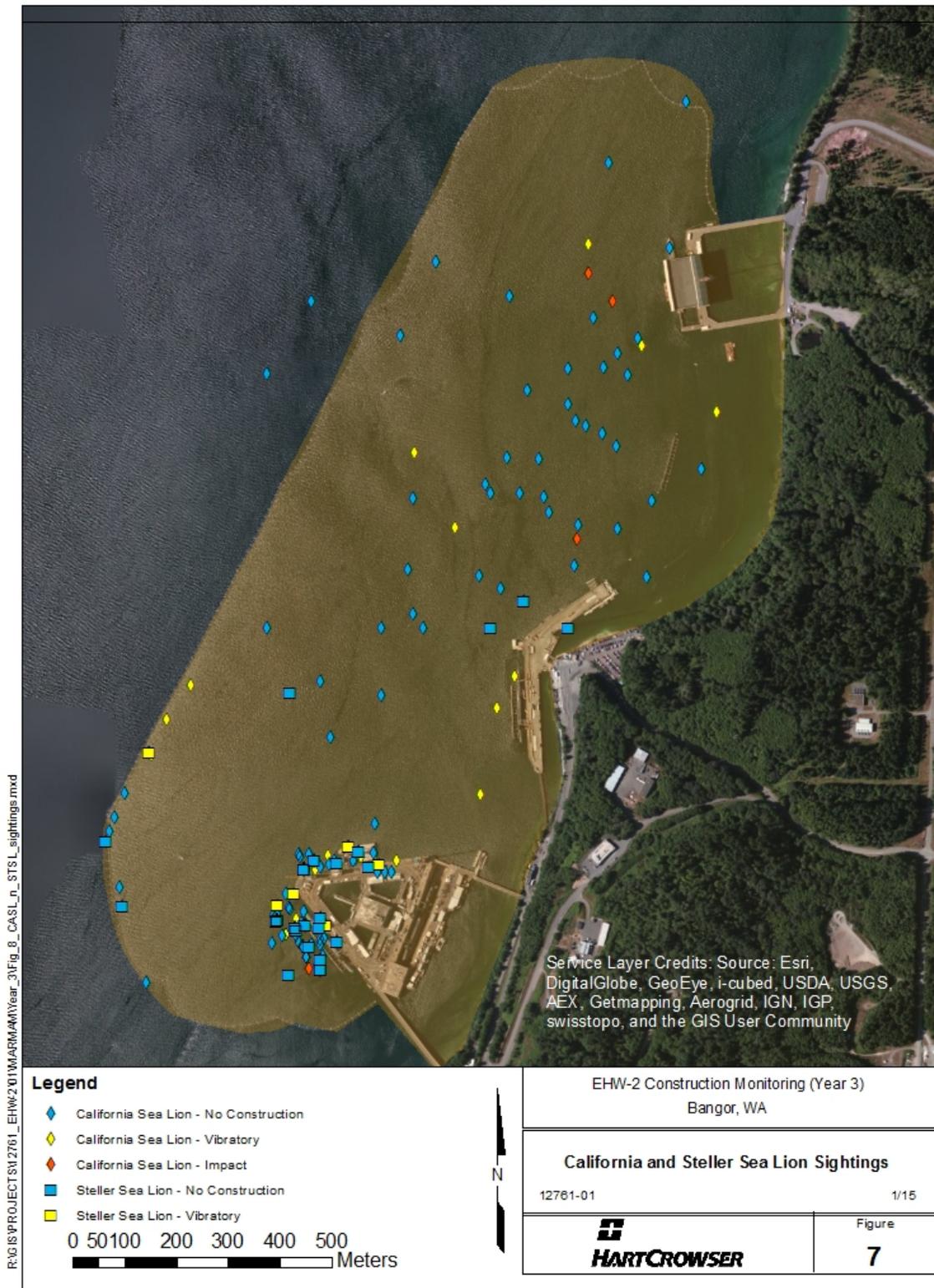


Figure 7. California and Steller Sea Lion Sightings

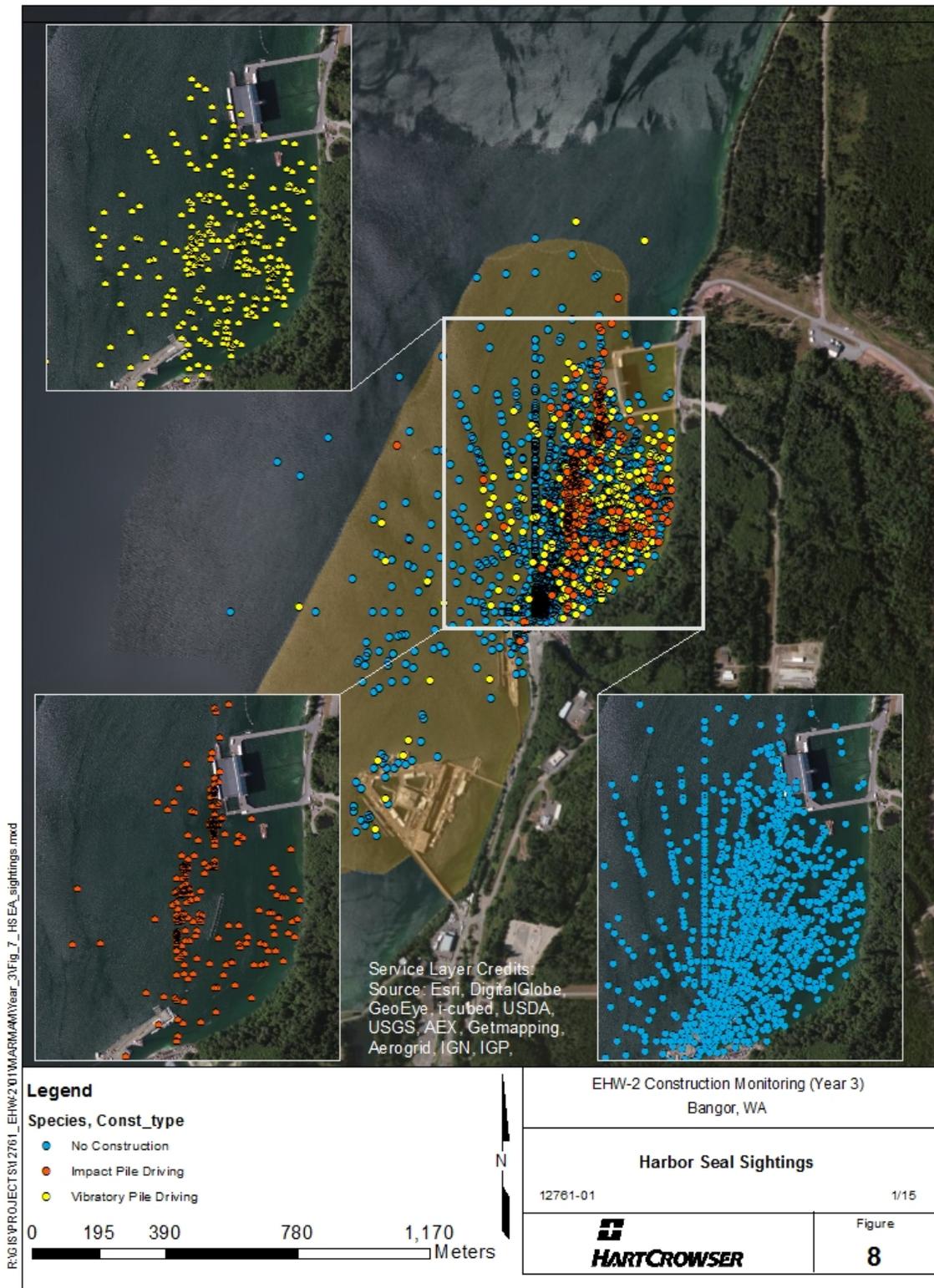


Figure 8. Harbor Seal Sightings

Marine Mammal Sightings during Pile Installation and Removal Activities. Pile installation and removal activities included installation and removal by vibratory and impact hammers including soft start (soft start was only required for impact pile driving during the Year 3 EHW-2 CMP). Therefore, there were three types of construction: vibratory pile driving (V), impact pile driving (I), and soft start impact (SSI) pile driving. Soft starts were intended to provide an opportunity for nearby marine animals to voluntarily leave the area, and thus avoid potential harassment or injury. Vibratory pile driving typically required more time per pile, and all piles were subject to pile driving. Vibratory driving times ranged from 1 second to 1 hour and 50 minutes, with a total time of 138 hours, and 5 minutes for all piles combined, both permanent and temporary piles. Of this total, the total vibratory drive time for temporary piles only was 29 hours, 8 minutes, and 53 seconds. Impact pile driving was of shorter duration, on average, and only a subset of piles were subject to impact driving. Impact drives lasted between 1 second and 41 minutes, with a total time for all piles of 27 hours, 52 minutes. There was no impact driving of temporary piles. The total concurrent drive time when both impact and vibratory pile driving were occurring simultaneously is 2 hours, 54 minutes, and 25 seconds. The total concurrent drive time when two vibratory pile driving rigs were driving simultaneously was 6 hours, 29 minutes, and 33 seconds.

A total of 641 sightings of 1,096 marine mammals were observed during surveys of pile installation and removal activities (impact and vibratory pile driving; **Table 4**; **Figures 7** and **8**). Harbor seals were the most frequently sighted species during impact and vibratory pile driving, accounting for 93% of all sightings. California sea lions were also observed during vibratory pile driving and impact pile driving. California sea lions were observed hauled out in groups during vibratory pile driving (average $n=7$). MMOs observed California sea lions singularly during impact pile driving, but these sightings only accounted for 1.5% of all impact sightings. Steller sea lions were observed hauled out in groups and only during vibratory pile driving (average $n=3$).

Table 4. Summary of Unique Marine Mammal Sightings during Pile Installation and Removal Activities

Species	Total # of Animals	Total # of Sightings	Mean Group Size	Construction Type*	
				V	I
California Sea Lion	418	35	7	414	4
Harbor Seal	652	596	1	402	250
Steller Sea Lion	26	10	3	26	--
TOTAL	1096	641	3.62	816	254
* V= Vibratory Driving, I= Impact Hammer					

Observed Exposures (Takes)

Injury and behavioral harassment takes were calculated based on marine mammals sighted during impact and vibratory pile driving for the Year 3 EHW-2 CMP. Takes were calculated by: (1) measuring 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 (based on EHW-2 acoustic data and sound modeling) on a per-species and per-pile basis (**Appendix F**). Distance to pile was estimated (typically verified using laser rangefinders) and recorded by observers on field data sheets. Whenever possible, observers noted if an animal was likely a resighting (**Appendix F**) 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 observed and as the number of sightings within a given zone.

There were 22 sightings within the Level A Injury zone during the Year 3 EHW-2 CMP that resulted in Level A Takes, all during impact pile driving. These sightings are discussed in the Marine Mammal Mitigation Procedures section below.

The total number of Level B Harassment takes for marine mammals during the Year 3 EHW-2 CMP are summarized in **Table 5**. All animal sightings, including resightings of previously identified animals, are included here (i.e., “All Sightings”) to provide the most conservative estimate of takes. Take numbers for California and Steller sea lions are much lower than sighting numbers due to the large proportion of animals observed out of the water (e.g. “hailed out”). No Dall’s porpoise, harbor porpoise, or killer whales were observed during construction monitoring

or at any other time during the Year 3 EHW-2 CMP; however, these species frequent deeper water outside the WRA and would have been challenging to see from inside the WRA. Consequently, no observed takes were recorded for any of these species. No exceedances of any of the IHA-authorized Level B harassment take numbers occurred during the Year 3 EHW-2 CMP (NMFS 2014).

Table 5. Summary of Observed Level B Harassment Takes (includes resightings)

Species	Takes During Vibratory Driving	Takes During Impact Driving	Total Takes	Takes Per Day	Allowed Takes	Takes Allowed Per Day
California Sea Lion	13	4	17	0.13	6,630	52
Harbor Seal	387	250	637	4.98	8,580	67
Steller Sea Lion	6	0	6	0.05	585	5

Takes were also calculated on a per-pile basis (all observed Level B Harassment takes per number of production piles driven) and summarized in **Table 6**. Per-pile takes are more than 37 times higher for harbor seals than for California sea lions and over 106 times higher than for Steller sea lions, in keeping with the higher observed abundance of seals in the construction area.

Table 6. Summary of Observed Level B Harassment Takes Per Production Pile

Species	Takes Per Pile
California Sea Lion	0.04
Harbor Seal	1.6
Steller Sea Lion	.02

Extrapolated Exposures (Takes)

The calculated behavioral harassment zone during vibratory pile driving was defined as the marine area within the average distance to the 120 dB isopleth during the Year 3 EHW-2 CMP. This is a large area, with a total covered area of 41.4 km². Only a subset of this area was consistently monitored (1.4 km²) as outlined in the monitoring plan. It is therefore appropriate to estimate the number of potential Level B marine mammal takes that may have occurred in the ensonified, but unmonitored, zone.

Marine mammal density numbers taken from the IHA Application were used to develop this extrapolation. Specifically, extrapolated takes were calculated by multiplying the density of marine mammals in Hood Canal near the WRA (i.e., total animal sightings per km² per day) by the total unmonitored area inside the 120 dB isopleth (40.0 km²). This product was then multiplied by the total days of vibratory pile driving during the Year 3 EHW-2 CMP to arrive at the extrapolated number of takes in the unmonitored zone (**Table 7**).

Extrapolated take levels were summed with observed takes to derive an estimate of the total number of behavioral harassment takes during the Year 3 EHW-2 CMP (**Table 8**). The total takes ranged from an estimate of 72 for killer whale to 6,674 for harbor seal (**Table 8**). For all species, the estimate of total takes was less than the IHA levels for the Year 3 EHW-2 CMP.

Table 7. Extrapolated Level B Harassment Takes in the Unmonitored Area of the Behavioral Harassment Zone

Species	Density Estimate* (IHA)	Unmonitored Level B Harassment Zone (Area, km ²)	Estimated Abundance In the Unmonitored Area	Total Vibratory Pile Driving Days	Extrapolated Takes
California Sea Lion	0.63	40.0	25.2	111	2,797
Harbor Porpoise	0.25		10.0		1,110
Harbor Seal	1.3		52.0		5,772
Steller Sea Lion	0.028		1.12		124
Killer Whale ¹	0.04		1.6	45 ¹	72

*Density=observed animals/km²/day

¹ The number of exposures for transient killer whales due to behavioral harassment was calculated based on 45 days of exposure during the in-water construction period per the IHA.

Table 8. Summary of Observed and Extrapolated Level B Harassment Takes

Species	Observed Takes - Vibratory Driving	Extrapolated Takes – Vibratory Driving	Observed Takes - Impact Driving	Total Takes	Allowed Takes
California Sea Lion	418	2,797	4	3,219	6,630
Harbor Porpoise	-	1,110	-	1,110	1,170
Harbor Seal	652	5,772	250	6,674	8,580
Steller Sea Lion	26	124	-	150	585
Killer Whale	-	72	-	72	180

Marine Mammal Mitigation Procedures: Construction Delays and Shutdowns

If a marine mammal was observed in, or approaching the shutdown zone, ongoing construction was to be stopped, and imminent construction was to be delayed. During the Year 3 EHW-2 CMP, there was one construction delay due to a harbor seal observed within the shutdown zone just prior to planned pile driving, and 22 construction shutdowns due to harbor seals surfacing within or near the shutdown zone during vibratory or impact pile driving. During all of the 22 construction shutdowns, animals were close enough to the pile to result in Level A takes. All Level A takes were a result of animals surfacing within the shutdown zone (i.e., they were not observed approaching the zone prior to their emergence within the zone) and resulted in immediate suspension of pile driving. Most of these animals were subsequently observed outside of the shutdown zone and did not exhibit behaviors consistent with injury or distress. In other instances, animals were not re-observed and construction did not resume until 15 minutes had passed without a sighting of the animal in the zone. These construction delays and shutdowns with associated sightings are summarized in **Table 9**. All of the construction shutdowns were during impact pile driving. These 22 shutdowns occurred over a total of 12 days. Impact pile shutdowns resulted from animals located from 5 to 20 meters from the impacted pile. No adverse behaviors were noted for any of the sightings within the Level A zone.

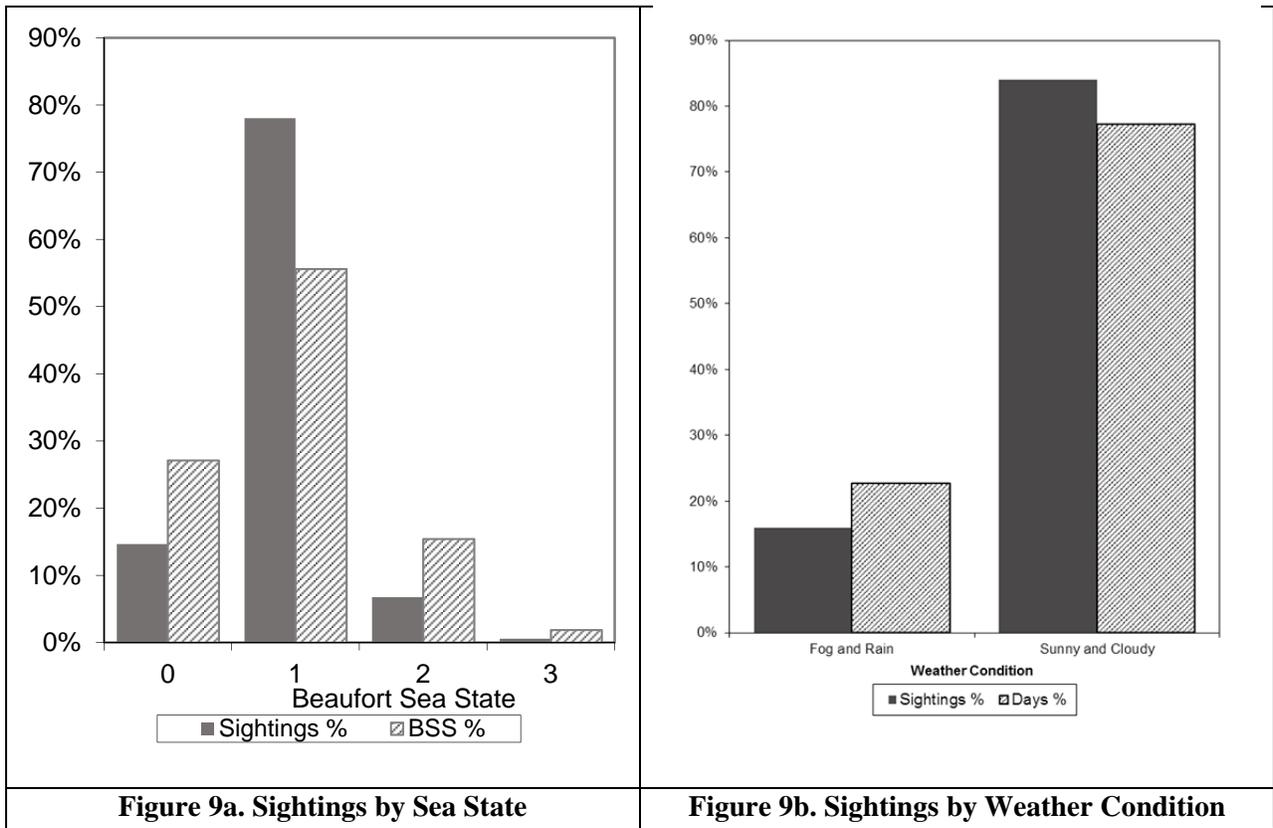
Table 9. Marine Mammal Mitigation Delays and Shutdowns

Date	Event Code ¹	Take	Event		Pile Driving Type ²	Species ³	Sighting		Dist. To Pile	# of Animals	Relative Motion	Behavior Code ⁴	Behavior Code 2	Comments
			Start Time	End Time			Start Time (hh:mm:ss)	End Time (hh:mm:ss)						
7/25/2014	MD	No	15:40:31	15:52:00	None	HSEA	15:36:48	15:37:10	10	1	None	RE	DI	Animal seen within the shutdown zone and initiated driving after 15 minutes.
8/4/2014	MS	Yes	9:51:30	9:58:45	I	HSEA	9:51:56	9:52:00	10	1	None	LO	--	Initiated shutdown, sighting within the zone.
8/13/2014	MS	Yes	13:13:25	13:18:28	I	HSEA	13:13:25	13:15:22	15	1	None	LO	DI	Seal popped in zone, shutdown impact pile driving.
							13:18:22	13:18:25	22	1	None	LO	MI	Animal seen outside shutdown zone, resumed impact driving.
8/15/2014	MS	Yes	12:39:55	12:53:43	I	HSEA	12:39:55	12:40:07	16	1	Toward	LO	SI	Initiated shutdown, sighting within the zone.
							12:41:21	12:49:01	15	1	None	LO	DI	Animal still sighting within the zone.
							12:52:32	12:52:39	54	1	None	LO	SI	Resumed impact, animal observed outside zone.
	MS	Yes	12:58:32	13:11:15	I	HSEA	12:58:32	13:00:53	13	1	None	LO	SI	Initiated shutdown, sighting within the zone.
							13:01:02	13:05:53	17	1	None	LO	SI	Animal reobserved within the shutdown zone. Resurfaced and sank multiple times.
13:11:14	13:18:09	25	1	Toward	SW-W	--	Animal seen outside shutdown zone, resumed impact driving.							
8/19/2014	MS	Yes	11:29:57	11:44:20	I	HSEA	11:29:19	11:29:37	13	1	Toward	SW-S	SI	Animal not reobserved, waiting for 15 minutes and resumed driving.
8/21/2014	MS	Yes	12:11:32	12:13:48	I	HSEA	12:11:32	12:11:32	15	1	Toward	DI	--	Initiated shutdown, sighting within the zone.
							12:13:39	12:13:46	25	1	Away	SI	--	Animal seen outside shutdown zone, resumed impact driving.
8/22/2014	MS	Yes	9:16:17	9:20:10	I	HSEA	9:16:21	9:17:49	5	1	None	LO	RE	Initiated shutdown, sighting within the zone.
							9:20:08	9:20:10	25	1	None	RE	DI	Animal seen outside shutdown zone, resumed impact driving.
	MS	Yes	9:37:43	9:48:08	I	HSEA	9:37:42	9:41:34	15	1	None	LO	RE	Initiated shutdown, sighting within the zone.
							9:48:07	9:48:12	22	1	Away	RE	DI	Animal seen outside shutdown zone, resumed impact driving.
8/23/2014	MS	Yes	8:26:45	8:32:02	I	HSEA	8:26:45	8:32:00	15	1	Parallel	SW-S	DI	Initiated shutdown, sighting within the zone. Swam outside zone at 35m and dove.
	MS	Yes	8:40:24	8:42:47	I	HSEA	8:40:24	8:42:40	10	1	None	MI	DI	Initiated shutdown, sighting within the zone. Swam outside zone at 25m and dove.
9/4/2014	MS	Yes	10:15:15	10:23:39	I	HSEA	10:15:15	10:23:33	15	1	Toward	SW-S	DI	Initiated shutdown, sighting within the zone. Swam outside zone at 25m and dove.
9/5/2014	MS	Yes	9:28:24	9:38:11	I	HSEA	9:28:24	9:28:56	15	1	None	LO	--	Initiated shutdown, sighting within the zone.
							9:39:19	9:39:29	85	1	None	LO	SI	Animal seen outside shutdown zone, resumed impact driving.
9/9/2014	MS	Yes	9:42:08	9:46:21	I	HSEA	9:41:22	9:41:53	10	1	None	LO	DI	Initiated shutdown, sighting within the zone.
							9:43:37	9:43:59	15	1	None	RE	DI	Animal still sighting within the zone.
							9:45:57	9:46:21	25	1	Toward	RE	DI	Animal seen outside shutdown zone, resumed impact driving.
	MS	Yes	9:55:25	10:01:23	I	HSEA	9:55:15	9:55:25	15	1	Parallel	LO	DI	Initiated shutdown, sighting within the zone.
							9:57:01	9:57:11	18	1	None	LO	SI	Animal still sighting within the zone.
							9:58:55	9:59:10	18	1	Toward	LO	DI	Animal still sighting within the zone.
	MS	Yes	10:04:03	10:07:37	I	HSEA	10:00:54	10:01:23	55	1	None	MI	SI	Animal seen outside shutdown zone, resumed impact driving.
							10:03:26	10:04:03	20	1	None	MI	DI	Initiated shutdown, sighting within the zone.
10:07:36	10:07:37	45	1	Parallel	DI	--	Animal seen outside shutdown zone, resumed impact driving.							
9/10/2014	MS	Yes	10:14:08	10:16:24	I	HSEA	10:13:53	10:14:08	17	1	None	LO	SI	Initiated shutdown, sighting within the zone.
							10:16:01	10:16:24	30	1	Away	SW-NE	--	Animal seen outside shutdown zone, resumed impact driving.
9/12/2014	MS	Yes	10:18:08	10:32:33	I	HSEA	10:18:03	10:23:45	15	2	Toward	SW-SE	MI	Initiated shutdown, sighting within the zone.
							10:25:59	10:32:36	15	2	Toward	SW-S	DI	Swam outside zone at 25m and dove.
	MS	Yes	10:39:53	10:44:06	HSEA	10:39:48	10:42:44	15	1	Away	SW-S	--	Swam outside zone at 35m and dove.	
	MS	Yes	10:48:23	10:51:00	HSEA	10:48:23	10:48:29	17	1	Away	SW-SW	DI	Swam outside zone at 26m and dove.	
	MS	Yes	10:51:38	10:58:28	HSEA	10:50:24	10:58:14	15	1	Away	MI	SW-S	Swam outside zone at 24m and dove.	
	MS	Yes	11:02:48	11:04:44	HSEA	11:03:04	11:04:40	15	1	Away	MI	SW-S	Swam outside zone at 28m and dove.	
MS	Yes	11:06:20	11:08:21	HSEA	11:06:28	11:06:30	15	1	Away	MI	SW-SW	Swam outside zone at 24m and dove.		

¹ MD=Mitigation Delay, MS=Mitigation Shutdown. ² I=Impact. ³ HSEA=Harbor Seal. ⁴ Behavior codes found in Appendix C.

Marine Mammal Sightings and Environmental Conditions

Most marine mammal sightings were made in calm conditions with low wave height (**Figures 9a** and **9b**). All marine mammal sightings (including resightings) were made during Beaufort sea state (BSS) conditions of 0–3 (winds at or below 16 knots; see **Appendix C** for the Beaufort scale). All surveys during pile driving occurred during sea states of BSS 3 or below. Sightings declined significantly at BSS 2 and above. This appeared to be due, at least in part, to reduced activity and movement by marine mammals, as the MMOs often reported good monitoring visibility at a BSS of 3. Favorable weather persisted throughout construction, and shutdowns due to reduced visibility were not required at any time.



Favorable weather conditions (cloudy and sunny) occurred on 77% of construction days; 84% of all sightings occurred under those conditions. Weather that produced reduced visibility (fog and rain) occurred on 23% of construction days; 16% of all sightings occurred under those conditions.

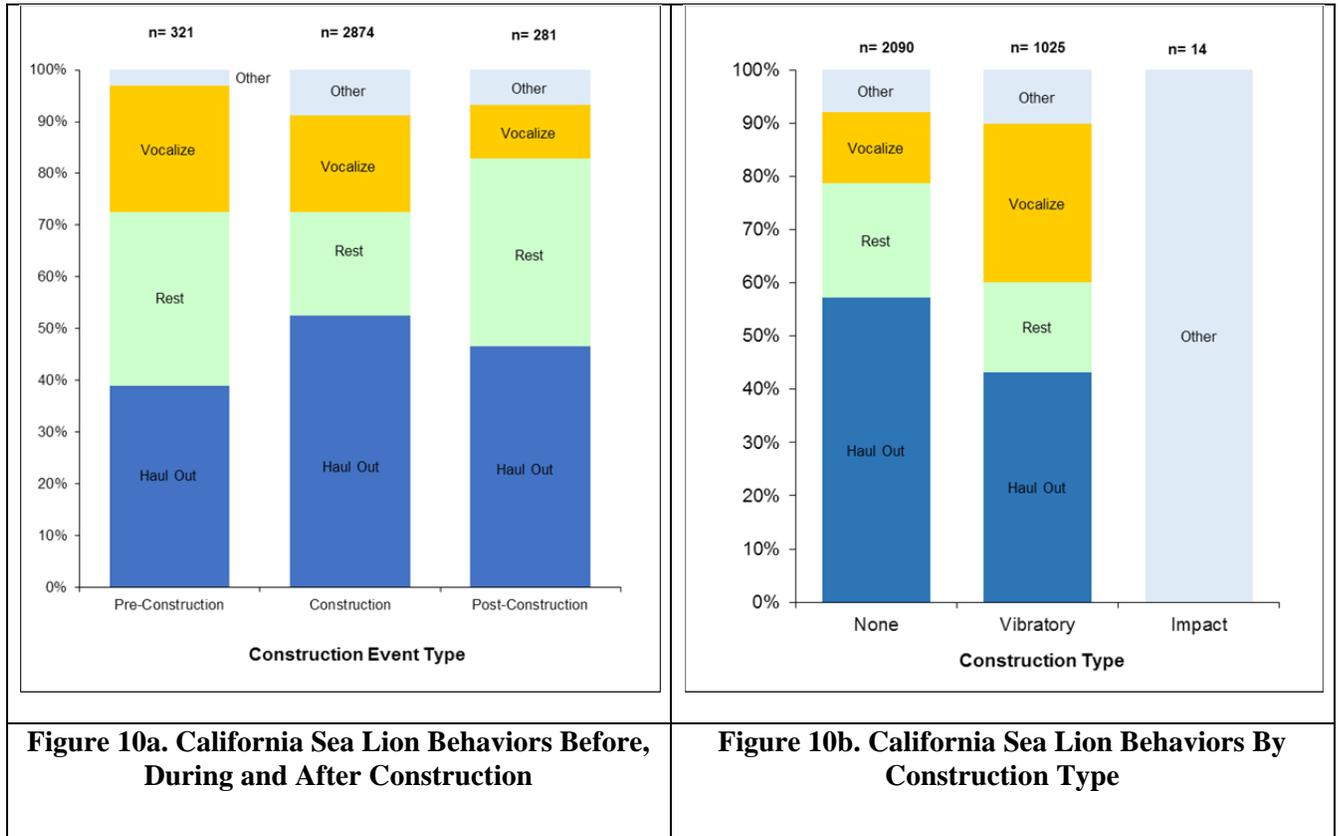
Marine Mammal Behavior

Quantitative Analysis. Observers typically searched for marine mammals continuously. When animals were observed, data were recorded continuously from the beginning of pre-watch until the end of the monitoring effort for the day (see **Table 2** for a summary of the monitoring effort). Behavior was recorded during both construction and non-construction periods (**Appendix F**). Behavioral analyses are presented by species where applicable and behavior codes are found in **Appendix C**. The number of observed animals and the number of observed behaviors are not necessarily the same due to: (1) instances where multiple animals were observed exhibiting the same behavior, and (2) situations where individual animals performed multiple behaviors during a single observation.

California Sea Lion. California sea lions were observed exhibiting similar behaviors throughout the day, due largely to the sea lions frequently being observed in large groups hauled out on submarines and the PSB. During pre-construction monitoring, California sea lions were observed “hauled out” (39%, n=125), and “resting” (34%, n=108) and “vocalizing” (24%, n=78) (**Figure 10a**). During construction, California sea lions were frequently observed “hauled out” (53%, n=1,509), “resting” (20%, n=574), and “vocalizing” (19%, n=536). In addition to these dominant behaviors observed during construction, California sea lions also exhibited a range of other behaviors (e.g., looking, milling, playing, and swimming), but less frequently, with less than two percent of animals demonstrating each behavior (these behaviors were collectively grouped as “other”) during construction. During post-construction monitoring, California sea lions were frequently observed “hauled out” (47%, n=131), “resting” (36%, n=102), and “vocalizing” (10%, n=29).

When analyzed by construction event type, California sea lions were frequently observed “hauled out” (53%, n=1,108), “resting” (20%, n=416), and “vocalizing” (12%, n=260) during construction events other than pile driving (referred to as “None” in **Figure 10b**). During vibratory pile driving, California sea lions were most frequently observed “hauled out” (39%, n=401), “vocalizing” (27%, n=276) and “resting” (15%, n=158). The 14 California sea lions observed during impact driving (grouped into “other” on the graph) were seen “swimming”, “porpoising”, “spyhopping” (each 14%, n=2) and “traveling” (7%, n=1). During impact driving

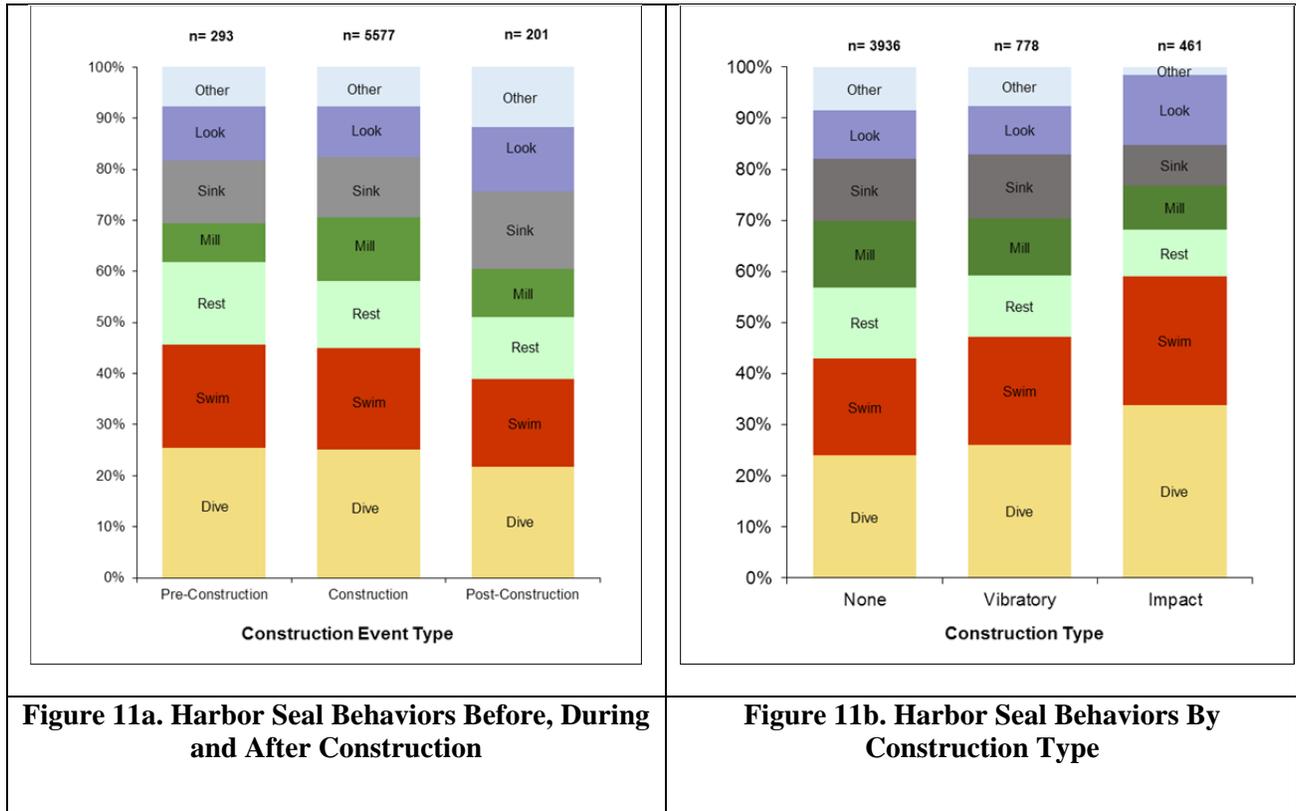
MMOs were never in the portion of the WRA where sea lions were typically observed hauled out due to the need to stay in the immediate vicinity of the pile in order to monitor the injury zone. Hence, data on behaviors during impact driving are strongly skewed against observations of haul out, resting, and vocalizing.



Harbor Seal. During pre-construction monitoring, harbor seals were most frequently observed “diving” (24%, n=69), “swimming” (19%, n=55), “resting” (15%, n=44), and “sinking” (11%, n=33) (**Figure 11a**). During construction, harbor seals were frequently observed “diving” (23%, n=1,302), “swimming” (18%, n=1030), “resting” (12%, n=677), and “milling” (11%, n=640). During post-construction monitoring, harbor seals exhibited similar behaviors as observed during construction. Of these behaviors “diving” (19%, n=39), “swimming” (15%, n=31), and “sinking” (13%, n=27) were most common.

When analyzed by construction event type, harbor seals were frequently observed “diving” (24%, n=943), “swimming” (19%, n=750), and “resting” (14%, n=542) during construction other

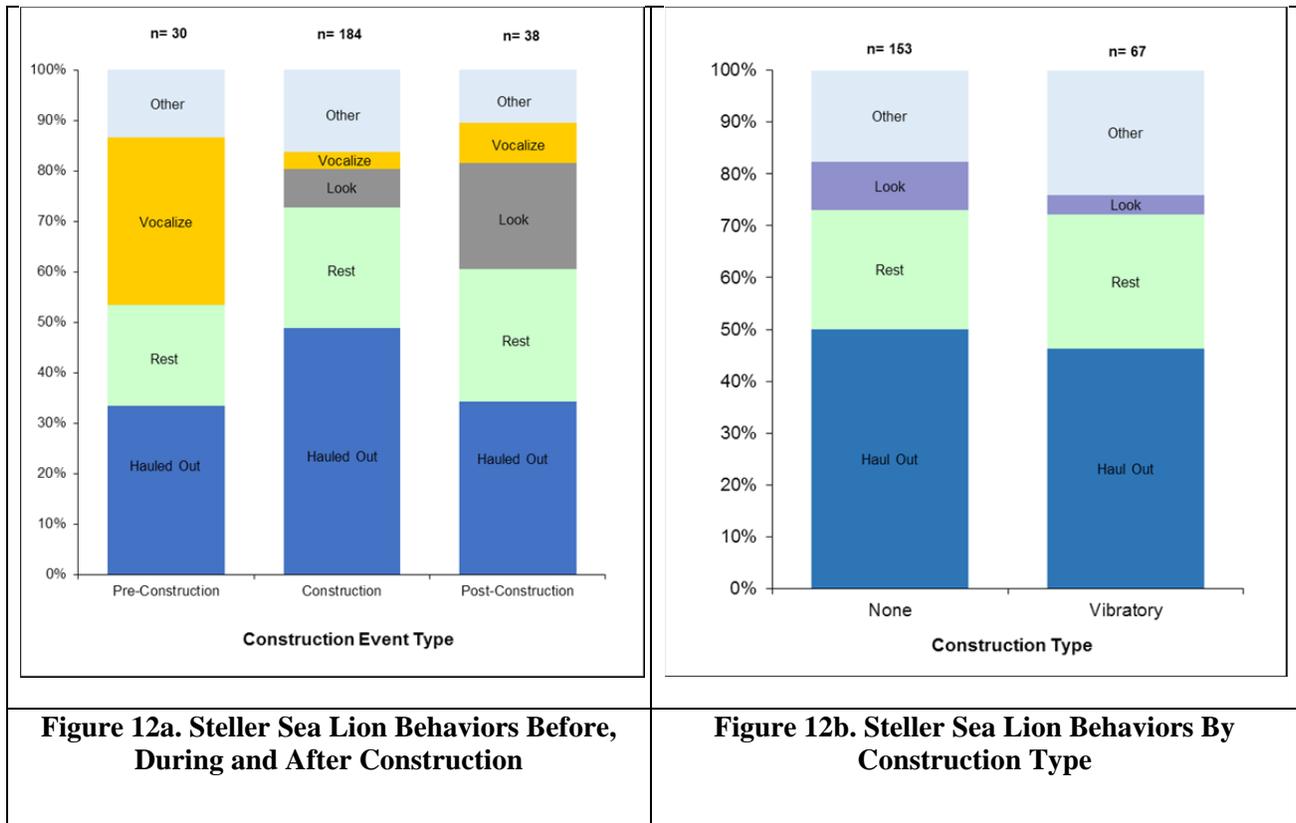
than pile driving (**Figure 11b**). During vibratory pile driving, harbor seals were most frequently observed “diving” (26%, n=203), “swimming” (21%, n=164), and “sinking” (13%, n=98). During impact pile driving, harbor seals were most frequently observed “diving” (34%, n=156), “swimming” (25%, n=116), and “looking” (14%, n=63).



Steller Sea Lion. During the Year 3 EHW-2 CMP, Steller sea lions were first observed on 9 September 2014, and sightings continued through January 2015. Like California sea lions, Steller sea lions were observed exhibiting similar behaviors throughout the day, due to the sea lions being frequently observed in large groups hauled out on submarines and the PSB. During pre-construction monitoring, Steller sea lions were observed “hauled out” and “vocalizing” (both 33%, n=10), and “resting” (20%, n=6) (**Figure 12a**). During construction, Steller sea lions were frequently observed “hauled out” (49%, n=90), “resting” (24%, n=44), and “looking” (8%, n=14). In addition to these dominant behaviors observed during construction, Steller sea lions also exhibited a range of other behaviors (e.g., chuffing, flushing, vocalizing, and milling), but less frequently, with less than two percent of animals demonstrating each behavior. For the Figures 12a and 12b, these behaviors were collectively grouped under “other.” During post-

construction monitoring, Steller sea lions were frequently observed “hauled out” (34%, n=13), “resting” (26%, n=10), and “looking” (21%, n=8).

When analyzed by construction event type, Steller sea lions were frequently observed “hauled out” (42%, n=65), “resting” (20%, n=30), and “vocalizing” (8%, n=12) during construction events other than pile driving (referred to as “None” in **Figure 12b**). During vibratory pile driving, Steller sea lions were most frequently observed “hauled out” (37%, n=25), “vocalizing” (21%, n=14) and “milling” and “vocalizing” (each 9%, n=6). Steller sea lions were not observed during impact pile driving.



Other Marine Mammals. No other marine mammal species were observed during Year 3 EHW-2 CMP surveys.

Summary of Quantitative Analysis. During periods of construction other than pile driving events, marine mammals were most frequently observed swimming parallel or having no relative

motion to the construction area (40%, n=359; **Figure 13**). During vibratory pile driving, marine mammals were most frequently observed having no relative motion (51%, n=91). There was also a decrease in the percentage of animals that moved toward the pile during vibratory pile driving (18%, n=33) compared to non-pile driving periods (26%, n=235; **Figure 13**). During impact driving events, animals were most frequently observed moving away from the pile (42%, n=53). Marine mammals moved toward the pile less frequently during impact pile driving (22%, n=28) than during periods of no construction (26%, n=235).

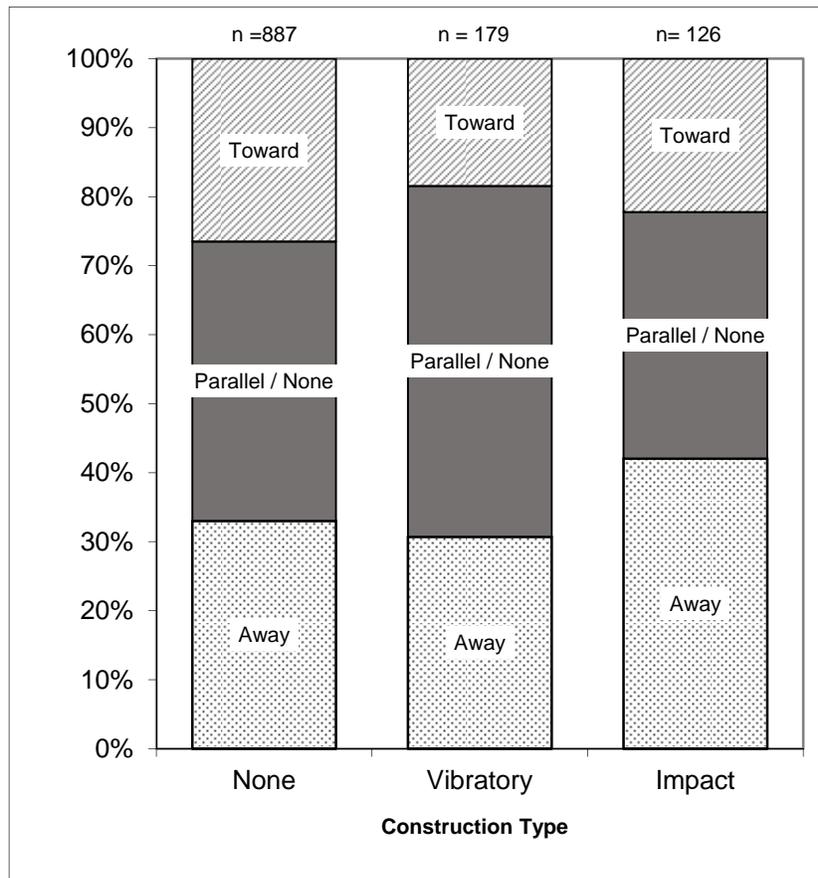


Figure 13. Relative Motion of Marine Mammals by Construction Event

California Sea Lion. Overall, due to the large majority of California sea lions being observed hauled out, they exhibited a similar range of behaviors during pile driving and non-pile driving periods, but vocalized more frequently during vibratory driving than during non-construction periods. California sea lions were also observed less frequently hauled out during vibratory pile driving. The low number of California sea lions observed during impact pile driving, as well as a

condensed monitoring zone, prohibits making meaningful comparisons between behaviors during impact pile driving and other construction types.

Harbor Seal. Harbor seals were by far the most frequently sighted marine mammal species during the Year 3 EHW-2 CMP. Harbor seals displayed a wide range of behaviors, which were fairly consistent during construction monitoring periods and non-construction periods. Harbor seals also exhibited a similar range of behaviors during pile driving and non-pile driving periods, a trend that is supported by the large sample size of sightings and anecdotal evidence from observers. Harbor seals were slightly more frequently observed “looking”, “swimming”, and “diving” during impact pile driving, which could suggest a response to impact pile driving activity.

Steller Sea Lion. Steller sea lions were less vocal and more frequently seen “hailed out” and “looking” during and post construction than before the construction monitoring period. However, when observations are condensed into construction and non-construction (i.e., “None” in **Figure 12**) periods Steller sea lions exhibited a remarkably similar range of behaviors. The difference in behaviors observed during pre-construction monitoring may therefore be due to factors that are not project related, such as diurnal event cycles.

Qualitative Behavioral Observations. MMOs made a number of qualitative observations on the movements and distribution of animals, and on the potential effects of pile driving activities on marine mammal behavior during the Year 3 EHW-2 CMP, in addition to the quantitative results presented above. In the areas where pile driving was conducted, many animals observed were in transit, generally moving along a north-south axis parallel to the shoreline. Aside from these sightings, observations of pinnipeds were generally of single animals, of which the majority were harbor seals. California sea lions were also seen in the general vicinity of pile driving activities, but 89% of California sea lions sightings (and all but one Steller sea lion sighting) were at Delta pier and the nearby PSB floats, approximately 1 km from the work area.

Understanding that subjective observations can be a useful adjunct to quantitative measurements, the MMOs were asked on a daily basis whether they had observed any behaviors consistent with injury, distress, or high-speed flight from the construction area. For pinnipeds, they did not report any such observations. In addition, the MCs on many occasions asked the marine mammal

observers to watch an individual seal or sea lion just as impact or vibratory driving commenced to look for any instantaneous change in behavior potentially associated with the onset of pile driving noise. In some cases, individual animals would submerge with the onset of pile driving, or would begin swimming away from the construction site. In many other cases, individual animals did not exhibit any change in behavior with the onset of pile driving. Occasionally, harbor seals that had not been observed near the pile field appeared near or inside the shutdown zone during impact pile driving. On two occasions, 15 and 21 August 2014, harbor seals were observed in the shutdown zone coincident with dead herring (see further discussion below). Despite the possibility of herring kills drawing harbor seals into the shutdown zone, based on the overall summation of qualitative observations, the MMOs generally felt that the behaviors of pinnipeds did not indicate adverse reaction to in-water construction activities.

Observations of Impacts to Pacific Herring

Although the focus of monitoring was on marine mammals, observers also looked for other environmental indicators of potential impacts from pile driving. Pacific herring (*Clupea pallasii*), a non-ESA-listed species, appeared in massive schools in August and September 2014. Marine mammal monitors observed large herring schools on numerous days during this period, which may also help explain the greater number of harbor seal sightings per monitoring hour during that period (**Figure 14**). These large schools of herring coincided with observed fish mortalities and stuns on five days between August and September, 2014 (**Table 10**). Observed herring impacts only occurred when large schools were present and adjacent to the piles, and were observed for a very limited number of work days (1% of all work days). Herring impacts occurred during both vibratory and impact pile driving events (all piles 36-inch diameter), with the number of herring impacted ranging from one to approximately 100 fish per incident. Herring recovered on 21 August 2014 after impact pile driving showed evidence of hemorrhaging in the abdominal walls (based on external observations and dissection) consistent with effects of barotrauma (**Photographs 1 and 2**). Fish were not collected and analyzed for other dates. Mitigation delays or shutdowns occurred during both instances when herring impacts were observed during impact pile driving due to harbor seals foraging near the pile (**Tables 9 and 10**).

Table 10. Summary of Herring Kill Observations

Pile Number	Hammer	Start Time	End Time	Shutdown?	Drive Type	Comments
FP-50	JM66	8/14/14 12:48 PM	8/14/14 12:58 PM	No	Vibratory	Herring stunned.
AB-34	D100	8/15/14 1:01 PM	8/15/14 1:07 PM	Yes	Impact	Dead and stunned herring (50-100 fish). Seals feeding.
AB-40	D100	8/21/14 12:14 PM	8/21/14 12:28 PM	Yes	Impact	Observed herring kills/stuns (10+ fish). Collected 3 dead herring for analysis.
N-14	APE600	8/23/14 2:32 PM	8/23/14 3:13 PM	No	Vibratory	Herring stunned (approx. 3). 50m from pile. Active ball in area.
T56-G	APE600	9/22/14 4:06 PM	9/22/14 5:40 PM	No	Vibratory	Stunned herring in area. HSEA feeding 20m-40m from pile.



Photograph 1. External signs of barotrauma on herring retrieved during impact pile driving 21 August 2014.



Photograph 2. Hemorrhaging in the abdominal wall of herring.

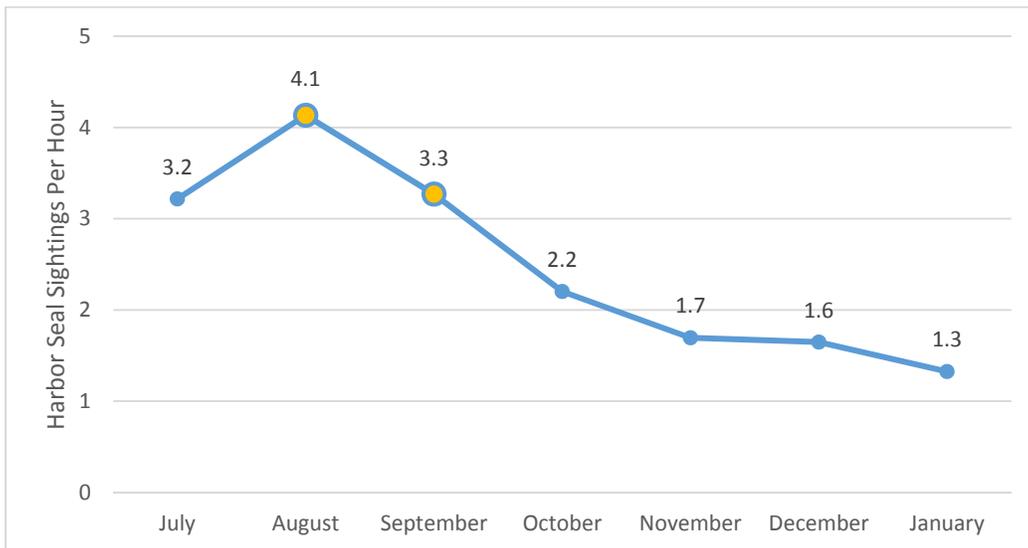


Figure 14. Harbor Seal Sightings per Hour by Month.

*Note: highlights indicate months of observed herring impacts.

Environmental Data

Environmental data can be found in **Appendix G** and are summarized by week in **Figures 15** and **16**. Average weekly air temperatures fluctuated from 65 degrees Fahrenheit (° F) in mid-September 2014 to the lowest recorded average temperature of 34° F in mid-November 2014. Water temperatures were steady between 57° F and 59° F from July through August 2014, then steadily decreased to 48° F by mid-January when monitoring ended. Neither air nor water temperatures had any effect on the observers’ ability to identify marine mammals within the



WRA.

Figure 15. Average Air and Water Temperatures in the WRA

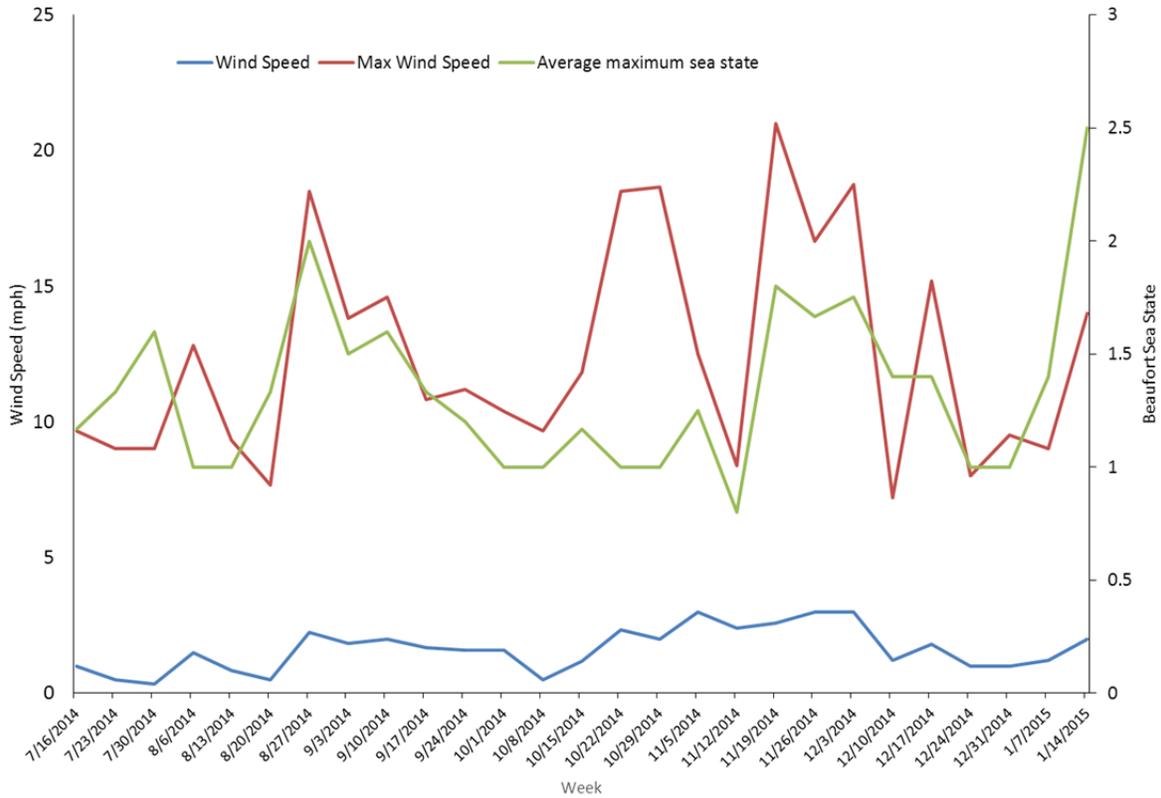


Figure 16. Wind Speed in the WRA

Average weekly wind speeds ranged from 0.3 to 3.0 miles per hour (mph), with the maximum wind speed of 32 mph on 24 November 2014 (**Figure 16**). No impact pile driving occurred during high wind periods due to the Marbled Murrelet Monitoring Plan protocol limiting sea state to less than BSS 3 during impact pile driving. Wind speeds did not result in unacceptable visibility ranges during pile driving activity, and resulted in a maximum BSS 3 during marine mammal monitoring (typically BSS 1–2). Observers found that localized wind “chop” was the primary determinant of the quality of viewing conditions. This benefited observers in the WRA as conditions in this area were generally calmer due, in part, to the location of the project area between EHW-1 and Marginal Wharf and in part, to the security fence, which provided a degree of shelter and dissipated wind and wave energy from the open waters of Hood Canal. Construction barges and boats also tended to reduce sea state in the vicinity of the construction work area.

Section 5 List of Preparers

Jeffrey Barrett, Ph.D.
Hart Crowser
Principal-in-Charge and Lead Biologist/Monitoring Coordinator/Observer

Hans Hurn
Hart Crowser
Project Manager, Monitoring Coordinator/GIS and Data Analysis

Emily Duncanson
Hart Crowser
Monitoring Coordinator/Database Manager/Data Analysis

Maria Sandercock
Observer/Data Analysis

Section 6 References

- DoN, 2012. Final Marine Mammal Monitoring Plan. Trident Support Facilities Explosives Handling Wharf (EHW-2). Naval Base Kitsap at Bangor, Silverdale, Washington. July, 2012.
- DoN, 2013. Naval Base Kitsap-Bangor Explosives, Handling Wharf 2 Year 1 Marine Mammal Monitoring Report (2012–2013), Bangor, Washington. Prepared by Hart Crowser for Naval Facilities Engineering Northwest, Silverdale, Washington. April 2013.
- DoN, 2014. Naval Base Kitsap-Bangor Explosives, Handling Wharf 2 Year 2 Marine Mammal Monitoring Report (2013–2014), Bangor, Washington. Prepared by Hart Crowser for Naval Facilities Engineering Northwest, Silverdale, Washington. April 2015.
- DoN, 2015. Naval Base Kitsap-Bangor, Explosives Handling Wharf 2, Bangor, Washington. Draft Year 3 Marbled Murrelet Monitoring Report (2014-2015). Prepared by Hart Crowser, Inc. for Naval Facilities Engineering Northwest, Silverdale, Washington. February 2014.
- Illingworth & Rodkin Inc., 2013. Naval Base Kitsap at Bangor EHW-2 Construction Monitoring Program, Bangor, Washington. Draft Marine Acoustic Monitoring Report. Prepared for Hart Crowser Inc., Seattle, Washington and Naval Facilities Engineering Northwest, Silverdale, Washington. March 2013.
- National Marine Fisheries Service (NMFS), 2014. 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 July 14 2014.

National Oceanic Atmospheric Administration (NOAA), 2013. NOAA Removes the Eastern Steller Sea Lion from the Endangered Species Act List. Accessed March 6 2013. <https://alaskafisheries.noaa.gov/newsreleases/2013/easternssl102313.htm>.