

Marine Mammal Protection Act and Endangered Species Act

Updated Marine Mammal Monitoring and Mitigation Plan

April 2013

Reference: 0648-BC69

Submitted to:

National Oceanic and Atmospheric Administration's
National Marine Fisheries Service
Office of Protected Resources
1315 East-West Highway
Silver Spring, Maryland 20910-3226

Submitted by:



City of Seattle
Department of Transportation
700 5th Avenue, Suite 3900
Seattle WA 98124

Prepared by:
Tetra Tech, Inc.





**MARINE MAMMAL PROTECTION ACT AND
ENDANGERED SPECIES ACT
UPDATED MARINE MAMMAL MONITORING AND MITIGATION PLAN**

Agreement No. T09-24

April 2013

The Elliott Bay Seawall Project (EBSP) is a joint effort between the City of Seattle Department of Transportation (SDOT), and the United States Army Corps of Engineers (USACE). To conduct this project, SDOT contracted with:

Tetra Tech, Inc.

1420 5th Avenue, Suite 550
Seattle WA 98101

In association with:

Anchor QEA
BergerABAM
Coast & Harbor Engineering
EnviroIssues
Fehr & Peers
Floyd|Snider
GHD
JA Brennan
LPES
Magnusson Klemencic Associates
Mimi Sheridan
Nelson\Nygaard
Power Engineers
Risk Strategics
Shannon & Wilson
SWCA Environmental Consultants
Washington2 Advocates
William P. Ott Construction Consultants
ZGF Architects

City of Seattle
**Marine Mammal Protection Act and Endangered Species Act
Updated Monitoring and Mitigation Plan**

TABLE OF CONTENTS

Title	Page No.
INTRODUCTION	1
SECTION 14. CONSERVATION AND MITIGATION MEASURES UPDATED MONITORING AND MITIGATION PLAN	3
14.1 Construction Monitoring	3
14.1.1 Background Details	3
14.1.1.1 Exclusion Zone and Level B Harassment Thresholds Monitoring	4
14.1.1.2 Level B Harassment Threshold Monitoring	7
14.1.2 Marine Mammal Monitoring Protocol	8
14.1.2.1 Marine Mammal Sighting Form	12
14.1.3 Acoustic Monitoring	13
14.2 Reporting	16
14.2.1 Daily Monitoring Log	16
14.2.2 Monitoring Data Spreadsheet	17
14.2.3 Annual Monitoring Reports	17
14.2.4 Comprehensive Final Report	18
14.2.5 Acoustic Monitoring Report	18
14.3 Adaptive Management	19
14.4 General Construction Guidance	19
SECTION 15. COORDINATING RESEARCH TO REDUCE AND EVALUATE INCIDENTAL TAKE	21
REFERENCES	23

LIST OF TABLES

No.	Title	Page No.
	Table 1. Summary table of exclusion zone thresholds and Level B harassment zones	5
	Table 2. Authorized “take” values provided by NOAA for EBSP pile installation and removal	8
	Table 3. Monitoring zones by pile installation and removal type.....	10
	Table 4. Equipment specifications for acoustic monitoring	14
	Table 5. Summary of near-source (10-meter) unattenuated sound pressures for in-water pile installation using an impact hammer and vibratory driver/extractor	16

LIST OF FIGURES

No.	Title	Page No.
	Figure 1. Map of exclusion zone thresholds and Level B harassment zones established for pile- related construction of the EBSP.....	6
	Figure 2. Proposed monitoring locations including projected viewsheds and the area of potential effects (out to 3.9 miles).....	9
	Figure 3. Example of EBSP daily pile-related construction schedule summary sheet	11

INTRODUCTION

This Marine Mammal Monitoring and Mitigation Plan updates Sections 14 and 15 of the Request for Letter of Authorization under the Marine Mammal Protection Act (MMPA), which was submitted by the Seattle Department of Transportation (SDOT) to the National Oceanic and Atmospheric Administration (NOAA) Office of Protected Resources in September 2012 for the Elliott Bay Seawall Project (EBSP). The monitoring plan was also provided to the NOAA Northwest Regional Office as an attachment to the Biological Assessment submitted in November 2012 for the Endangered Species Act (ESA) Section 7 consultation for the project.

This update provides more detail on the monitoring protocols, ensures better consistency with the Draft Rule (Reference: 0648-BC69) published on April 12, 2013 (NOAA 2013), and revises the primary form of monitoring as land-based rather than boat-based to more effectively ensure adequate monitoring coverage of the exclusion zones and thresholds for Level B harassment where a “take” must be recorded.

This page intentionally left blank.

SECTION 14. CONSERVATION AND MITIGATION MEASURES UPDATED MONITORING AND MITIGATION PLAN

The following conservation measures would be employed for the duration of the proposed project. The proposed conservation measures are intended to avoid and/or minimize potential effects to ESA-listed marine mammal species and designated critical habitat, as well as other marine mammals that may occur in the area of potential effects. Most proposed conservation measures are well established as effective and have been implemented for similar projects in Puget Sound and elsewhere.

Each conservation measure would be included in the Contract Plans and Specifications document, and SDOT would conduct monitoring for compliance with MMPA and ESA approvals. Existing SDOT policy and construction administration practice requires an SDOT inspector to be present onsite at all times during construction activities to ensure contract compliance. The inspector and the contractor will each have a copy of the Contract Plans and Specifications document and will be aware of all requirements. The inspector would also be formally trained in environmental provisions and compliance prior to the start of construction.

The monitoring and mitigation plan includes construction monitoring protocol as well as guidelines for construction activities associated with pile installation and removal. Monitoring would occur by observing construction activities and the surrounding marine environment for signs of marine mammals and/or potential threats to marine mammals, as well as measuring underwater noise produced by in-water pile-related activities. Observations accrued through the proposed monitoring and reporting plan will also provide baseline data and observations for scientific study. Implicit in this monitoring and mitigation plan is retaining enough flexibility for the monitors to use their best scientific judgment for unforeseen events that will allow for optimal protection of marine mammals.

14.1 CONSTRUCTION MONITORING

14.1.1 Background Details

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

For this updated plan, monitoring of in-water, pile-related construction would consist primarily of land-based observations. Boat-based observations would only be employed as necessary to supplement the land-based monitoring. The proposed land-based monitoring would survey the nearshore environment immediately surrounding active pile-related construction, as well as all areas of Elliott Bay and Puget Sound designated as exclusion zones or Level B harassment zones where a “take” must be recorded for the relevant marine mammal species (exclusion zone thresholds and Level B harassment zones are listed

in Table 1 and shown on Figure 1 below). Boat-based observations would be used only to monitor areas of open water during poor visibility conditions (i.e., fog or poor lighting conditions) or for other unforeseen reasons. Appropriate exclusion zones and thresholds will be established in the field prior to the start of construction and will be maintained throughout all periods of active pile installation or removal activities. Exclusion zones and thresholds located close to the source of pile-related noise (i.e., exclusion zones at 200 feet and 50 feet, and the 400-foot Level B harassment threshold) would be demarcated with temporary buoys, as feasible. Alternative options for demarcating the more distant exclusion zones and Level B harassment thresholds may include using repeatable compass bearings and several fixed, never-obscured sighting points as references. Acoustic monitoring would also occur during periods of in-water pile-installation activities to document actual pile-related sound levels and to ensure construction noise does not reach levels known to be damaging to marine mammals at appropriate calculated distances. Important details regarding these aspects are discussed in the following sections.

14.1.1.1 Exclusion Zone and Level B Harassment Thresholds Monitoring

All exclusion zones and Level B harassment zones established by the MMPA Request for Letter of Authorization (LoA) Draft Rule are provided in Table 1, below. Each exclusion zone threshold and Level B harassment threshold was determined by using the Practical Spreading Model for the pile types proposed for the EBS and ambient acoustic data for Elliott Bay (Laughlin 2011), and through consultation with NOAA. The threshold for Level B harassment for large cetaceans has been established in such a manner to ensure the number of Level B harassment (behavioral) “takes” are determined to cause no more than a “negligible impact” on those species. All Level B harassment thresholds represent radii distances from the point-source pile-related work, and each is specific to marine mammal taxa (large cetaceans, small cetaceans, or pinnipeds), pile work type (impact or vibratory), and pile type (steel sheet pile or concrete pile). Pile installation or removal activities can continue when marine mammals are present within the Level B harassment thresholds, but a “take” must be recorded for each individual observed in a 24-hour period until the level of take authorized in a year for the species is reached.

Exclusion zones are intended to provide a physical threshold that, when crossed by an applicable marine mammal taxa, will trigger a stop-work order for relevant in-water pile-installation activity. If a stop-work order is triggered, the triggering marine mammal(s) will be closely monitored while they remain in or near the exclusion zone, and only when they move well outside of the exclusion zone or have not been observed for at least 15 minutes will the lead monitor allow work to recommence. It will be up to the best scientific judgment of the monitor(s) observing the marine mammal to determine when they have moved far enough away from the exclusion zone. A full discussion on potential triggers of stop-work orders is provided below.

All marine mammals near an applicable exclusion zone threshold will be closely monitored and every precaution will be taken to ensure they are not harmed in any way. If an individual marine mammal shows signs of distress or unexpected behavior even while they are well outside of an applicable exclusion zone threshold, a stop-work order will be issued and further consultation will be made with NOAA.

TABLE 1. SUMMARY TABLE OF EXCLUSION ZONE THRESHOLDS AND LEVEL B HARASSMENT ZONES

Taxa¹	Threshold or Zone Location (radius distance from point-source pile-related noise)	Pile Work Type	Pile Type
Exclusion Zone Thresholds (stop-work order will be issued if threshold is crossed)			
Pinnipeds & small cetaceans	50 feet	Impact	Concrete
Pinnipeds & small cetaceans	200 feet	Impact	Steel sheet
Large cetaceans (Level B)	3,280 feet ¹	Impact	Steel sheet & concrete
Large cetaceans (Level B)	2.5 miles ²	Vibratory	Steel sheet
Level B Harassment Zones (“take” will be issued for a marine mammal in applicable zone)³			
Large cetaceans	3.9 miles ⁴ to 2.5 miles	Vibratory	Steel sheet
Pinnipeds & small cetaceans	2.5 miles to point-source noise	Vibratory	Steel sheet
Pinnipeds & small cetaceans	3,280 feet to 200 feet	Impact	Steel sheet
Pinnipeds & small cetaceans	400 feet ⁴ to 50 feet	Impact	Concrete

¹ Large cetaceans include killer whales and all balaenoptera whales; small cetaceans include all porpoises.

² Distance represents both an exclusion threshold and Level B threshold for large cetaceans, but is not expected to represent a Level A injury threshold; this conservative exclusion threshold was established by NOAA to minimize behavioral “take” of large cetaceans to ensure each stock bears no more than a “negligible impact.”

³ A maximum of one “take” will be issued per individual per 24-hour period.

⁴ Note that there are no exclusion zones at 3.9 miles and 400 feet.

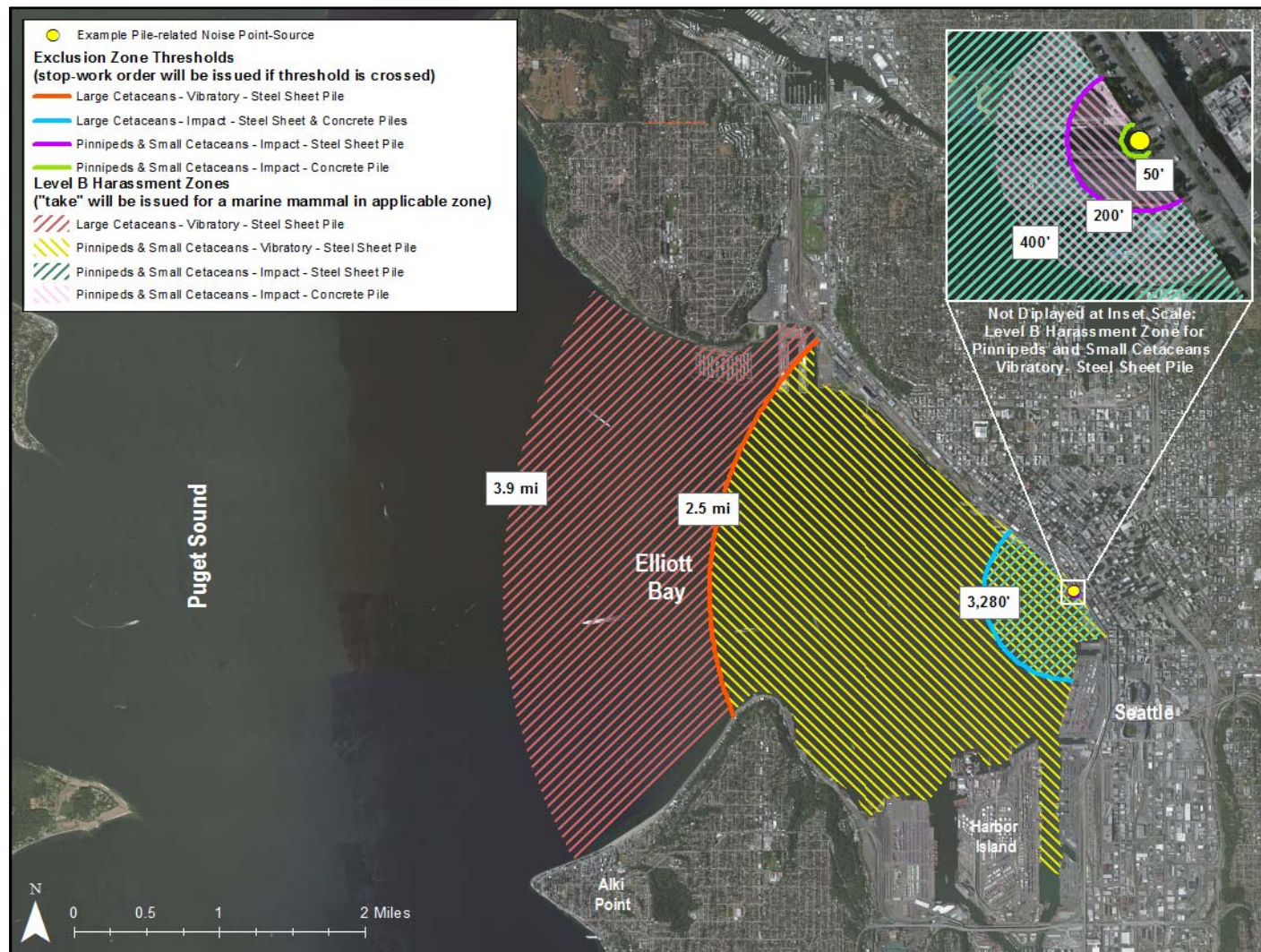


Figure 1. Map of exclusion zone thresholds and Level B harassment zones established for pile-related construction of the EBSP.

(See Table 1 for further explanation. Note that there is no exclusion zone at 3.9 miles or 400 feet, but rather Level B harassment thresholds.)

14.1.1.1.1 Stop-Work Order Protocol

When a marine mammal is observed approaching the applicable exclusion zones (see Table 1 and Figure 1 above), the monitor(s) will immediately notify the construction manager overseeing the pile-related equipment of the direction of travel and distance of the marine mammal relative to the exclusion zone. A stop-work order would be immediately issued if a monitor observes a marine mammal clearly crossing an applicable exclusion zone regardless of observed marine mammal behavior. In response, the construction manager will immediately alert the operator(s) of the pile-related equipment to stop work. Following an issued stop-work order, the marine mammal will be closely monitored and updates of location and behavior will be provided to the construction manager at appropriate intervals, likely less than 15 minutes apart. The marine mammal will continue to be monitored while it is present within the exclusion zone either until it has clearly moved out of and away from the threshold, it has not been observed for at least 15 minutes, or the end of the work day is reached (attempts to locate the marine mammal will be made the following work day up to 1 hour prior to the start of pile-related activities – see Section 14.5 Other Best Management Practices and Mitigation below). Work will resume after the marine mammal monitor(s) has notified the construction manager that the marine mammal has moved outside of and is headed away from the exclusion zone or has not been observed for at least 15 minutes. At times, unanticipated scenarios may be encountered by the marine mammal monitors, who will use best scientific judgment to make conservative decisions to ensure no marine mammal will be harmed by the pile-related work associated to the EBSP.

14.1.1.2 Level B Harassment Threshold Monitoring

In addition to the monitoring described above for the exclusion zones, the Level B harassment thresholds will be monitored to record “takes” for the relevant marine mammal species that enter this zone. Within this monitoring area, the daily and cumulative number of “takes” will be documented throughout each pile installation or removal work day and work year. All sightings of marine mammals will be documented by the monitors on a marine mammal sighting form (described below). A “take” will be documented for each individual marine mammal per 24-hour period. The monitors will be required to keep an accurate “take” count of marine mammals sighted within their applicable Level B harassment zone, document each “take” on the sighting form, and notify the construction crew and other appropriate staff if any marine mammal has the potential to cross an applicable exclusion zone threshold. Once a marine mammal is within the Level B harassment threshold, the observers will track its movements and document its behaviors until it moves well out of the area. If the authorized total annual number of “takes” for any particular species is equaled at any point prior to the completion of in-water pile-related activities, NOAA will be immediately notified that the “take” limit has been reached and will be consulted for further guidance. At the point that the “take” limit is reached, any additional observation of that species within an applicable Level B harassment threshold will trigger a stop-work order.

Table 2 provides the number of “takes” for each marine mammal taxa authorized by NOAA for the EBSP in-water pile-installation and removal activities.

TABLE 2. AUTHORIZED “TAKE” VALUES PROVIDED BY NOAA FOR EBSP PILE INSTALLATION AND REMOVAL

Species	Maximum Number of “Takes” Per Year	Approximated Number of “Takes” Per Day ¹	Percentage of Stock that may be “Taken”
Pinnipeds			
Harbor seal	700	20	4.8
California sea lion	175	5	<0.1
Steller sea lion	175	5	0.3
Small Cetaceans			
Harbor porpoise	315	9	2.9
Dall’s porpoise	70	2	0.2
Large Cetaceans			
Killer whale (southern resident)	16	1	20
Killer whale (transient)	24	1	6.9
Gray whale	8	1	<0.1
Humpback whale	4	1	0.2

¹ Number of “take” values per day are approximated due to some values being less than one.

14.1.2 Marine Mammal Monitoring Protocol

Marine mammal monitors would be deployed at all times during in-water pile-installation or removal activities in strategic locations around the area of potential effects. Monitors would be based on land and positioned to have overlapping viewsheds (Figure 2). If visibility becomes limited, additional land-based monitors and/or boat-based monitors may be deployed to ensure adequate visual coverage of the exclusion zones and Level B harassment thresholds.

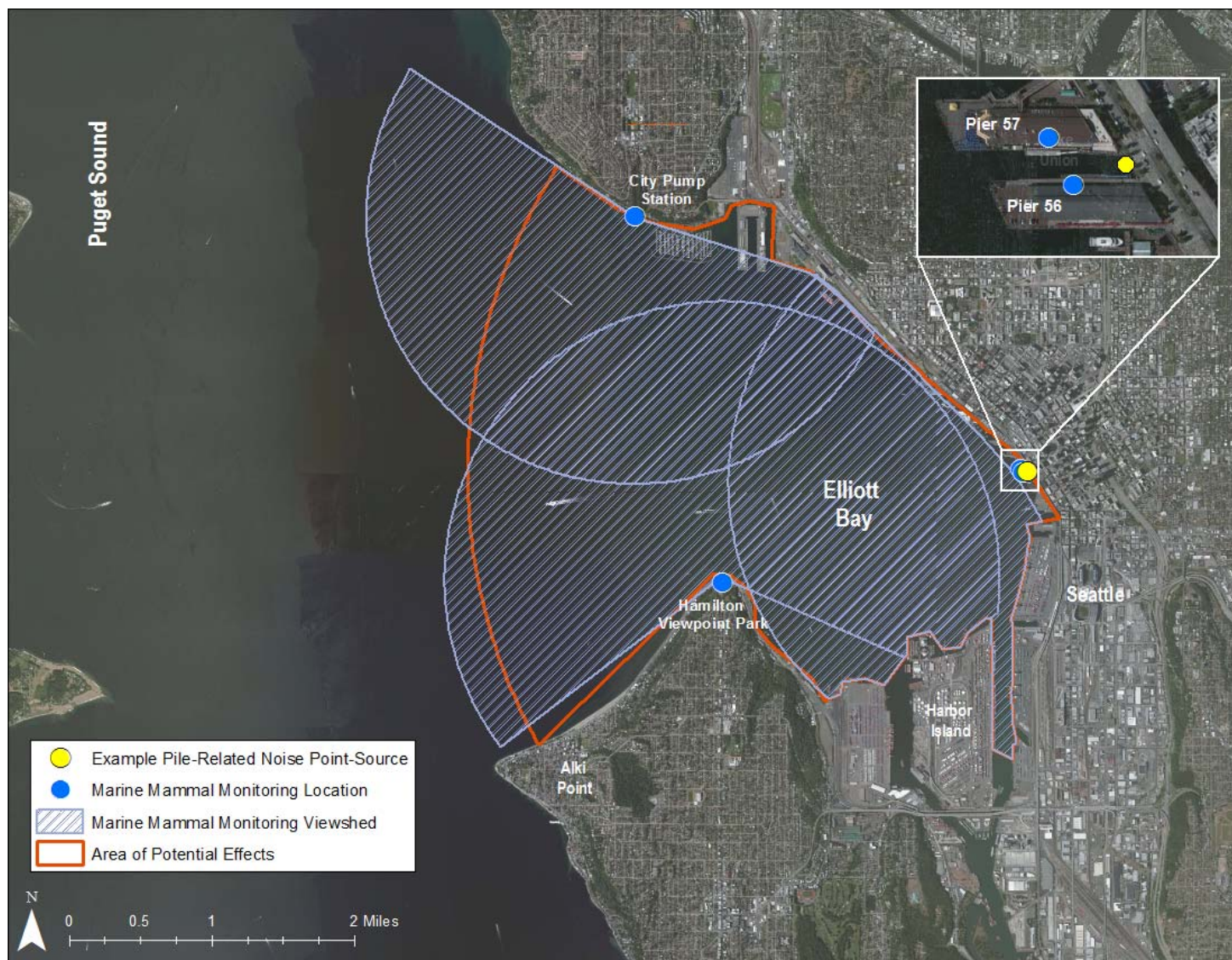


Figure 2. Proposed monitoring locations including projected viewsheds and the area of potential effects (out to 3.9 miles)

It is anticipated that up to four land-based observers would be present to monitor the exclusion zones and Level B harassment thresholds during all times of pile-installation and removal activities (Figure 2). Two monitors will be stationed on either side of the noise source (i.e., pile-related construction) on adjacent piers or on the sidewalk, or in positions that maximize their unobstructed view of the nearshore environment, and will monitor the exclusion zone thresholds at 50 feet and 200 feet, as well as visible portions of the Level B harassment zones (out to 3,280 feet). These close-in monitors would be used during all pile-installation or removal activities (vibratory and impact pile driving). Two additional monitors would be stationed at designated viewpoints on the north and south entrance of Elliott Bay, such as on the pier at Hamilton Viewpoint Park (Alki Point) and the street end at West 32nd Avenue (city pump station), providing them broad, unobstructed viewsheds. These outer monitors would be used to monitor the outer exclusion zones, Level B harassment thresholds, and surrounding marine environment only during vibratory pile installation or removal. Table 3 outlines the exclusion zones and Level B harassment thresholds applicable to each type of pile driving.

TABLE 3. MONITORING ZONES BY PILE INSTALLATION AND REMOVAL TYPE

Zone/Threshold	Location to Monitor	Species	No. of Monitors/ Location
Vibratory/Steel Sheet Piles			
Exclusion Zone	2.5 miles to source	Large cetaceans	4 (near and outer)
Level B Harassment Threshold	From 3.9 miles to 2.5 miles	Large cetaceans	
Level B Harassment Threshold	2.5 miles to source	Pinnipeds & small cetaceans	
Impact/Steel Sheet Piles			
Exclusion Zone	3,280 feet to source	Large cetaceans	2 (near)
Exclusion Zone	200 feet to source	Pinnipeds & small cetaceans	
Level B Harassment Threshold	3,280 feet to 200 feet	Pinnipeds & small cetaceans	
Impact/Concrete Piles			
Exclusion Zone	3,280 feet to source	Large cetaceans	2 (near)
Exclusion Zone	50 feet to source	Pinnipeds & small cetaceans	
Level B Harassment Threshold	400 feet to 50 feet	Pinnipeds & small cetaceans	

Each marine mammal monitor will be tasked with continuously scanning their viewshed within the area of potential effects, documenting all marine mammals and if seen closely tracking their behaviors and locations, and communicating their observations to the rest of the monitoring crew and SDOT inspector. Proper coordination between the team of monitors and land-based crew will be facilitated by a designated monitoring coordinator who will establish coordination details each morning prior to the start of construction and strictly maintain them throughout the construction day. Monitors will have a clear understanding of the location of various zones and their applicable marine mammal taxa for each type of pile-related work, and will continually coordinate and update each other as well as other crew members, as appropriate. Communication will be facilitated via two-way radio and/or cellular phone, as

necessary, to ensure unobstructed lines of communication. Each monitor will have a list of important contact phone numbers and radio channels, including for the monitoring coordinator, construction manager, SDOT inspector, and other management and staff.

Coordination between monitors and construction contractors would occur at least once each day prior to the start of work. This coordination will include a review of the pile-related work schedule and any marine mammal issues that could potentially occur. Other details provided to the monitors would include construction location, number and type of piles, timing, methods of pile work, and whether work would be pile installation or removal. This information should be transferred to the monitors in writing in an easy reference format (see example below in Figure 3). Any changes in pile-related work schedule will be conveyed to the monitors at least 30 minutes prior to their implementation.

EBSP DAILY PILE-RELATED CONSTRUCTION SCHEDULE				
Date: 6 Oct 2013	Prepared by: John Doe/engineer	Contact info: 206-###-####		
Work interval (hrs.)	Location	Pile type	Pile work type	Notes
0800-1000	N of Pier 57	Concrete	Installation, impact	5 piles scheduled, may require 2 additional
1000-1200	N of Pier 57	Steel sheet	Installation, vibratory	3 piles scheduled, no impact proofing scheduled
1200-1300	NA	NA	NA	Lunch Break
1300-1800	S of Pier 57	Steel sheet	Installation, vibratory and impact	10 piles scheduled, up to 3 to be impact proofed – will communicate to monitors when impact proofing is to occur

Figure 3. Example of EBSP daily pile-related construction schedule summary sheet

Marine mammal monitoring will begin at least 30 minutes prior to the start of all in-water pile-related activities each day, continue at all times during active construction, and if necessary for up to 30 minutes following construction. If visibility precludes monitors from viewing their designated viewshed (due to fog or poor lighting), pile-driving activities would not be allowed or alternate methods of monitoring must be employed (i.e., boat-based monitoring). Monitors will be continually updated on pile-related construction activities in a manner that would allow them to make adjustments to provide accurate and appropriate marine mammal observations. For example, monitors need to be informed of scheduled impact installation of concrete piles so they can monitor the correct exclusion zone thresholds and Level B harassment zones that apply to that type of construction activity.

All monitors will be qualified biologists or field technicians with good eyesight and identification skills; they will receive training (NOAA approved) covering the detection, identification, and distance estimation (i.e., estimating the distance a marine mammal is from an observer; provides a metric for location) of all marine mammal species potentially found in and around Elliott Bay. Each monitor must pass an identification test conducted at the training. Each will have the experience and ability to conduct field observations and collect data according to this protocol. They will be experienced with directional orienteering, using binoculars and spotting scopes, efficiently accessing and referencing marine mammal identification materials, understanding safety protocol, and writing field notes and entering data into the provided field datasheet. Each monitor will be properly equipped with necessary gear during their shifts, including binoculars, spotting scope, range finder, field guides, sighting compass, two-way radio, cellular phone, and spare fresh batteries for all electronics.

Each monitor would work, on average, 8 to 10 daylight hours per day and would be relieved by a fresh monitor if pile-related activities occur over a longer day (i.e., 12 to 16 hours, daylight dependent) or fatigue and/or lack of preparedness begins to decrease ability to detect marine mammals. If necessary, the number of monitors would be increased and/or their positions would be changed to ensure full visibility of the area of potential effects and to ensure early sighting of any marine mammal that enters the area. Monitors will have no other responsibilities while making observations.

A comprehensive Marine Mammal Monitoring Plan Manual will be assembled for the monitoring team prior to the start of in-water work. The manual will contain all contractual and permit requirements for the project and will describe the procedures SDOT and its contractors will implement to comply with the conditions of all applicable permits. Conformance with the plan will be discussed at weekly construction meetings to ensure that procedures are working and to identify and implement any revisions necessary to tailor procedures to the specifics of ongoing construction. Marine mammal monitors will fully understand permit requirements and will be diligent in facilitating the conditions of the permit. Monitors will implement quality checks to ensure communication channels are working properly at all times.

14.1.2.1 Marine Mammal Sighting Form

The sighting form would capture all necessary details important to marine mammal identification and protection during the EBSP. The sighting form can be converted into any robust format that would help facilitate monitoring, including electronic format, and would record any or all of the following information:

- Background information
 - Date, monitoring type (land-based/boat-based), observer name and location, and weather and tidal conditions;
 - Environmental conditions (weather, wind, waves), plus notes on conditions that could confound marine mammal detections and the time and location that they occurred; and
 - Level of human disturbance (baseline) independent of associated construction, type, and location.

- For marine mammal sightings
 - Species observed, number, pod composition (i.e., age and color class), distance to pile-related activities, and behavior (e.g., group cohesiveness, direction of travel) of marine mammals throughout duration of sighting;
 - Time of first and last sighting;
 - In the case where a marine mammal crossed an applicable exclusion zone or Level B harassment threshold, documented species and number, plus time and location;
 - Discrete behavioral reactions to construction, if apparent;
 - Initial and final sighting locations marked on a grid map;
 - A log of coordination with other monitors and/or construction crew members;
 - Pile-related activities taking place concurrently with each sighting;
 - Monitor response including whether a stop-work order was issued, why, and for how long, or if a “take” was recorded; and
 - The number of “take(s)” (by species), their locations, and behavior.

Specific data collected on sighting forms will be made available for scientific study to agencies and/or independent professional researchers.

14.1.3 Acoustic Monitoring

Acoustic monitoring will be conducted during pile-related in-water work. The purpose of the monitoring will be to document noise levels, as described in the interim NOAA guidance (NOAA 2010). Collection of most of the acoustic data will be accomplished via a fixed hydrophone likely to be installed on a pier piling, and via a hydrophone deployed aboard a drifting boat to reduce the effect of flow noise. At least one stationary land-based microphone would also be deployed to record airborne sound levels. The microphone would measure far-field airborne sounds.

For all underwater acoustic monitoring, there shall be a direct line of acoustic transmission through the water column between the pile-related noise source and the hydrophones (unless otherwise specified), without any interposing structures, including other piles, that could impede sound transfer. All acoustical recordings will be conducted approximately 1 meter below the water surface and 1 meter above the sea floor, or as applicable to optimize sound recordings in the nearshore environment. Background noise recordings (in the absence of pile-related work) will also be made during the study to provide a baseline background noise profile. The results and conclusions of the study will be summarized and presented to NOAA with recommendations on any modifications to this proposed plan or exclusion zones.

All sensors, signal conditioning equipment, and sampling equipment will be calibrated at the start of the monitoring period to National Institute of Standards and Technology standards and will be rechecked at the start of each day. Equipment should meet minimum standards as outlined in Table 4 below.

TABLE 4. EQUIPMENT SPECIFICATIONS FOR ACOUSTIC MONITORING

Item	Specifications	Quantity	Usage
Hydrophone with 200 feet of cable	Receiving Sensitivity - In the range: -195 to -210 dB re 1V/ μ Pa	1	Capture underwater sound pressures and convert to voltages that can be recorded/analyzed by other equipment.
Calibrator (pistonphone type)	Accuracy - IEC 942 (1988) Class 1	1	Calibration check of hydrophone in the field.
Portable dynamic signal analyzer (four-channel)	Sampling Rate - 24 kHz or greater	1	Analyzes and transfers digital data to laptop hard drive.
Microphone (free field type)	Range - 30 to 120 dBA	1	Monitor airborne sounds from pile driving activities (if not raining).
If velocity $\sim > 1$ m/s, flow shield	Open cell foam cover or functional equivalent	1/hydrophone	Eliminate flow noise contamination.
Laptop computer	Compatible with digital analyzer	1	Record digital data on hard drive and signal analysis.
Real time and post-analysis software	-	1	Monitor real-time signal and post-analysis of sound signals.

A stationary two-channel hydrophone recording system will be deployed to record a representative sample (subset of piles) during the monitoring period. A minimum of five steel sheet piles and five concrete piles will be monitored at the start of each type of pile driving (and also for vibratory and impact driving). The hydrophones will provide a continuous recording of the specified piles to be monitored. The data will be analyzed after completion of the acoustic monitoring to determine if more acoustic monitoring is warranted. Some key methodological details are as follows:

- Prior to monitoring, water depth measurements will be made to ensure that hydrophones will not drag on the bottom during tidal changes. One hydrophone will be placed near the surface at approximately 3.3 feet (1 meter) below the surface and the other at a position close to the bottom of the sea floor (70 to 85 percent of water depth). Because the hydrophones may be supported from a floating platform (i.e., barge) or pier, the depth with respect to the bottom may vary somewhat due to tidal changes and current effects.
- The hydrophone systems will be deployed to maintain a constant distance of approximately 10 meters from the pile-related noise source.
- The hydrophones, signal conditioning, and recording equipment will be configured to acquire maximum source levels without clipping recorded data. Hydrophone calibration will be checked at the beginning of each day of monitoring.

- The primary hydrophone will be deployed with an Autonomous Multichannel Acoustic Recorder to record the broad spectrum of noise levels, and the levels for each functional hearing group of marine mammals will be calculated. These specific sound levels will be calculated for each 30-second period recorded during the specified pile-driving activities.

Appropriate measures will be taken to eliminate strumming of the hydroacoustic cable in the current and minimize flow noise over the hydrophones (such as using a nylon sleeve over the cage that protects the hydrophone).

To empirically verify the modeled behavioral disturbance zones, underwater and airborne acoustic monitoring would occur during both vibratory and impact driving of the first five steel sheet piles and first five concrete piles during each year of pile driving. If a representative sample has not been achieved after the five piles have been monitored (e.g., if there is high variability of sound levels between pilings), acoustic monitoring will continue until a representative acoustic sample has been collected. If underwater sound monitoring shows that noise generation from pile installation exceeds the levels originally expected and approved in the MMPA Rule, NOAA will be consulted on this matter.

Post-analysis of underwater sound level signals would include the following:

Impact Pile Driving

- Determination of the maximum absolute value of the instantaneous pressure within each strike,
- Root mean square (RMS) value for the period of which 90 percent of the energy is represented (RMS 90 percent, 5 percent to 95 percent) for each absolute peak pile strike,
- Mean and standard deviation/error of the RMS 90 percent for all pile strikes of each pile,
- Rise time,
- Number of strikes per pile and per day,
- Number of strikes exceeding the 206-decibel (dB) peak,
- Sound exposure level (SEL) of the single pile strike with the absolute peak sound pressure, mean SEL,
- Cumulative SEL (cumulative SEL = single strike SEL + $10 \cdot \log [\# \text{ hammer strikes}]$), and
- Frequency spectrum, between a minimum of 20 Hz and 20 kHz for up to eight successive strikes with similar sound levels.

Vibratory Pile Driving

- RMS values (average, standard deviation/error, minimum, and maximum) for each recorded pile. The 10-second RMS averaged values will be used for determining the source value and extent of the 120-dB underwater isopleth.
- Frequency spectra will be provided for each functional hearing group as outlined in the NOAA guidance (2010).
- All underwater source levels will be standardized to a reference distance of 10 meters (33 feet).

Post-analysis of airborne noise will be presented in an unweighted format, and will include:

- The unweighted RMS values (average, minimum, and maximum) for each recorded pile. The average values will be used for determining the extent of the airborne isopleths relative to species specific criteria.
- Frequency spectra will be provided from 10 Hz to 20 kHz provided for representative pile related activity.
- All airborne source levels will be standardized to a reference distance of approximately 15 meters (50 feet).

It is intended that acoustic monitoring will be performed using a standardized method that will facilitate comparisons with other studies. Real-time monitoring of noise levels during in-water pile-related activities will ensure sound levels do not surpass those assumed in the MMPA Letter of Authorization Rule (Table 5 below). If pile-related noise trends toward consistently surpassing calculated levels, NOAA will be contacted immediately to discuss the situation.

TABLE 5. SUMMARY OF NEAR-SOURCE (10-METER) UNATTENUATED SOUND PRESSURES FOR IN-WATER PILE INSTALLATION USING AN IMPACT HAMMER AND VIBRATORY DRIVER/EXTRACTOR

Pile Type and Approximate Size	Method	Relative Water Depth	Average Sound Pressure Measured in dB	
			Peak	RMS
16.5-inch-diameter precast concrete octagonal pile	Impact	~15 meters	188	176
Steel sheet pile pair; 48 inches long per pair	Vibratory (Installation and Removal)	~15 meters	182	165
Steel sheet pile pair; 48 inches long per pair	Impact (Installation Proofing)	~15 meters	205	190

Sources: California Department of Transportation 2009 and Washington State Department of Transportation 2011

Notes: dB = decibels; RMS = root mean square

14.2 REPORTING

In addition to capturing marine mammal monitoring data on field datasheets, a daily monitoring log, monitoring data spreadsheet, annual and final monitoring reports, and acoustic monitoring report will be drafted and used to quantify and/or describe factors regarding marine mammals and the EBSP.

14.2.1 Daily Monitoring Log

A running daily monitoring log will be maintained and updated at the end of each survey day, summarizing important observations and applicable aspects of construction. The daily monitoring log will be intended to summarize important details noted by the monitors in a format that readily conveys these details to interested and appropriate parties. Details that would be summarized each day include:

- Date, start and end time, weather, tide range and timing, monitors, and locations of monitors;
- A description of pile-related construction that occurred including:
 - Pile type (concrete or steel), size, and number
 - Location of work
 - Pile work type (impact or vibratory)
 - Timeline for pile-related construction
 - The distance from the pile to the water's edge
 - The total number of strikes to drive each pile (if applicable)
- A description of marine mammals in the area including whether they were observed or not, and if so what species, number, behavior, location, location relative to applicable thresholds/zones, whether any "take" was issued as compared to the total allowable yearly "take" and if a stop-work order was made, duration in the area of potential effects, and monitors and crew members involved in the observations and response;
- Any other biological observations that may be important;
- Any applicable photos or other descriptive information; and
- Notes intended to capture other applicable information such as descriptions of any unusual or unpredicted observations, confounding conditions, or anecdotal accounts.

14.2.2 Monitoring Data Spreadsheet

A running spreadsheet would also be created and maintained daily to capture data accumulated during each survey day. The spreadsheet would capture all data recoded on the field datasheets. If appropriate, field data can be collected digitally in a manner that would facilitate the entry of the field data into the monitoring data spreadsheet.

14.2.3 Annual Monitoring Reports

Each year, an annual monitoring report would be drafted and submitted to NOAA's Office of Protected Resources and Northwest Regional Office at the end of each construction season. Each annual report would summarize information presented in the daily monitoring log and monitoring data spreadsheet in a manner to effectively convey important marine mammal-related observations made during that year. The annual monitoring report would include the following:

- Data and time collected for each distinct marine mammal species observed in the project area;
- Weather conditions;
- Approximate distance from the source;
- Activity at the construction site when a marine mammal was sighted;
- A summary of the number of "takes" issued per species that year and to date;

- A summary of any stop-work orders given that year including number, species involved, and circumstances;
- Descriptions of marine mammal species observed, overall numbers of individuals observed, frequency of observation, behavior and any behavioral changes, and context of the changes relative to construction activities;
- Other important details that would provide context to the marine mammal observations made that year.

14.2.4 Comprehensive Final Report

In addition to annual reports, a draft comprehensive final report would be submitted to NOAA's Office of Protected Resources and Northwest Regional Office 180 days prior to the expiration of the regulations (*date to be determined in Final Rule*). This comprehensive technical report would provide full documentation of methods, results, and interpretation of all monitoring during the 5-year term of the regulations. A revised final comprehensive technical report, including all monitoring results during the entire period of the regulations, would be due 90 days after the end of the period of effectiveness of the regulations.

14.2.5 Acoustic Monitoring Report

A report(s) concerning the results of all acoustic monitoring would also be drafted and submitted to NOAA. This report(s) would include the following:

- Size and type of piles monitored;
- A detailed description of any sound attenuation device used, including design specifications;
- The impact hammer energy rating used to drive the piles, description of the vibratory hammer, and make and model of the hammer(s);
- A description of the sound monitoring equipment;
- The distance between hydrophones and depth of water and the hydrophone locations;
- The depth of the hydrophones;
- The distance from the pile to the water's edge;
- The depth of water in which the pile was driven;
- The depth into the substrate that the pile was driven;
- The physical characteristics of the bottom substrate into which the pile were driven;
- The total number of strikes to drive each pile; and
- The results of the hydroacoustic monitoring, including the frequency spectrum, ranges and means for the peak and RMS sound pressure levels, and an estimation of the distance at which RMS values reach the relevant marine mammal thresholds and background sound levels. Vibratory driving results would include the maximum and overall average RMS calculated from 30-s RMS values during the drive of the pile.

- A description of any observable marine mammal behavior in the immediate area and, if possible, correlation to underwater sound levels occurring at that time.

14.3 ADAPTIVE MANAGEMENT

The final regulations governing the “take” of marine mammals incidental to the specified activities at EBSP would contain an adaptive management component. In accordance with 50 CFR 216.105(c), regulations for the proposed activity must be based on the best available information. As new information is developed through monitoring, reporting, or research, the LoA may be modified in whole or in part to ensure sufficient protection for the marine mammals. The use of adaptive management would allow NOAA to consider new information from different sources to determine if mitigation or monitoring measures should be modified (including additions or deletions) if new data suggest that such modifications are appropriate. The following are some of the possible sources of applicable data:

- Results from EBSP monitoring from the previous year;
- Results from general marine mammal and sound research; and/or
- Any information that reveals a “take” of marine mammals may have occurred in a manner, extent, or number not authorized by these regulations or subsequent MMPA permit requests.

If, during the effective dates of the regulations, new information is presented from monitoring, reporting, or research, these regulations may be modified, in whole or in part, after notice and an opportunity of public review as allowed for in 50 CFR 216.105(c). In addition, the LoA would be withdrawn or suspended if, after notice and opportunity for public comment, the Assistant Administrator finds, among other things, that the regulations are not being substantially complied with or that the authorized “take” is having more than a negligible impact on the species or stock, as allowed for in 50 CFR 216.106(e). That is, should substantial changes in marine mammal populations in the project area occur or monitoring and reporting show that EBSP actions are having more than a negligible impact on marine mammals, then NOAA may request to modify the regulations and/or withdraw or suspend a LoA after public review.

14.4 GENERAL CONSTRUCTION GUIDANCE

All SDOT construction will be performed in accordance with the conditions required by the various permitting agencies and city requirements. SDOT activities are subject to federal, state, and local permit conditions and use the best guidance available to accomplish the necessary work while avoiding and minimizing environmental effects to the greatest extent possible. Other Best Management Practices and Mitigation include:

- **Equipment Noise Standards:** To mitigate noise levels and, therefore, effects to marine mammals, all construction equipment would comply with applicable United States Environmental Protection Agency equipment noise standards.
- **Sound Attenuation Measures:** Specific to pile-related work, the following mitigation measures are proposed to reduce effects to marine mammals to the greatest extent practicable:

- **Vibratory pile driving:** All steel sheet piles would be installed using a vibratory driver, unless limited impact driving is required to drive piles that encounter obstructions or for proofing load bearing sections. The use of vibratory pile driving reduces pile-driving noise to levels less than the injury threshold for either pinnipeds or cetaceans. Any impact driving used in conjunction with vibratory pile driving would employ attenuation measures such as a cushioning block, where applicable. Any attenuation measures for vibratory pile driving that become available would be considered for this project.
- **Containment for impact pile driving:** The majority of permanent concrete piles would be impact driven behind the temporary containment wall that may function to partially attenuate pile-driving noise. Estimated noise-reduction values are not available for this attenuation type; however, it has been shown that the use of cofferdams, which are analogous to the temporary containment wall, are more effective at reducing noise than not employing one at all (California Department of Transportation 2009).
- **Additional attenuation:** Other attenuation measures, such as the use of a cushioning block, will be used for impact pile driving of concrete piles to reduce sound levels. Cushioning blocks used between a hammer and pile (during impact pile installation) can reduce noise up to 26 dB (California Department of Transportation 2009) and would be used during all concrete impact pile-installation activities. If noise generation is shown to exceed levels calculated in the MMPA LoA request (as shown by acoustic monitoring), the implementation of additional attenuation devices would be reevaluated, and further discussions with NOAA will be triggered in order to pursue a better strategy that would more effectively attenuate noise propagation in the marine environment. The use of bubble curtains for impact pile driving of concrete piles will be considered if necessary to ensure noise levels do not exceed the estimated levels in this MMPA LoA Request, but are not proposed at this time.
- **Timing Windows:** Timing restrictions would be used to avoid in-water work, when feasible, when ESA-listed fish species are most likely to be present in the area of potential effects. SDOT will comply with all in-water timing restrictions (primarily targeting to avoiding peak salmonid out-migration as well as the summer tourist season along the waterfront) as determined through the ESA Section 7 consultation and included in the Hydraulic Project Approval.
- **Ramp-up:** A ramp-up technique would be used at the beginning of each day's in-water pile-installation or removal activities, or if pile-related activities have been suspended for more than 1 hour. This technique would allow any marine mammal that may be in the immediate area to leave before pile-related construction reaches full energy. The ramp-up requires contractors to initiate noise from a vibratory driver for 15 seconds at reduced energy followed by a 1-minute waiting period. The procedure would be repeated two additional times before full energy may be achieved. For non-diesel impact pile installation, contractors would be required to provide an initial set of three strikes from the impact hammer at reduced energy, followed by a 1-minute waiting period, then two subsequent three-strike sets.

SECTION 15. COORDINATING RESEARCH TO REDUCE AND EVALUATE INCIDENTAL TAKE

During previous vibratory pile installation activities at Lopez Island in the San Juan Islands, Washington State Ferries coordinated with local marine mammal sighting networks (Orca Network; the Center for Whale Research; and/or the Whale Museum Whale Hotline) to determine the location of the southern resident killer whales prior to initiating vibratory pile installation (Ziegler, pers. comm., 2007). These organizations receive sighting information primarily on killer whales and other whale species; however, their sighting database also contains seal and sea lion sightings. All sightings received by the Orca Network are posted online usually within a few days and email notifications are sent out almost daily with current sightings. Sightings may also be reported to the Whale Museum Whale Hotline, where the information is cataloged into a database, which is available upon request to the public and researchers. The Whale Museum receives sighting information from various sources including the Orca Network and all sightings are sent annually to NOAA.

Real-time coordination with these organizations would occur during pile-driving activities. Communication between contractors (and SDOT) and the aforementioned organizations would further reduce the potential for harassment by providing current data on the presence and location of marine mammals, particularly the ESA-listed southern resident killer whales, prior to commencing activities that may harass marine mammals.

This page intentionally left blank.

REFERENCES

- California Department of Transportation. 2009. Final Technical Guidance for Assessment & Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Prepared by ICF Jones & Stokes and Illingworth & Rodkin, Inc. 298 p.
- Laughlin, J. 2011. Seattle Ferry Terminal Background Sound Measurement Results, April 2011. Washington State Department of Transportation Technical Memorandum to R. Huey, R. Wilson, and T. Castor. May 18.
- National Oceanic and Atmospheric Administration (NOAA). 2010. Interim Sound Threshold Guidance. Dated September 10. Available: <http://www.nwr.noaa.gov/Marine-Mammals/MM-sound-thrshld.cfm>.
- National Oceanic and Atmospheric Administration (NOAA). 2013. Taking and importing marine mammals: taking marine mammals incidental to replacement of the Elliott Bay Seawall in Seattle, Washington. Proposed Rule. Federal Register 78(71): 22096-22124.
- Washington State Department of Transportation. 2011. ESA Marine Mammal Consultation and Monitoring for Vibratory Pile Removal and Driving. Port Townsend Dolphins Replacement Project
- Ziegler, E. 2007. Personal communication (email) between Ellie Ziegler, Washington State Ferries Biologist, and Andrea Balla-Holden, Fisheries and Marine Mammal Biologist, on June 12.



DATE: October 6, 2014

TO: Jennifer Horwitz – Anchor QEA, LLC

CC: Jody Robinson – Jacobs

FROM: Justin Morgan, INCE – The Greenbusch Group, Inc.
Adam C Jenkins, PE(OR), INCE Bd. Cert. – The Greenbusch Group, Inc.

RE: EBSP Season 2 Hydroacoustic Monitoring Approach

Transmitted by: ☐ Mail ☐ Delivery ☐ Fax ☒ E-mail

INTRODUCTION

The intent of this memorandum is to present proposed Season 2 hydroacoustic monitoring and reporting approaches for the Elliott Bay Seawall Project (“Project”) and to utilize data collected during Season 1 of construction to predict underwater sound levels from vibratory sheet pile installation during Season 2.

PROPOSED MONITORING APPROACH

Proposed hydroacoustic monitoring data collection methods and reporting include: background sound monitoring farther into Elliott Bay, reporting of 1-second sound exposure levels (SEL), monitoring the first five unobstructed piles, and reporting underwater sound levels from ramp-up activities separately from pile driving performed under full power. These proposed modifications are discussed in the following sections.

Background Sound Monitoring

During Season 1 of construction, background sound levels were measured in the absence of in-water pile installation. These measurements were conducted from piers in close proximity to the construction area. One of these locations was adjacent to Colman Dock and ferry traffic appeared to heavily influence the background sound level measurements leading to higher than expected background sound levels.

Background sound levels measured during Season 2 of construction will be performed between 500 and 1,000 meters from construction activities during periods when no construction is taking place per the NOAA Guidance Document: “Data Collection Methods to Characterize Underwater Background Sound Relevant to Marine Mammals in Coastal Nearshore Waters and Rivers of Washington and Oregon” dated January 31, 2012.

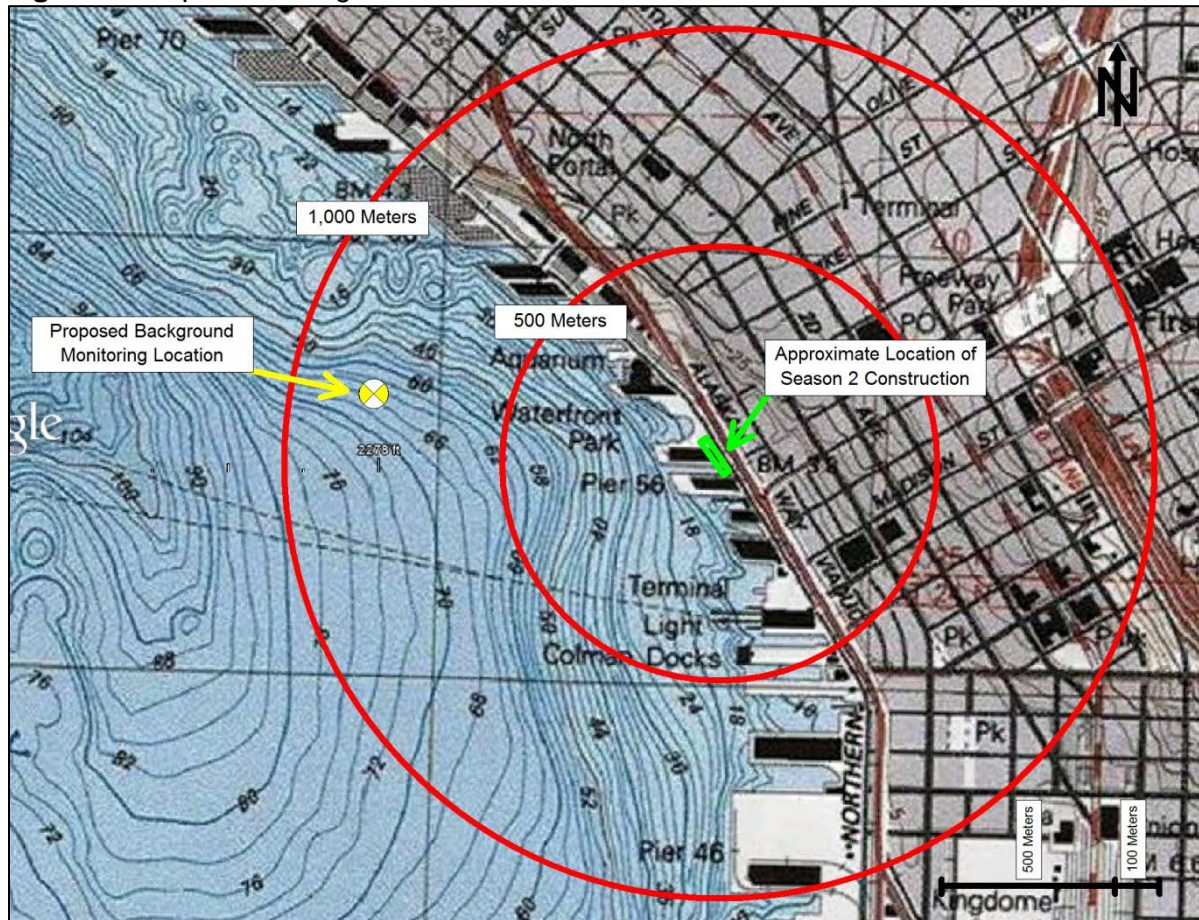
Measurement Equipment

Sound level measurements will be conducted using equipment capable of measuring and recording sound levels ranging between 7 Hz and 20 kHz at a sampling rate of at least 48 kHz. The hydrophone will have a receiving sensitivity of -211 dB re: 1 V/μPa and will be calibrated before the measurements with a IEC 942 (1988) Class 1 pistonphone and verified immediately after the measurements have been completed. The noise floor of the equipment will be measured before the measurements to ensure that measured levels are not limited by the performance of the equipment.

Measurement Location

The background sound monitoring equipment will be deployed between 500 and 1,000 meters waterward of the construction area. The hydrophone depth will be between mid-water column and 4 meters above the seafloor. If the hydrophone is deployed at a depth less than 4 meters from the seafloor, a flow shield constructed of latex or spandex will be used to minimize flow noise. The proposed measurement location is presented in the Figure below.

Figure 1. Proposed Background Sound Level Measurement Location



Source: The Greenbusch Group, Inc.

The proposed measurement location is in proximity to measurements previously conducted by the Washington State Department of Transportation (WSDOT) in April, 2011.

Measurement Time

Measurements will be conducted in the absence of any in-water construction activities. Background sound levels will be measured during daytime hours over the course of three consecutive days to characterize background sound levels during times construction activities will be occurring.

Season 2 of construction is anticipated to begin near the middle of October, 2014. Background sound monitoring will take place when no in-water work is taking place, likely between December, 2014 and January, 2015, after sheet pile installation is complete.

Data Processing and Reporting

Data will be reported in broadband RMS sound pressure levels referenced to 1 μ Pa (micro-Pascal). RMS levels will be based on 10 to 30 second RMS averages to capture temporal variations in sound levels. Data collected during nighttime periods will not be included in the analysis because construction activities do not occur during nighttime hours.

Data will be analyzed for each of the marine mammal functional hearing groups shown in the Table below.

Table 1. Marine Mammal Functional Hearing Groups

Functional Hearing Group	Low Frequency	High Frequency
Low-Frequency Cetaceans	7 Hz	20 kHz
Mid-Frequency Cetaceans	150 Hz	20 kHz
High-Frequency Cetaceans	200 Hz	20 kHz
Pinnipeds	75 Hz	20 kHz

Source: NOAA Guidance Document: "Data Collection Methods to Characterize Underwater Background Sound Relevant to Marine Mammals in Coastal Nearshore Waters and Rivers of Washington and Oregon" dated January 31, 2012

Data for each of these hearing groups will be used to generate cumulative distribution functions (CDF). Overall background sound levels for each of the hearing groups described in Table 1 above will be reported as the 50th percentile of the CDFs.

Sound Exposure Levels (SEL)

Sound exposure levels (SEL) for vibratory pile driving are not discussed in the Project's MMPA LOA, only impact piles. However, it is our understanding that Services would like this information to be included in the Season 2 monitoring and reporting. Therefore, 1-second SEL data will be calculated and included in the Season 2 report for vibratory piles. No impact piles are scheduled for Season 2.

Monitoring Unobstructed Piles

The Marine Mammal Monitoring and Mitigation Plan as well as the LOA require hydroacoustic monitoring be conducted during the first five vibratory sheet piles, impact piles, and impact proofing of sheet piles. During Season 1 the first five vibratory sheet piles and impact piles were measured, however many of the piles were obstructed by piers. Because of these obstructed piles, additional measurements were made of unobstructed piles.

During Season 2 the first five unobstructed piles will be monitored, which may not be the first five piles driven.

Ramp Up

During Season 1, sound levels were analyzed and reported for all periods when pile driving was taking place. These periods included the start-up and shutdown of the pile driving equipment, which occurred anytime the equipment started up or was turned off. Results also included the ramp-up of pile driving activities which is required by the LOA and the Updated Marine Mammal Monitoring and Mitigation Plan under the following conditions:

- “At the beginning of each day’s in-water pile installation or removal, or”
- “If pile-related activities have been suspended for more than 1 hour.”
- “Pile driving or removal is delayed or shutdown for >15 minutes due to the presence of a delphinid or pinniped within or approaching the exclusion zone; or”
- “If pile driving or removal is delayed or shutdown for >30 minutes due to the presence of a large whale.”

Because these activities were included in the analysis, reported underwater sound levels displayed a high level of variability. During Season 2, sound levels measured during ramp-up will be reported separately than those measured during pile installation at full power. Sound levels measured during full power pile installation will include the start-up and shutdown of the pile driving equipment.

PREDICTED SEASON 2 UNDERWATER SOUND LEVELS

Utilizing broadband underwater sound levels measured for vibratory sheet pile installation during Season 1, sound levels from Season 2 can be predicted. No impact proofing of sheet piles was conducted during Season 1, which prevents the prediction of underwater sound levels for this activity during Season 2.

Reported average sound levels from Season 1 are likely quieter than those that will be reported during Season 2 because the analysis of Season 1 included the quieter start-up, shut down, and ramp-up procedures. Season 2 will separate the measurements made during ramp-up from those during piles installation. Piles installed during Season 2 will be installed using the same equipment and pile type as Season 1. Because average sound levels during Season 2 will likely be higher than those from Season 1, 3 dB has been added to the loudest average sound levels measured during unobstructed vibratory sheet pile installation prior to the implementation of noise mitigation strategies during Season 1.

The Table below presents the predicted underwater sound levels for vibratory sheet pile installation for Season 2 as well as the sound levels assumed in the MMPA Letter of Authorization.

Table 2. Unmitigated Vibratory Sheet Pile Installation Underwater Sound Levels, dB re: 1 μ Pa

Vibratory Sheet Pile Installation	Average / Maximum Sound Levels at 10 meters, dB		
	Peak	RMS	SEL ³
Assumed in MMPA Letter of Authorization ¹	182	165	165
Predicted Season 2 Sound Levels	188 / 196	163 / 169	163 / 169

1. Average sound levels

2. Season 1 sound levels during unobstructed and unmitigated pile driving at 10 meters, +3 dB

3. 1-second SEL

Source: The Greenbusch Group, Inc.